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NTA NEET

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BIOLOGY
2020-1988

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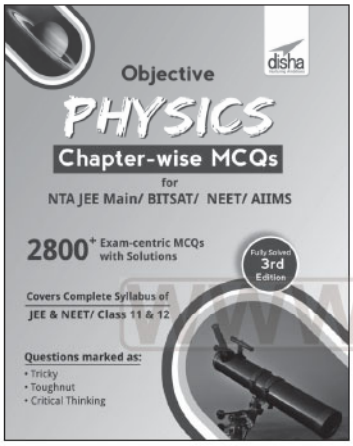

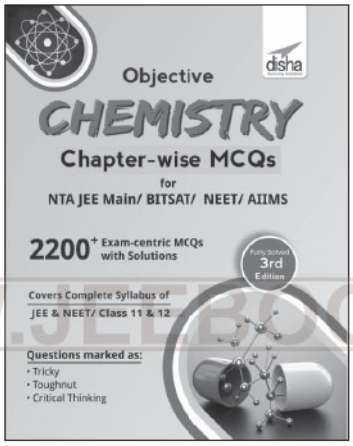

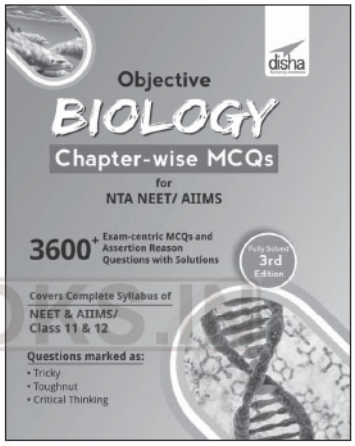

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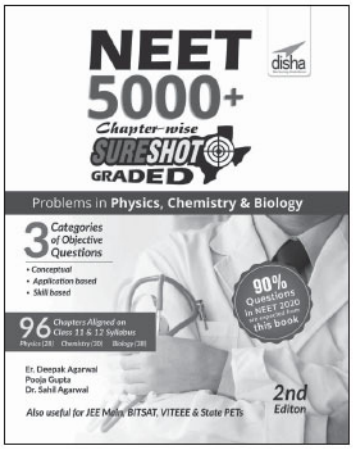

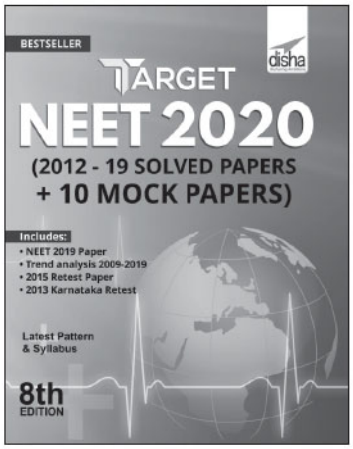

NEET COLLEGES/ SEAT INTAKES

BEST MEDICAL COLLEGES IN INDIA 2020

Name of the College	NIRF Score 2020
All India Institute of Medical Sciences, AIIMS Delhi	90.69
Post Graduate Institute of Medical Education & Research, PGIMER Chandigarh	80.06
Christian Medical College, CMC Tamil Nadu	73.56
National Institute of Mental Health & Neuro Sciences, Karnataka	71.35
Sanjay Gandhi Postgraduate Institute of Medical Sciences, UP	70.21
Banaras Hindu University, BHU UP	64.72
Amrita Institute of Medical Sciences & Research, Kerala	64.39
Jawaharlal Institute of Post Graduate Medical Education & Research, Pondicherry	63.17
Kasturba Medical College, Karnataka	62.84
King George`s Medical University, UP	62.2

LIST OF AIIMS COLLEGES IN INDIA

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The main aim of the AIIMS institutes is to make medical education affordable and reachable to people from all strata of society. In this article, we present to you the ranking of AIIMS colleges in India with their location, ranking and total intake below:

S.No	Name	Location (State)	Year of Establishment	Rank among AIIMS Colleges in India
1.	AIIMS Delhi	New Delhi	1956	1
2.	AIIMS Bhopal	Madhya Pradesh	2012	2
3.	AIIMS Bhubaneswar	Odisha	2012	3
4.	AIIMS Jodhpur	Rajasthan	2012	4
5.	AIIMS Patna	Bihar	2012	5
6.	AIIMS Raipur	Chhatisgarh	2012	6
7.	AIIMS Rishikesh	Uttarakhand	2012	7
8.	AIIMS Raebareli	Uttar Pradesh	2012	Not Available
9.	AIIMS Nagpur	Maharashtra	2018	Not Available
10.	AIIMS Mangalgiri	Andhra Pradesh	2018	Not Available
11	AIIMS Gorakhpur	Uttar Pradesh	2019	Not Available
12	AIIMS Bibinagar	Telangana	2019	Not Available
13	AIIMS Bathinda	Punjab	2019	Not Available
14	AIIMS Kalyani	West Bengal	2019	Not Available
15	AIIMS Deogarh	Jharkhand	2019	Not Available
16	AIIMS Telangana	Telangana	2019	Not Available

Under Development AIIMS in India

As of now, there are 8 AIIMS colleges under development in India. In a few of the under-development AIIMS in India, the construction work has already been started and some of them will be functional soon. Check out the under-development AIIMS in India below:

S.No	Name	Location (State)
1	AIIMS Madurai	Tamil Nadu
2	AIIMS Rajkot	Gujarat
3	AIIMS Vijay Pur	J&K (Jammu Region)
4	AIIMS Awantipora	J&K (Kashmir Region)
5	AIIMS Bilaspur	Himachal Pradesh
6	AIIMS Chandsari	Assam
7	AIIMS Rewari	Haryana
8	AIIMS Darbhanga	Bihar

Furthermore, the Union Cabinet has approved a proposal to set up 20 new AIIMS colleges soon.

Total Seats and Reservation at AIIMS

Sr.No.	AIIMS Institute	General	OBC	SC	ST	PWD	Foreign	Total
1	AIIMS, New Delhi	51	27	15	8	5%	7	107
2	AIIMS, Bhopal	51	27	15	8	5%		100
3	AIIMS, Bhubaneswar	51	27	15	8	5%		100
4	AIIMS, Guntur	51	27	15	8	5%		100
5	AIIMS, Jodhpur	51	27	15	8	5%		100
6	AIIMS, Nagpur	51	27	15	8	5%		100
7	AIIMS, Patna	51	27	15	8	5%		100
8	AIIMS, Raipur	51	27	15	8	5%		100
9	AIIMS, Rishikesh	51	27	15	8	5%		100
10	AIIMS, Bathinda	24	14	8	4	3%		50
11	AIIMS, Gorakhpur	24	14	8	4	3%		50
12	AIIMS, Kalyani	24	14	8	4	3%		50
13	AIIMS, Rae Bareli	26	13	7	4	2%		50
14	AIIMS, Deogarh	26	13	7	4	2%		50
15	AIIMS, Telangana	26	13	7	4	2%		50
	Total	600	321	180	96		7	1207

NEET COUNSELLING GUIDELINES

Type of Counselling	Counselling Body
Counselling for 15% AIQ Seats (except in Jammu & Kashmir) in Government medical and dental colleges	DGHS, on behalf of MCC
Counselling for all MBBS seats in AIIMs and JIPMER	
Counselling for all the seats in Central and Deemed Universities including BDS at Jamia Millia Islamia, New Delhi	
Counselling for 85% State Quota seats in DU colleges (MAMC, LHMC, UCMS)	
Counselling for IP Quota seats in ESIC Colleges	
Counselling for Armed Forces Medical College (AFMC)	DGHS, on behalf of MCC and AFMC Pune
Counselling for 85% State Quota seats and 100% state private colleges.	Respective State Counselling Authorities
In case of Jammu & Kashmir - 100% of all government and private colleges	

NEET SEAT INTAKE: (No. may increase in NEET 2021)

- AIIMS MBBS (15 institutes) - 1205 seats
- JIPMER MBBS (2 institutes) - 200 seats
- MBBS seats in 532 colleges - 76,928
- BDS seats in 313 colleges - 26,949
- Ayush seats in 914 colleges - 52,720 seats

NEET CUT OFF FOR TOP MEDICAL COLLEGES

Students appearing in NEET 2020 can check Previous year cut off of some well-known medical institutes in India from the table given below:

Name of the College	Number of Seats	Closing Rank
Maulana Azad Medical College	250	32
VMMC and Safdarjung Hospital	150	157
University College of Medical Science	150	171
Govt. Medical College	250	360
Seth G.S Medical College	180	638
Lady Hardinge Medical College	150	489
CSM Medical University	250	3692

S. M. S Medical College	250	356
Grant Medical College & Sir J. J. Hospital	200	382
Pt. B. D. Sharma PGIMS	200	600
King George Medical College	NA	506
Sardar Patel Medical College	250	1083
Madras Medical College	250	501

Note :- This is a rough estimate & many vary from year to year

NEET Result - Marks vs Rank 2019, 2018 and 2017 (will be updated with 2020 results are out)

Marks Range	Rank Range (2019)	Rank Range (2018)	Rank Range (2017)
701		-	-
691-700		1	1 - 9
681-690	20 - 88	2 - 7	10 - 25
671-680	99 - 214	8 - 31	26 - 83
661-670	223 - 476	32 - 63	84 - 163
651-660	568 - 930	64 - 122	164 - 301
641-650	946 - 1714	123 - 232	302 - 535
631-640	1809 - 2570	233 - 398	534 - 870
621-630	2788 - 3956	399 - 639	871 - 1308
611-620	4074 - 5630	640 - 994	1309 - 1962
601-610	5692 - 7580	995 - 1505	1963 - 2786
591-600	7784 - 10036	1506 - 2169	2787 - 3874
581-590	10248 - 12898	2170 - 3084	3875 - 5229
571-580	13064 - 16008	3085 - 4202	5230 - 6788
561-570	16173 - 19478	4203 - 5615	6789 - 8736
551-560	19967 - 23501	5616 - 7433	8737 - 10851
541-550	23695 - 27650	7434 - 9493	10851 - 13353
531-540	27994 - 32317	9494 - 11885	13354 - 16163
521-530	32796 - 37464	11886 - 14629	16163 - 18876
511-520	37780 - 38736	14630 - 17816	18876 - 22372
501-510	38822 - 44553	17817 - 21337	22372 - 25842
491-500	45023 - 51086	21338 - 25229	25843 - 29557
481-490	51498 - 58114	25230 - 29528	29558 - 33893
471-480	58214 - 65316	29529 - 34037	33894 - 38152
461-470	65801 - 73197	34038 - 38947	38153 - 43019
451-460	73337 - 81607	38948 - 44227	43020 - 47809
441-450	82216 - 89872	44228 - 49907	47810 - 53184
431-440	90825 - 99323	49908 - 55928	53185 - 59177
421-430	99914 - 109429	55929 - 62506	59178 - 65280
411-420	109937 - 120258	62507 - 69529	65281 - 71938

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1 The Living World

Trend Analysis with Important Topics & Sub-Topics

		2020		2019		2018		2017		2016	
Topic	Sub-Topics	Qns.	LOD	Qns.	LOD	Qns.	LOD	Qns.	LOD	Qns.	LOD
Characteristics of Living Organisms	What is Living									1	A
	Diversity in the Living World										
Classification and Taxonomic Categories	Taxonomic Categories			1	A						
Taxonomical Aids	Aids					1	A				

LOD - Level of Difficulty | E - Easy | A - Average | D - Difficult | Qns - No. of Questions

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Topic 1: Characteristics of Living Organisms

1. Which of the following has proved helpful in preserving pollen as fossils? *[2018]*
   (a) Pollenkitt (b) Cellulosic intine
   (c) Sporopollenin (d) Oil content
2. It is much easier for a small animal to run uphill than for a large animal, because *[2016]*
   (a) it is easier to carry a small body weight.
   (b) smaller animals have a higher metabolic rate.
   (c) small animals have a lower O_2 requirement.
   (d) the efficiency of muscles in large animals is less than in the small animals.
3. Which one of the following aspects is an exclusive characteristic of living things? *[2011M]*
   (a) Isolated metabolic reactions occur in vitro
   (b) Increase in mass from inside only
   (c) Perception of events happening in the environment and their memory
   (d) Increase in mass by accumulation of material both on surface as well as internally.
4. Biological organisation starts with *[2007]*
   (a) cellular level
   (b) organismic level
   (c) atomic level
   (d) submicroscopic molecular level
5. The living organisms can be unexceptionally distinguished from the non-living things on the basis of their ability for *[2007]*
   (a) interaction with the environment and progressive evolution
   (b) reproduction
   (c) growth and movement
   (d) responsiveness to touch.
6. Angiosperms have dominated the land flora primarily because of their *[2004]*
   (a) power of adaptability in diverse habitat
   (b) property of producing large number of seeds
   (c) nature of self pollination
   (d) domestication by man

7. Organisms which obtain energy by the oxidation of reduced inorganic compounds are called *[2002]*
   (a) photoautotrophs (b) chemoautotrophs
   (c) saprozoic (d) coproheterotrophs
8. What is true for photolithotrops? *[2001]*
   (a) Obtain energy from radiations and hydrogen from organic compounds
   (b) Obtain energy from radiations and hydrogen from inorganic compounds
   (c) Obtain energy from organic compounds
   (d) Obtain energy from inorganic compounds
9. First life on earth was *[2001]*
   (a) Cyanobacteria (b) Chemoheterotrophs
   (c) Autotrophs (d) Photoautotrophs
10. The most important feature of all living systems is to *[2000]*
   (a) utilize oxygen to generate energy
   (b) replicate the genetic information
   (c) produce gametes
   (d) utilize solar energy for metabolic activities
11. The book Genera Plantarum was written by *[1999]*
   (a) Bessy (b) Hutchinson
   (c) Engler and Prantl (d) Bentham & Hooker
12. Study of fossils is *[1991]*
   (a) palaeontology (b) herpetology
   (c) saurology (d) organic evolution
13. Homeostasis is organism's *[1991]*
   (a) tendency to change with change in environment
   (b) tendency to resist change
   (c) disturbance in regulatory control
   (d) plants and animal extracts used in homeopathy
14. Employment of hereditary principles in the improvement of human race is *[1990]*
   (a) Euthenics (b) Eugenics
   (c) Euphenics (d) Ethnology
15. Static concept of species was put forward by
   (a) de Candolle (b) Linnaeus *[1988]*
   (c) Theophrastus (d) Darwin

Topic 2: Classification and Taxonomic Categories

16. Which of the following is against the rules of ICBN? *[2019, Odisa]*
   (a) Generic and specific names should be written starting with small letters.
   (b) Hand written scientific names should be underlined.
   (c) Every species should have a generic name and a specific epithet.
   (d) Scientific names are in Latin and should be italized.
17. Select the **correctly** written scientific name of Mango which was first described by Carolus Linnaeus: *[2019]*
   (a) *Mangifera indica* Car. Linn.
   (b) *Mangifera indica* Linn.
   (c) Mangifera indica
   (d) *Mangifera Indica*
18. Nomenclature is governed by certain universal rules. Which one of the following is contrary to the rules of nomenclature? *[2016]*
   (a) Biological names can be written in any language
   (b) The first word in a biological name represents the genus name, and the second is a specific epithet
   (c) The names are written in Latin and are italicised
   (d) When written by hand, the names are to be underlined
19. The common characteristics between tomato and potato will be maximum at the level of their *[NEET Kar. 2013]*
   (a) Genus (b) Family
   (c) Order (d) Division
20. Which one of the following organisms is scientifically correctly named, correctly printed according to the International Rules of Nomenclature and correctly described? *[2012M]*
   (a) *Musca domestica* - The common house lizard, a reptile.
   (b) *Plasmodium falciparum* – A protozoan pathogen causing the most serious type of malaria.
   (c) *Felis tigris* - The Indian tiger, well protected in Gir forests.
   (d) *E.coli* - Full name *Entamoeba coli*, a commonly occurring bacterium in human intestine.
21. Which one of the following animals is correctly matched with its particular named taxonomic category ? *[2011]*
   (a) Tiger - tigris, the species
   (b) Cuttle fish - mollusca, a class
   (c) Humans - primata, the family
   (d) Housefly - musca, an order

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22. ICBN stands for *[2007]*
    (a) International Code of Botanical Nomenclature
    (b) International congress of Biological Names
    (c) Indian Code of Botanical Nomenclature
    (d) Indian Congress of Biological Names.
23. Phenetic classification is based on *[2003, 04]*
    (a) sexual characteristics
    (b) the ancestral lineage of existing organisms
    (c) observable characteristics of existing organisms
    (d) dendograms based on DNA characteristics
24. Biosystematics aims at *[2003]*
    (a) identification and arrangement of organisms on the basis of their cytological characteristics
    (b) the classification of organisms based on broad morphological characters
    (c) delimiting various taxa of organisms and establishing their relationships
    (d) the classification of organisms based on their evolutionary history and establishing their phylogeny on the totality of various parameters from all fields of studies
25. Species are considered as *[2003]*
    (a) real units of classification devised by taxonomists
    (b) real basic units of classification
    (c) the lowest units of classification
    (d) artificial concept of human mind which cannot be defined in absolute terms
26. What is true for individuals of same species?
    (a) Live in same niche *[2002]*
    (b) Live in same habitat
    (c) Interbreeding
    (d) Live in different habitat
27. The practical purpose of classification of living organisms is to *[1999]*
    (a) explain the origin of living organisms
    (b) trace the evolution of living organisms
    (c) name the living organisms
    (d) facilitate identification of unknown organisms
28. A taxon is *[1990, 91, 92, 96]*
    (a) a group of related families
    (b) a group of related species
    (c) a type of living organisms
    (d) a taxonomic group of any ranking
29. Binomial nomenclature was introduced by *[1994]*
    (a) de Vries (b) Carlous Linnaeus
    (c) Huxley (d) John Ray
30. Species is a *[1994]*
    (a) unit of classification
    (b) unit in the evolutionary history of a tree
    (c) specific class of evolution
    (d) not related to evolution
31. Binomial nomenclature consists of two words *[1994]*
    (a) Genus and species (b) Order and family
    (c) Family and genus (d) Species and variety
32. "Taxonomy without phylogeny is similar to bones without flesh" is the statement of *[1994]*
    (a) Oswald Tippo
    (b) John Hutchinson
    (c) Takhtajan
    (d) Bentham and Hooker
33. Binomial nomenclature means *[1993]*
    (a) one name given by two scientists
    (b) one scientific name consisting of a generic and specific epithet
    (c) two names, one latinised, other of a person
    (d) two names of same plant
34. Linnaeus is credited with *[1993]*
    (a) binomial nomenclature
    (b) theory of biogenesis
    (c) discovery of microscope
    (d) discovery of blood circulation
35. The term phylum was given by *[1992]*
    (a) Cuvier (b) Haeckel
    (c) Theophrastus (d) Linnaeus
36. Sequence of taxonomic categories is *[1992]*
    (a) Class – Phylum – Tribe – Order – Family – Genus – Species
    (b) Division – Class – Family – Tribe – Order – Genus – Species
    (c) Division – Class – Order – Family – Tribe – Genus – Species
    (d) Phylum – Order – Class – Tribe – Family – Genus – Species
37. An important criterion for modern day classification is *[1991]*
    (a) resemblances in morphology
    (b) anatomical and physiological traits
    (c) breeding habits
    (d) presence or absence of notochord

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38. Linnaeus evolved a system of nomenclature called *[1990]*
(a) mononomial
(b) vernacular
(c) binomial
(d) polynomial

39. Basic unit or smallest taxon of taxonomy/ classification is *[1990]*
(a) species (b) kingdom
(c) family (d) variety

40. The term "New Systematics" was introduced by *[1988]*
(a) Bentham and Hooker
(b) Linnaeus
(c) Julian Huxley
(d) A.P. de Candolle

Topic 3: Taxonomical Aids

41. The contrasting characteristics generally in a pair used for identification of animals in Taxonomic Key are referred to as : *[2019]*
(a) Alternate (b) Lead
(c) Couplet (d) Doublet

42. Which one of the following is not a correct statement ? *[NEET 2013]*
(a) Botanical gardens have collection of living plants for reference.
(b) A museum has collection of photographs of plants and animals
(c) Key is taxonomic aid for identification of specimens.
(d) Herbarium houses dried, pressed and preserved plant specimens.

ANSWER KEY

1	(c)	7	(b)	13	(b)	19	(b)	25	(c)	31	(a)	37	(b)
2	(b)	8	(b)	14	(b)	20	(b)	26	(c)	32	(c)	38	(c)
3	(c)	9	(b)	15	(b)	21	(a)	27	(d)	33	(b)	39	(a)
4	(d)	10	(b)	16	(a)	22	(a)	28	(d)	34	(a)	40	(c)
5	(b)	11	(d)	17	(b)	23	(c)	29	(b)	35	(a)	41	(c)
6	(a)	12	(a)	18	(a)	24	(d)	30	(a)	36	(c)	42	(b)

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Hints & Solutions

1. (c) Sporopollenin cannot be degraded by enzyme; strong acids and alkali, therefore it is helpful in preserving pollen as fossil.
2. (b) Basal metabolic rate is inversely proportional to body size. So smaller animals have a higher metabolic rate. Hence production of energy is more.
3. (c) All living things have an ability to respond to their environment, which is also called stimulation.
4. (d) Biological organisms starts with submicroscopic molecular level like viruses, bacteria etc.
5. (b) There are several factors and processes which differentiate living beings from non-living things like reproduction, respiration, growth etc. But among them, reproduction is the only difference, which differentiates living beings from no-living things without any exception.
6. (a) Angiosperms have adapted themselves to all kinds of habitat - terrestial, aquatic, tropical, deciduous and alpine.

NOTES
Self pollination is seen in very few angiosperms. Production of large number of seeds ensure that at least some will germinate. Not all plants have been domesticated by man.

7. (b) The organisms obtaining energy by chemical reactions independent of light are called chemotrophs. When the reductants obtained from the environment are in inorganic form then organisms are called chemoautotrophs. If they are organic, then the organisms are chemoheterotrophs.

Photoautotrophs make their food by photosynthesis using energy from the sun.
Saprozoic organisms obtain food from dead and decaying matter.

NOTES

Chemoheterotrophs can be chemolithoheterotrophs, utilizing inorganic electron sources such as sulfur, or chemoorganoheterotrophs, utilizing organic electron sources such as carbohydrates, lipids, and proteins. Most animals and fungi are examples of chemoheterotrophs, obtaining most of their energy from O_2.

8. (b) Photolithotrophs manufacture their own organic nutrients from inorganic raw materials (H_2, O_2) with the help of radiation energy.

NOTES

Some examples of photolithotrophic bacteria are purple bacteria (e. g., Chromatiaceae), green bacteria (Chlorobiaceae and Chloroflexi) and Cyanobacteria. Purple and green bacteria oxidize sulfide, sulfur, sulfite, iron or hydrogen.

9. (b) First life on earth was chemoheterotroph. These were formed in the environment of sea having abundant organic molecules. They absorbed the organic materials for the sake of nutrtion and hence were chemoheterotrophs.
10. (b) Replication of the genetic information causes transfer of genetic information from one generation to the next.
11. (d) Bentham & Hooker wrote the book Genera Plantarum.

NOTES

His greatest work was the Genera Plantarum, which begun in 1862, and concluded in 1883 in collaboration with Sir Joseph Dalton Hooker.

12. (a) Palaentology is the branch of zoology concerned with the study of fossils.
13. (b) Homoeostasis is the property of all living beings, which is a self regulatory mechanism of maintaining favourable internal condition for uninterrupted chemical reactions in the living system despite the changes in the external environment. E.g., in winter the skin contracts to conserve body heat.
14. (b) Eugenics is the science that deals with factors (such as principles of genetics) related to improvement of human race. Improvement of race is positive eugenics and if factors are impaired, then it is negative eugenics.
    - Euthenics is the science which improves the condition of life and the environment of human being.
    - Ethnology is the study of different races of mankind, their distribution, relationship and activities.
    - Euphenics is the study of body functions and treatment of heredity defect through medical means i.e. genetic engineering.
15. (b) Carolus Linnaeus introduced Binomial System of Nomenclature in his book Species Plantarum (1753). He said that there can be variation within species, but they do not change from one species to another.
16. (a) The first word denoting the genus starts with a capital letter while the specific epithet starts with a small letter.

NOTES

In plant nomenclature (ICBN), tautonyms are not valid i.e. generic name and specific name should not be same in plants. E.g. Mangifera mangifera But tautonyms are valid for animal nomenclature (ICZN-International Code of Zoological Nomenclature) e.g. & *Naja naja* (Indian cobra), *Rattus rattus* (Rat).

17. (b) According to rules of binomial nomenclature, correctly written scientific name of mango is Mangifera indica Linn.
This system of nomenclature was given by Carl Linnaeus. The scientific name of mango is given as *Mangifera indica Linn. Mangifera* indicates the 'genus' while *indica* represents a particular species or 'specific epithet' and Linn indicates the Biologist Linnaeus who first described the species of mango.
18. (a) Binomial nomenclature is a formal system of naming species of living things by giving each a name composed of two parts, both of which use Latin grammatical forms, although they can be based on words from other languages.
19. (b) Families are characterised on the basis of both vegetative and reproductive features of plant species. Tomato *(Lycopersicon esculentum)* and potato *(Solanum tuberosum)* belong to the same family Solanaceae.
20. (b) *Plasmodium falciparum* – A protozoan pathogen causes the most serious type of malaria that is falciparum malaria.
Musca domestica – House fly, an insect belongs to phylum arthropoda.
Felis tigris – The Bengal tiger, is well protected in Sundarbans (tiger reserve)
E.coli – *Escherichia coli*, a commonly occurring bacterium in human intestine.

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21. (a) Tiger and tigris both are from same genus with a particular taxonomic category.
22. (a) ICBN (International code of Botanical Nomenclature) - It is one of the code of nomenclature which is independent of zoological and bacteriological nomenclature.

NOTES The code applies equally to names of taxonomic groups treated as plants whether or not these groups were originally treated as such.

23. (c) Phenetic classification is based upon observable characteristics of an organism. Phylogenetic system of classification is a system indicating the evolutionary or phylogenetic relationship of organisms.
24. (d) Biosystematics is the study of diversity of organism and all their comparative and evolutionary relationships.

NOTES Biosystematics is the science through which life forms are discovered, identified, described, named, classified and catalogued, with their diversity, life histories, living habits, roles in an ecosystem, and spatial and geographical distributions recorded.

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25. (c) Species is the lowest or basic taxonomic category comprising of one or more natural population of individuals that interbreed freely.
26. (c) Individuals of the same species can interbreed. No two individuals share the same ecological niche.
27. (d) Biological classification is the scientific arrangement of organisms in a hierarchial series of groups and subgroups on the basis of similarities and differences in their traits. It helps in building evolutionary pathways and in identifying new organisms.
28. (d) Taxon is a taxonomic group of any rank. E.g. Family, Genus, Species etc.
29. (b) Linnaeus.

NOTES Binomial nomenclature, also called binominal nomenclature or binary nomenclature, is a formal system of naming species of living things by giving each a name composed of two parts, both of which use Latin grammatical forms, although they can be based on words from other languages.

30. (a) Species is the basic unit of classification. It is defined as a group of natural population whose members can interbreed among themselves and are reproductively isolated from other such groups.
31. (a) Binomial nomenclature consists of two words – genus and species. First word denotes genus name and second word denotes species name.
32. (c) The statement was given by Takhtajan.

NOTES Armen Leonovich Takhtajan or Takhtajian, was a Soviet-Armenian botanist, one of the most important figures in 20th century plant evolution and systematics and biogeography. His other interests included morphology of flowering plants, paleobotany, and the flora of the Caucasus.

33. (b) Binomial nomenclature means the scientific name of any organism consist of a generic and a specific epithet. Generic name starts with capital letter and specific name with small letter. Both the names are in Italics when printed, or underlined in manuscripts.
34. (a) Binomial Nomenclature.
35. (a) Cuvier, the father of modern palaeontology, introduced the term "phylum".

NOTES In biology, a phylum is a level of classification or taxonomic rank below kingdom and above class. Traditionally, in botany the term division has been used instead of phylum, although the International Code of Nomenclature for algae, fungi, and plants accepts the terms as equivalent.

36. (c) With the discovery of more and more organisms, it sometimes becomes, difficult to adjust an organism to the traditional categories. Therefore to make taxonomic position of a species more precise, the various obligate categories in hierarchial classification are explained below.
Division → Class → Order → Family → Tribe → Genus → Species
37. (b) Modern day classification is new systematics or biosystematics which includes all the characteristic of organisms gathered from the study of different sections like physiology, ecology, anatomy, biochemistry, cytology.
38. (c) A system for classification was developed by Carolus Linnaeus is known as "Binomial nomenclature". This system provides organisms with appropriate and distinct names consisting of two words, the generic name and the specific epithert. E.g. potato is named as

Solanum tuberosum. *Solanum* represents genus and tuberosum species. The first name or genus begins always with a capital letter and second or species name with small letter, and both are separately underlined, when written and italicised when printed.

NOTES

The first scientific attempt to name the organism was polynomial nomenclature which consisted of number of words that incorporate all its important characters.

39. (a) Species, the basic unit for understanding taxonomy, occupies a key position. It is defined as a dynamic genetically distinct group of organisms, which resemble each other in all respect and freely interbreed among themselves to produce fertile offsprings.

40. (c) The term "New Systematics" was coined by Julian Huxley (1940).

41. (c) The keys are based on the set of contrasting characters in pair known as couplet.

42. (b) **Museums**– are generally set up in educational institutes such as schools and colleges. Museums have collections of preserved plant and animal specimens for study and reference.

NOTES

Specimens are preserved in the containers or jars in preservative solutions. Plant and animal specimens may also be preserved as dry specimens. Insects are preserved in insect boxes after collections, killing and pinning. Larger animals like birds and mammals are usually stuffed and preserved. Museums often have collections of skeletons of animals too.

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2 Biological Classification

Trend Analysis with Important Topics & Sub-Topics

		2020		2019		2018		2017		2016	
Topic	**Sub-Topics**	**Qns.**	**LOD**	**Qns.**	**LOD**	**Qns.**	**LOD**	**Qns.**	**LOD**	**Qns.**	**LOD**
Five Kingdom Classification	Diversity in the Living World										
Monera	Habitat							1	E		
	Glycocalyx							1	A		
	Mycoplasma							1	E		
Protista	Protozoa					1	A				
	Algae					1	E				
	Diatoms					1	A				
	Members									1	A
Fungi	Pseudopodia					1	A				
	Cell-Wall									1	E
	Members									1	A
Viruses and Viroids	Genetic Material	1	A					1	A		
	Outer Membrane			1	A					1	A
Lichens											

LOD - Level of Difficulty	E - Easy	A - Average	D - Difficult	Qns - No. of Questions

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Topic 1: Five Kingdom Classification

1. Pick up the wrong statement *[2015 RS]*
   (a) Protista have photosynthetic and heterotrophic modes of nutrition
   (b) Some fungi are edible
   (c) Nuclear membrane is present in Monera
   (d) Cell wall is absent in Animalia
2. Five kingdom system of classification suggested by R.H. Whittaker is **not** based on: *[2014]*
   (a) Presence or absence of a well defined nucleus.
   (b) Mode of reproduction.
   (c) Mode of nutrition.
   (d) Complexity of body organisation.
3. In the five-kingdom system of classification, which single kingdom out of the following can include blue green algae, nitrogen-fixing bacteria and methanogenic archaebacteria? *[1998, 2003]*
   (a) Fungi (b) Plantae
   (c) Protista (d) Monera
4. In five kingdom system, the main basis of classification is *[2002]*
   (a) structure of nucleus
   (b) mode of nutrition
   (c) structure of cell wall
   (d) asexual reproduction
5. A system of classification in which a large number of traits are considered, is *[1999]*
   (a) artificial system
   (b) synthetic system
   (c) natural system
   (d) phylogenetic system
6. Phylogenetic classification is based on *[1994]*
   (a) utilitarian system
   (b) habits
   (c) overall similarities
   (d) common evolutionary descent
7. Artificial system of classification was first used by
   (a) Linnaeus (b) De Candolle *[1989]*
   (c) Pliny the Elder (d) Bentham and Hooker

8. System of classification used by Linnaeus was
   (a) natural system *[1989]*
   (b) artificial system
   (c) phylogenetic system
   (d) asexual system
9. Classification given by Bentham and Hooker is
   (a) artificial (b) natural *[1988]*
   (c) phylogenetic (d) numerical

Topic 2: Monera

10. One scientist cultured Cladophora in a suspension of Azotobacter and illuminated the culture by splitting light through a prism. He observed that bacteria accumulated mainly in the region of : *[2019[*
    (a) Blue and red ligh
    (b) Violet and green light
    (c) Indigo and green light
    (d) Orange and yellow light
11. Match the organisms in column I with habitats in column II. *[2019[*

Column-I	Column-II
(A) Halophiles	(i) Hot springs
(B) Thermoacidophiles	(ii) Aquatic environment
(C) Methanogens	(iii) Guts of ruminants
(D) Cyanobacteria	(iv) Salty areas

    Select the correct answer from the options given below :
    (a) (A)-(ii), (B)-(iv), (C)-(iii), (D)-(i)
    (b) (A)-(iv), (B)-(i), (C)-(iii), (D)-(ii)
    (c) (A)-(i), (B)-(ii), (C)-(iii), (D)-(iv)
    (d) (A)-(iii), (B)-(iv), (C)-(ii), (D)-(i)
12. Which among the following is not a prokaryote? *[2018[*
    (a) Saccharomyces (b) Mycobacterium
    (c) Oscillatoria (d) Nostoc
13. Which of the following are found in extreme saline conditions? *[2017]*
    (a) Eubacteria (b) Cyanobacteria
    (c) Mycobacteria (d) Archaebacteria
14. Which of the following components provides sticky character to the bacterial cell? *[2017]*
    (a) Nuclear membrane (b) Plasma membrane
    (c) Glycocalyx (d) Cell wall
15. Which among the following are the smallest living cells, known without a definite cell wall, pathogenic to plants as well as animals and can survive without oxygen? *[2017]*
    (a) *Pseudomonas* (b) *Mycoplasma*
    (c) *Nostoc* (d) *Bacillus*
16. Which of the following structures is not found in a prokaryotic cell? *[2015 RS]*
    (a) Ribosome (b) Mesosome
    (c) Plasma membrane (d) Nuclear envelope
17. The structures that help some bacteria to attach to rocks and / or host tissues are: *[2015 RS]*
    (a) Fimbriae (b) Mesosomes
    (c) Holdfast (d) Rhizoids
18. Archaebacteria differ from eubacteria in: *[2014]*
    (a) Cell membrane
    (b) Mode of nutrition
    (c) Cell shape
    (d) Mode of reproduction
19. The motile bacteria are able to move by: *[2014]*
    (a) Fimbriae (b) Flagella
    (c) Cilia (d) Pili
20. Which of the following are likely to be present in deep sea water? *[NEET 2013]*
    (a) Eubacteria (b) Blue-green algae
    (c) Saprophytic fungi (d) Archaebacteria
21. Specialized cells for fixing atmospheric nitrogen in *Nostoc* are *[NEET Kar. 2013]*
    (a) Akinetes (b) Heterocysts
    (c) Hormogonia (d) Nodules
22. The most abundant prokaryotes helpful to humans in making curd from milk and in production of antibiotics are the ones categorised as: *[2012]*
    (a) Cyanobacteria
    (b) Archaebacteria
    (c) Chemosynthetic autotrophs
    (d) Heterotrophic bacteria
23. The cyanobacteria are also referred to as *[2012]*
    (a) protists (b) golden algae
    (c) slime moulds (d) blue green algae
24. How many organisms in the list given below are autotrophs?
    Lactobacillus, Nostoc, Chara, Nitrosomonas, Nitrobacter, Streptomyces, Saccharomyces, Trypanosomes, Porphyra, Wolffia *[2012M]*
    (a) Four (b) Five
    (c) Six (d) Three
25. In eubacteria, a cellular component that resembles eukaryotic cells is: *[2011]*
    (a) plasma membrane (b) nucleus
    (c) ribosomes (d) cell wall
26. Organisms called methanogens are most abundant in a : *[2011]*
    (a) sulphur rock (b) cattle yard
    (c) polluted stream (d) hot spring

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27. Bacterial leaf blight of rice is caused by a species of *[2008]*
(a) *Xanthomonas* (b) *Pseudomonas*
(c) *Alternaria* (d) *Erwinia*

28. In the light of recent classification of living organisms into three domains of life (bacteria, archaea and eukarya), which one of the following statements is true about archaea? *[2008]*
(a) Archaea resemble eukarya in all respects
(b) Archaea have some novel features that are absent in other prokaryotes and eukaryotes
(c) Archaea completely differ from both prokaryotes and eukaryotes
(d) Archaea completely differ from prokaryotes.

29. *Thermococcus*, *Methanococcus* and Methanobacterium exemplify: *[2008]*
(a) Archaebacteria that contain protein homologous to eukaryotic core histones
(b) Archaebacteria that lack any histones resembling those found in eukaryotes but whose DNA is negatively supercoiled
(c) Bacteria whose DNA is relaxed or positively supercoiled but which have a cytoskeleton as well as mitochondria
(d) Bacteria that contain a cytoskeleton and ribosomes

30. Which one of the following statements about mycoplasma is wrong ? *[2007]*
(a) They are pleomorphic
(b) They are sensitive to penicillin
(c) They cause diseases in plants
(d) They are also called PPLO.

31. In which of the animals dimorphic nucleus is found? *[2005]*
(a) *Amoeba proteus*
(b) *Trypanosoma gambiense*
(c) *Plasmodium vivax*
(d) *Paramecium caudatum*

32. The most throughly studied fact of the known bacteria-plant interactions is the *[2004]*
(a) cyanobacterial symbiosis with some aquatic ferns
(b) gall formation on certain angiosperms by *Agrobacterium*
(c) nodulation of Sesbania stems by nitrogen fixing bacteria
(d) plant growth stimulation by phosphate-solubilising bacteria

33. The chief advantage of encystment to an *Amoeba* is *[2003]*
(a) the chance to get rid of accumulated waste products
(b) the ability to survive during adverse physical conditions
(c) the ability to live for sometime without ingesting food
(d) protection from parasites and predators

34. Which bacteria is utilized in gober gas plant? *[2002]*
(a) Methanogens
(b) Nitrifying bacteria
(c) Ammonifying bacteria
(d) Denitrifying bacteria

35. Which statement is correct for bacterial transduction ? *[2002]*
(a) Transfer of some genes from one bacteria to another bacteria through virus
(b) Transfer of genes from one bacteria to another bacteria by conjugation
(c) Bacteria obtains its DNA directly
(d) Bacteria obtains its DNA from other external source

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36. What is true for cyanobacteria? *[2001]*
(a) Oxygenic with nitrogenase
(b) Oxygenic without nitrogenase
(c) Non-oxygenic with nitrogen
(d) Non-oxygenic without nitrogenase

37. What is true for archaebacteria ? *[2001]*
(a) All halophiles (b) All photosynthetic
(c) All fossils (d) Oldest living beings

38. The main difference in Gram (+)ve and Gram (–)ve bacteria resides in their *[2001]*
(a) cell wall (b) cell membrane
(c) cytoplasm (d) flagella

39. Photosynthetic bacteria have pigments in *[1999]*
(a) leucoplasts (b) chloroplasts
(c) chromoplasts (d) chromatophores

40. In prokaryotes, the genetic material is *[1999]*
(a) linear DNA with histones
(b) circular DNA with histones
(c) linear DNA without histones
(d) circular DNA without histones

41. A few organisms are known to grow and multiply at temperatures of 100–105°C. They belong to *[1998]*
(a) marine archaebacteria
(b) thermophilic sulphur bacteria
(c) hot-spring blue-green algae (cyanobacteria)
(d) thermophilic, subaerial fungi

42. Transfer of genetic information from one bacterium to another in the transduction process is through *[1998]*
(a) Conjugation
(b) Bacteriophages released from the donor bacterial strain
(c) Another bacterium
(d) Physical contact between donor and recipient strain

43. The hereditary material present in the bacterium *Escherichia coli* is *[1998]*
(a) single stranded DNA
(b) deoxyribose sugar
(c) double stranded DNA
(d) single stranded RNA

44. Sex factor in bacteria is *[1996]*
(a) Chromosomal replicon
(b) F-replicon
(c) RNA
(d) Sex-pilus

45. Temperature tolerance of thermal blue-green algae is due to *[1994]*
(a) cell wall structure
(b) cell organisation
(c) mitochondrial structure
(d) homopolar bonds in their proteins

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46. Nitrogen fixer soil organisms belong to *[1994]*
(a) mosses (b) bacteria
(c) green algae (d) soil fungi

47. *Entamoeba coli* causes *[1994]*
(a) Pyrrhoea (b) Diarrhoea
(c) Dysentery (d) None

48. *Escherichia coli* is used extensively in biological research as it is *[1993]*
(a) easily cultured
(b) easily available
(c) easy to handle
(d) easily multiplied in host

49. Genophore/bacterial genome or nucleoid is made of *[1993]*
(a) histones and nonhistones
(b) RNA and histones
(c) a single double stranded DNA
(d) a single stranded DNA

50. Bacteria lack alternation of generation because there is *[1992]*
(a) neither syngamy nor reduction division
(b) distinct chromosomes are absent
(c) no conjugation
(d) no exchange of genetic material

51. Name the organisms which do not derive energy directly or indirectly from sun *[1991]*
(a) Chemosynthetic bacteria
(b) Pathogenic bacteria
(c) Symbiotic bacteria
(d) Mould

52. Which one belongs to monera? *[1990]*
(a) *Amoeba* (b) *Escherichia*
(c) *Gelidium* (d) *Spirogyra*

Topic 3: Protista

53. Which of the following organisms are known as chief producers in the oceans? *[2018]*
(a) Dinoflagellates (b) Diatoms
(c) Euglenoids (d) Cyanobacteria

54. Ciliates differ from all other protozoans in *[2018]*
(a) using flagella for locomotion
(b) having a contractile vacuole for removing excess water
(c) having two types of nuclei
(d) using pseudopodia for capturing prey

55. Chrysophytes, Euglenoids, Dinoflagellates and Slime moulds are included in the kingdom *[2016]*
(a) Monera (b) Protista
(c) Fungi (d) Animalia

56. In which group of organisms the cell walls form two thin overlapping shells which fit together? *[2015 RS]*
(a) Euglenoids (b) Dinoflagellates
(c) Slime moulds (d) Chrysophytes

57. In the five-kingdom classification, *Chlamydomonas* and *Chlorella* have been included in *[2012M]*
(a) protista (b) algae
(c) plantae (d) monera

58. Which one of the following organisms is not an example of eukaryotic cells ? *[2011]*
(a) *Paramecium caudatum*
(b) *Escherichia coli*
(c) *Euglena viridis*
(d) *Amoeba proteus*

59. Single-celled eukaryotes are included in: *[2010]*
(a) Protista (b) Fungi
(c) Archaea (d) Monera

60. Which one of the following is a slime mould? *[2007]*
(a) *Physarum* (b) *Thiobacillus*
(c) *Anabaena* (d) *Rhizopus*

61. The thalloid body of a slime mould (Myxomycetes) is known as *[2006]*
(a) plasmodium (b) fruiting body
(c) mycelium (d) protonema

62. Auxopores and hormocysts are formed, respectively, by: *[2005]*
(a) Some diatoms and several cyanobacteria
(b) Some cyanobacteria and diatoms
(c) Several cyanobacteria and several diatoms
(d) Several diatoms and a few cyanobacteria.

63. In *Amoeba* and *Paramecium* osmoregulation occurs through *[2002]*
(a) pseudopodia (b) nucleus
(c) contractile vacuole (d) general surface

64. Which of the following organism possesses characteristics of both a plant and an animal?
(a) Bacteria (b) *Euglena* *[1995]*
(c) *Mycoplasma* (d) *Paramecium*

65. The function of contractile vacuole, in protozoa, is *[1995]*
(a) locomotion (b) food digestion
(c) osmoregulation (d) reproduction

66. Macro and micronucleus are the characteristic feature of *[1995]*
(a) *Paramecium* and *Vorticella*
(b) *Opelina* and *Nictothisus*
(c) *Hydra* and *Ballantidium*
(d) *Vorticella* and *Nictothirus*

67. Excretion in *Amoeba* occurs through *[1995]*
(a) lobopodia (b) uroid portion
(c) plasma membrane (d) contractile vacuole

68. Protistan genome has *[1994]*
(a) membrane bound nucleoproteins embedded in cytoplasm
(b) free nucleic acid aggregates
(c) gene containing nucleoproteins condensed together in loose mass
(d) nucleoprotein in direct contact with cell substance

69. Protists obtain food as *[1994]*
(a) photosynthesisers, symbionts and holotrophs
(b) photosynthesisers
(c) chemosynthesisers
(d) holotrophs

70. Protista includes *[1994]*
(a) heterotrophs (b) chemoheterotrophs
(c) chemoautotrophs (d) all the above

71. African sleeping sickness is due to *[1991]*
(a) *Plasmodium vivax* transmitted by Tse tse fly
(b) *Trypanosoma lewsii* transmitted by Bed Bug
(c) *Trypanosoma gambiense* transmitted by *Glossina palpalis*
(d) *Entamoeba gingivalis* spread by Housefly.

72. Genetic information in *Paramecium* is contained in *[1990]*
(a) micronucleus
(b) macronucleus
(c) both micronucleus and macronucleus
(d) mitochondria

73. Which is true about *Trypanosoma* ? *[1990]*
(a) Polymorphic (b) Monogenetic
(c) Facultative Parasite (d) Non-pathogenic

74. *Plasmodium*, the malarial parasite, belongs to class *[1990]*
(a) Sarcodina (b) Ciliata
(c) Sporozoa (d) Dinophyceae

75. The causal organism for African sleeping sickness is *[1989]*
(a) *Trypanosoma cruzi* (b) *T. rhodesiense*
(c) *T. tangela* (d) *T. gambiense*

76. The vector for sleeping sickness is *[1989]*
(a) House fly (b) Tse-Tse fly
(c) Sand fly (d) Fruit fly

77. Trypanosoma belongs to class *[1989]*
(a) Sarcodina (b) Zooflagellata
(c) Ciliata (d) Sporozoa

78. A bite of Tse-Tse fly may pass to humans
(a) *Leishmania donovani* *[1989]*
(b) *Trypanosoma gambiense*
(c) *Entamoeba histolytica*
(d) *Plasmodium vivax*

79. The infective stage of malarial parasite Plasmodium that enters human body is *[1989]*
(a) merozoite (b) sporozoite
(c) trophozoite (d) minuta form

80. What is common about *Trypanosoma*, *Noctiluca*, *Monocystis* and *Giardia* ? *[2006]*
(a) They have flagella
(b) They produce spores
(c) These are all parasites
(d) These are all unicellular protists

Topic 4: Fungi

81. Which of the following statements is **incorrect**? *[2019]*
(a) Morels and truffles are edible delicacies.
(b) *Claviceps* is a source of many alkaloids and LSD.
(c) Conidia are produced exogenously and ascospores endogenously.
(d) Yeasts have filamentous bodies with long thread-like hyphae.

82. One of the major components of cell wall of most fungi is *[2016]*
(a) Chitin (b) Peptidoglycan
(c) Cellulose (d) Hemicellulose

83. Which one of the following statements is wrong? *[2016]*

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(a) Cyanobacteria are also called blue-green algae
(b) Golden algae are also called desmids
(c) Eubacteria are also called false bacteria
(d) Phycomycetes are also called algal fungi

84. Which one one of the following matches is correct ? ***[2015 RS]***

(a)	*Alternaria*	Sexual reproduction absent	Deuteromycetes
(b)	*Mucor*	Reproduction by Conjugation	Ascomycetes
(c)	*Agaricus*	Parasitic fungus	Basidiomycetes
(d)	*Phytophthora*	Aseptate mycelium	Basidiomycetes

85. True nucleus is absent in : ***[2015 RS]***
(a) *Mucor* (b) *Vaucheria*
(c) *Volvox* (d) *Anabaena*

86. The imperfect fungi which are decomposers of litter and help in mineral cycling belong to: ***[2015 RS]***
(a) Basidiomycetes (b) Phycomycetes
(c) Ascomycetes (d) Deuteromycetes

87. Choose the wrong statements: ***[2015 RS]***
(a) *Neurospora* is used in the study of biochemical genetics
(b) Morels and truffles are poisonoues mushrooms
(c) Yeast is unicellular and useful in fermentation
(d) *Penicillium* is multicellular and produces antibiotics

88. Which one of the following fungi contains hallucinogens? ***[2014]***
(a) *Morchella esculenta* (b) *Amanita muscaria*
(c) *Neurospora sp.* (d) *Ustilago sp.*

89. Which one of the following is true for fungi?
(a) They are phagotrophs ***[NEET Kar. 2013]***
(b) They lack a rigid cell wall
(c) They are heterotrophs
(d) They lack nuclear membrane

90. Membrane-bound organelles are absent in: ***[2010]***
(a) *Saccharomyces* (b) *Streptococcus*
(c) *Chlamydomonas* (d) *Plasmodium*

91. Which one is the wrong pairing for the disease and its causal organism? ***[2009]***
(a) Black rust of wheat - *Puccinia graminis*
(b) Loose smut of wheat - *Ustilago nuda*
(c) Root-knot of vegetables - *Meloidogyne sp*
(d) Late blight of potato - *Alternaria solani*

92. Which pair of the following belongs to Basidiomycetes? ***[2007]***
(a) puffballs and *Claviceps*
(b) peziza and stink borns
(c) *Morchella* and mushrooms
(d) birds nest fungi and puffballs.

93. Ergot of rye is caused by a species of ***[2007]***
(a) *Uncimula* (b) *Ustilago*
(c) *Claviceps* (d) *Phytophthora.*

94. Which of the following environmental conditions are essential for optimum growth of *Mucor* on a piece of bread ? ***[2006]***
A. Temperature of about 25°C
B. Temperature of about 5° C
C. Relative humidity of about 5%
D. Relative humidity of about 95%
E. A shady place
F. A brightly illuminated place
Choose the answer from the following options:
(a) A, D and E only (b) B, D and E only
(c) B, C and F only (d) A, C and E only

95. Viruses that infect bacteria, multiply and cause their lysis, are called ***[2004]***
(a) lysozymes (b) lipolytic
(c) lytic (d) lysogenic

96. Mycorrhiza represents ***[2003]***
(a) antagonism (b) endemism
(c) symbiosis (d) parasitism

97. Which of the following secretes toxins during storage conditions of crop plants? ***[2002]***
(a) *Aspergillus* (b) *Penicillium*
(c) *Fusarium* (d) *Colletotrichum*

98. Which fungal disease spreads by seed and flowers?
(a) Loose smut of wheat ***[2002]***
(b) Corn stunt
(c) Covered smut of barley
(d) Soft rot of potato

99. Plant decomposers are ***[2001]***
(a) Monera and fungi
(b) Fungi and plants
(c) Protista and animalia
(d) Animalia and monera

100. Adhesive pad of fungi penetrates the host with the help of ***[2001]***
(a) mechanical pressure and enzymes
(b) hooks and suckers
(c) softening by enzymes
(d) only by mechanical pressure

101. A good green manure in rice fields is ***[2000]***
(a) *Aspergillus* (b) *Azolla*
(c) *Salvinia* (d) *Mucor*

102. In fungi stored food material is ***[2000]***
(a) glycogen (b) starch
(c) sucrose (d) glucose

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103. Black rust of wheat is caused by *[2000]*
(a) *Puccinia* (b) *Mucor*
(c) *Aspergillus* (d) *Rhizopus*

104. *Puccinia* forms *[1998]*
(a) uredia and aecia on wheat leaves
(b) uredia and telia on wheat leaves
(c) uredia and aecia on barberry leaves
(d) uredia and pycnia on barberry leaves

105. Mycorrhiza is *[1996]*
(a) a symbiotic association of plant roots and certain fungi
(b) an association of algae with fungi
(c) a fungus parasitising root system of higher plants
(d) an association of *Rhizobium* with the roots of leguminous plants

106. Which of the following is not correctly matched? *[1995]*
(a) Root knot disease - *Meloidogyne javanica*
(b) Smut of bajra - *Tolysporium penicillariae*
(c) Covered smut of barley - *Ustilago nuda*
(d) Late blight of potato - *Phytophthora infestans*

107. The chemical compounds produced by the host plants to protect themselves against fungal infection is *[1995]*
(a) phytotoxin (b) pathogen
(c) phytoalexins (d) hormone

108. White rust disease is caused by *[1995]*
(a) *Claviceps* (b) *Alternaria*
(c) *Phytophthora* (d) *Albugo candida*

109. *Ustilago* causes plant diseases called smut because
(a) they parasitise cereals *[1994]*
(b) mycelium is black
(c) they develop sooty masses of spores
(d) affected parts becomes completely black.

110. *Claviceps purpurea* is causal organism of
(a) Smut of Barley *[1994]*
(b) Rust of Wheat
(c) Ergot of Rye
(d) Powdery Mildew of Pea.

111. Absorptive heterotrophic nutrition is exhibited by *[1990]*
(a) Algae (b) Fungi
(c) Bryophytes (d) Pteridophytes

Topic 5: Viruses Virioids and Prions

112. Which of the following is correct about viroids? *[2020]*
(a) They have free RNA without protein coat
(b) They have DNA with protein coat
(c) They have free DNA without protein coat
(d) They have RNA with protein coat

113. Which of the following statements is **incorrect**? *[2019]*
(a) Viroids lack a protein coat.
(b) Viruses are obligate parasites.
(c) Infective constituent in viruses is the protein coat.
(d) Prions consist of abnormally folded proteins.

114. Mad cow disease in cattle is caused by an organism which has : *[2019]*
(a) Free DNA without protein coat
(b) Inert crystalline structure
(c) Abnormally folded protein
(d) Free RNA without protein coat

115. Viroids differ from viruses in having; *[2017]*
(a) DNA molecules without protein coat
(b) RNA molecules with protein coat
(c) RNA molecules without protein coat
(d) DNA molecules with protein coat

116. Which of the following statements is wrong for viroids? *[2016]*
(a) They lack a protein coat
(b) They are smaller than viruses
(c) They cause infections
(d) Their RNA is of high molecular weight

117. Which of the following shows coiled RNA strand and capsomeres? *[2014]*
(a) Polio virus
(b) Tobacco masaic virus
(c) Measles virus
(d) Retrovirus

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118. Viruses have: *[2014]*
(a) DNA enclosed in a protein coat
(b) Prokaryotic nucleus
(c) Single chromosome
(d) Both DNA and RNA

119. Satellite RNAs are present in some *[NEET Kar. 2013]*
(a) Plant viruses (b) Viroids
(c) Prions (d) Bacteriophages

120. Which statement is **wrong** for viruses? *[2012]*
(a) All are parasites
(b) All of them have helical symmetry
(c) They have ability to synthesize nucleic acids and proteins
(d) Antibiotics have no effect on them

121. Virus envelope is known as: *[2010]*
(a) Capsid (b) Virion
(c) Nucleoprotein (d) Core

122. The causative agent of mad-cow disease is a
(a) Prion (b) Worm *[2006]*
(c) Bacterium (d) Virus

123. Viruses are no more "alive" than isolated chromosomes because *[2003]*
(a) both require the environment of a cell to replicate
(b) they require both RNA and DNA
(c) they both need food molecules
(d) they both require oxygen for respiration

124. Which one of the following statements about viruses is correct ? *[2003]*
(a) Nucleic acid of viruses is known as capsid
(b) Viruses possess their own metabolic system
(c) All viruses contain both RNA and DNA
(d) Viruses are obligate parasites

125. Tobacco mosaic virus is a tubular filament of size *[2003]*
(a) 700 × 30 nm (b) 300 × 10 nm
(c) 300 × 5 nm (d) 300 × 20 nm

126. Cauliflower mosaic virus contains *[2001]*
(a) ss RNA (b) ds RNA
(c) ds DNA (d) ss DNA

127. Enzymes are absent in *[2000]*
(a) Cyanobacteria (b) Viruses
(c) Algae (d) Fungi

128. A virus can be considered a living organism because it *[2000]*
(a) responds to touch stimulus
(b) respires
(c) reproduces (inside the host)
(d) can cause disease

129. Which one of the following statements about viruses is correct? *[1997]*
(a) Viruses possess their own metabolic system
(b) Viruses contain either DNA or RNA
(c) Viruses are facultative parasites
(d) Viruses are readily killed by antibiotics

130. Influenza virus has *[1996]*
(a) DNA
(b) RNA
(c) both DNA and RNA
(d) only proteins and no nucleic acids.

131. Tobacco Mosaic Virus (TMV) genes are *[1994]*
(a) double stranded RNA
(b) single stranded RNA
(c) polyribonucleotides
(d) proteinaceous

132. Rickettsiae constitute a group under *[1994]*
(a) bacteria
(b) viruses
(c) independent group between bacteria and viruses
(d) fungi

Topic 6: Lichens

133. Which of the following statements is correct? *[2019, Odisa]*
(a) Lichens are not good pollution indicators.
(b) Lichens do not grow in polluted areas.
(c) Algal component of lichens is called mycobiont.
(d) Fungal component of lichens is called phycobiont.

134. Which of the following are most suitable indicators of SO_2 pollution in the environment?
(a) Conifers (b) Algae *[2015 RS]*
(c) Fungi (d) Lichens

134. Which one single organism or the pair of organisms is **correctly** assigned to its taxonomic group? *[2012]*
(a) *Paramoecium* and *Plasmodium* belong to the same kingdom as that of *Penicillium*
(b) Lichen is a composite organism formed from the symbiotic association of an algae and a protozoan
(c) Yeast used in making bread and beer is a fungus
(d) *Nostoc* and *Anabaena* are examples of protista

136. There exists a close association between the alga and the fungus within a lichen. The fungus *[2005]*
(a) provides protection, anchorage and absorption for the alga
(b) provides food for the alga
(c) fixes the atmospheric nitrogen for the alga
(d) releases oxygen for the alga

137. Lichens are a well known combination of an alga and a fungus where fungus has *[2004]*
(a) a saprophytic relationship with the alga
(b) an epiphytic relationship with the alga
(c) a parasitic relationship with the alga
(d) a symbiotic relationship with the alga

138. Most of the Lichens consist of *[1997]*
(a) blue-green algae and basidomycetes
(b) blue-green algae and ascomycetes
(c) red algae and ascomycetes
(d) brown algae and phycomycetes

139. Which one of the following is not true about lichens? *[1996]*
(a) Their body is composed of both algal and fungal cells
(b) Some form food for reindeers in arctic regions
(c) Some species can be used as pollution indicators
(d) These grow very fast at the rate of about 2 cm per year

140. Organisms which are indicator of SO_2 pollution of air *[1992]*
(a) Mosses (b) Lichens
(c) Mushrooms (d) Puffballs

141. Lichens indicate SO_2 pollution because they *[1989]*
(a) show association between algae and fungi
(b) grow faster than others
(c) are sensitive to SO_2
(d) flourish in SO_2 rich environment

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ANSWER KEY																			
1	(c)	16	(d)	31	(d)	46	(b)	61	(a)	76	(b)	91	(d)	106	(c)	121	(a)	136	(a)
2	(a)	17	(a)	32	(b)	47	(d)	62	(d)	77	(b)	92	(d)	107	(c)	122	(a)	137	(d)
3	(d)	18	(a)	33	(b)	48	(a)	63	(c)	78	(b)	93	(c)	108	(d)	123	(a)	138	(b)
4	(b)	19	(b)	34	(a)	49	(c)	64	(b)	79	(b)	94	(a)	109	(d)	124	(d)	139	(d)
5	(c)	20	(d)	35	(a)	50	(a)	65	(c)	80	(d)	95	(c)	110	(c)	125	(d)	140	(b)
6	(d)	21	(b)	36	(a)	51	(a)	66	(a)	81	(d)	96	(c)	111	(b)	126	(c)	141	(c)
7	(c)	22	(d)	37	(d)	52	(b)	67	(d)	82	(a)	97	(a)	112	(a)	127	(b)		
8	(b)	23	(d)	38	(a)	53	(b)	68	(a)	83	(c)	98	(a)	113	(c)	128	(c)		
9	(b)	24	(c)	39	(d)	54	(c)	69	(a)	84	(a)	99	(a)	114	(c)	129	(b)		
10	(a)	25	(a)	40	(d)	55	(b)	70	(d)	85	(d)	100	(a)	115	(c)	130	(b)		
11	(b)	26	(b)	41	(a)	56	(d)	71	(c)	86	(d)	101	(b)	116	(d)	131	(b)		
12	(a)	27	(a)	42	(b)	57	(b)	72	(a)	87	(b)	102	(a)	117	(b)	132	(c)		
13	(d)	28	(b)	43	(c)	58	(b)	73	(a)	88	(b)	103	(a)	118	(a)	133	(b)		
14	(c)	29	(a)	44	(b)	59	(a)	74	(c)	89	(c)	104	(b)	119	(a)	134	(d)		
15	(b)	30	(b)	45	(d)	60	(a)	75	(d)	90	(b)	105	(a)	120	(b)	135	(c)		

Hints & Solutions

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1. (c) The kingdom Monera possesses unicellular organisms (e.g - bacteria) having no nuclear membrane.
2. (a) **Five kingdom system of classification** was proposed by **R.H. Whittaker** (1969). The five kingdom classification is based on the following criteria :
   - Complexity of cell structure – Prokaryotes or eukaryotes.
   - Complexity of organisms body – Unicellular or multicellular.
   - Mode of obtaining nutrition – Autotrophic or heterotrophic.
   - Phylogenetic relationships.
3. (d) Monera is the prokaryotic kingdom that includes bacteria, blue green algae (cyanobacteria) and archae-bacteria (a group of ancient bacteria).
4. (b) The five kingdom classification is a mode of classification based on the following criteria.
   - Complexity of cell structure
   - Complexity of body structure
   - Modes of nutrition
   - Ecological life styles
   - Phylogenetic relationship
5. (c) Artificial system of classification is based on comparison of one or a few characters. A system based upon a large no. of natural characters or traits is natural system of classification. Proposed by de Jussieu, phylogenetic system of classification indicates the evolutionary or phylogenetic relationship of organisms.
6. (d) The first phylogenetic system of classification was proposed by Adolf Engler and his associate Karl Prantl in their monograph "Die Naturlichen Pflanzen Familien". In this system of classification, organisms are classified on the basis of evolutionary sequence and genetic relationship among the organisms. Hence, this system is highly dynamic not static.

NOTES

Fossil records play a vital role in elucidation of evolutionary relationships. This system has led to new systematics.

7. (c) During the early period in taxonomy, only external morphology (the characters observable with naked eye) were the sole criteria to classify plants and animals. Theophrastus gave names and description of 480 plants in his book "*Historia plantarum*", on the basis of their habit but Pliny the Elder introduced first artificial system of classification in his book *Historia Naturalis*. He classified both plants and animals.
8. (b) Linnaeus put forward an "Artificial system" of plant classification which was based on sexual characters. It is commonly also called as sexual system of plant classification.
9. (b) George Bentham and Joseph Dalton Hooker have given Natural system of classification. In this system of classification all the important characteristic of the organisms that provide information regarding their natural relationship are taken into consideration which helps in bringing out maximum number of similarities in a group and comparable differences with other groups of organisms. For example, mammals are characterised by the presence of mammary gland, hair, vivipary, 4 chambered heart etc.
10. (a) *Azotobacter is aerobic bacteria.* and *Cladophora* is green alga.
Engelmann used a prism to split light into its spectral components, and then illuminated a green alga, *Cladophora*, placed in a suspension of aerobic bacteria. The bacteria were used to detect the sites of oxygen evolution.
He observed that aerobic bacteria accumulated mainly in the region of blue and red light of the split spectrum thus giving the first action spectrum of photosynthesis.

NOTES

Theodor Wilhelm Engelmann was a German botanist, whose 1882 experiment measured the effects of different colours of light on photosynthetic activity and showed that the conversion of light energy to chemical energy took place in the chloroplast.

11. (b) *Halophiles* live in salty areas.
Thermoacidophiles are present in hot springs.
Methanogens are present in gut of several ruminants.
Cyanobacteria can be present in freshwater/ marine or terrestrial habitat.
12. (a) Saccharomyces i.e. yeast is an eukaryote (unicellular fungi). Mycobacterium is a bacterium. Oscillatoria and Nostoc are cyanobacteria.
13. (d) Archaebacteria are able to survive in harsh conditions due to the presence of branched lipid chain in cell membrane that reduces fluidity of cell membrane.
It includes halophiles which are exclusively found in saline habitats.

NOTES

The halophiles, named after the Greek word for "salt-loving", are extremophiles that thrive in high salt concentrations. While most halophiles are classified into the domain Archaea, there are also bacterial halophiles and some eukaryotic species, such as the alga *Dunaliella salina* and fungus *Wallemia* ichthyophaga.

14. (c) Sticky character of the bacterial wall is due to glycocalyx which is rich in glycoproteins.

NOTES

When on eukaryotic cells the glycocalyx can be a factor used for the recognition of the cell. On bacterial cells, the glycocalyx provides a protective coat from host factors.

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15. (b) Mycoplasmas are smallest, prokaryotes lacking cell wall and are pleomorphic in nature. These are pathogenic to both plants and animals.
16. (d) Nuclear envelope is not found in a prokaryotic cell.
17. (a) Fimbriae assist some bacteria in attaching to rocks or host body for obtaining establishment and nutrition.

NOTES

A holdfast is a root-like structure that anchors aquatic sessile organisms, such as seaweed, other sessile algae, stalked crinoids, benthic cnidarians, and sponges, to the substrate.

18. (a) Archaebacteria differ from other bacteria in having a different cell wall structure. They lack peptidoglyan in cell wall and possess a monolayer of branched fatty acids attached to glycerol by ether bonds in their cell membranes.
19. (b) Motile bacteria have thin filamentous extensions on their cell wall called flagella.
20. (d) Archaebactera live in some of the most harsh habitats such as extreme salty areas (halophiles), hot springs (thermoacidophiles) and marshy areas (methanogens) and in deep sea water.

21. (b) Heterocysts are large sized, thick-walled specialised cells which occur in terminal, intercalary or lateral position in **filamentous cyanobacteria,** *e.g., Nostoc.* They have enzyme **nitrogenase** and are specialised to perform biological nitrogen fixation.
22. (d) The most abundant prokaryotes helpful to humans in making curd from milk and in production of antibiotics are the heterotrophic bacteria. *Lactobacillis* bacteria convert milk into curd.
23. (d) Cyanobacteria are also referred as blue green algae, they perform oxygenic photosynthesis. They are most successful autotrophic organisms on earth which are found in all types of environment - fresh water, sea water, salt marshes, moist rocks, tree trunks, moist soils, hot springs, frozen waters.
24. (c) Autotrophs are those organisms that are able to make energy-containing organic molecules from inorganic raw material by using basic sunlight. *Nostoc*, *Chara*, *Porphyra* and *Wolffia* are photoautotrophs while *Nitrosomonas* and *Nitrobacter* are chemoautotrophs.
25. (a) Eubacteria are prokaryotic but eubacteria are enclosed by plasma membrane like eukaryotic cells.
26. (b) *Methanogens* are archaebacteria, abundant in cattle yard and paddy fields.

NOTES: Methanogens produce methane as a metabolic byproduct in hypoxic conditions. They are prokaryotic and belong to the domain of archaea.

27. (a) Bacterial leaf blight of rice is caused by a species of *Xanthomonas*. Mature rice plant are infected by these bacteria, lesion begins as water soaked stripes on the leaf blades and eventually would increase in length and width becoming yellow to grayish-white until the entire leaf dries up.
28. (b) A domain of prokaryotic organisms containing the archaebacteria including the methanogens, which produce methane; the thermoacidophilic bacteria, which live in extremely hot and acidic environments, & the halophilic bacteria, which can only function at high salt concentrations are abundant in the world's oceans.
29. (a) *Thermococcus*, *Methanococcus* and Methanobacterium exemplify archaebacteria that contain protein homologous to eukaryotic core histones.
30. (b) While working at the Rockefeller Institute, Brown reported isolation of a PPLO from human arthritic joint tissue in 1938. In 1949, Diennes reported to the 7th International Rheumatology Congress, the isolation of PPLO from the genitourinary tracts of men afflicted with arthritis. In discussing the significance of this observation, Brown reported successful treatment of arthritic patients in 1949 with a new antibiotic called aureomycin (Clark, 1997).
31. (d) *Paramecium* has two types of nucleus, a larger macronucleus involved with the vegetative activities and a smaller involved with reproduction.
32. (b) This phenomenon has been successfully used in genetic engineering to produce disease resistant varieties of plants.
33. (b) Encystment enables the zygote to survive under adverse or infavourable conditions wherein it lies dormant.
34. (a) *Methanobacillus* (methanogen) occurs in marshes and also in dung. It produces CH_4 gas under anaerobic condition and is utilized in gobar gas plant.

NOTES: Methanogenesis from the biomass in the anoxic biogas reactors is catalyzed by syntrophic cooperation between anaerobic bacteria, syntrophic acetogenic bacteria and methanogenic archaea.

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35. (a) Transduction is virus mediated gene transfer in bacteria.

NOTES: Viral transfer of DNA from one bacterium to another is an example of **horizontal gene transfer**.

36. (a) Cyanobacteria are oxygenic photoautotroph. Many members perform nitrogen fixation.
37. (d) Archaebacteria are the most ancient and halogenous group of bacteria and are called living fossils.
38. (a) Gram +(ve) and Gram –(ve) bacteria are separated on the basis of their cell wall composition. Christian Gram, on the basis of staining behaviour of the cell wall with Gram's stain, grouped bacteria into Gram +ve and Gram –ve type. The bacteria which retain blue or purple colour after staining are Gram +ve e.g. *Bacillus subtilis* and which loses blue colour is Gram –ve e.g. *E. coli*. In Gram –ve, stain is washed due to high lipid content in the cell having thick wall, Gram +ve has single layered cell wall rich in peptidoghycans which retain the colour.
39. (d) Chloroplasts, chromoplasts and leucoplasts are the types of plastids found in higher plants. Chloroplasts contain the green pigment chlorophyll.

NOTES

Chromatophores are internal membrane systems present in photosynthetic prokaryotes. These develop as membrane lined sacs or thylakoids from plasma membrane. Thylakoid membranes contain photosynthetic pigments in cyanobacteria and purple bacteria.

40. (d) In prokayotes nucleoid consist of double stranded circular DNA without histone protein.
41. (a) These are archaebacteria which can tolerate high temperature.
42. (b) Transfer of genetic information from one bacterium to another by physical contact is called conjugation while if it takes place by some other medium like virus than it is called transduction.
43. (c) In (*E.coli*) double stranded DNA is present.

NOTES

E. coli is a Gram-negative, facultative anaerobic, rod-shaped, coliform bacterium of the genus *Escherichia* that is commonly found in the lower intestine of warm-blooded organisms. Most types of *E. coli* are harmless and even help keep your digestive tract healthy. But some strains can cause diarrhea if you eat contaminated food or drink fouled water.

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44. (b) Sex-factor or F-factor in bacteria results in high frequency conjugation. It allows bacteria to produce sex pilus necessary for conjugation.
45. (d) Some of the blue green algae can tolerate extremes of temperature due to presence of gelatinous sheath, and compactness of protein molecules in protoplasm.
46. (b) Only some bacteria and blue green algae (cynobacteria) have the capacity to fix atmospheric nitrogen.
    - Bacteria : *Azotobacter, Rhizobium, Frankia* etc.
    - Blue green algae : *Nostoc, Oscillatoria, Anabaena* etc.
47. (d) Pyrrhoea is caused by bacterial infections along with other factors, Diarrhoea by caused by rotavirus along with many other factors. Dysentery is caused by *Entamoeba histolytica*.

NOTES

Entamoeba coli is a non-pathogenic species of *Entamoeba* that frequently exists as a commensal parasite in the human gastrointestinal tract. *E. coli* is important in medicine because it can be confused during microscopic examination of stained stool specimens with the pathogenic *Entamoeba histolytica*.

48. (a) *Escherichia coli*, lives as a symbiont in human intestine.
49. (c) The bacterial genome/nucleoid is made of single circular double stranded DNA without histone protein as it is a prokaryotic organisms. The genome contains some 100 chemical sites or loci. Each locus in *E. coli* contains about 40 genes.
50. (a) In bacteria asexual reproduction through binary fission is the most common method of multiplication. Sexual reproduction which comprises of syngamy and meiosis is entirely absent. Hence, no gamete formation takes place. In sexually reproducing organism alternation of generation occurs.
51. (a) Chemosynthetic bacteria do not require sunlight as a source of energy either directly or indirectly. The energy for the synthesis of food is obtained by the oxidation of certain inorganic substances present in the medium. The chemical energy obtained from oxidation reaction is trapped in ATP molecules. The ATP is used in CO_2 assimilation.
52. (b) Whittaker (1969) divided organisms into five kingdoms : Monera, Protista, Plantae, Fungi and Animalia. Kingdom Monera includes all prokaryotes – Mycoplasma, bacteria, actinomycetes, blue-green algae, archaebacteria, methanogens. *Escherichia* is bacteria, *Amoeba*, *Gelidium* come under Protista, *Spirogyra* is algae.
53. (b) Diatoms are the chief producers in some oceans and in some seasons as they are the primary producers and the food chain in marine ecosystem depends on it.
54. (c) Ciliates differs from other protozoans in having two types of nuclei. E.g., Paramoecium have two types of nuclei i.e. macronucleus & micronucleus.
55. (b) All unicellular eukaryotic organism like diatoms, desmids (chrysophytes), euglenoids, dinoflagellates and slime mould are included in Protista.
56. (d) In chrysophytes, the cell walls form two thin overlapping shells held together. The body of Diatoms appears like soap box due to overlapping shells.
57. (b) *Chlamydomonas* & *Chlorella* have been included in algae. Algae are chlorophylus, thalloid avascular plants with no cellular differentiation. Algae belong to thallophyta of plant kingdom.
58. (b) *E. coli* is a prokaryotic gram negative bacterium.

59. (a) Single celled eukaryotes are included in protista. Protista includes all unicellular and colonial eukaryotes except green and red algae. It is also known as kingdom of unicellular eukaryotes.

60. (a) *Physarum polycephalum* belongs to phylum Amoebozoa, infraphylum Mycetozoa, and class Myxogastrea. *P. polycephalum*, often referred to as the "many-headed slime," is a slime mold that inhabits shady, cool, moist areas, such as decaying leaves and logs.

61. (a) The thalloid body of slime moulds is made up of multinucleated cell which lacks septa in between and hence it is a multinucleated single celled mass called plasmodium.

62. (d) Binary fission in diatoms reduces the size of most daughters which is corrected through the development of auxospores.
In some filamentous cyanobacterial forms unisexual reproduction occurs by hormogonia (hormocysts). They are identified by presence of biconcave (one disk or separation disc between two adjacent cells e.g. *Oscillatoria*).

63. (c) Contractile vacuole in *Amoeba* and *Paramecium* maintain the water balance of the cell. This is known as osmoregulation.

NOTES
It was previously known as pulsatile or pulsating vacuole.

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64. (b) The *Euglena* is an organism, which possesses both the characteristics of plants and animals, as it can move with a flagella and also contains chlorophyll. Its nutrition is mixotrophic.

NOTES
Euglena is a genus of single cell flagellate eukaryotes. It is the best known and most widely studied member of the class Euglenoidea. Species of Euglena are found in both freshwater and salt water.

65. (c) In protozoa, the function of contractile vacuole is the removal of excretory substances, carbon dioxide etc. It is very essential to regulate water content i.e., osmoregulation.

66. (a) The macronucleus lacks nuclear membrane and is formed of trophochromatin. It regulates the metabolic activities of the body and it is also known as trophonucleus. The micronucleus has a definite nuclear membrane and controls the reproductive activities of *Paramecium* and *Vorticella*.

67. (d) The conractile vacuole is supposed to assist excertion in *Amoeba*, as its watery contents possess traces of carbon dioxide and urea. The CO_2 diffuses directly through plasmalemma.

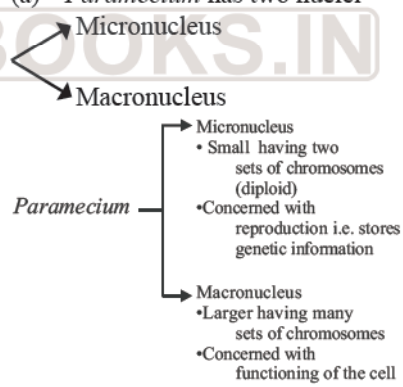
68. (a) Protistans are eukaryotes and their genetic material is organised in form of nucleus. DNA is associated with histone protein.

69. (a) Members of kingdom Protista have diverse mode of nutrition. They are photosynthetic, saprophytic, parasitic and ingestive. They are major heterotrophs.

70. (d) Kingdom Protista includes flagellates (euglenophyceae), diatoms, dinoflagellates, slime moulds, sarcodines, ciliates, sporozoans. They have photosynthetic, chemotrophic, heterotropic mode of nutrition.

71. (c) I. African sleeping sickness disease also called as trypansomiasis is common in western and central parts of African continent.
II. The disease is caused by parasite *Trypanosoma gambiense* of class zooflagellata.
III. The parasite is transmitted through bite of Tse-Tse fly (vector *Glossina palpalis*).
IV. The disease appears when the causal organism enters into cerebrospinal fluid of human.
V. Trypanosoma is an obligate parasite, digenetic and polymorphic organism.

72. (a) *Paramecium* has two nuclei



73. (a) *Trypanosoma* is polymorphic i.e. it exists in different forms in the successive stages of its life cycle. These are *Leishmania*, Leptomonad, Crituidial and trypanosomal stages.

74. (c) *Plasmodium* belongs to class Sporozoa of protozoan protists. It is an endoparasite lacking any locomotory structure and contractile vacules. It reproduces through spore formation.

75. (d) African sleeping sickness disease also called trypanosomiasis, that is common in Africa which is caused by parasite, *Trypanosoma gambiense*. The parasite is transmitted by Tse-Tse fly (*Glossina palpalis*).

76. (b) Vector for sleeping sickness is Tse-Tse fly (*Glossina palpalis*). The parasite *Trypanosoma*

is transmitted through the bite of this fly. Tse-tse have been extensively studied because they are biological vectors of the African trypanosomiasis, deadly disease which includes sleeping sickness in people and nagana in cattle. Tse-tse have existed in the modern morphological form for at least 34 million years since fossil tse-tse have been recovered from the Florissant Fossil Beds in Colorado.

77. (b) Zooflagellata of Protozoan Protista. They have flagella and heterotrophic (Parasitic) mode of nutrition.
78. (b) Tse-Tse fly is vector of sleeping sickness disease and it transmits *Trypanosoma gambiense* through its bite.
79. (b) The infective stage of *Plasmodium* that enters human blood is sporozoite.
80. (d) *Trypanosoma*, *Noctiluca*, *Monocystis* & *Giardia* are unicellular protists *i.e.* unicellular eukaryotes.
81. (d) Yeast is an unicellular sac fungi. It lacks filamentous structure or hyphae.
82. (a) A cell wall is a rigid structural layer, which provides protection and structural support to the cells. The composition of cell wall varies from one species to another. In fungi, the cell wall is composed of strong covalent linkages of chitin, glucans and glycoproteins. Alternatively, in case of land plants, the cell wall is composed of cellulose and hemicellulose. Archean cell walls consists of peptidoglycans.
83. (c) Eubacteria are the true bacteria.

NOTES

Eubacteria are prokaryotic organisms, as characterized by the lack of a membrane-enclosed nucleus, predominantly unicellular, with DNA in single circular chromosome, and have peptidoglycan on cell wall when present. They include most of the familiar bacteria of medical and economic importance such as *E. coli*.

84. (a) *Alternaria* belongs to class - Deuteromycetes, which lack sexual reproduction. Asexual reproduction takes place by conidia produced on conidiophores.
85. (d) *Anabaena* is a cyanobacteria which lack a true nucleus because of absence of nuclear membrane.

NOTES

Anabaena is a genus of filamentous cyanobacteria that exist as plankton. They are known for nitrogen-fixing abilities, and they form symbiotic relationships with certain plants, such as the mosquito fern.

86. (d) Class- deuteromycetes comprises of imperfect fungi which play role in decomposition of organic wastes.

NOTES

The fungi imperfecti or imperfect fungi, also known as Deuteromycota, are fungi which do not fit into the commonly established taxonomic classifications of fungi that are based on biological species concepts or morphological characteristics of sexual structures because their sexual form of reproduction has never been reported.

87. (b) Morel and truffles are used as food and they are members of Ascomycetes fungi.
88. (b) Several mushrooms such as *Amanita muscaria*, *Psilocybe mexicana* and *Panaeolus* spp. secrete hallucinogenic substances like psilocybin and psilocin. These substances may destroy brain cells and power of perception in human beings.
89. (c) Fungi lack chlorophyll, hence, they do not prepare their food by photosynthesis. They can grow where organic material is available. So, they are heterotrophs that acquire their nutrient by absorption and store in the form of glycogen.
90. (b) Membrane bound organelles are absent in *Streptococcus*. It is a bacterium that is included under kingdom Monera. Monerans are prokaryotes which lack membrane bound organelles like mitochondria, E.R, Golgi etc. *Saccharomyces*, *Chlamydomonas* and *Plasmodium* are eukaryotes that have membrane bound organelles.
91. (d) Late blight is caused by the fungus *Phytophthora infestans*. Late blight appears on potato or tomato leaves as pale green, water-soaked spots, often beginning at leaftips or edges. The circular or irregular leaf lesions are often surrounded by a pale yellowish-green border that merges with healthy tissue. Lesions enlarge rapidly and turn dark brown to purplish-black.

NOTES

During periods of high humidity and leaf wetness, a cottony, white mold growth is usually visible on lower leaf surfaces at the edges of lesions. In dry weather, infected leaf tissues quickly dry up and the white mold growth disappears. Infected areas on stems appear brown to black and entire veins may be killed in a short time when moist weather persists.

92. (d) The class Basidiomycetes includes those members that produce their basidia and basidiospores on or in a basidiocarp.

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93. (c) Ergot of Rye is a plant disease that is caused by the fungus *Claviceps purpurea*. The so-called ergot that replaces the grain of the rye is a dark, purplish sclerotium, from which the sexual stage, of the life cycle will form after over wintering.

Ergot of Rye

94. (a) Mucor is a fungus and most of the fungi require the optimum temperature of about 15-30°C, good moisture content in atmosphere and not very dark and not very lightened place. So *Mucor* requires a temperature of about 25°C, humidity about 95% and a shady place to grow fully.

95. (c) Viruses that get integrated with the bacterial host genome are called lysogenic. Virus which transmit its DNA into bacterial cell and divide within bacterial cell causing breakdown of bacterial cell wall are called lytic virus. Lysozymes are lipolytic enzymes that catalyse breakdown of fats (lipids).

96. (c) Mycorrhiza is a symbiotic association between fungi and roots of higher plants. Mycorrhiza form wooly covering of fungal hyphae on the surface and remain in upper layers. It is of two types ecto and endomycorrhiza.

NOTES

In some endomycorrhiza, the fungal hyphae develop some organs called vesicles within the root cortical cells, such mycorrhizae are called VAM (vesicular arbuscular mycorrhizae). It is meant for phosphate nutrition.

97. (a) *Aspergillus flavus* produces carcinogenic fungus toxin (Aflatoxin) during storage condition of crop plant.

NOTES

Aflatoxins are poisonous carcinogens and mutagens that are produced by certain molds (*Aspergillus flavus* and *Aspergillus parasiticus*) which grow in soil, decaying vegetation, hay, and grains.

98. (a) *Ustilago* causes loose smut of wheat, as a result the grain and flower get converted into powdered mass.

99. (a) Plant decomposers are bacteria (Kingdom Monera) and fungi.

100. (a) The fungal hyphae secrete enzymes which convert insoluble complex food material in the substratum to the soluble ones. The hyphae wall of intracellular hyphae come in contact with the host protoplasm and obtain food by direct diffusion.

101. (b) *Aspergillus* is a fungus, *Mucor* is also a fungus. Azolla harbors blue-green algae *Anabaena* which fixes N_2, increasing fertility.

NOTES

Azolla is unique because it is one of the fastest growing plants on the planet – yet it does not need any soil to grow. Unlike almost all other plants, Azolla is able to get its nitrogen fertilizer directly from the atmosphere. Azolla is able to do this because it has a unique mutually beneficial 'symbiotic relationship' with a cyanobacterium (blue-green alga) called Anabaena.

102. (a) Glycogen is a glucosan homopolysaccharide which is the major reserve food of animals, fungi and some bacteria. Starch is also glucosan homopolysaccharide and is the major reserve food of plants. Sucrose is formed of one molecule of glucose and one molecule of fructose.

103. (a) Black rust of wheat is caused by *Puccinia graminis*. The symptoms are seen in stem or leaf sheath as brownish spot.

104. (b) *Puccinia* causes black rust of wheat . It completes its life cycle in two hosts-wheat and barberry. Two types of spores are produced on wheat - uredospores and teleutospores.

105. (a) Association of algae and fungi is referred to as lichen. Symbiotic association of *Rhizobium* with roots of leguminous plants is referred to as symbiosis. Mycorrhiza is a symbiotic association between fungi and roots of higher plants. The fungal partner of mycorrhiza obtains food from roots of the higher plant and in return supplies mineral elements to it.

106. (c) Covered smut of barley is caused by *Ustilago hordei,* not by *Ustilago nuda*. This disease is purely externally seed borne.

107. (c) Phytoalexins are non-specific antibiotic substances produced by plants in response to infection by a fungus.

NOTES

Phytoalexins are antimicrobial and often antioxidative substances synthesized de novo by plants that accumulate rapidly at areas of pathogen infection. They are broad spectrum inhibitors and are chemically diverse in a particular plant species.

108. (d) *Albugo candida* is an obligate parasite causing white rust on members of family Cruciferae and other hosts.

109. (d) Smut disease is caused by *Ustilago* species of basidiomycetes fungi. It is characterised by formation of black coloured chlamydospores or teleutospores called smut spore due to which the affected part becomes black.

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110. (c) The fungus that causes the disease 'Ergot of Rye' is *Claviceps purpurea*. It contains many poisonous alkaloids. The hallucinogenic drug LSD is extracted from this fungi.
   - Rust of wheat is used by *Puccinia graminis*.
   - Powdery mildew of pea is caused by *Erysiphae*.
111. (b) Fungi are nutritionally saprophytes, which grow on dead and decaying matter. They secrete enzyme to the external medium where digestion takes place and digested food is absorbed by the body surface. They convert complex organic constituents of dead body into simple soluble forms. That is why fungi are regarded as decomposers.
112. (a) Viroids have free RNA without protein coat. Viroid, an infectious particle smaller than any of the known viruses, an agent of certain plant diseases. The particle consists only of an extremely small circular RNA (ribonucleic acid) molecule, lacking the protein coat of a virus.

NOTES

Dr. Theodor o. Diener, discovered viroids and also to distinguish it from a virus.

113. (c) Infective constituent in viruses is either DNA or RNA, not protein. The simplest form consist of two basic components: nucleic acid (single- or double-stranded RNA or DNA) and a protein coat, the capsid, which functions as a shell to protect the viral genome from nucleases and which during infection attaches the virion to specific receptors exposed on the prospective host cell.
114. (c) Prions are disease causing agents having abnormally folded proteins. Prions induce other healthy proteins to fold incorrectly, leaving patches of useless debris and holes that turn brains to sponge, resulting in death. The disease has an incubation period in cattle of up to eight years.

NOTES

Mad cow disease (or bovine spongiform encephal-opathy) is a transmissible, slowly progressive, degenerative, and fatal disease affecting the central nervous system of adult cattle. It's related to a disease in humans called variant Creutzfeldt-Jakob disease (vCJD). Both disorders are universally fatal brain diseases caused by a prion.

115. (c) Viroids in nature are sub-viral agents as infectious RNA particles, without protein coat.
116. (d) Viroids, the smallest known pathogens, are naked, circular, single-stranded RNA molecules that do not encode protein but autonomously replicate when introduced into host plants. Viroids only infect plants; some cause economically important diseases of crop plants, while others appear to be benign.
117. (b) **TMV** (**Tobacco Mosaic Virus**) is a rod-shaped virus. The rod has a core which contains helically coiled single stranded **RNA.** There is a protective covering of protein called **capsid** around the infective part. Capsid consists of small subunits called **capsomeres** and has antigenic property.
118. (a) All viruses are nucleoproteins (Nucleic acid + Protein) in the structure. The nucleic acid (DNA and RNA) is the genetic material. In a particular virus either DNA or RNA is the genetic material. Both are never present in a virus.
   Single stranded RNA or ss RNA - Tobacco mosaic virus (TMV)
   Virus envelope is known as capsid. The capsid is composed of protein subunits called capsomere.
119. (a) Plant viruses often contain parasites of their own, referred to as satellites. Satellite RNAs are dependent on their associated (helper) virus for both replication and encapsidation. Example—Tobacco Necrosis Virus (TNV). Viroids are infectious agents smaller than viruses. Bacteriophages are viruses that infect the bacteria. A prion is an infectious agent that is composed primarily of protein.
120. (b) All the viruses are obligate parasite *i.e.* they remain inert outside the host cell. They have ability to syntheize nucleic acids and proteins by using host cellular machinery (ribosomes, tRNAs, aminoacids, energy). Three shapes are found in viruses helical (elongate body *e.g.* T.M.V), cuboidal (short broad body with rhombic rounded, polyhedral shape *e.g.* Poliomyelitis virus) and binal (with both cuboidal and helical parts *e.g.* many bacteriophages like T_2). Antibiotics have no effect on them, antiviral drugs can only kill them.
121. (a) Virus envelope is known as capsid. The capsid is composed of protein subunits called capsomere.
122. (a) Mad cow disease is actually Bovine Spongiform Encephalopathy or BSE. In this disease cattles in Britain got spongy brain & ultimately gradual degradation of nervous system. It is caused by some virus like but nucleic acid devoid proteinaceous particles called prions (proteinaceous infectious particle).
123. (a) Viruses can live only inside the host cell, using their machinery for its own metabolism.
124. (d) Virus is a nucleoprotein entity which becomes active only inside a living cells utilizing the latter machinery for multiplication. Capsid is the protein covering the genetic material.
125. (d) Tobacco mosaic virus is 300 nm long and 20 nm in diameter.
126. (c) Cauliflower mosaic virus contains double stranded DNA.
127. (b) Enzymes are absent in viruses because they are unable to transmit their nucleic acid from one host cell to another.

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128. (c) Virus is an ultra microscopic nucleoprotein entity which becomes active only inside a living cell. It resembles living beings due to presence of genetic material and reproduction.
129. (b) Viruses have either DNA or RNA as the genetic material. Viruses having RNA as the genetic material are known as retroviruses.
130. (b) Influenza virus is a retrovirus wherein, the genetic material comprises of RNA.
There are three genera of influenza virus, identified by antigenic differences in their nucleoprotein and matrix protein:
- Influenza virus A are the cause of all flu pandemics and are known to infect humans, other mammals and birds (see also avian influenza).
- Influenza virus B are known to infect humans and seals.
- Influenza virus C are known to infect humans and pigs.

131. (b) All viruses are nucleoprotein (Nucleic acid + Protein) in their structure. The nucleic acid (DNA and RNA) is genetic material. In a particular virus either DNA or RNA is genetic material. Both are never present in a virus. Hence viruses contains:
(i) Double stranded DNA (ds DNA) - Hepatitis B
(ii) Single stranded DNA (ss DNA) - coliphage
(iii) Double stranded RNA (ds RNA) - Reo virus, wound Tumor virus
(iv) Single stranded RNA (ss RNA) - Tobacco mosaic virus (TMV)
132. (c) Rickettsia are tiny obligate, intracellular parasites found in blood sucking insects like lices, mites, ticks.

NOTES
They were first observed by Ricketts in 1909 but it was properly described by Rocha-lime 1916, who named them as Rickettsia. They have mucopeptide cell wall with DNA as genetic material and are independent entity causing diseases like Q-fever, typhus etc.

133. (b) Lichen is a symbiosis between different organisms. It is composed of a fungal partner (mycobiont) and one or more photosynthetic partners (photobiont). The photosynthetic partner is generally green algae or cyanobacteria.
Lichens are well known as sensitive indicators of air pollution, particularly for sulphur dioxide. If air is very badly polluted with sulphur dioxide there may be no lichens present, just green algae may be found. If the air is clean, shrubby, hairy and leafy lichens become abundant.
134. (d) Lichens cannot grow in places where sulphur dioxide is present in the environment.
135. (c) *Saccharomyces cervisiae* is a yeast used in making bread (Baker's yeast) and commercial production of ethanol.
Paramoecium & *Plasmodium* are of animal kingdom while *Pencillium* is a fungi. Lichen is composite organism formed from the symbiotic association of an algae and a fungus. *Nostoc* & *Anabaena* are examples of kingdom monera.
136. (a) Lichens (coined by Theophrastus) are composite or dual organisms which are formed by a fungus partner or mycobiont (mostly ascomycetes) and an algal partner (mostly blue green algae). Fungus forms the body of lichen as well as its attaching and absorbing structures. Algae performs photosynthesis and provides food to the fungus.
137. (d) Lichens are composite organisms formed by symbiotic association between a fungus and alga. A saprophyte is an organism feeding on dead, decaying organic matter. Epiphyte is a plant growing over another plant. Parasites live inside their host.
138. (b) The lichen fungus is typically a member of the Ascomycota, rarely a member of the Basidiomycota. The algal or cyanobacterial cells are photosynthetic, and as in higher plants they reduce atmospheric carbon dioxide into organic carbon sugars to feed both symbionts. Both partners gain water and mineral nutrients mainly from the atmosphere through rain and dust. The fungal partner protects the alga by retaining water, serving as a larger surface area for capture of mineral nutrients and, in some cases, provides minerals obtained from the substratum.

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NOTES
If a cyanobacterium is present, as a primary partner or another symbiont in addition to green alga as in certain tripartite lichens, they can fix atmospheric nitrogen, complementing the activities of the green alga.

139. (d) Lichens are composite organisms formed by the association between a fungus and a photosynthetic symbiont. The bulk of lichen body is formed of fungus.
140. (b) Lichens are composite organisms representing a symbiotic association between fungus and a algae. It can be crustose, foliose and fruticose types. They are the pioneer organisms in a new habitat. Lichens are used as indicator of air pollution. It does grow in the environment where pollution level is high, SO_2 is strong air pollutant and lichens are very sensitive to SO_2.
141. (c) Lichens typically grow in harsh environments in nature. Most lichens, especially epiphytic fruticose species and those containing cyanobacteria, are sensitive to manufactured pollutants. Hence, they have been widely used as pollution indicator organisms.

3 Plant Kingdom

Trend Analysis with Important Topics & Sub-Topics

		2020		2019		2018		2017		2016	
Topic	Sub-Topics	Qns.	LOD	Qns.	LOD	Qns.	LOD	Qns.	LOD	Qns.	LOD
Algae	Chlorophyceae			1	E			1	E		
	Phaeophyceae					1	E	1	E		
	Rhodophyceae	2	E			1	E				
Bryophytes	Reproduction							1	E		
Pteridophytes	Reproduction									1	E
Gymnosperms	Reproduction							1	A	1	E
	Pinus			1	A						
	Cones	1	A								
	Transport System			1	A						
Angiosperms	Double Fertilisation							1	A		
	Female Reproductive parts					1	A				
	Alteration of Generation	1	A								

LOD - Level of Difficulty	E - Easy	A - Average	D - Difficult	Qns - No. of Questions

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Topic 1: Algae

1. Which of the following pairs is of unicellular algae? *[2020]*
   (a) *Gelidium and Gracilaria*
   (b) *Anabaena and Volvox*
   (c) *Chlorella and Spirulina*
   (d) *Laminaria and Sargassum*
2. Floridean starch has structure similar to *[2020]*
   (a) Amylopectin and glycogen
   (b) Mannitol and algin
   (c) Laminarin and cellulose
   (d) Starch and cellulose
3. Which one is wrongly matched? *[2018]*
   (a) Uniflagellate gametes – Polysiphonia
   (b) Biflagellate zoospores – Brown algae
   (c) Unicellular organism – Chlorella
   (d) Gemma cups – Marchantia
4. After karyogamy followed by meiosis, spores are produced exogenously in *[2018]*
   (a) Neurospora
   (b) Alternaria
   (c) Saccharomyces
   (d) Agaricus
5. An example of colonial alga is : *[2017]*
   (a) *Volvox* (b) *Ulothrix*
   (c) *Spirogyra* (d) *Chlorella*
6. Male gametes are flagellated in : *[2015 RS]*
   (a) *Anabaena*
   (b) *Ectocarpus*
   (c) *Spirogyra*
   (d) *Polysiphonia*

7. Which one of the following statements is wrong? ***[2015 RS]***
   (a) Agar - agar is obtained from *Gelidium* and *Gracilaria*
   (b) *Chlorella* and *Spirulina* are used as space food
   (c) Mannitol is stored food in Rhodophyceae
   (d) Algin and carragen are products of algae
8. Which one of the following shows isogamy with non-flagellated gametes? ***[2014]***
   (a) *Sargassum* (b) *Ectocarpus*
   (c) *Ulothrix* (d) *Spirogyra*
9. Which one of the following is **wrong** about ***Chara***? ***[2014]***
   (a) Upper oogonium and lower round antheridium.
   (b) Globule and nucule present on the same plant.
   (c) Upper antheridium and lower oogonium.
   (d) Globule is male reproductive structure.
10. An alga which can be employed as food for human being is: ***[2014]***
   (a) *Ulothrix* (b) *Chlorella*
   (c) *Spirogyra* (d) *Polysiphonia*
11. Isogamous condition with non-flagellated gametes is found in : ***[NEET 2013]***
   (a) *Spirogyra* (b) *Volvox*
   (c) *Fucus* (d) *Chlamydomonas*
12. Which of the following is not correctly matched for the organism and its cell wall degrading enzyme? ***[NEET 2013]***
   (a) Plant cells-Cellulase
   (b) Algae-Methylase
   (c) Fungi-Chitinase
   (d) Bacteria-Lysozyme
13. Which one of the following is wrongly matched? ***[NEET Kar. 2013]***
   (a) *Nostoc*-Water blooms
   (b) *Spirogyra*-Motile gametes
   (c) *Sargassum*-Chlorophyll *c*
   (d) Basidiomycetes-Puffballs
14. Algae have cell wall made up of: ***[2010]***
   (a) cellulose, galactans and mannans
   (b) hemicellulose, pectins and proteins
   (c) pectins, cellulose and proteins
   (d) cellulose, hemicellulose and pectins
15. Mannitol is the stored food in: ***[2009]***
   (a) *Porphyra* (b) *Fucus*
   (c) *Gracillaria* (d) *Chara*
16. If you are asked to classify the various algae into distinct groups, which of the following characters you should choose? ***[2007]***
   (a) nature of stored food materials in the cell
   (b) structural organization of thallus
   (c) chemical composition of the cell wall
   (d) types of pigments present in the cell.
17. Floridean starch is found in ***[2000]***
   (a) Chlorophyceae (b) Rhodophyceae
   (c) Myxophyceae (d) Cyanophyceae
18. A research student collected certain algae both as and found that its cells contained both chlorophyll a and chlorophyll b as well as phycoerythrin.The alga belongs to ***[2000]***
   (a) Rhodophyceae (b) Bacillariophyceae
   (c) Chlorophyceae (d) Phaeophyceae
19. Columella is a specialised structure found in the sporangium of ***[1999]***
   (a) *Ulothrix* (b) *Rhizopus*
   (c) *Spirogyra* (d) None of these
20. *Ulothrix* can be described as a ***[1998]***
   (a) non-motile colonial alga lacking zoospores
   (b) filamentous alga lacking flagellated reproductive stages
   (c) membranous alga producing zoospores
   (d) filamentous alga with flagellated reproductive stages
21. An alga very rich in protein is ***[1997]***
   (a) *Spirogyra* (b) *Ulothrix*
   (c) *Oscillatoria* (d) *Chlorella*
22. *Ulothrix* filaments produce ***[1997]***
   (a) isogametes (b) anisogametes
   (c) heterogametes (d) basidiospores
23. Brown algae is characterised by the presence of ***[1997]***
   (a) phycocyanin (b) phycoerythrin
   (c) fucoxanthin (d) haematochrome
24. Blue-green algae belong to ***[1996]***
   (a) Eukaryotes (b) Prokaryotes
   (c) Rhodophyceae (d) Chlorophyceae
25. The absence of chlorophyll, in the lowermost cell of *Ulothrix*, shows ***[1995]***
   (a) functional fission
   (b) tissue formation
   (c) cell characteristic
   (d) beginning of labour division
26. Agar is commercially obtained from ***[1995]***
   (a) red algae (b) green algae
   (c) brown algae (d) blue-green algae

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27. In Chlorophyceae, sexual reproduction occurs by *[1994]*
(a) Isogamy and anisogamy
(b) Isogamy, anisogamy and oogamy
(c) Oogamy only
(d) Anisogamy and oogamy

28. Which of the following cannot fix nitrogen? *[1994]*
(a) *Nostoc* (b) *Azotobacter*
(c) *Spirogyra* (d) *Anabaena*

29. In *Ulothrix*/*Spirogyra*, reduction division (meiosis) occurs at the time of *[1993]*
(a) gamete formation
(b) zoospore formation
(c) zygospore germination
(d) vegetative reproduction

30. Chloroplast of *Chlamydomonas* is *[1993]*
(a) stellate (b) cup-shaped
(c) collar-shaped (d) spiral

31. Pyrenoids are the centres for formation of
(a) porphyra (b) enzymes *[1993]*
(c) fat (d) starch

32. The product of conjugation in *Spirogyra* or fertilization of *Chlamydomonas* is *[1991]*
(a) zygospore (b) zoospore
(c) oospore (d) carpospore

33. The common mode of sexual reproduction in *Chlamydomonas* is *[1991]*
(a) isogamous (b) anisogamous
(c) oogamous (d) hologamous

34. Sexual reproduction involving fusion of two cells in *Chlamydomonas* is *[1988]*
(a) isogamy (b) homogamy
(c) somatogamy (d) hologamy

Topic 2: Bryophytes

35. Zygotic meiosis is characteristic of: *[2017]*
(a) *Fucus* (b) *Funaria*
(c) *Chlamydomonas* (d) *Marchantia*

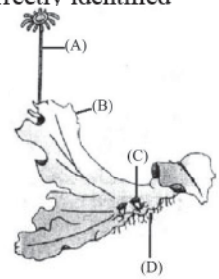
36. Life cycle of *Ectocarpus* and *Fucus* respectively are: *[2017]*
(a) Diplontic, Haplodiplontic
(b) Haplodiplontic, Diplontic
(c) Haplodiplontic, Haplontic
(d) Haplontic, Diplontic

37. Which one is wrong statement ? *[2015 RS]*
(a) *Mucor* has biflagellate zoospores
(b) Haploid endosperm is typical feature of gymnosperms
(c) Brown algae have chlorophyll *a* and *c* and fucoxanthin
(d) Archegonia are found in Bryophyta, Pteridophyta and Gymnosperms.

38. Which of the following is responsible for peat formation? *[2014]*
(a) *Marchanita* (b) *Riccia*
(c) *Funaria* (d) *Sphagnum*

39. Which one of the following is common to multicellular fungi, filamentous algae and protonema of mosses *[2012]*
(a) Diplontic life cycle
(b) Members of kingdom plantae
(c) Mode of Nutrition
(d) Multiplication by fragmentation

40. Examine the figure given below and select the right option giving all the four parts (a, b, c and d) correctly identified *[2011M]*



(a) (a) Archegoniophore
(b) Female thallus
(c) Gemmacup
(d) Rhizoids
(b) (a) Archegoniophore
(b) Female thallus
(c) Bud
(d) Foot
(c) (a) Seta
(b) Sporophyte
(c) Protonema
(d) Rhizoids
(d) (a) Antheridiophore
(b) Male thallus
(c) Globule
(d) Roots

41. Archegoniophore is present in : *[2011]*
(a) *Marchantia* (b) *Chara*
(c) *Adiantum* (d) *Funaria*

42. Some hyperthermophilic organisms that grow in highly acidic (PH_2) habitats belong to the two groups: *[2010]*
(a) Eubacteria and archaea
(b) Cyanobacteria and diatoms
(c) Protists and mosses
(d) Liverworts and yeasts

43. Spore dissemination in some liverworts is aided by *[2007]*
(a) indusium (b) calyptra
(c) peristome teeth (d) elaters

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44. In a moss the sporophyte *[2006]*
(a) produces gametes that give rise to the gametophyte
(b) arises from a spore produced from the gametophyte
(c) manufactures food for itself as well as for the gametophyte
(d) is partially parasitic on the gametophyte

45. Peat Moss is used as a packing material for sending flowers and live plants to distant places because *[2006]*
(a) it is hygroscopic
(b) It reduces transpiration
(c) it serves as a disinfectant
(d) it is easily available

46. Which of the following propagates through leaf- tip? *[2004]*
(a) Walking fern (b) Sproux-leaf plant
(c) *Marchantia* (d) Moss

47. Sexual reproduction in *Spirogyra* is an advanced feature because it shows *[2003]*
(a) physiologically differentiated sex organs
(b) different sizes of motile sex organs
(c) same size of motile sex organs
(d) morphologically different sex organs

48. The antherozoids of *Funaria* are *[1999]*
(a) aciliated (b) flagellated
(c) multiciliated (d) monociliated

49. Bryophytes comprise *[1999]*
(a) sporophyte of longer duration
(b) dominant phase of sporophyte which is parasitic
(c) dominant phase of gametophyte which produces spores
(d) small sporophyte phase and generally parasitic on gametophyte.

50. Which of the following is true about bryophytes? *[1999]*
(a) They possess archegonia
(b) They contain chloroplast
(c) They are thalloid
(d) All of these

51. Bryophytes are dependent on water because *[1998]*
(a) water is essential for fertilization for their homosporous nature
(b) water is essential for their vegetative propagation
(c) the sperms can easily reach upto egg in the archegonium
(d) archegonium has to remain filled with water for fertilization

52. Bryophytes can be separated from algae because they *[1997]*
(a) are thalloid forms
(b) have no conducting tissue
(c) possess archegonia with outer layer of sterile cells
(d) contain chloroplasts in their cells

53. In which one of these the elaters are present along with mature spores in the capsule (to help in spore dispersal)? *[1996]*
(a) *Riccia* (b) *Marchantia*
(c) *Funaria* (d) *Sphagnum*

54. The plant body of moss (*Funaria*) is *[1995]*
(a) completely sporophyte
(b) completely gametophyte
(c) predominantly sporophyte with gametophyte
(d) predominantly gametophyte with sporophyte

55. Unique features of Bryophytes is that they
(a) produce spores *[1994]*
(b) have sporophyte attached to gametophyte
(c) lack roots
(d) lack vascular tissues

56. Protonema occurs in the life cycle of *[1990, 1993]*
(a) *Riccia* (b) *Funaria*
(c) Somatogamy (d) *Spirogyra*

57. Bryophytes are amphibians because *[1991]*
(a) they require a layer of water for carrying out sexual reproduction
(b) they occur in damp places
(c) they are mostly aquatic
(d) all the above

58. Apophysis in the capsule of *Funaria* is *[1990]*
(a) lower part (b) upper part
(c) middle part (d) fertile part

59. Moss peristome takes part in *[1990]*
(a) spore dispersal (b) photosynthesis
(c) protection (d) absorption

60. Sperms of both *Funaria* and *Pteris* were released together near the archegonia of *Pteris*. Only its sperms enter the archegonia as *[1989]*
(a) *Pteris* archegonia repel *Funaria* sperms
(b) *Funaria* sperms get killed by *Pteris* sperms
(c) *Funaria* sperms are less mobile
(d) *Pteris* archegonia release chemical to attract its sperms

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Topic 3: Pteridophytes

61. In bryophytes and pteridophytes, transport of male gametes requires *[2016]*
(a) Wind (b) Insects
(c) Birds (d) Water

62. The plant body is thalloid in *[NEET Kar. 2013]*
(a) *Funaria* (b) *Sphagnum*
(c) *Salvinia* (d) *Marchantia*

63. *Selaginella* and *Salvinia* are considered to represent a significant step towards evolution of seed habit because: *[2011M]*
(a) female gametophyte is free and gets dispersed like seeds
(b) female gametophyte lacks archaegonia
(c) megaspores possess endosperm and embryo surrounded by seed coat
(d) embryo develops in female gametophyte which is retained on parent sporophyte.

64. In which one of the following, male and female gametophytes do not have free living independent existence? *[2008]*
(a) *Pteris* (b) *Funaria*
(c) *Polytrichum* (d) *Cedrus*

65. Which one of the following is heterosporous? *[2008]*
(a) *Dryopteris* (b) *Salvinia*
(c) *Adiantum* (d) *Equisetum*

66. In the prothallus of a vascular cryptogam, the antherozoids and eggs mature a different times. As a result *[2007]*
(a) there is high degree of sterility
(b) one can conclude that the plant is apomictic
(c) self-fertilization is prevented
(d) there is no change in success rate of fertilization

67. In Ferns meiosis occurs when *[2000]*
(a) spore germinates
(b) gametes are formed
(c) spores are formed
(d) antheridia and archegonia are formed

68. Dichotomous branching is found in *[1999]*
(a) Fern (b) *Funaria*
(c) *Liverworts* (d) *Marchantia*

69. The "walking" fern is so named because *[1998]*
(a) it is dispersed through the agency of walking animals
(b) it propagates vegetatively by its leaf tips
(c) it knows how to walk by itself
(d) its spores are able to walk

70. Multicellular branched rhizoids and leafy gametophytes are characteristic of *[1997]*
(a) all bryophytes
(b) some bryophytes
(c) all pteridophytes
(d) some peteriodphytes

71. The 'amphibians' of plant kingdom are *[1996]*
(a) unicellular motile algae
(b) multicellular non-motile algae
(c) bryophytes with simple internal organization
(d) pteridophytes with complex internal organization not reaching angiosperm level.

72. Pteridophytes differ from mosses/bryophytes in possessing *[1993]*
(a) independent gametophyte
(b) well developed vascular system
(c) archegonia
(d) flagellate spermatozoids

73. The plant group that produces spores and embryo but lacks vascular tissues and seeds is *[1992]*
(a) Pteridophyta (b) Rhodophyta
(c) Bryophyta (d) Phaeophyta

74. Which one of the following is not common between *Funaria* and *Selaginella*? *[1992]*
(a) Archegonium (b) Embryo
(c) Flagellate sperms (d) Roots

75. Evolutionary important character of *Selaginella* is *[1989]*
(a) heterosporous nature
(b) rhizophore
(c) strobili
(d) ligule

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76. Prothallus (gametophyte) gives rise to fern plant (sporophyte) without fertilization. It is *[1988]*
(a) apospory (b) apogamy
(c) parthenocarpy (d) parthenogenesis

77. Which one of the following is considered important in the development of seed habit? *[2009]*
(a) Heterospory
(b) Haplontic life cycle
(c) Free -living gametophyte
(d) Dependent sporophyte

78. Plants reproducing by spores such as mosses and ferns are grouped under the general term *[2003]*
(a) Thallophytes (b) Cryptogams
(c) Bryophytes (d) Sporophytes

Topic 4: Gymnosperms

79. Strobili or cones are found in *[2020]*
(a) *Pteris* (b) *Marchantia*
(c) *Equisetum* (d) *Salvinia*

80. Pinus seed cannot germinate and establish without fungal association. This is because: *[2019]*
(a) its embryo is immature.
(b) it has obligate association with mycorrhizae.
(c) it has very hard seed coat.
(d) its seeds contain inhibitors that prevent germination.

81. Phloem in gymnosperms lacks: *[2019]*
(a) Albuminous cells and sieve cells
(b) Sieve tubes only
(c) Companion cells only
(d) Both sieve tubes and companion cells

82. Select the wrong statement : *[2018]*
(a) Cell wall is present in members of Fungi and Plantae
(b) Mushrooms belong to Basidiomycetes
(c) Mitochondria are the powerhouse of the cell in all kingdoms except Monera
(d) Pseudopodia are locomotory and feeding structures in Sporozoans

83. Select the mismatch *[2017]*
(a) *Cycas* – Dioecious
(b) *Salvinia* – Heterosporous
(c) *Equisetum* – Homosporous
(d) *Pinus* – Dioecious

84. Select the correct statement: *[2016]*
(a) Gymnosperms are both homosporous and heterosporous
(b) *Salvinia*, *Ginkgo* and *Pinus* all are gymnosperms
(c) *Sequoia* is one of the tallest trees
(d) The leaves of gymnosperms are not well adapted to extremes of climate

85. In which of the following gametophyte is not independent free living ? *[2015 RS]*
(a) *Marchantia* (b) *Pteris*
(c) *Pinus* (d) *Funaria*

86. Read the following five statements (A to E) and select the option with all correct statements : *[2015 RS]*
(A) Mosses and Lichens are the first organisms to colonise a bare rock.
(B) *Selaginella* is a homosporous pteridophyte
(C) Coralloid roots in *Cycas* have VAM
(D) Main plant body in bryophytes is gametophytic, whereas in pteridophytes it is sporophytic
(E) In gymnosperms, male and female gametophytes are present within sporangia located on sporophyte
(a) (B), (C) and (D) (b) (a), (D) and (E)
(c) (B), (C) and (E) (d) (a), (C) and (D)

87. Besides paddy fields cyanobacteria are also found inside vegetative part of : *[NEET 2013]*
(a) *Cycas* (b) *Equisetum*
(c) *Psilotum* (d) *Pinus*

88. Read the following statements (A-E) and answer the question which follows them. *[NEET 2013]*
A. In liverworts, mosses and ferns gametophytes are free-living
B. Gymnosperms and some ferns are heterosporous.
C. Sexual reproduction in *Fucus*, *Volvox* and *Albugo* is oogamous
D. The sporophyte in liveworts is more elaborate than that in mosses
E. Both, *Pinus* and *Marchantia* are dioecious
How many of the above statements are correct?
(a) Two (b) Three
(c) Four (d) One

89. What is common in all the three, *Funaria, Dryopteris* and *Ginkgo?* *[NEET Kar. 2013]*
(a) Independent sporophyte
(b) Presence of archegonia
(c) Well developed vascular tissues
(d) Independent gametophyte

90. *Cycas* and *Adiantum* resemble each other in having: *[2012]*
(a) Seeds (b) Motile Sperms
(c) Cambium (d) Vessels

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91. Which one of the following is a correct statement? *[2012]*
(a) Pteridophyte gametophyte has a protonemal and leafy stage
(b) In gymnosperms female gametophyte is free-living
(c) Antheridiophores and archegoniophores are present in pteridophytes.
(d) Origin of seed habit can be traced in pteridophytes

92. Read the following five statements (A - E) and answer the question. *[2012M]*
(A) In *Equisetum* the female gametophyte is retained on the parent sporophyte.
(B) In *Ginkgo* male gametophyte is not independent.
(C) The sporophyte in *Riccia* is more developed than that in *Polytrichum*.
(D) Sexual reproduction in *Volvox* is isogamous.
(E) The spores of slime molds lack cell walls.
How many of the above statements are correct?
(a) Two (b) Three
(c) Four (d) One

93. Which one of the following pairs is wrongly matched? ***[2012M]***
    (a) *Ginkgo* -Archegonia
    (b) *Salvinia* - Prothallus
    (c) Viroids - RNA
    (d) Mustard - Synergids
94. Consider the following four statements whether they are correct or wrong? ***[2011M]***
    (A) The sporophyte in liverworts is more elaborate than that in mosses
    (B) *Salvinia* is heterosporous
    (C) The life cycle in all seed-bearing plants is diplontic
    (D) In *Pinus* male and female cones are borne on different trees.
    The two wrong statements together are
    (a) Statements (A) and (C)
    (b) Statements (A) and (D)
    (c) Statements (B) and (C)
    (d) Statements (A) and (B)
95. The gametophyte is not an independent, free living generation in : ***[2011]***
    (a) *Polytrichum* (b) *Adiantum*
    (c) *Marchantia* (d) *Pinus*
96. Which one of the following plants is monoecious? ***[2009]***
    (a) *Pinus* (b) *Cycas*
    (c) Papaya (d) *Marchantia*
97. Which one of the following is a vascular cryptogam? ***[2009]***
    (a) *Ginkgo* (b) *Marchantia*
    (c) *Cedrus* (d) *Equisetum*
98. Select one of the following pairs of important features distinguishing *Gnetum* from *Cycas* and *Pinus* and showing affinities with angiosperms ***[2008]***
    (a) absence of resin duct and leaf venation
    (b) presence of vessel elements and absence of archegonia
    (c) perianth and two integuments
    (d) embryo development and apical meristem
99. Flagellated male gametes are present in all the three of which one of the following sets? ***[2007]***
    (a) *Zygnema*, *Saprolegnia* and *Hydrilla*
    (b) *Fucus*, *Marsilea* and *Calotropis*
    (c) *Riccia*, *Dryopteris* and *Cycas*
    (d) *Anthoceros*, *Funaria* and *Spirogyra*
100. In gymnosperms, the pollen chamber represents ***[2007]***
    (a) a cavity in the ovule in which pollen grains are stored after pollination
    (b) an opening in the megagametophyte through which the pollen tube approaches the egg
    (c) the microsporangium in which pollen grains develop
    (d) a cell in the pollen grain in which the sperms are formed.
101. Conifers differ from grasses in the ***[2006]***
    (a) lack of xylem tracheids
    (b) absence of pollen tubes
    (c) formation of endosperm before fertilisation
    (d) production of seeds from ovules
102. Match items in Column I with those in Column II:

Column I	Column II
(A) Peritrichous flagellation	(J) *Ginkgo*
(B) Living fossil	(K) *Macrocystis*
(C) Rhizophore	(L) *Escherichia coli*
(D) Smallest flowering plant	(M) *Selaginella*
(E) Largest perennial alga	(N) *Wolffia*

    Select the correct answer from the following:
    (a) A-L; B-J; C-M; D-N; E-K; ***[2005]***
    (b) A-K; B-J; C-L; D-M; E-N
    (c) A-N; B-L; C-K; D-N; E-J;
    (d) A-J; B-K; C-N; D-L; E-K
103. Which one of the following is a living fossil?
    (a) *Cycas* (b) Moss ***[2003, 04]***
    (c) *Saccharomyces* (d) *Spirogyra*
104. Which one of the following pairs of plants are not seed producers? ***[2003]***
    (a) *Funaria* and *Pinus*
    (b) *Fern* and *Funaria*
    (c) *Funaria* and *Ficus*
    (d) *Ficus* and *Chlamydomonas*
105. Which one of the following is a living fossil? ***[1996, 97, 2003]***
    (a) *Pinus* (b) *Opuntia*
    (c) *Ginkgo* (d) *Thuja*
106. *Cycas* has two cotyledons but not included in angiosperms because of ***[2001]***
    (a) Naked ovules
    (b) Seems like monocot
    (c) Circinate ptyxis
    (d) Compound leaves

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107. In which of the following would you place the plants having vascular tissue lacking seeds? *[1999, 2000]*
(a) Algae (b) Bryophytes
(c) Pteridophytes (d) Gymnosperms

108. Which one of the following statements about *Cycas* is incorrect? *[1998]*
(a) It does not have a well-organized female flower
(b) It has circinate vernation
(c) Its xylem is mainly composed of xylem vessels
(d) Its roots contain some blue-green algae.

109. A well developed archegonium with neck consisting of 4-6 rows of neck canal cells, characterises *[1995]*
(a) Gymnosperms only
(b) Bryophytes and pteridophytes
(c) Pteridophytes and gymnosperms
(d) Gymnosperms and flowering plants

110. The 'wing' of *Pinus* seed is derived from
(a) testa *[1994]*
(b) testa and tegmen
(c) surface of ovuliferous scale
(d) all the above

111. Which one is the most advanced from evolutionary point of view. *[1993]*
(a) *Selaginella* (b) *Funaria*
(c) *Chlamydomonas* (d) *Pinus*

112. A plant in which sporophytic generation is represented by zygote *[1992]*
(a) *Pinus* (b) *Selaginella*
(c) *Chlamydomonas* (d) *Dryopteris*

113. A plant having seeds but lacking flowers and fruits belongs to *[1992]*
(a) Pteridophytes (b) Mosses
(c) Ferns (d) Gymnosperms

114. In *Pinus*, the pollen grain has 6 chromosomes then in its endosperm will have *[1992]*
(a) 12 (b) 18
(c) 6 (d) 24

115. Resin and turpentine are obtained from
(a) *Cycas* (b) *Pinus* *[1992]*
(c) *Cedrus* (d) *Abies*

116. In *Pinus*/gymnosperms, the haploid structure are *[1989]*
(a) megaspore, endosperm and embryo
(b) megaspore, pollen grain and endosperm
(c) megaspore, integument and root
(d) pollen grain, leaf and root

117. In gymnosperms like *Pinus* and *Cycas*, the endosperm is *[1988]*
(a) triploid (b) haploid
(c) diploid (d) tetraploid

Topic 5: Angiosperms

118. Double fertilization is exhibited by : *[2017]*
(a) Algae (b) Fungi
(c) Angiosperms (d) Gymnosperms

119. Male gametophyte in angiosperms produces: *[2015 RS]*
(a) Single sperm and vegetative cell
(b) Single sperm and two vegetative cells
(c) Three sperms
(d) Two sperms and a vegetative cell

120. In angiosperms, microsporogenesis and megasporogenesis : *[2015 RS]*
(a) form gametes without further divisions
(b) involve meiosis
(c) occur in ovule
(d) occur in anther

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121. In angiosperms, functional megaspore develops into *[2011M]*
(a) embryo sac (b) ovule
(c) endosperm (d) pollen sac

122. Compared with the gametophytes of the bryophytes the gametophytes of vascular plant are *[2011]*
(a) smaller but have larger sex organs.
(b) larger but have smaller sex organs.
(c) larger and have larger sex organs.
(d) smaller and have smaller sex organs.

123. Male and female gametophytes are independent and free -living in: *[2010]*
(a) Mustard (b) Castor
(c) *Pinus* (d) *Sphagnum*

124. Which one of the following has haplontic life cycle? *[2009]*
(a) *Polytrichum* (b) *Ustilago*
(c) Wheat (d) *Funaria*

125. Which one pair of examples will correctly represent the grouping Spermatophyta according to one of the schemes of classifying plants ? *[2003]*
(a) *Ginkgo*, *Pisum* (b) *Acacia*, Sugarcane
(c) *Pinus*, *Cycas* (d) *Rhizopus*, *Triticum*

126. Which of the following plants produces seeds but not flowers? *[2002]*
(a) Maize (b) Mint
(c) Peepal (d) *Pinus*

127. Which of the following is without exception in angiosperms? *[2002]*
(a) presence of vessels
(b) double fertilisation
(c) secondary growth
(d) autotrophic nutrition

128. The largest ovules, largest male and female gametes and largest plants are found among *[2000]*
(a) angiosperms
(b) tree ferns and some monocots
(c) gymnosperms
(d) dicotyledonous plants

129. Largest sperms in the plant world are found in *[1998]*
(a) *Pinus* (b) Banyan
(c) *Cycas* (d) *Thuja*

130. Seed-habit first originated in *[1996]*
(a) certain ferns (b) certain pines
(c) certain monocots (d) primitive dicots

131. Sunken stomata is the characteristic feature of *[1995]*
(a) hydrophyte (b) mesophyte
(c) xerophyte (d) halophyte

132. *Pinus* differs from mango in having *[1993]*
(a) tree habit
(b) green leaves
(c) ovules not enclosed in ovary
(d) wood

133. Turpentine is obtained from *[1992]*
(a) angiospermous wood
(b) pteridophytes
(c) gymnospermous wood
(d) ferns

134. Which one has the largest gametophyte? *[1991]*
(a) *Cycas*
(b) Angiosperm
(c) *Selaginella*
(d) Moss

ANSWER KEY

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1	(c)	15	(b)	29	(c)	43	(d)	57	(a)	71	(c)	85	(c)	99	(c)	113	(d)	127	(b)
2	(d)	16	(d)	30	(b)	44	(d)	58	(a)	72	(b)	86	(b)	100	(a)	114	(c)	128	(c)
3	(a)	17	(b)	31	(d)	45	(a)	59	(a)	73	(c)	87	(a)	101	(c)	115	(b)	129	(c)
4	(d)	18	(a)	32	(a)	46	(a)	60	(d)	74	(d)	88	(b)	102	(a)	116	(b)	130	(a)
5	(a)	19	(b)	33	(a)	47	(a)	61	(d)	75	(a)	89	(b)	103	(a)	117	(b)	131	(c)
6	(b)	20	(d)	34	(a)	48	(b)	62	(d)	76	(b)	90	(b)	104	(b)	118	(c)	132	(c)
7	(c)	21	(d)	35	(c)	49	(d)	63	(d)	77	(a)	91	(d)	105	(c)	119	(d)	133	(c)
8	(d)	22	(a)	36	(b)	50	(d)	64	(d)	78	(b)	92	(a)	106	(a)	120	(b)	134	(d)
9	(c)	23	(c)	37	(a)	51	(c)	65	(b)	79	(c)	93	(a)	107	(c)	121	(a)		
10	(b)	24	(b)	38	(d)	52	(c)	66	(c)	80	(b)	94	(b)	108	(c)	122	(a)		
11	(a)	25	(d)	39	(a)	53	(b)	67	(c)	81	(d)	95	(d)	109	(b)	123	(d)		
12	(b)	26	(a)	40	(a)	54	(d)	68	(d)	82	(d)	96	(a)	110	(c)	124	(b)		
13	(b)	27	(b)	41	(a)	55	(b)	69	(b)	83	(d)	97	(d)	111	(d)	125	(a)		
14	(a)	28	(c)	42	(a)	56	(b)	70	(b)	84	(c)	98	(b)	112	(c)	126	(d)		

Hints & Solutions

1. (c) *Chlorella* and *Spirulina* are unicellular algae. *Gelidium, Gracilaria*, *Laminaria* and *Sargassum* are multicellular. *Volvox* is colonial.

NOTES: Chlorella is the most cultivated eukaryotic alga since it is widely used as a health food and feed supplement, as well as in the pharmaceutical and cosmetics industry. It contains proteins, carotenoids, some immuno-stimulators, polysaccharides, vitamins, and minerals.

2. (d) Floridean starch is stored food material in red algae. Its structure is similar to Amylopectin and Glycogen.

NOTES: Floridean starch is a type of a storage glucan found in glaucophytes and in red algae (also known as rhodophytes), in which it is usually the primary sink for fixed carbon from photosynthesis.

3. (a) Polysiphonia is a genus of red algae, where asexual spores and gametes are non-motile or non-flagellated.

4. (d) In Agaricus (a genus of basidiomycetes), basidiospores or meiospores are produced exogenously. Neurospora (a genus of ascomycetes) produces ascospores as meiospores but endogenously inside the ascus). Alternaria (a genus of deuteromycetes) does not produce sexual spores. Saccharomyces (Unicellular ascomycetes) produces ascospores, endogenously.

5. (a) *Volvox* is a motile colonial fresh water green alga. It forms spherical colonies. It was first observed with a light microscope by Van Leeuwenhoek (1700) within the volvocales.

NOTES: *Volvox* is autotrophs and contributes to oxygen production. They also serve as a food for various aquatic organisms such as microscopic invertebrates called rotifers.

6. (b) Male gametes are flagellated in Ectocarpus belonging to Phaeophyceae. The flagella of male gamete plays an important role in establishing initial sexual contact with the female gamete. However, in Ectocarpus the female gamete too, is flagellated but is different in structure. In Polysiphonia (Rhodophyceae) flagellated gametes are not observed, in *Anabaena* sexual reproduction through gametes is absent while in *Spirogyra* sexual reproduction takes place by conjugation wherein male gamete passes through a tube to the adjacent filament. The male gametes here are non-flagellated and show amoeboid movement.

7. (c) Mannitol or laminarin is the stored food in phaeophyceae (brown algae). Example, *Ectocarpus, fucus, Sargassam* etc.

NOTES: The food is stored as floridean starch in Rhodophyceae which is very similar to amylopectin and glycogen in structure.

8. (d) In *Spirogyra,* sexual reproduction occurs through conjugation. Gametes are non-flagellated, morphologically similar. But physiologically different (isogamy with physiological anisogamy).

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NOTES: Conjugation is the biological process by which one bacterium transfers genetic material to another bacterium through direct contact. During conjugation, one bacterium serves as the donor of the genetic material, and the other serves as the recipient. The donor bacterium carries a DNA sequence called the fertility factor, or F-factor.

9. (c) *Chara* belongs to chlorophyceae, is a green alga found attached to bottoms of shallow water of ponds, pools and lakes. Male sex organ is called antheridium. Female sex organ is called oogonium. Oogonium is borne at the top of the four celled filament.

10. (b) *Chlorella* and *Spirullina* are unicellular algae, rich in proteins and are used as food supplements by space travellers.

11. (a) In *Spirogyra,* sexual reproduction occurs through conjugation. Gametes are non-flagellated, morphologically similar. But physiologically different (isogamy with physiological anisogamy). *Volvox* and *Fucus* are examples of oogamous and *Chlamydomonas* contains isogamous flagellated gametes.

12. (b) Algae is a plant and so its cell wall is made up of cellulose. Cellulase enzyme is needed for degradation of its cell wall.

13. (b) Cyanobacteria, e.g., *Nostoc*, grow in such abundance as to form water blooms. *Sargassum* belongs to brown algae which possess chl *a*, *c*, carotenoids, xanthophyll and a characteristic brown pigment, fucoxanthin. Commonly known forms of basidiomycetes are mushrooms, bracket fungi or puffballs. In *Spirogyra* gametes are non-flagellated (non-motile) but similar in size. They show amoeboid movements.
14. (a) Algae possess a definite cell wall containing cellulose, galactans and mannans.
15. (b) Mannitol is a food stored in *Fucus*. *Fucus* is a genus of brown alga in the class Phaeophyceae to be found in the intertidal zones of rocky seashores almost everywhere in the world. Primary chemical constituents of this plant include mucilage, algin, mannitol, beta-carotene, zeaxanthin, iodine, bromine, potassium, volatile oils, and many other minerals.
16. (d) Algae are classified on the basis of types of pigment present in the cell, like Rhodophyceae shows presence of phycoerythrin, chlorophyceae shows presence of phycocyanin etc. Phaeophyceae contains the amount of the xanthophyll pigment such as fucoxanthin.
17. (b) Reserve food in red algae (Rhodophyceae) is floridean starch. In green algae, (Chlorophyceae), reserve food is starch. In brown algae, reserve food is laminarin and mannitol. In cyanophyceae, reserve food is cyanophycean starch.
18. (a) In green algae, the photosynthetic pigments are chlorophyll a & b, carotenes and xanthophylls. In phaeophyceae, the pigments are chlorophyll a, chlorophyll c and carotenes and xanthophylls. Phycoerythrin gives red colour to rhodophyceae.
19. (b) *Ulothrix* is a green alga. *Spirogyra* is a filamentous green alga. In *Rhizopus* the columella bears the spores for asexual reproduction.

NOTES

Columella is located on the tip of long erect stalk known as sporangiophore, present in the *Rhizopus*. It supports the Sporangium which has asexual spores. It helps nutrient exchange between the active protoplasm below and the developing spores inside the upper portion of the sporangial head.

20. (d) *Ulothrix* is a genus of filamentous green algae, generally found in fresh and marine water. *Ulothrix* reproduces vegetatively by fragmentation, asexually by non-motile resting spores and motile quadriflagellate spores and sexually by biflagellate gametes.
21. (d) *Chlorella* can be grown to provide human food rich in protein, lipid, carbohydrates, vitamins and minerals.
Chlorella has been researched as a potential source of food and energy, because of its efficiency of photosynthesis can reach 8%, which is comparable with other highly efficient crops such as sugar cane. It is high in protein and other essential nutrients. When dried, it has about 45 percent protein, 20 percent fat, 20 percent carbohydrate, 5% fibre, and 10 percent minerals and vitamins.
22. (a) Sexual reproduction in *Ulothrix* is isogamous type. Only similar type of gametes called isogametes are produced.
23. (c) Fucoxanthin is a caretenoid pigment present besides chlorophyll in brown algae. Phycoerythrins are accessory photosynthetic pigments along with phycocyanins. They both are water soluble pigments phycobilin. Haematochrome is a red pigment present in hypnospores (non-motile resting spores) of *Chlamydomonas*.
24. (b) Blue green algae or cyanobacteria are prokaryotes. Prokaryotes lack a well defined nucleus surrounded by nuclear membrane. Eukaryotes have well organised nucleus. Rhodophyceae & Chlorophyceae are members of algae which come under eukaryotes.
25. (d) The plant body of *Ulothrix* is divided into three regions-basal cells, apical cells and middle cells. Basal cell is the lower most cell of the filament. It expands and forms a disc shaped structure called holdfast. It is meant for attaching the filaments to the substratum which shows beginning of labour division.
26. (a) The agar is obtained from several members of red algae such as *Gracilaria*, *Gelidium*, *Chondrus* etc. Agar gels are extensively used for growing micro-organisms.
27. (b) In chlorophyceae, sexual reproduction takes place by all the three processes
    1. Isogamy – Fusion of morphologically and physiologically similar gametes.
    2. Anisogamy – Morphologically similar but physiologically dissimilar gametes.
    3. Oogamy – Fusing gametes are dissimilar in all respect.

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28. (c) *Spirogyra* is a member of green algae which cannot fix atmospheric nitrogen. Only *Nostoc* and *Anabaena* (Blue green algae) and *Azotobacter* (bacteria) can fix nitrogen.
29. (c) Plant body of *Ulothrix* and *Spirogyra* is gametophyte (haploid), they produce zoogametes(n) which fuse to form zygospore (2n) diploid, which is a resting spore. Under favourable condition zygospore undergoes reductional division or meiosis to produce zoospores which give rise to new plant.
30. (b) Shape and number of chloroplast in different members of algae is different
    Chlamydomonas – cup shaped, 1/cell
    Zygnema – Stellate, 2/cell
    Spirogyra – Spiral, 1/ cell
    Ulothrix – Collar shaped, 1/cell
31. (d) Pyrenoids are the subcellular microcompartments found in chloroplast of many algae. Pyrenoids are the centres for the formation of starch. It is a seat of synthesis and storage of starch present in the chloroplast of algae.

NOTES A pyrenoid has a core of protein around which starch is deposited as layers.

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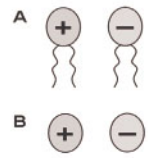
32. (a) In both the members of green algae, *Spirogyra* and *Chlamydomonas*, gametes fuse to form zygote which develops into a thick walled resting zygospore. Zoospore is asexual spore while oospore is sexual spore. Carpospore is a diploid spore produced by red algae.
33. (a) In *Chlamydomonas*, sexual reproduction takes place through :
    1. Isogamy : Fusion of two similar gametes.
    2. Anisogamy : Fusion between morphologically similar but physiologically different gametes.
    3. Oogamy : Fusion between two dissimilar gametes.
    4. Hologamy : Fusion of two young cells. Most common mode is isogamy.
34. (a) Isogamy refers to a form of sexual reproduction involving gametes of the same size. Since both gametes look alike, they cannot be classified as "male" or "female." Instead, organisms undergoing isogamy are said to have different mating types, most commonly noted as "+" and "–" strains. Fertilisation occurs when "+" and "–" strain gametes fuse to form a zygote. There are several types of isogamy. Both gametes may be flagellated and thus motile. This type mating occurs in algae such as *Chlamydomonas*.



    A. Isogamy of motile cells
    B. Isogamy of non-motile cells
35. (c) *Chlamydomonas* has haplontic life cycle hence shows zygotic meiosis.
36. (b) *Ectocarpus* exhibits haplodiplontic life cycle while *Fucus* has diplontic life cycle.
37. (a) The spores are non-motile in *Mucor*.
38. (d) *Sphagnum,* a moss, provides peat that has long been used as fuel. It has the capacity to retain water for long periods and as such used to cover the plant roots during transportation.
39. (a) Vegetative reproduction in mosses is by fragmentation and budding in the secondary proteonema. In sexual reproduction, the sex organs antheridia and archegonia are produced at the apex of the leafy shoots. So, Multiplication by fragmentation takes place in the multicellular fungi, filamentous algae and protonema of mosses.
40. (a) The main plant body of the bryophyte is haploid. It produces gametes, hence is called a gametophyte. The sex organs in bryophytes are multicellular. The male sex organ is called antheridium. They produce biflagellate antherozoids. The female sex organ called archegonium is flask-shaped and produces a single egg. A sexual reproduction in liverworts takes place by fragmentation of thalli, or by the formation of specialised structures called gemmae (sing. gemma).

NOTES Gemmae are green, multicellular, asexual buds, which develop in small receptacles called gemma cups located on the thalli. The gemmae become detached from the parent body and germinate to form new individuals. During sexual reproduction, male and female sex organs are produced either on the same or on different thalli. The sporophyte is differentiated into a foot, seta and capsule. After meiosis, spores are produced within the capsule. These spores germinate to form free-living gametophytes.

41. (a) Archegoniophore is the female sex organ of bryophytes (*Marchantia*) and pteridophytes. Its neck region is made up of 4-6 vertical rows of cells.
42. (a) Hyperthermophilic organism that grow in highly acidic habitats belong to eubacteria and archae groups.
43. (d) Elater is an elongated, spirally thickened, water-attracting cell in the capsule of a liverwort, derived from sporogenous tissue and assist in spore dispersal.
In mosses calyptra is a structure initially present around sporophyte then break later. It is developed from ventral wall after fertilization. It provides protective covering to the developing sporogonium.
Peristome teeth are found in the capsule of moss. These are present below operculum and are hygroscopic in nature.
44. (d) In moss, main plant body is gametophyte while sporophyte is meant for spore dispersal mainly. Hence it is called that the sporophyte is partially parasitic on gametophyte.
45. (a) Peat moss is used wherever we require to retain water for a long because peat mosses are hygroscopic in nature and they absorb the moisture from the atmosphere and this moisture keep the living materials and flowers fresh for a long time.
46. (a) In mosses, vegetative propagation occurs by fragmentation. *Marchantia* is a liverwort in which propagation also occurs by fragmentation. Walking fern *Adiantum* propagates through leaf tip.
47. (a) Sexual reproduction in *Spirogyra* occurs by conjugation involving union of two gametes. The fusing gametes are similar but one is more active and passes onto the other cell. This differentiation of gametes is called physiological anisogamy.
48. (b) Antherozoids of *Funaria* bear two flagella at anterior end and is spirally coiled.
49. (d) In bryophytes, the dominant and independent living phase of the life cycle is gametophyte. Sporophyte is always attached and dependent upon the gametophytic plant body for water supply, fixation, and part or whole nutrient requirement.
50. (d) Bryophytes are non-vascular embryophytes characterised by the presence of an independent gametophyte and a parasitic sporophyte. Plant body is either thalloid or foliose. Archegonium is the flask shaped female sex organ. They bear chloroplast.
51. (c) Bryophytes require a thin film of water on the surface of their substratum during sexual reproduction for the following reasons:
(i) Dehiscence of antheridia requires absorption of water from outside.
(ii) Dehiscence of archegonium.
(iii) Swimming of sperms to reach the archegonia.
52. (c) Archegonium is the flask shaped female sex organ in bryophytes while algae have non-jacketed sex organs (gametangia).
53. (b) In *Marchantia,* capsule elaters are present which help in dispersal of spores.
54. (d) The gametophytic generation represents the dominant phase in the life cycle of bryophytes. The sporophyte phase is dependent on the gametophyte. That is why, the plant body of *Funaria* is predominantly gametophyte with sporophyte.
55. (b) In bryophytes, the plant body is gametophyte. Sporophyte remains attached to the gametophyte and produces spores. Sporophyte is dependent on gametophyte.
56. (b) In *Funaria*, the spore germinates to form a green multicellular structure called as protonema which later on develops into gametophyte.

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NOTES Presence of protonema is a characteristic feature of mosses.

57. (a) Bryophytes are amphibians because they complete their vegetative phase on land but water is necessary for their reproductive phase.
58. (a) Capsule of *Funaria* is differentiated into:
(1) Operculum – upper part - forms lid
(2) Theca – Middle – fertile part
(3) Apophysis – lower part -photosynthetic

NOTES Apophysis is basal portion of capsule in continuation with seta. The outer layer of apophysis is epidermis which has stomata for gaseous exchange. In capsule of *Funaria* stomata are present only in apophysis.

59. (a) Peristomes is a ring of tooth like structure around. These are in two rows and helps in the dispersal of the spores due to hygroscopic nature.
60. (d) Archegonia of a particular species recognises antherozoids (sperms) of the same species through release of chemical. In *Pteris*, archegonia produces malic acid which attracts sperms of *Pteris* only for fertilization.

61. (d) Bryophytes neither have pollen nor flowers and rely on water to carry the male gametes (sperm) to the female gametes (eggs). The antherozoids (male gametes of pteridophytes) are armed with hair-like or whip-like cilia or flagellae and are able to swim through water; they do not travel great distances and are only released when free water is available.
62. (d) The plant body of a liverwort is haploid (n), gametophytic, small, dorsoventrally flattened, thallose, dichotomously branched fixed by unicellular and unbranched rhizoids, *e.g.*, *Marchantia.*
63. (d) *Selaginella* and *Salvinia* are advanced pteridophytes.
64. (d) Male and female gametophytes of *Cedrus* do not have free living independent existence. *Cedrus* belongs to conifer.
65. (b) *Salvinia* is an heterosporous aquatic fern with both annual and perennial species. The heterosporous have two types of spores, microspores and megaspores.
66. (c) In the prothallus of a vascular cryptogams the antherozoids and eggs mature at different times which result in failure of self-fertilisation.
67. (c) Gametic meiosis is found in all animals. In sporic meiosis the sporophyte produces sporangia where as meiosis occurs producing haploid spores.
68. (d) In mosses, branching is lateral but extra-axillary (*Funaria*). *Marchantia* is a dorsiventral dichotomously branched thalloid liverwort. In *Sphagnum* branching is profuse.
69. (b) Vegetative reproduction occurs in ferns by fragmentation of rhizome and growth of adventitious buds. In *Adiantum caudatum* the adventitious buds occur at the leaf tips.

NOTES
Adiantum is also called the walking fern because of its ability to form new ferns whenever the leaf tip happens to come in contact with soil.

70. (b) In pteridophytes, the gametophyte is independent living, small thalloid structure called prothallus. In pteridophytes, the primary roots are replaced by adventitious roots. Whereas in bryophytes, the gametophyte is leafy.
71. (c) Bryophytes are terrestial plants but they require a thin film of water on the surface of their substratum during sexual reproduction, hence they are called amphibians of the plant kingdom.
72. (b) Well developed vascular system is present in the members of Pteridophytes but absent in mosses as the plant body is sporophyte which is distinguished into true root, stem and leaves.
Independent gametophyte, archegonia flagellate spermatozoids are present in moss and pteridophyte both.
73. (c) Bryophytes are the plants which produces spores and embryo but no vascular tissues are present, although primitive type of conducting tissues are present in the form of hadrome and leptome.
    - Rhodophytes & phaeophytes are algae producing spores, but no embryo & vascular tissue.
    - Pteridophytes have spores, embryo and true vascular tissues.
74. (d) *Funaria*, is a moss (Bryophyte) that possesses archegonium, embryo, flagellated sperms. These are also present in *Selaginella* (Pteridophyte) but it also has roots which are absent in *Funaria*.
75. (a) Presence of two types of spores microspores and megaspores (heterospory) is the evolutionary characteristic feature in the life cycle of *Selaginella*.
76. (b) When prothallus of a fern gives rise to sporophyte directly from somatic cell without forming gametes it is apogamy. Such type of sporophyte is haploid in nature.
Development of gametophyte directly from sporophyte without meiosis and without forming spores, is apospory.
77. (a) Heterospory is considered important in the development of seed habit. Heterospory was evolved from isospory independently by several plant groups in the Devonian period as part of the process of evolution of the timing of sex differentiation. Heterosporic plants produce small spores called microspores which either germinate to become male gametophytes or have reduced male gametophytes packaged within them, and similarly larger spores called megaspores that germinate into female gametophytes, or which have female gametophytes packaged within them.

NOTES
Heterospory is the production of spores of two different sizes and sexes by the sporophytes of land plants.

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78. (b) The plants which reproduce by spores and do not produce seeds are called cryptogams. The term cryptogams is made of 2 Greek words *i.e.* Kryptos (hidden) + gamos (marriage). These include Bryophytes (mosses) and Pteridophytes (ferns).
79. (c) Strobili or cones are found in *Equisetum*. Strobili or **cones** are the dense and compact structure **present** on non flowering plants. They contain sporangia and perform function of protecting spores from wild animals and harsh conditions of environment.

NOTES Equisetum is the only living genus in *Equisetaceae*, a family of vascular plants that reproduce by spores rather than seeds.

80. (b) Fungus associated with roots of *Pinus* increases minerals and water absorption for the plant by increasing surface area and in turn fungus gets food from plant. Therefore, mycorrhizal association is obligatory for *Pinus* seed germination.
81. (d) Phloem, a complex tissue, is found in highly organised plants ("higher plants") and characterised by the possession of certain specialised cells, the sieve elements, and which functions as the major channel of rapid conduction of sugars over fairly long distances in the plant body. In addition to sieve elements, it always contains parenchyma cells, usually of more than one type, and frequently includes sclerenchyma cells.
Phloem in gymnosperms lacks both sieve tube and companion cells.
82. (d) Pseudopodia are locomotory structures in sarcodines (amoeboid).
83. (d) Pinus is monoecious plant comprising of both male and female cones on same plant.
84. (c) *Sequoia semepervirans* is one of the tallest trees.
85. (c) *Pinus* belongs to gymnosperms in which male and female gametophytes do not have an independent free living existence. They remain within the sporangia which are of two types — microsporangia and megasporangia.
86. (b) *Selaginella* is a heterosporus pteridophyte containing micro & megaspores. In *Cycas,* corolloid root has the cyanobacteria - *Anabaena*.
87. (a) In *Cycas* specialised root called coralloid roots are associated with N_2–fixing cyanobacteria either *Nostoc* or *Anabaena*. Coralloid roots lie near the soil surface. They are irregular and often dichotomously branched. Root hair and root cap are absent in these roots.
88. (b) Statement (a), (B) and (C) are correct. In liverworts and ferns gametophytes are free living while in fern, sporophytes are free living. Gymnosperms and genera like *Selaginella* and *Salvinia* are heterosporous. The sporophyte in mosses are more elaborate than that of liverworts, *Pinus* is monoecious and heterosporous. *Marchantia* is dioecious.
89. (b) The female sex organ archegonium is formed in bryophytes (*Funaria),* pteridophytes (*Dryopteris*) and gymnosperms (*Ginkgo*).
90. (b) *Cycas* (a gymnosperm) and *Adiantum* a pteridophyte, known as Maiden hair fern resemble each other in having motile sperm. Seeds, cambium are common in gymnosperms and absent in pteridophytes.

NOTES True vessels are absent in both pteridophytes and gymnospems.

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91. (d) (1) Gametophyte of bryophytes bears protonemal & leafy stage.
(2) In gymnosperm female gametophyte is not free living.
(3) Antheridiophores and archegoniophores are present in *Marchantia* which is a bryophyte.
(4) Origin of seed habit started in pteridophyte *Selaginaella*.
92. (a) Statement (a) and (B) are correct
Riccia is a liverwort in which simplest sporophyte consists of capsule only while *Polytrichum* is a moss in which sporophyte consists of foot, seta & capsule. *Volvox* is a fresh water green colonial alga. Reproduction is both sexual and asexual. Sexual reproduction is oogamous.

NOTES Slime molds are also called consumer decomposer protists. They possess characters of plants (cellulosic cell wall), animals (phagotrophic nutrition) and fungi (spores). They represents a connecting link between animal and fungi. They are also known as Myxomycota.

93. (a) Archegonia are not formed in *Ginkgo*.
94. (b) Statements (a) and (D) are wrong.
(a) Sporophyte is more developed in mosses rather than liverwort.

(D) *Pinus* is monoecious in which male & female cones are borne on different branches.

95. (d) Unlike bryophytes and pteridophytes, in gymnosperms the male and female gametophytes do not have an independent free-living existence. They remain within the sporangia retained on the sporophytes.

96. (a) *Pinus* plant is monoecious i.e. both male and female cone are present in same plant but on different branches. *Pinus*, with over 100 species, is the largest genus of conifers and the most widespread genus of trees in the Northern Hemisphere.

NOTES *Pinus* are also extensively planted in temperate regions of the Southern Hemisphere. Pines have a relatively rich fossil record.

97. (d) *Equisetum* is a vascular cryptogam. *Equisetum* is the only living genus in the Equisetaceae, a family of vascular plants that reproduce by spores rather than seeds. They are commonly known as horse tails.

NOTES *Equisetum* is a "living fossil," as it is the only known genus of the entire class Equisetopsida.

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98. (b) The important features distinguishing *Gnetum* from *Cycas* and *Pinus* and showing affinities with angiosperms are presence of vessel elements and absence of archegonia.

99. (c) The male gametes of bryophytes are biflagellate and those of pteridophytes are multiflagellate, except *Selaginella* having biflagellates gametes. The male gametes of gymnosperms are non-motile except those of *Cycas* having multiciliate gametes.

100. (a) In gymnosperms, the pollen chamber represents a cavity in the ovule in which pollen grains are stored after pollination within the pollen chamber, the generative cell nucleus divides to form two genetic nuclei and the tube cells elongates results in the formation of pollen tube, the pollen tube penetrates the female gametophyte and the sperm nuclei and then it pass through the tube. So, one of the sperm nuclei get fused with the egg results in the formation of zygote (diploid).

101. (c) Conifers (Gymnosperms) differ from grasses (angiosperms) because in gymnosperms the female gametophyte is actually endosperm which is made before fertilisation. While in grasses endosperm is a tissue formed by the fertilisation of second male gamete to polar nuclei. Moreover in gymnosperms the endosperm is a haploid tissue while in angiosperms it is triploid.

102. (a) Peritrichous flagellation : Flagella all around, e.g. *Escherichia coli*.
Living fossil : Organisms which have undergone very little change since they first evolved, e.g. *Ginkgo*.
Rhizophore : Rhizophores are present in *Selaginella* which is a colourless, leafless, positively geotropic, elongated structure.
Smallest flowering plant : *Wolffia*.
Largest perennial alga : *Macrocystis*.

103. (a) *Cycas revoluta* a native of China and Japan is commonly known as "Tesso" or Sago palm. It is also called living fossil due to its primitive characters.

104. (b) Pteridophytes (fern) and bryophytes (*Funaria*) are seedless plants. Gymnosperms (pines) and angiosperms (*Ficus*) are seed bearing plants.

105. (c) Ginkgophyta is an ancient group, of which the sole living representative or living fossil is *Ginkgo biloba* or Maiden hair tree. It is native of South China.

106. (a) In *Cycas* (gymnosperm) the seed does not occur inside a fruit but lies naked or exposed on the surface of megasporophyll.

107. (c) Pteridophytes are primitive seedless vascular plants. Bryophytes are non vascular embryophytes. Gymnosperms are seed plants in which conducting part of xylem consists of tracheids.

NOTES Algae are non-vascular photosynthetic aquatics forming accessory spores for asexual reproduction.

108. (c) In *Cycas*, conducting part of xylem consists of tracheids.

109. (b) Archegonia is the female sex organ of bryophytes and pteridophytes. Its neck region is made up of 4-6 vertical rows of cells.

110. (c) The ovule matures into seed and is provided with wings. The upper surface of ovuliferous scale forms the membranous wings of the seed which helps in dispersal of the seed. The time taken from cone formation to seed dispersal is about two years in *Pinus*.

111. (d) *Pinus* is a conifer, a member of gymnosperm has well developed conducting tissue and presence of seed, whereas *Selaginella* is a member of pteridophyte (heterospory), *Funaria* is a moss, *Chlamydomonas* is an alga.
112. (c) The plant body of *Chlamydomonas* is gametophyte (haploid). It reproduces asexually by zoospore formation and sexually by gametes. Gametes are isogametes which fuse to produce diploid zygote which is the only structure representing sporophytic generation. In *Pinus* main plant body is sporophyte and it is the case with *Selaginella* and *Dryopteris*.
113. (d) Gymnosperms are vascular land plants having naked ovules *i.e.*, ovules are not enclosed in a ovary hence, flower is absent. Ovules after fertilisation produce naked seeds. Pteridophytes (ferns) and mosses do not produce seed.
114. (c) Pollen grains are haploid (n). If haploid no. of chromosomes are 6 then endosperm will also have 6 chromosomes as it is formed before fertilisation and is haploid.
115. (b) *Pinus* species → Resins and turpentine
Cedrus → Timber for railway sleepers
Abies → Paper, Canada balsam.
Cycas → Ornamental plant
116. (b) *Pinus* and in all other gymnosperms endosperm produced before fertilization and is haploid. Megaspore and pollen grain are initial structures of female gametophyte and male gametophyte respectively hence, they are haploid.
117. (b) In gymnosperms like *Cycas*/*Pinus*, endosperms of female gametophyte is haploid and formed before fertilisation.
In angiosperms, endosperm is triploid and develops after fertilisation.
118. (c) Double fertilisation is a unique feature exhibited only by angiosperms. It involves both syngamy and triple fusion.
119. (d) Two sperms and a vegetative cell are produced by male gametophyte in angiosperms.
120. (b) In meiosis, the number of chromosomes are reduced by half producing haploid daughter cells. The microspore mother cell and the megaspore mother cell undergo meiosis to produce haploid microspore and megaspore respectively.
121. (a) During megagametogenesis functional megaspore (mostly chalazal) gives rise to embryo sac. This is the mature female gametophyte generation.
122. (a) The gametophyte of bryophytes are smaller but have large sex organs.
123. (d) *Sphagnum* is a bryophyte in which male and female gametophytes are independent and free living. In *Pinus* (a gymnosperm), mustard and castor (angiosperms), the main plant body is sporophytic. Gametophyte is highly reduced and is completely dependent on sporophyte.
124. (b) *Ustilago* has a haplontic life cycle. This is a simplest and most primitive type of life cycle. The other pattern of life-cycle have originated from this type. This type is found in all chlorophyceae. In such cases, the somatic phase (plant) is haploid (gametophyte) while the diploid phase (sporophyte) is represented by zygote. During germination the zygote (2n) divides meiotically producing haploid (n) zoospores, which develop into individual plant. Here, the unicellular or filamentous gametophyte (n) alternates with one-celled zygote or sporophyte (2n).

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NOTES

The haploid filamentous plants are known as haplonts which reproduce asexually by zoospores or aplanospores producing the individals like parents.

125. (a) Spermatophytes are the seed plants. They are the plants bearing seeds containing a dormant embryo. It includes gymnosperms and angiosperms. *Ginkgo* belongs to group gymnosperms and *Pisum* belongs to group angiosperms.
126. (d) Maize, mint and peepal are flowering plants or angiosperms but *Pinus* is a gymnosperm in which seeds are produced but flowers are not produced or seeds are not enclosed in flowers.
127. (b) Vesselless angiosperms are *Wintera*, *Trochodendron* etc. Secondary growth is absent in some angiosperms. Angiospermic plants are autotrophic in nutrition. But some angiosperms are heterotrophic in nutrition. The 4 special modes of nutrition and their examples include:
(i) Saprophytic : e.g. *Neottia, Monotropa.*
(ii) Symbiotic – e.g. Mycorrhiza-between fungus and roots of higher plants.

(iii) Parasitic – *Cuscuta*.
(iv) Insectivorous plant – *Nepenthes*.
Double fertilisation is characteristic of all angiosperms.

128. (c) Egg of *Cycas* (Gymnosperms) and its nucleus are the largest in the plant kingdom. The sperms of *Cycas* are also the largest in the plant kingdom.

129. (c) The sperms of *Cycas* are the largest in the plant kingdom reaching a size of 300 mm. Egg of *Cycas* and its nucleus are also the largest in the plant kingdom.

130. (a) Seed habit originated in Cycadophiles or pteridosperms.

131. (c) Sunken stomata is the characteristic feature of xerophytes which help in reducing loss of water from leaf surface. These type of stomata are found in *Oleander* or *pine*.

132. (c) *Pinus* is a member of gymnosperm in which ovules are not enclosed in the ovary *i.e.* naked seed, whereas mango is a typical angiosperm whose ovules are enclosed in ovary *i.e.*, presence of fruit.

133. (c) Turpentine is extracted from the wood (xylem) of *Pinus* (Gymnosperm).
Turpentine is a fluid obtained by the complex distillation of resin obtained from trees, mainly various species of pine (*Pinus*). It is composed of terpenes, mainly the monoterpenes, alpha-pinene and beta-pinene.

NOTES

Turpentine oil is obtained by boiling resin at 155 degrees Celsius in large tubs. It has a potent odour that is similar to that of nail polish remover.

134. (d) As one moves from thallophyta → Bryophyta → Pteriodophyta → Gymnosperm → Angiosperms, there is reduction in the gametophyte and elaboration of sporophyte.
Hence, moss has largest gametophyte. Moss → *Selaginella* → *Cycas* → Angiosperm → Reduction in Gametophyte.

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4 Animal Kingdom

Trend Analysis with Important Topics & Sub-Topics

Topic	Sub-Topics	2020		2019		2018		2017		2016	
		Qns.	LOD	Qns.	LOD	Qns.	LOD	Qns.	LOD	Qns.	LOD
Basis of Classification of Animals											
Porifera, Coelenterata, Ctenophora, Platyhelminthes, Aschehelminthes	Water Canal System							1	A		
Annelida, Arthropoda, Mollusca, Echinodermata, Hemichordata, Chordata	Characteristics	3	A/D/D	1	D	1	A	1	A	1	A
	Metamorphosis					1	A				
	Locomotory System									1	A
	Respiratory System							1	A	1	A
	Nervous System	1	D								
	Excretory System			1	D						
Cyclostomata, Chondrichythes, Osteichythes	Characteristics									1	D
	Respiratory System	1	D								
Amphibia, Reptiles, Aves, Mammalia	Characteristics									1	D
	Examples & Members							1	D		
	Homiotherms & Poikilotherms					1	D				

LOD - Level of Difficulty	E - Easy	A - Average	D - Difficult	Qns - No. of Questions

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Topic 1: Basis of Classification of Animals

1. Bilaterally symmetrical and acoelomate animals are exemplified by *[2020]*
   (a) Platyhelminthes (b) Aschelminthes
   (c) Annelida (d) Ctenophora
2. Which of the following animals are true coelomates with bilateral symmetry ? *[2019]*
   (a) Annelids (b) Adult echinoderms
   (c) Aschelminthes (d) Platyhelminthes
3. Consider following features: *[2019]*
   (a) Organ system level of organisation
   (b) Bilateral symmetry
   (c) True coelomates with segmentation of body
   Select the correct option of animal groups which possess all the above characteristics.
   (a) Annelida, Arthropoda and Chordata
   (b) Annelida, Arthropoda and Mollusca
   (c) Arthropoda, Mollusca and Chordata
   (d) Annelida, Mollusca and Chordata
4. Which of the following characteristics is mainly responsible for diversification of insects on land? *[2015 RS]*
   (a) Bilateral symmetry (b) Exoskeleton
   (c) Eyes (d) Segmentation
5. Metagenesis refers to: *[2015 RS]*
   (a) Alteration of generation between asexual and sexual phases of an organisms
   (b) Occurrence of a drastic change in form during post-embroyonic development
   (c) Presence of a segmented body and parthenogenetic mode of reproduction
   (d) Presence of different morphic forms

6. Which one of the following have the highest number of species in nature? *[2011]*
(a) Fungi (b) Insects
(c) Birds (d) Angiosperms

7. Radial symmetry is usually associated with
(a) aquatic mode of life *[1996]*
(b) lower grade of organisation
(c) creeping mode of locomotion
(d) sedentary mode of life

8. True coelom is the space lying between the alimentary canal and body wall enclosed by the layers of *[1996]*
(a) ectoderm on both sides
(b) endoderm on one side and ectoderm on the other
(c) mesoderm on one side and ectoderm on the other
(d) mesoderm on both sides

9. The organisms attached to the substratum, generally, possess *[1995]*
(a) radial symmetry
(b) one single opening of digestive canal
(c) asymmetrical body
(d) cilia on surface to create water current

10. Radial symmetry is often exhibited by animals having *[1994]*
(a) one opening of alimentary canal
(b) aquatic mode of living
(c) benthos/sedentary living
(d) ciliary mode of feeding

11. Coelom derived from blastocoel is known as
(a) enterocoelom (b) schizocoel *[1994]*
(c) pseudocoelom (d) haemocoelom

12. Metamorphosis of insects is regulated through hormone *[1991]*
(a) pheromone (b) thyroxine
(c) ecdysone (d) all the above

13. Ecdysis is shedding of *[1990]*
(a) stratum corneum (b) epidermis
(c) dermis (d) stratum Malpighi

Topic 2: Porifera, Coelenterate, Ctenophora, Platyhelminthes, Aschelminthes

14. In case of poriferans, the spongocoel is lined with flagellated cells called: *[2017]*
(a) oscula (b) choanocytes
(c) mesenchymal cells (d) ostia

15. Body having meshwork of cell, internal cavities lined with food filtering flagellated cells and indirect development are the characteristics of phylum. *[2015 RS]*
(a) Porifera (b) Mollusca
(c) Protozoa (d) Coelenterate

16. Select the Taxon mentioned that represents both marine and fresh water species: *[2014]*
(a) Echinoderms (b) Ctenophora
(c) Cephalochordata (d) Cnidaria

17. Which one of the following living organisms completely lacks a cell wall? *[2014]*
(a) Cyanobacteria (b) Sea–fan(*Gorgonia*)
(c) *Saccharomyces* (d) Blue–green algae

18. *Planaria* possesses high capacity of: *[2014]*
(a) Metamorphosis
(b) Regeneration
(c) Alternation of generation
(d) Bioluminescence

19. Which one of the following groups of animals reproduces only by sexual means? *[NEET Kar. 2013]*
(a) Ctenophora (b) Cnidaria
(c) Porifera (d) Protozoa

20. Which one of the following kinds of animals are triploblastic? *[2010]*
(a) Flat worms (b) Sponges
(c) Ctenophores (d) Corals

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21. Which one of the following groups of animals is bilaterally symmetrical and triploblastic? *[2009]*
(a) Aschelminthes (round worms)
(b) Ctenophores
(c) Sponges
(d) Coelenterates (Cnidarians)

22. Ascaris is characterized by *[2008]*
(a) absence of true coelom but presence of metamerism
(b) presence of neither true coelom nor metamerism
(c) presence of true coelom but absence of metamerism
(d) presence of true coelom and metamerism (metamerisation)

23. From the following statements select the wrong one. *[2005]*
(a) Prawn has two pairs of antennae
(b) Nematocysts are characteristic of the Pylum Cnidaria
(c) Millepedes have two pairs of appendages in each segment of the body
(d) Animals belonging to Phylum Porifera are exclusively marine

24. In contrast to Annelids the Platyhelminths show: ***[2005]***
    (a) Absence of body cavity
    (b) Bilaterial symmetry
    (c) Radial symmetry
    (d) Presence of pseudocoel
25. During its life-cycle, *Fasciola hepatica* (liver fluke) infects its intermediate host and primary host at the following larval stages respectively:
    (a) miracidium and metacercaria ***[2003]***
    (b) redia and miracidium
    (c) cercaria and redia
    (d) metacercaria and cercaria
26. *Sycon* belongs to a group of animals, which are best described as ***[2003]***
    (a) multicellular having tissue organization, but no body cavity
    (b) unicellular or acellular
    (c) multicellular without any tissue organization
    (d) multicellular with a gastrovascular system
27. What is common between *Ascaris lumbricoides* and *Anopheles stephensi*? ***[2000]***
    (a) Sexual dimorphism
    (b) Hibernation
    (c) Anaerobic respiration
    (d) Metamerism
28. Most appropriate term to describe the life cycle of *Obelia* is ***[1998]***
    (a) metagenesis
    (b) metamorphosis
    (c) alternation of generations
    (d) neoteny
29. What is true about all sponges without exception?
    (a) They are all marine ***[1996]***
    (b) They have flagellated collar cells
    (c) They have a mixed skeleton consisting of spicules and spongin fibres
    (d) They reproduce only asexually by budding
30. Special character of Coelenterates is ***[1994]***
    (a) polymorphism (b) nematocysts
    (c) flame cells (d) hermaphroditism
31. Which one belongs to Platyhelminthes? ***[1994]***
    (a) *Schistosoma* (b) *Trypanosoma*
    (c) *Plasmodium* (d) *Wuchereria*
32. Budding is a normal mode of asexual reproduction in ***[1993]***
    (a) starfish and Hydra
    (b) hydra and sponges
    (c) tapeworm and Hydra
    (d) sponge and starfish
33. What is true about *Taenia saginata*? ***[1993]***
    (a) Life history has pig as intermediate host
    (b) There are two large suckers on scolex
    (c) Rostellar hooks are absent
    (d) Rostellum has double circle of hooks
34. The simplest type of canal system in Porifera is ***[1992]***
    (a) ascon type (b) leucon type
    (c) sycon type (d) radial type
35. What is correct about *Taenia* ? ***[1992]***
    (a) Male organs occur in posterior proglottides
    (b) Male organs occur in anterior proglottides
    (c) Female organs occur in anterior proglottides
    (d) Mature proglottides contain both male and female organs
36. *Ascaris* larva is called ***[1992]***
    (a) cysticercus (b) rhabditiform
    (c) hexacanth (d) onchosphere
37. Bladderworm/cysticercus is the larval stage of ***[1991]***
    (a) Tapeworm (b) Roundworm
    (c) Pinworm (d) Liver Fluke
38. The excretory structures of flatworms/*Taenia* are
    (a) flame cells ***[1991]***
    (b) protonephridia
    (c) malpighian tubules
    (d) green glands
39. Classification of Porifera is based on ***[1991]***
    (a) branching (b) spicules
    (c) reproduction (d) symmetry
40. *Ascaris lumbricoides* infection occurs through
    (a) sole of uncovered feet ***[1991]***
    (b) contaminated cooked measly pork
    (c) improperly cooked measly pork
    (d) from air through inhalation
41. Onchosphere occurs in ***[1990]***
    (a) *Ascaris* (b) *Fasciola*
    (c) *Taenia* (d) *Planaria*
42. *Taenia saginata* differs from *Taenia solium* in
    (a) absence of scolex hooks ***[1990]***
    (b) absence of scolex hooks and uterine branching
    (c) absence of scolex hooks and presence of both male and female reproductive organs
    (d) presence of scolex hooks

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43. Transfer of *Taenia* to secondary host occurs as *[1989]*
(a) onchosphere (b) cysticercus
(c) morula (d) egg.

44. Animals/organisms floating on the surface of water are *[1988]*
(a) plankton (b) pelagic
(c) benthos (d) neritic

45. Organ Pipe Coral is *[1988]*
(a) *Tubipora* (b) *Astraea*
(c) *Helipora* (d) *Fungia*

Topic 3: Annelida, Arthropoda, Mollusca, Echinodermata, Hemichordata, Chordata

46. Match the following columns and select the correct option. *[2020]*

	Column-I		Column-II
(a)	Gregarious, polyphagous pest	(i)	*Asterias*
(b)	Adult with radial symmetry and larva with bilateral symmetry	(ii)	*Scorpion*
(c)	Book lungs	(iii)	*Ctenoplana*
(d)	Bioluminescence	(iv)	*Locusta*

	(A)	(B)	(C)	(D)
(a)	(iv)	(i)	(ii)	(iii)
(b)	(iii)	(ii)	(i)	(iv)
(c)	(ii)	(i)	(iii)	(iv)
(d)	(i)	(iii)	(ii)	(iv)

47. Which of the following statements are true for the phylum-Chordata? *[2020]*
(i) In Urochordata notochord extends from head to tail and it is present throughout their life.
(ii) In Vertebrata notochord is present during the embryonic period only.
(iii) Central nervous system is dorsal and hollow.
(iv) Chordata is divided into 3 subphyla: Hemichordata, Tunicata and Cephalochordata.
(a) (iii) and (i) (b) (i) and (ii)
(c) (ii) and (iii) (d) (i) and (iii)

48. Match the following columns and select the correct option. *[2020]*

	Column-I		Column-II
(a)	6-15 pairs of	(i)	*Trygon gill slits*
(b)	Heterocercal caudal fin	(ii)	Cyclostomes
(c)	Air Bladder	(iii)	Chondrichthyes
(d)	Poison sting	(iv)	Osteichthyes

	(A)	(B)	(C)	(D)
(a)	(iii)	(iv)	(i)	(ii)
(b)	(iv)	(ii)	(iii)	(i)
(c)	(i)	(iv)	(iii)	(ii)
(d)	(ii)	(iii)	(iv)	(i)

49. Match the following genera with their respective phylum : *[2019, Odisa]*

	Column-I		Column-II
(A)	*Ophiura*	(i)	Mollusca
(B)	*Physalia*	(ii)	Platyhelminthes
(C)	*Pinctada*	(iii)	Echinodermata
(D)	*Planaria*	(iv)	Coelenterata

Select the correct option :
(a) (A)-(iii), (B)-(iv), (C)-(ii), (D)-(i)
(b) (A)-(iv), (B)-(i), (C)-(iii), (D)-(ii)
(c) (A)-(iii), (B)-(iv), (C)-(i), (D)-(ii)
(d) (A)-(i), (B)-(iii), (C)-(iv), (D)-(ii)

50. Match the following organisms with their respective characteristics: *[2019]*
(A) *Pila* (i) Flame cells
(B) *Bombyx* (ii) Comb plates
(C) *Pleurobrachia* (iii) Radula
(D) *Taenia* (iv) Malpighian tubules

Select the correct option from the following:

	(A)	(B)	(C)	(D)
(a)	(iii)	(ii)	(i)	(iv)
(b)	(iii)	(iv)	(ii)	(i)
(c)	(ii)	(iv)	(iii)	(i)
(d)	(iii)	(ii)	(iv)	(i)

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51. Which of the following animals does not undergo metamorphosis? *[2018]*
(a) Earthworm (b) Tunicate
(c) Starfish (d) Moth

52. An important characteristic that Hemichordates share with Chordates is : *[2017]*
(a) Ventral tubular nerve cord
(b) Pharynx with gill slits
(c) Pharynx without gill slits
(d) Absence of notochord

53. Which of the following featrues is not present in the Phylum - Arthropoda ? *[2016]*
(a) Chitinous exoskeleton
(b) Metameric segmentation
(c) Parapodia
(d) Jointed appendages

54. Which group of animals belong to the same phylum? *[NEET 2013]*
(a) Earthworm , Pinworm, Tapeworm
(b) Prawn, Scorpion, Locusta
(c) Sponge, Sea anemone, Starfish
(d) Malarial parasite, *Amoeba*, Mosquito

55. One of the representatives of phylum Arthropoda is : *[NEET 2013]*
(a) Silverfish (b) Pufferfish
(c) Flying fish (d) Cuttlefish

56. In which one of the following the genus name, its two charcters and its phylum are not correctly matched, whereas the remaining three are correct *[2012]*

	Genus name	Two characters	Phylum
(a)	*Pila*	(a) Body Segmented Mouth with radula	Mollusca
(b)	*Asterias*	(b) Spiny Skinned Water vascular system	Echinoermata
(c)	*Sycon*	(c) Pore bearing Canal system	Porifera
(d)	*Periplaneta*	(d) Jointed appendages Chitinous exoskeleton	Arthropoda

57. Which one of the following statements is totally wrong about the occurrence of notochord, while the other three are correct? *[2011M]*
(a) It is present only in larval tail in Ascidians
(b) It is replaced by a vertebral column in adult frog
(c) It is absent throughout life in humans from the very beginning
(d) It is present throughout life in *Amphioxus*

58. The figure shows four animals (A), (B), (C) and (D). Select the correct answer with respect to a common characteristics of two of these animals. *[2011M]*

(A) (B)

(C) (D)

(a) (A) and (D) respire mainly through body wall
(b) (B) and (C) show radial symmetry
(c) (A) and (B) have cnidoblasts for self-defense
(d) (C) and (D) have a true coelom

59. One example of animals having a single opening to the outside that serves both as mouth as well as anus is: *[2010]*
(a) *Octopus* (b) *Asterias*
(c) *Ascidia* (d) *Fasciola*

60. Which one of the following statements about certain given animals is correct? *[2010]*
(a) Round worms (Aschelminthes) are pseudocoelomates
(b) Molluscs are acoelomates
(c) Insects are pseudocoelomates
(d) Flat worms (Platyhelminthes) are coelomates

61. Which one of the following is NOT a characteristic of phylum Annelida? *[2008]*
(a) Closed circulatory system
(b) Segmentation
(c) Pseudocoelom
(d) Ventral nerve cord

62. Which one of the following phyla is correctly matched with its two general characteristics? *[2008]*
(a) Arthropoda - Body divided into head, thorax and abdomen and respiration by tracheae
(b) Chordata - Notochord at some stage and separate anal and urinary openings to the outside
(c) Echinodermata - Pentamerous radial symmetry and mostly internal fertilization
(d) Mollusca - Normally oviparous and development through a trochophore or veliger larva

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63. Which one of the following groups of three animals each is correctly matched with their one characteristic morphological feature? *[2008]*

	Animals		Morphological feature
(a)	Liver fluke, Sea anemone, Sea cucumber	-	Bilateral symmetry
(b)	Centipede, Prawn Sea urchin	-	Jointed appendages
(c)	Scorpion, Spider, Cockroach	-	Ventral solid central nervous system
(d)	Cockroach, Locust, Taenia	-	Metameric segmentation

64. What is true about *Nereis*, scorpion, cockroach and silver fish ? *[2007]*
(a) They all posses dorsal heart
(b) None of them is aquatic
(c) They all belong to the same phylum
(d) They all have jointed paired appendages

65. Two common characters found in centipede, cockroach and crab are *[2006]*
(a) Jointed legs and chitinous exoskeleton
(b) Green gland and tracheae
(c) Book lungs and antennae
(d) Compound eyes and anal cerci

66. Biradial symmetry and lack of cnidoblasts are the characteristics of *[2006]*
(a) *Ctenoplana* and *Beroe*
(b) *Aurelia* and *Paramecium*
(c) *Hydra* and *starfish*
(d) Starfish and sea anemone

67. Metameric segmentation is the characteristic of
(a) Echinodermata and Annelida *[2006]*
(b) Annelida and Arthropoda
(c) Mollusca and Chordata
(d) Platyhelminthes and Arthropoda

68. Which one of the following is a matching set of a phylum and its three examples? *[2006]*
(a) Platyhelminthes - *Planaria, Schistosoma, Enterobius*
(b) Mollusca - *Loligo, Teredo, Octopus*
(c) Porifera - *Spongilla, Euplectella, Pennatula*
(d) Cnidaria - *Bonellia, Physalia, Aurelia*

69. The animals with bilateral symmetry in young stage, and radial pentamerous symmetry in the adult stage, belong to the phylum *[2004]*
(a) Annelida (b) Mollusca
(c) Cnidaria (d) Echinodermata

70. In Arthropoda, head and thorax are often fused to form cephalothorax, but in which one of the following classes, is the body divided into head, thorax and abdomen ? *[2004]*
(a) Insecta
(b) Myriapoda
(c) Crustacea
(d) Arachnida and Crustacea

71. Which one of the following is a matching pair of an animal and a certain phenomenon it exhibits?
(a) *Taenia* – Polymorphism *[2003]*
(b) *Pheretima* – Sexual dimorphism
(c) *Musca* – Complete metamorphosis
(d) *Chameleon* – Mimicry

72. In which of the following notochord is present in embryonic stage? *[2002]*
(a) All chordates (b) Some chordates
(c) Vertebrates (d) Non chordates

73. In which of the following animal post anal tail is found? *[2001]*
(a) Earthworm (b) Lower invertebrate
(c) Scorpion (d) Cobra

74. In which of the following, haemocyanin pigment is found ? *[2001]*
(a) Mollusca (b) Annelida
(c) Echinodermata (d) Lower chordata

75. Cell-tissue-body organisation is characteristic of *[2000]*
(a) Star fish (b) *Hydra*
(c) Liver fluke (d) Sponge

76. What is common among silverfish, scorpion, crab and honey bee? *[1997]*
(a) Compound eyes (b) Poison gland
(c) Jointed legs (d) Metamorphosis

77. Besides annelida and arthropoda, the metamerism is exhibited by *[1995]*
(a) cestoda (b) chordata
(c) mollusca (d) acanthocephala

78. Point out the non-parasite *[1994]*
(a) Tapeworm (b) Mosquito
(c) Leech (d) Sea anemone

79. Tube feet occur in *[1994]*
(a) Cockroach (b) Star Fish
(c) Cuttle Fish (d) Cat Fish

80. All chordates possess *[1994]*
(a) exoskeleton
(b) limbs
(c) skull
(d) axial skeletal rod of notochord

81. A common characteristic of all vertebrates is
(a) presence of skull *[1994]*
(b) division of body into head, neck, trunk and tail
(c) presence of two pairs of functional appendages
(d) body is covered with an exoskeleton

82. Which one assists in locomotion? *[1993]*
(a) Trichocysts in *Paramecium*
(b) Pedicellariae of Star Fish
(c) Clitellum in *Pheretima*
(d) Posterior sucker in *Hirudinaria*

83. Adult *Culex* and *Anopheles* can be distinguished with the help of *[1992]*
(a) mouth parts/colour (b) sitting posture
(c) antennae/wings (d) feeding habits

84. Eye of the molluscan group that resembles vertebrate eye is *[1992]*
(a) bivalvia (b) gastropoda
(c) pelecypoda (d) cephalopoda

85. Star fish belongs to *[1992]*
(a) Asteriodea (b) Ophiuroidea
(c) Holothuroidea (d) Crinoidea

86. Aristotle's lantern occurs in class *[1992]*
(a) Echinoidea (b) Asteroidea
(c) Holothuroidea (d) Ophiuroidea

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87. An insect regarded as greatest mechanical carrier of diseases is *[1991]*
(a) *Pediculus* (b) *Cimex*
(c) *Musca* (d) *Xenopsylla*

88. Which one occurs in *Echinodermata*? *[1991]*
(a) Bilateral symmetry
(b) Radical symmetry
(c) Porous body
(d) Soft skin

89. *Pheretima posthuma* is highly useful as *[1990]*
(a) their burrows make the soil loose
(b) they make the soil porous, leave their castings and take organic debris in the soil
(c) they are used as fish meal
(d) they kill the birds due to biomagnification of chlorinated hydrocarbons

90. Blood of *Pheretima* is *[1990]*
(a) blue with haemocyanin in corpuscles
(b) blue with haemocyanin in plasma
(c) red with haemoglobin in corpuscles
(d) red with haemoglobin in plasma

91. Malpighian tubules are *[1990]*
(a) excretory organs of insects
(b) excretory organs of annelids
(c) respiratory organs of insects
(d) respiratory organs of annelids

92. Kala-azar and Oriental Sore are spread by
(a) Housefly (b) Bed Bug *[1990]*
(c) Sand Fly (d) Fruit Fly

93. Photoreceptors of earthworm occur on *[1989]*
(a) clitellum (b) many eyes
(c) dorsal surface (d) lateral sides

94. Earthworms are *[1989]*
(a) useful
(b) harmful
(c) more useful than harmful
(d) more harmful

95. A chordate character is *[1989]*
(a) gills
(b) spiracles
(c) postanal tail
(d) chitinous exoskeleton

96. Silk thread is obtained from Silk Moth during
(a) pupal state (b) larval state *[1988]*
(c) nymph state (d) adult state

97. A wood boring mollusc/Shipworm is *[1988]*
(a) *Chiton* (b) *Teredo*
(c) *Limax* (d) *Patella*

Topic 4: Cyclostomata, Chondrichthyes, Osteichthyes

98. A jawless fish, which lays eggs in fresh water and whose ammocoetes larvae after metamorphosis return to the ocean is: *[2015 RS]*
(a) *Myxine* (b) *Neomyxine*
(c) *Petromyzon* (d) *Eptatretus*

99. A marine cartilaginous fish that can produce electric current is: *[2014]*
(a) *Pristis* (b) *Torpedo*
(c) *Trygon* (d) *Scoliodon*

100. Which of the following are correctly matched with respect to their taxonomic classification? *[NEET 2013]*
(a) Centipede, millipede, spider, scorpion-Insecta
(b) House fly, butterfly, tse tse fly, silverfish-Insecta
(c) Spiny anteater, sea urchin, sea cucumber-Echinodermata
(d) Flying fish, cuttlefish, silverfish-Pisces

101. Which one of the following animals is correctly matched with its one characteristics and the taxon? *[NEET Kar. 2013]*

	Animal	Characteristic	Taxon
(a)	Duckbilled platypus	Oviparous	Mammalian
(b)	Millipede	Ventral nerve cord	Arachnida
(c)	Sea Anemone	Triploblastic	Cnidaria
(d)	Silverfish	Pectoral and Pelvic fins	Chordata

102. Sharks and dogfishes differ from skates and rays by *[NEET Kar. 2013]*
(a) Their pectoral fins distinctly marked off from cyclindrical bodies
(b) Gill slits are ventrally placed
(c) Head and trunk are widened considerably
(d) Distinct demarcation between body and tail

103. Which one of the following pairs of animals are similar to each other pertaining to the feature stated against them? *[2012M]*
(a) Pteropus and Ornithorhyncus - Viviparity
(b) Garden lizard and Crocodile - Three chambered heart
(c) Ascaris and Ancylostoma - Metameric segmentation
(d) Sea horse and Flying fish - Cold blooded (poikilothermal)

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104. Which one of the following pairs of animals comprises 'jawless fishes'? *[2009]*
(a) Mackerals and Rohu
(b) Lampreys and hag fishes
(c) Guppies and hag fishes
(d) Lampreys and eels

105. Which one of the following is a matching pair of a body feature and the animal possessing it? *[2007]*
(a) Ventral central nervous system - Leech
(b) Pharyngeal gill slits absent in embryo - Chameleon
(c) Ventral heart - Scorpion
(d) Post-end tail - Octopus.

106. Given below are four matchings of an animal and its kind of respiratory organ : *[2003]*
(a) Silver fish – trachea
(b) Scorpion – book lung
(c) Sea squirt – pharyngeal gills
(d) Dolphin – skin
The correct matchings are
(a) C and D (b) A and D
(c) A, B and C (d) B and D

107. Fish which can be used in biological control of mosquitoes/Larvicidal fish is *[2001]*
(a) *Eel* (b) *Carp*
(c) Cat Fish (d) *Gambusia*

108. Blastopore is the opening of *[2000]*
(a) coelenteron (b) coelom
(c) blastocoel (d) archenteron

109. In desert grasslands which type of animals are relatively more abundant? *[1998]*
(a) Arboreal (b) Aquatic
(c) Fussorial (d) Diurnal

110. Closed circulatory system occurs in *[1994]*
(a) snail (b) cockroach
(c) cuttle Fish (d) all of these

111. Jelly Fishes belongs to class *[1989]*
(a) Hydrozoa (b) Scyphozoa
(c) Anthozoa (d) None of these

112. Association between Sucker Fish (*Remora*) and Shark is *[1988]*
(a) Commensalism (b) Symbiosis
(c) Predation (d) Parasitism

Topic 5: Amphibia, Reptiles, Aves, Mammals

113. If the head of cockroach is removed, it may live for few days because *[2020]*
(a) the cockroach does not have nervous system.
(b) the head holds a small proportion of a nervous system while the rest is situated along the ventral part of its body.
(c) the head holds a $1/3^{rd}$ of a nervous system while the rest is situated along the dorsal part of its body.
(d) the supra-oesophageal ganglia of the cockroach are situated in ventral part of abdomen.

114. Which among these is the correct combination of aquatic mammals? *[2017]*
(a) Dolphins, Seals, Trygon
(b) Whales, Dolphins, Seals
(c) Trygon, Whales, Seals
(d) Seals, Dolphins, Sharks

115. Which of the following characteristic features always holds true for the corresponding group of animals? *[2016]*
(a) Cartilaginous endoskeleton — Chondrichthyes
(b) Viviparous — Mammalia
(c) Possess a mouth with an upper and a lower jaw — Chordata
(d) 3 - chambered heart with one incompletely divided ventricle — Reptilia

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116. Which one of the following characteristics is not shared by birds and mammals? *[2016]*
(a) Ossified endoskeleton
(b) Breathing using lungs
(c) Viviparity
(d) Warm blooded nature

117. Which of the following animals is not viviparous? *[2015 RS]*
(a) Elephant (b) Platypus
(c) Whale (d) Flying fox (Bat)

118. Which of the following represents the correct combination without any exception? *[2015 RS]*

	Characteristics	Class
(a)	Mouth ventral, gills without operculum; skin with placoid scales; persistent notochord	Chondrichthyes
(b)	Sucking and circular mouth; jaws absent, integument without scales; paired appendages	Cyclostomata
(c)	Body covered with feathers; skin moist and glandular; fore-limbs form wings; lungs with air sacs	Aves
(d)	Mammary gland; hair on body; pinnae; two pairs of Limbs	Mammalia

119. Match the name of the animal (column I), with one characteristics (column II), and the phylum/class (column III) to which it belongs: ***[NEET 2013]***

	Column I	Column II	Column III
(a)	*Ichthyophis*	terrestrial	Reptilia
(b)	*Limulus*	body covered by chitinous exoskeleton	Pisces
(c)	*Adamsia*	radially symmetrical	Porifera
(d)	*Petromyzon*	ectoparasite	Cyclostomata

120. The characteristics of class Reptilia are: ***[NEET Kar. 2013]***
(a) Body covered with dry and cornified skin, scales over the body are epidermal, they do not have external ears
(b) Body covered with moist skin which is devoid of scales, the ear is represented by a tympanum, alimentary canal, urinary and reproductive tracts open into a common cloaca
(c) Fresh water animals with bony endoskeleton, air-bladder to regulate buoyancy
(d) Marine animals with cartilaginous endoskeleton, body covered with placoid scales

121. Which one of the following categories of animals, is correctly described with no single exception in it? ***[2012M]***
(a) All sponges are marine and have collared cells.
(b) All mammals are viviparous and possess diaphragm for breathing.
(c) All bony fishes have four pairs of gills and an operculum on each side.
(d) All reptiles possess scales, have a three chambered heart and are cold blooded (poikilothermal).

122. What will you look for to identify the sex of the following? ***[2011]***
(a) Female *Ascaris*- Sharply curved posterior end
(b) Male frog- A copulatory pad on the first digit of the hind limb
(c) Female cockroach-Anal cerci
(d) Male shark-Claspers borne on pelvic fins

123. Which one of the following groups of animals is correctly matched with its one characteristic feature without even a single exception? ***[2011]***
(a) Reptilia : possess 3 - chambered heart with one incompletely divided ventricle
(b) Chordata : possess a mouth provided with an upper and lower jaw
(c) Chondrichthyes : possess cartilagious endoskeleton
(d) Mammalia : give birth to young one.

124. In which one of the folllowing, the genus name, its two characters and its class/phylum are correctly matched? ***[2011]***

	Genus name		Two characters	Class/ phylum
(a)	*Ascaris*	(i)	Body segmented	Annelida
		(ii)	Males and females distinct	
(b)	Sala-mandra	(i)	A tympanum represents ear	Amphibia
		(ii)	Fertilization is external	
(c)	*Pteropus*	(i)	Skin possesses hair	Mammalia
		(ii)	Oviparous	
(d)	*Aurelia*	(i)	Cnidoblasts	Coelen-terata
		(ii)	Organ level of organization	

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125. Frogs differ from humans in possessing: ***[2011M]***
(a) paired cerebral hemispheres
(b) hepatic portal system
(c) nucleated red blood cells
(d) thyroid as well as parathyroid

126. Which one of the following statements about all the four of *Spongilla*, *Leech*, Dolphin and Penguin is correct? ***[2010]***
(a) Penguin is homeothermic while the remaining three are poikilothermic
(b) Leech is a fresh water form while all others are marine
(c) *Spongilla* has *special* collared cells called choanocytes, not found in the remaining three
(d) All are bilaterally symmetrical

127. Which one of the following is the true description about an animal concerned? *[2008]*
(a) Earthworm - The alimentary canal consists of a sequence of pharynx, oesophagus, stomach, gizzard and intestine
(b) Frog - Body divisible into three regions - head, neck and trunk
(c) Rat - Left kidney is slightly higher in position than the right one
(d) Cockroach - 10 pairs of spiracles (2 pairs on thorax and 8 pairs on abdomen)

128. Which of the following pairs are correctly matched? *[2007]*

	Animals	**Morphological features**
(i)	Crocodile	4-chambered heart
(ii)	Sea urchin	Parapodia
(iii)	Obelia	Thecodont
(iv)	Lemur	Thecodont

(a) (ii), (iii) and (iv) (b) only (i) and (iv)
(c) only (i) and (ii) (d) (i), (iii) and (iv)

129. In which one of the following sets of animals do all the four give birth to young ones? *[2006]*
(a) Platypus, Penguin, Bat, Hippopotamus
(b) Shrew, Bat, Cat, Kiwi
(c) Kangaroo, Hedgehog, Dolphin, , Loris
(d) Lion, Bat, Whale, Ostrich

130. Annual migration does not occur in the case of *[2006]*
(a) Siberian crane (b) Salamander
(c) Arctic tern (d) Salmon

131. Which one of the following characters is not typical of the class Mammalia? *[2005]*
(a) Thecodont dentition
(b) Alveolar lungs
(c) Ten pairs of cranial nerves
(d) Seven cervical vertebrae

132. One of the following is a very unique feature of the mammalian body: *[2004]*
(a) Homeothermy
(b) Presence of diaphragm
(c) Four chambered heart
(d) Rib cage

133. Indicate the correct statement *[2000]*
(a) Camel has biconcave red blood cells
(b) Bat bears feathers
(c) Rat bears cloaca
(d) Platypus lays eggs

134. The long bones are hollow and connected by air passages these are characteristics of *[1998]*
(a) mammals (b) reptilia
(c) aves (d) all land vertebrates

135. Pneumatic bones are expected to be found in *[1996]*
(a) pigeon (b) house lizard
(c) frog's tadpole (d) flying fish

136. Functionwise, just as there are nephridia in an earthworm, so are *[1996]*
(a) parotid glands in toad
(b) statocysts in prawn
(c) flame cells in liver fluke
(d) myotomes in fish

137. The flightless bird Cassowary is found in
(a) Mauritius (b) Australia *[1996]*
(c) New Zealand (d) Indonesia

138. The cervical vertebrae in humans is *[1993]*
(a) same as in whale
(b) more than that in rabbit
(c) double than that of horse
(d) less than that in giraffe

139. What is common in Whale, Bat and Rat? *[1993]*
(a) Absence of neck
(b) Muscular diaphragm between thorax and abdomen
(c) Extra-abdominal testes to avoid high temperature of body
(d) Presence of external ears

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140. Gorilla, Chimpanzee, Monkeys and Humans belongs to the same *[1993]*
(a) species (b) genus
(c) family (d) order

141. All vertebrates possess *[1993]*
(a) renal portal system
(b) dorsal hollow central nervous system
(c) four chambered ventral heart
(d) pharyngeal gill slits

142. Mucus helps frog in forming *[1993]*
(a) thick skin (b) dry skin
(c) smooth skin (d) moist skin

143. A larval stage occurs in the life history of all members of the group *[1993]*
(a) frog, lizard and cockroach
(b) ascaris, housefly and frog
(c) housefly, earthworm and mosquito
(d) butterfly, frog and mosquito

144. Tracheae of cockroach and mammal are similar in having *[1993]*
(a) paried nature
(b) noncollapsible walls
(c) ciliated inner lining
(d) origin from head

145. Which one of the following animals possesses nerve cells but no nerves? ***[1993]***
(a) Hydra (b) Tapeworm
(c) Earthworm (d) Frog's tadpole

146. What is common between Ostrich, Penguin and Kiwi? ***[1993]***
(a) Running birds (b) Migratory birds
(c) Flightless birds (d) Four toed birds

147. An egg laying mammal is ***[1992]***
(a) Kangaroo (b) Platypus
(c) Koala (d) Whale

148. Sound box of birds is called ***[1992]***
(a) pygostyle (b) larynx
(c) syrinx (d) synsacrum

149. Bull Frog of India is ***[1992]***
(a) *Rana tigrina* (b) *R. sylvatica*
(c) *R. ecutesbeiana* (d) *R. esculenta*

150. Kidney of adult rabbit is ***[1991]***
(a) pronephros (b) metanephros
(c) mesonephros (d) opisthonephros

151. Penguin occurs in ***[1990]***
(a) Australia (b) Antarctica
(c) Africa (d) America

152. Skin is a respiratory organ in ***[1990]***
(a) lizards (b) birds
(c) primitive mammals (d) frog

153. Flight muscles of birds are attached to ***[1989]***
(a) clavicle (b) keel of sternum
(c) scapula (d) coracoid

154. Wish bone of birds is from ***[1989]***
(a) pelvic girdle
(b) skull
(c) hind limbs
(d) pectoral girdle/clavicles

155. Eutherians are characterised by ***[1989]***
(a) hairy skin (b) true placentation
(c) ovoviviparity (d) glandular skin

156. Which is not a true amphibian animal? ***[1988]***
(a) Salamander (b) Toad
(c) Tortoise (d) Frog

157. Fire bellied toad is ***[1988]***
(a) *Amphiuma* (b) *Discoglossus*
(c) *Necturus* (d) *Salamandra*

158. *Necturus* is ***[1988]***
(a) Hell Bender (b) Congo Eel
(c) Mud Puppy (d) Blind Worm

159. *Typhlops* is ***[1988]***
(a) Sea Snake (b) Glass Snake
(c) Blind Snake (d) Grass Snake

160. Both male and female pigeons secrete milk through ***[1988]***
(a) Salivary glands
(b) Modified sweat glands
(c) Crop
(d) Gizzard

161. Feet of kingfisher are modified for ***[1988]***
(a) wading (b) perching
(c) running (d) catching

162. Bird vertebrae are ***[1988]***
(a) acoelous (b) heterocoelous
(c) amphicoelous (d) procoelous

163. Hair occur in all mammals except those of ***[1988]***
(a) Rodentia (b) Chiroptera
(c) Primata (d) Cetacea

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ANSWER KEY

1	(a)	18	(b)	35	(d)	52	(b)	69	(d)	86	(a)	103	(d)	120	(a)	137	(b)	154	(d)
2	(a)	19	(a)	36	(b)	53	(c)	70	(a)	87	(c)	104	(b)	121	(a)	138	(a)	155	(b)
3	(a)	20	(a)	37	(a)	54	(b)	71	(c)	88	(b)	105	(a)	122	(d)	139	(b)	156	(c)
4	(b)	21	(a)	38	(a)	55	(a)	72	(a)	89	(b)	106	(c)	123	(c)	140	(d)	157	(b)
5	(a)	22	(b)	39	(b)	56	(a)	73	(d)	90	(d)	107	(d)	124	(c)	141	(b)	158	(c)
6	(b)	23	(d)	40	(b)	57	(c)	74	(a)	91	(a)	108	(d)	125	(c)	142	(d)	159	(c)
7	(d)	24	(a)	41	(c)	58	(d)	75	(b)	92	(c)	109	(c)	126	(c)	143	(d)	160	(c)
8	(d)	25	(b)	42	(b)	59	(d)	76	(c)	93	(c)	110	(c)	127	(d)	144	(b)	161	(a)
9	(a)	26	(c)	43	(a)	60	(a)	77	(b)	94	(a)	111	(b)	128	(b)	145	(a)	162	(b)
10	(c)	27	(a)	44	(a)	61	(c)	78	(d)	95	(c)	112	(a)	129	(c)	146	(c)	163	(d)
11	(c)	28	(a)	45	(a)	62	(d)	79	(b)	96	(a)	113	(b)	130	(b)	147	(b)		
12	(c)	29	(b)	46	(a)	63	(c)	80	(d)	97	(b)	114	(b)	131	(c)	148	(c)		
13	(a)	30	(b)	47	(c)	64	(a)	81	(a)	98	(c)	115	(a)	132	(b)	149	(a)		
14	(b)	31	(a)	48	(d)	65	(a)	82	(d)	99	(b)	116	(c)	133	(d)	150	(b)		
15	(a)	32	(b)	49	(c)	66	(a)	83	(b)	100	(b)	117	(b)	134	(c)	151	(b)		
16	(b)	33	(c)	50	(b)	67	(b)	84	(d)	101	(a)	118	(a)	135	(a)	152	(d)		
17	(b)	34	(a)	51	(a)	68	(b)	85	(a)	102	(a)	119	(d)	136	(c)	153	(b)		

Hints & Solutions

1. (a) Platyhelminthes are bilaterally symmetrical, triploblastic and acoelomate animals with organ level of organisation.

NOTES

The body plane of most animals, including humans, exhibit mirror symmetry, also called bilateral symmetry. A body that is bilaterally symmetrical is easier for the brain to recognize while in different orientations and positions, thus making visual perception easier.

2. (a) Annelids exhibit bilateral symmetry with metameric segmentation where external segments correspond to internal segments.
Adult echinoderms are bilaterally symmetrical.
Aschelminthes are pseudocoelomates and platyhelminthes are acoelomates.

3. (a) Organ system of organisation, bilateral symmetry and true coelomates with segmented body are found in annelid, arthropoda and chordates.
In mollusca , the body is unsegmented.

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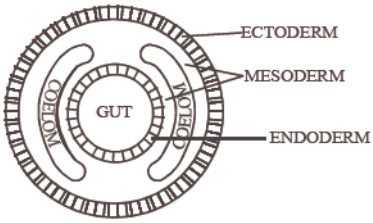
4. (b) The exoskeleton of insects consists of chitinous cuticle. It gets hardened due to deposition of calcium. It prevents dessication and gives protection.

5. (a) Metagenesis is defined as alternation of generation found in phylum cnidaria (eg. Obelia). In this phenomenon one generation of an organism reproduces asexually, followed by a sexually reproducing generation.

6. (b) In nature insects have the highest number of species (30 million). Fungi have 100,000, angiosperms have 260000 and birds have 10,000 species.

7. (d) Radial Symmetry is usually associated with sedentary mode of life (e.g. cnidarians). It permits an animal to detect food or danger approaching from any side. In radial symmetry body is in the form of flat or tall cylinder and can be divided into similar halves by more than two planes passing through one main axis. It is found in some sponges, hydras, jellyfish, sea urchin, etc.

8. (d) Coelom is a fluid filled space between body wall and alimentary canal which is lined by parietal peritoneum (mesoderm) on the outer side and visceral peritoneum (mesoderm) on the inner side.



9. (a) The organisms, which are attached to substratum, generally, possess radial symmetry in all vertical planes.

10. (c) In radial symmetry – body is cut longitudinally through any radius into two equal halves. Present in sessile animals *i.e.* star fish that live in the sea bottom.

11. (c) Coelom or body cavity, when derived from blastocoel is pseudocoelom as in nematodes, rotifers. In this type of cavity, mesoderm is lined by only one side *i.e.*, towards the body wall. Schizocoel is true coelom derived from mesodermal segments.

12. (c) Metamorphosis of insects is regulated through ecdysone hormone.

NOTES

Ecdysone is a steroidal prohormone of the major insect molting hormone 20-hydroxyecdysone, which is secreted from the prothoracic glands. Insect molting hormones (ecdysone and its homologues) are generally called ecdysteroids.

13. (a) Stratum corneum is the outermost, partially cornified layer of scale like cells. Small fragments of this layer are periodically shed off from the body known as ecdysis. The new layer is regularly formed by underlaying stratum germinativum.

14. (b) In poriferans (sponges) choanocytes (collar cells) form lining of spongocoel. Flagella present in collar cells provide circulation to water in water canal system.

NOTES

By cooperatively moving their flagella, choanocytes generate a flow of water through the sponges' pores, into the spongocoel, and out through the osculum.

15. (a) The given characteristic features define the phylum porifera.
16. (b) Members of Ctenophora, Cephalochordata and Echinodermata are exclusively marine.
17. (b) *Gorgonia* (sea-fan) is an animal. All animals lack cell wall.

NOTES Gorgonia is a genus of soft corals, sea fans in the family Gorgoniidae.

18. (b) *Planaria* is a flatworm which possesses a high capacity of regeneration.
19. (a) In **Ctenophora,** sexes are not separate. Reproduction takes place only by sexual means. In **Cnidaria**, which exist in both forms, polyps produce medusae asexually and medusae form the polyps sexually. **Porifera (sponge)** reproduce asexually by fragmentation and sexually by formation of gametes. **Protozoans** come under protista which reproduce asexually and sexually by cell fusion and zygote formation.
20. (a) Triploblastic condition can be seen in flat worms. Ctenophores, sponges and corals are diploblastic.
21. (a) Aschelminthes is bilaterally symmetrical and triploblastic. These are mostly aquatic, free living or parasitic. Their body is three layered which is ectoderm, mesoderm and endoderm.
22. (b) Ascaris is a common parasite found in the large intestine of man. It is world wide in distribution. The number of worms may be 500 or more in a single host. Ascaris is characterised by presence of neither true coelom nor metamerism.
23. (d) Animals belonging to Phylum Porifera are mostly marine except a few which are found in fresh water- *e.g. Spongilla*, *Euspongia*.
24. (a) Platyhelminthes includes flat warms. There is no body cavity. The animals are therefore acoelomates. Annelids also have bilateral symmetry. They are coelomate having a perivisceral cavity divided into compartments.
25. (b) When in contact with water, the egg capsule form non feeding larva miracidium. Miracidium enters the body of snail to from sporocyst . The sporocyst develops into redia. Redia form cercaria and come out of snail. They get encysted forming metacercaria.
26. (c) Sponges show cellular grade of organization. They do not have tissue system. *Sycon* is a sponge.
27. (a) Sexual dimorphism is common between *Ascaris lumbricoides* and *Anopheles stephensi*. Male and female round worms can be morphologically differentiated. Female *Anopheles* mosquito is sanguivorous whereas male *Anopheles* mosquito sucks nectar.
28. (a) Metamorphosis is the gradual transformation of the embryo to the adult through a larval and pupal stage. Alternation of generation is seen in the plant kingdom wherein a haploid gametophyte generation alternates with diploid sporophyte generation. Phenomenon of sexual reproduction by a larva is known as neoteny *e.g.* Axolotl larva. In *Obelia* polyps reproduce medusaes asexually and medusae form the polyps sexually. Such alternation of asexual and sexual phases in the life cycle of *Obelia* is called metagenesis.
29. (b) Sponges are marine with the exception of family spongilidae, the members of which occur in fresh water *e.g.* Spongilla. Their endoskeleton is made of either spicules or spongin fibres or both. Sponges reproduce asexually by fragmentation or by budding or through gemmules and reduction bodies. Sponges also exhibit sexual reproduction.
30. (b) Presence of nematocysts or stinging cells are the characteristic feature of the phylum Coelenterata. It serves the function of offence and defence by producing toxin to kill the prey & enemy.
31. (a) *Schistosoma* (Blood fluke) – Platyhelminthes
Trypanosoma – Aschelminthes
Wuchereria – Aschelminthes
Plasmodium – Protozoa
32. (b) Budding is an asexual mode of reproduction in *Hydra* & sponges. Bud is formed as an outgrowth on the body surface, then detached to form new animal.
33. (c) Rostellum and hooks are absent in *Taenia saginata*.

NOTES A rostellum is a knob-like protrusion at the extreme anterior end of a tapeworm, as an extension of the tegument. It is globular, spiny structure when it protrudes, and a circular hollow pit when retracted. It is structurally composed of a number of concentric rows of hooks.

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34. (a) Presence of canal system - a network of channels for water transport - is an important feature in sponges. Ascon type of canal is simplest in Porifera which brings in food, oxygen and carries away CO_2 and nitrogenous waste.
35. (d) The body of *Taenia* is ribbon like and is divided into segments called proglottids. Each proglottid has one or two sets of male and female reproductive organs.
36. (b) *Ascaris* larva is also called rhabditiform.

NOTES

In the free-living cycle: Rhabditiform larvae are passed in the stool of an infected definitive host, develop into either infective filariform larvae (direct development) or free-living adult males and females that mate and produce eggs, from which rhabditiform larvae hatch and eventually become infective filariform larvae.

37. (a) Bladderworm or cysticerus larva forms in tapeworm.

NOTES

Cysticercus is a scientific name given to the young tapeworms belonging to the genus Taenia. It is a small, sac-like vesicle resembling a bladder; hence, it is also known as bladder worm. It is filled with fluid, in which the main body of the larva, called scolex, resides.

38. (a) Excretory system of *Taenia* consists of a pair of peculiar flame cells, which absorb the waste material from the body and discharges it through excretory duct.
39. (b) The term porifera was given by Grant, the phylum includes animals with pores in their body. Its classification is based on skeleton or spicules.
40. (b) *Ascaris* enters into the human by eating semi-cooked (improperly) cooked pork contaminated with *Ascaris*.
41. (c) Onchosphere is the larval stage in *Taenia solium*.
42. (b) *Taenia saginata* lacks rostellum and scolex hooks.
43. (a) The eggs of *Taenia* pass out through human faeces which is eaten by pigs, eggs and develops into onchosphere, then to cyst larva in the muscle of pig; The entry stage into secondary host (pig) is onchosphere.
44. (a) Organisms passively floating on the surface of water are planktons. Floating animals are called zooplanktons and plants are phytoplanktons.
45. (a) *Tubipora* is organ pipe coral included in class Anthozia.
46. (a) *Locusta* is a gregareous pest. In Echinoderms, adults are radially symmetrical but larvae are bilaterally symmetrical. Scorpions respire through book lungs. Bioluminescence is well marked in ctenophores.
47. (c) In vertebrata, notochord is present during embryonic period only as it is replaced by vertebral column. In chordates, central nervous system is dorsal and hollow.

NOTES

The notochord derives during gastrulation (infolding of the blastula, or early embryo) from cells that migrate anteriorly in the midline between the hypoblast and the epiblast (inner and outer layers of the blastula). These cells coalesce immediately beneath the developing central nervous system.

48. (d) Cyclostomes have an elongated body bearing 6-15 pairs of gill slits for respiration. The caudal fin is the tail fin located at the end of the caudal peduncle and is used for propulsion. See body-caudal fin locomotion. **Heterocercal** means the vertebrae extend into the upper lobe of the tail, making it longer (as in sharks). It is the opposite of hypocercal. Air bladder and poison string (for. e.g, *Trygon*) are found in Chondrichthyes as they have to swim constantly to avoid sinking.
49. (c) *Ophiura* is an echinoderm commonly known as brittle star.
Physalia is coelenterate (cnidarian) commonly known as portuguese man of war.
Pinctada is pearl oyster belonging to taxon bivalve molluscs.
Planaria belongs to platyhelminthes (flatworms).
50. (b) (a) *Pila* is a member of mollusc. The mouth contains a rasping organ for feeding called radula.
(b) *Bombyx* is an arthropod. In Bombyx excretion takes place through malpighian tubules.
(c) *Pleurobrachia* is a ctenophore. The body bears eight external rows of ciliated comb plates, which help in locomotion.
(d) *Taenia* is a platyhelminth. In it specialised cells, called flame cells are present which help in osmoregulation and excretion.

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51. (a) Metamorphosis refers to transformation of larva into adult. Animal that perform metamorphosis are said to have indirect development. Metamorphosis includes, in insects, the transformation of a maggot into an adult fly and a caterpillar into a butterfly and, in amphibians, the changing of a tadpole into a frog. In earthworm development is direct which means no larval stage are there and hence no metamorphosis.
52. (b) Pharyngeal gill slits are present in hemichordates and in chordates. Notochord is present in chordates only. Ventral tubular nerve cord is present in non-chordates.
53. (c) All arthropods possess a stiff exoskeleton (external skeleton) composed primarily of chitin. Arthropod bodies are divided into segments. Parapodia are paired, lateral appendages extending from the body segments. Arthropod appendages may be either biramous (branched) or uniramous (unbranched). They possess jointed appendages.
54. (b) Prawn , Scorpion and Locusta belong to phylum Arthropoda. This is the largest phylum of Animalia, over two-thirds of all named species on earth are Arthropoda. Phylum is named so due to presence of jointed appendages (arthros = jointed, poda = appendages) in body of members of this phylum.
55. (a) Representive of Phylum Arthropoda is silverfish. Arthropoda is the largest phylum of Animalia, which covers two-thirds of all named species.
56. (a) Molluscans are soft bodied animals. Their body is unsegmented with a distinct head, muscular foot and visceral hump. In *Pila,* the buccal cavity contains a resping organ, the radula with transverse rows of teeth.
57. (c) Notochord is a flexible rod like structure that forms the main support of the body in the lowest chordates. It is not absent in humans through out their life. Notochord is present in embryonic stage and get changed or replaced by vertebral column in the adult.
58. (d) From annelida to chordata all organisms are eucoelomate. C-Mollusca (Octopus), D-Arthropoda (Scorpion) have a true coelom.
59. (d) *Fasciola*, a flatworm has a single body cavity to the outside that serves both as mouth for ingestion and anus for egestion of undigested food. This is known as blind sac plan.
60. (a) Acoelomates are animals that have no body cavity or coelom. The examples are poriferans, coelentrates, ctenophores, platyhelminthes and nemertean. Pseudo-coelomates are animals that have false or pseudo coelom. Examples are aschelmin-thes.

NOTES

Coelomates are animals that has true coelom enclosed by mesoderm on both sides. Examples: from annelida to arthropoda are coelomates. Hence roundworms are pseudocoelomates, molluses and insects are coelomates while flatworms are acoelomates.

61. (c) Characteristic of phylum-Annelida is pseudocoelomate. Pseudocoelomate is any invertebrate animal whose body cavity is a pseudocoel, a cavity between the gut and the outer body wall derived from a persistent blastocoel, rather than a true coelom. Pseudocoelomate animal include the Rotifera and Nematoda.
62. (d) Mollusca mostly oviparous and a few viviparous. The development may be direct or indirect with trochophore, velliger and glochidium.
63. (c) Scorpion, spider and cockroach have ventral solid central nervous system. All three belongs to phylum-Arthopoda.
    — Spider belong to class-Archnida
    — Scorpion belong to c1ass- Archnida
    — Cockroach belong to class-Insecta
64. (a) *Nereis* (belonging to class polychaeta of phylum Annelida), scorpion and cockroach (belonging to phylum arthropoda) and silver fish all have dorsal heart.
65. (a) Jointed legs & chitinous exoskeleton are the common characters found in centipede, cockroach & crab.
66. (a) Aurelia, Hydra & Sea anemone have the characteristic cnidoblast cells.
67. (b) Metameric segmentation means body is divided externally as well as internally. This characteristic is present in annelida (*eg.* earth worm) and arthropoda (*eg.* cockroach). Their body is divided externally and internally as well.
68. (b) Mollusca is the second-largest phylum of invertebrate animals after the Arthropoda. The members are known as molluscs or mollusks. Around 85,000 extant species of molluscs are recognized. They are soft-bodied, bilaterally

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symmetrical, segmented, coelomate animals; usually shelled having a mantle, ventral foot, anterior head, and a dorsal visceral mass.

69. (d) Echinoderms show bilateral symmetry in their larval stage and pentamerous radial symmetry in the adult stage. Annelids are bilaterally symmetrical, coelenterates show radial symmetry. Molluscs are also bilaterally symmetrical.

70. (a) Insects show a distinct division into head, thorax and abdomen. In crustaceans and myriapods head and thorax are fused. In arachnids body is divided into prothorax, mesothorax and metathorax.

71. (c) *Obelia* exhibits polymorphism. Round worm (*Ascaris*) exhibits sexual dimorphism. *Pheretima* is a hermaphrodite and *Chameleon* shows camouflage.

NOTES *Musca* is a genus of flies. It includes *Musca domestica* (the housefly), as well as *Musca autumnalis* (the face fly or autumn housefly). It is part of the family Muscidae.

72. (a) Presence of notochord in any stage of the life cycle is a major chordate characteristic.

NOTES Notochord is a cartilaginous skeletal rod supporting the body in all embryonic and some adult chordate animals.

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73. (d) Post anal tail is present in chordates at some stage in the life.

74. (a) Haemocyanin is the pigment carrying O_2 in molluscs. Annelids have erythrocruosin.

NOTES These metalloproteins contain two copper atoms that reversibly bind a single oxygen molecule. They are second only to hemoglobin in frequency of use as an oxygen transport molecule.

75. (b) Sponges show cell aggregate body organization. Cell tissue organization appear in coelenterates. Platyhelminthes show tissue organ organizations.

NOTES Hydra is a genus of small, fresh-water organisms of the phylum Cnidaria and class Hydrozoa. They are native to the temperate and tropical regions. Biologists are especially interested in Hydra because of their regenerative ability – they do not appear to die of old age, or indeed to age at all.

76. (c) Silver fish (Insecta), scorpion (Arachnida); crab (Crustacea) and honey bee (Insecta) all belong to phylum Arthropoda which is characterized by the presence of jointed appendages. Poison gland occur only in scorpion. Compound eyes and metamorphosis are the characteristic of insects.

77. (b) Metamerism is an important character of annelida and arthropoda. The body is divided externally into segments called metameres. Metamerism is also exhibited by chordata due to repetition of a succession of homologous structures along anterio-posterior axis.

78. (d) Sea anemone (*Adamsia*) is marine animal attached to the empty shell of gastropods occupied by hermit crab. They live as symbionts, not as parasites.

Tapeworm
Leech
Mosquitoes
] are parasites

79. (b) Tube feet is the locomotory organ that occurs in star fishes.

NOTES Tube feet are small tube-like projections on the underside (oral side) of echinoderms. They are part of the water vascular system of echinoderms. Tube feet are used to move, feed and breathe. They are arranged in grooves along the arms. They operate through hydraulic pressure.

80. (d) All chordate possess :
— Notochord at some stage of life
— Dorsal tubular nervous system
— Pharyngeal gill slits at same stage of life cycle.

81. (a) Vertebrates are also known as craniata due to presence of skull in all its members.

82. (d) *Hirudinaria* (leech), does not possesses setae or parapodia for locomotion. Its posterior sucker helps in locomotion.

83. (b) The body of an adult lies more or less parallel to the surface in *Culex* where as in *Anopheles* the body lies at an angle of 45° to the surface.

84. (d) Class Cephalopoda of the phylum Mollusca has well developed eyes and resemble vertebrate eyes *e.g.*, *Octopus*, *Sepia* etc.

85. (a) Star fish belongs to the class – Asteroidea.

NOTES Starfish or sea stars are star-shaped echinoderms belonging to the class Asteroidea. Common usage frequently finds these names being also applied to ophiuroids, which are correctly referred to as brittle stars or basket stars. Starfish are also known as Asteroids due to being in the class Asteroidea.

86. (a) Jaw apparatus is called Aristotle's Lantern which is present in the Class Echinoidae of the Phylum Echinodermata.

NOTES

The highly developed jaw apparatus of the sea urchin, named after Aristotle, is the most famous and controversial among the eponymous structures of echinoderms. Jacob Klein, in his Naturalis Dispositio Echinodermatum was the first to specifically refer to it as "Aristotle's lantern" in 1734.

87. (c) *Musca* is the zoological name of house fly which is regarded as mechanical carrier of many diseases.
88. (b) Larval stage of Echinoderms have bilateral symmetry and the adults have radial symmetry, pentamerous i.e., body parts arranged in five or multiples of five.
89. (b) Earthworms are very useful to human as they make the soil porous and increase its fertility through worm casting. They are called as Nature's 'plough man'.
90. (d) In the blood of earthworm, haemoglobin is dissolved in the plasma. RBCs are absent.
91. (a) Malpighian tubules are fine, unbranched, yellow tubules that lie more or less free in the haemocoel. They open into alimentary canal. They absorb nitrogenous waste product, and thus acts as excretory organs in insects.
92. (c) Sand fly is the vector of Kala azar, causes severe liver infection.

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NOTES

Sand fly adults are small flies – only about 3 mm long – and are golden, brownish or gray colored. They have long, piercing mouthparts that are well adapted for sucking blood from their selected host. Sand flies hold their hairy-looking wings in a vertical V-shape when at rest, a characteristic that distinguishes them from some other small flies. Also, the six legs on the adults are extremely long, being longer than the insect's body.

93. (c) Light receptors are found in diffused condition to differentiate between light and dark. These receptors are present on the dorsal surface.
94. (a) Earthworms are very useful to human as they make the soil porous and increase its fertility through worm casting. They are called as Nature's 'plough man'.
95. (c) Chordates are featured by the presence of the following characters.
    - Notochord (cephalic or head region)
    - Pharyngeal gill silts
    - Postanal tail.
96. (a) Caterpillar larva is a voracious eater, it gets matured and by secreting silk thread changes into pupa which encloses into silk cocoon.
97. (b) *Teredo* (shipworm) is the member of class – Bivalvia (double shell plates).
    Shipworms are in fact not worms at all, but rather a group of marine molluscs (Eulamellibranchiata) in the family Teredinidae. They bore into submerged wood, and bacteria in a special organ called the gland of Deshayes enabling them to digest cellulose. The shipworms belong to several genera of which *Teredo* is the most commonly mentioned. The best known species is *Teredo navalis*.
98. (c) *Petrormyzon marinus*, commonly known as sea lamprey lays eggs in fresh water and its larvae, after metamorphosis, return to the ocean (saline water).
99. (b) *Torpedo* is a sluggish fish. It is carnivorous. The prey is killed due to electric shock. The shock can also be harmful for human beings.
100. (b) House fly, butterfly, tse tse fly, silverfish all belongs to insecta.
101. (a) Duckbilled platypus is oviparous and comes under phylum mammalia. Millipede belongs to the phylum arthropoda. Sea-anemone is diploblastic and belongs to phylum cnidaria. Silver-fish is an insect belonging to phylum arthropoda, having long antennae, no wings and move in a wiggling motion that resembles the movement of a fish.
102. (a) Sharks and dogfishes have cylindrical body while skates and rays have flattened body with winglike pectoral fins which are not distinct from body.
103. (d) Sea horse and flying fish are cold blooded animals. Ornithorhyncus is oviparous. Crocodile has four chambered heart. Ascaris and Ancylostoma are segmented roundworms.
104. (b) Lampreys and hagfishes are unusual, jawless fish that comprise the order Cyclostomata, so named because of the circular shape of the mouth. The brains of lampreys and hagfishes differ a lot, but they also show a large number of similarities, as do all craniate brains.
105. (a) Leech has ventral central nervous system which consists of nerve ring, and a solid, double, mid ventral nerve cord with ganglia.
106. (c) Sea squirt is *Herdmania*. Dolphin is an aquatic mammal and breathes through lungs.

107. (d) *Gambusia*

NOTES

Gambusia is a large genus of viviparous fish in the family Poeciliidae (order Cyprinodontiformes). Gambusia contains over 40 species, most of which are principally found in freshwater habitats, though some species may also be found in brackish or saltwater habitats. Mosquito fishes (Gambusia spp.), so called for their ability to eat numerous mosquito larvae, actually often eat other Diptera, especially adults fallen to the water surface.

108. (d) Coelom is a fluid filled space between body wall and alimentary canal which is lined by mesoderm on both sides. Coelenteron is the sac like body cavity in coelenterates. Blastocoel is the fluid filled cavity of blastocyst. Archenteron is the gut cavity in the gastrula enclosed by the endoderm. The open and of it is called blastopore.

109. (c) Fussorial are the animals which live beneath the soil (in low temperature) and are found abundant in desert grasslands.

110. (c) Cockroach & snail have open type of circulatory system.
Closed type of blood circulatory system occurs in cuttlefish.

NOTES

Closed circulatory systems (evolved in echinoderms and vertebrates) have the blood closed at all times within vessels of different size and wall thickness. In this type of system, blood is pumped by a heart through vessels, and does not normally fill body cavities. Blood flow is not sluggish.

111. (b) Animals which are marine, solitary, bell or umbrella shaped belong to class Scyphozoa e.g., Jelly fish.

112. (a) Commensalism is an association between two organisms in which one is benefitted but the other is not harmed.

113. (b) Cockroaches breathe passively through a network of pipes connected to holes called spiracles along the length of their body. They are independent of blood circulation to move oxygen around and their body fluids are at a much lower pressure. The sensory input from the eyes and antennae, along with many other behaviours, are transmitted and handled by their brain such as running and reacting to touch, handled by 'mini brains' called ganglia in each body segment. A decapitated cockroach will eventually starve to death but this can still take few days.

NOTES

Cockroaches also have a higher tolerance for radiation than other animals (especially compared to humans), though this would only help them survive the longer-term radioactive contamination that could follow a nuclear blast.

114. (b) Sharks and Trygon (sting ray) are the members of cartilaginous fish while Whale, Dolphin and Seals are aquatic mammals belong to class mammalia.

115. (a) Chondrichthyes always have cartilaginous endoskeleton. Most mammals are viviparous, giving birth to young. However, the five species of monotreme, the platypuses and the echidnas, lay eggs. Chordates have jawless animals (Agnatha) as well. Most reptiles have 3 chambered heart. Crocodilians have 4 chambered hearts. Turtles have 3 chambered heart but with an incomplete wall in the single ventricle, so their hearts are functionally 4 chambered.

116. (c) Giving birth to young that develop within the mother's body rather than hatching from eggs. All mammals except the monotremes are viviparous.

117. (b) *Platypus* is an oviparous (egg laying animal). It belongs to class-mammalia.

118. (a) (i) Aves possess dry skin, without glands except oil gland near the base of tail.
(ii) Pinnae are not found in aquatic animals and egg laying mammals.
(iii) In cyclostomes, unpaired appendages (joints) are found.

119. (d)

Ichthyophis	–	Amphibian
Limulus	–	Arthropoda
Adamsia	–	Cnidaria
Petramyzon	–	Jawless vertebrate & ectoparasite, cyclostomate

120. (a) In option (a), all the characteristics belong to class Reptilia. In options (b), (c) and (d) the characteristics belong to the classes Amphibia, Osteichthyes and Chondrichthyes respectively.

121. (a) All sponges are marine and have collared cells without any exception. Sponges are animals of the phylum Porifera. They are multicellular organisms which have bodies full of pores and channels allowing water to circulate through them, consisting of jelly-like mesohyl sandwiched between two thin layers of cells.

122. (d) A male shark possesses a pair of claspers which are inserted into a female shark's cloaca (an opening on the underside of the body) at

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the time of mating. Claspers are located on the inner edge of the pelvic fins near the male's cloaca. The function of claspers is to introduce sperm into a female shark's body for the purpose of fertilizing her eggs. Female sharks do not have claspers.

123. (c) Chondrichthyes are the cartilaginous fish with a flexible skeleton made of cartilage rather than bone.

124. (c) The characteristics and phylum of *Pteropus* is accurate.

> **NOTES** Pteropus is a genus of megabats which are among the largest bats in the world. They are commonly known as fruit bats or flying foxes, among other colloquial names. They live in the tropics and subtropics of Asia, Australia, East Africa, and some oceanic islands in the Indian and Pacific Oceans.

125. (c) Human possesses enucleated RBCs in mature state. But frog blood has both white and red blood cells which are nucleated. Frog cells do not lack platelets.

126. (c) *Spongilla* is a fresh water sponge that belongs to phylum porifera. It has special collared cells called choanocytes. Choanocytes are not found in leech, dolphin and penguin.

127. (d) Cockroach belongs to phylum-Arthropoda. It has 10 pairs of Spiracles (2 pairs on thorax and 8 pairs on abdomen).

128. (b) Crocodile belongs to class reptilia which has four chambered heart. Lemur teeth are embedded in the sockets of two which is known as thecodont.

129. (c) Penguin, Kiwi & Ostrich all belong to class Aves of chordata (*i.e.* birds) and they do not give birth to their young ones, they are oviparous, while Kangaroo, Hedgehog, Dolphin, Loris all belong to class mammalia and are viviparous.

130. (b) Salamander does not undergo any annual migration as it occurs in Siberian crane, Arctic tern and Salmon mainly for the search of food or for breeding.

131. (c) Mammals have 12 pairs of cranial nerves.

> **NOTES** The cranial nerves are 12 pairs of nerves that can be seen on the ventral (bottom) surface of the brain. Some of these nerves bring information from the sense organs to the brain; other cranial nerves control muscles; other cranial nerves are connected to glands or internal organs such as the heart and lungs.

132. (b) Presence of diaphragm which separates the thoracic cavity from the abdominal cavity is the characteristic feature of all mammals. Homeothermy is the phenomenon whereby warm blooded animals, birds and mammals can maintain a constant body temperature. Four chambered heart is observed in birds and mammals. Rib cage occurs in all vertebrates.

133. (d) Duck-billed platypus is an egg laying mammal.

134. (c) Hollow bones are characteristic adaptive features of birds. It reduces their body weight and is a major flight adaptation.

135. (a) Birds have pneumatic bones.

> **NOTES** The pneumatic bones are important to birds for respiration. They are hollow bones which are connected to the bird's respiratory system and are important for birds to be able to breathe. Examples of pneumatic bones are the skull, humerus, clavicle, keel (sternum), pelvic girdle, and the lumbar and sacral vertebrae.

136. (c) Toads possess a pair of large parotid glands behind the tympana. They produce a milky poisonous fluid. Statocysts are the organs of equilibrium and sensory perception located at the base of antennae. Flame cells in liver fluke are the excretory organs.

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137. (b) Flightless birds are restricted to the islands of Australia and New Guinea.

138. (a) The number of cervical vertebrae are same in man & whale that is 7 in number.

139. (b) Diaphragm is present in mammals as a muscular seperator between thorax and abdominal region.

140. (d) Gorilla, Chimpanzee, Monkeys and Man belongs to same order- Primates of class mammalia.

> **NOTES** Some characteristics of primates are, brains that are larger than those of most other mammals (larger brain/body ratio than similar-sized non-primates), claws that have been modified into flattened nails, typically only one offspring per pregnancy, and a trend toward holding the body upright.

141. (b) Dorsal hollow nervous system is one of the important feature of vertebrates.

142. (d) Mucus helps frog in forming moist skin as it is necessary for cutaneous respiration during hibernation of frog.

143. (d) A larval stage occurs in the life history of butterfly, frog and mosquito.

144. (b) Tracheal tube of cockroach and human have non-collapsable wall. Each tracheal tube is lined with cuticle which prevents collapsing.

145. (a) Nerve cells are present in the form of network of neurons in Hydra but the brain and nerves are absent.

146. (c) Ostrich, Kiwi, Penguin are all flightless birds.
147. (b) Prototherians are egg laying mammals, they share characters with reptiles.
e.g., - *Duck bill Platypus*
The Platypus (*Ornithorhynchus anatinus*) is a semi-aquatic mammal endemic to eastern Australia and Tasmania. Together with the four species of *Echidna*, it is one of the five species of *monotremes*, the only mammals that lay eggs instead of giving birth to young. It is the sole living representative of its family (Ornithorhynchidae) and genus (*Ornithorhynchus*), though a number of related species have been found in the fossil record.
148. (c) Sound box or syrinx is present below trachea which produces sound in birds.
149. (a) *Rana tigrina* – Bull frog; Order - Anura Amphibia.
150. (b) Metanephric kidney is found differentiated into cortex and medulla and duct of such kidney is ureter.
151. (b) Penguin is a flightless bird found in colder regions like Antarctica.
152. (d) Skin in fact is a secondary or accessory respiratory organ in frog when frog undergoes the hybernation or aestivation i.e. winter sleep or summer sleep & when it goes into the water for a long time.
153. (b) In birds flight muscles or breast muscles are attached to the large sternum or breast bone. The wings are powered by these flight muscles.
154. (d) Two clavicles are fused with inter clavicle to form a fork shaped bone called wish bone or furcula or bone of merry thoughts.
155. (b) Eutherians are placental animals. The foetus develop inside uterus of female where they are nourished by special structure called placenta.
156. (c) Tortoise (*Testudo*) is a member of order-Chelonia, class – Reptiles.
157. (b) Fire bellied toad (*Bombina orientalis*) is a member of family Discoglossidae of order Anura of class Amphibia. Its belly is red or orange-red.
158. (c) Necturus (Mud puppy) order – Urodela class – Amphibia is a species of which salamanders is a part of the genus *Necturus*.
159. (c) Typhols is a non-poisonous blind snake.

NOTES

Typhlops is a genus of blind snakes in the family Typhlopidae. The genus is endemic to the West Indies. *Typhlops hectus* is a fossorial species that occurs in a range of habitats including various types of forests.

160. (c) Crop in birds stores & softens food and secretes milk in pigeons.
161. (a) In birds, hind limbs are variously modified for various functions like perching, grasping etc. In the kingfisher they are modified for wading.
162. (b) Bird vertebrae are heterocoelous. Acoelous vertebrae are found in mammals.
163. (d) Members of the order Cetacea of class Mammalia are aquatic animals like whales, dolphins having smooth and hairless skin.

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5 Morphology of Flowering Plants

Trend Analysis with Important Topics & Sub-Topics

Topic	Sub-Topics	2020 Qns.	2020 LOD	2019 Qns.	2019 LOD	2018 Qns.	2018 LOD	2017 Qns.	2017 LOD	2016 Qns.	2016 LOD
Root	Pneumatophores					1	E				
	Modified Root					1	E				
Stem	Modified Stem							1	E	1	A
Leaf	Modified Leaf									1	D
Inflorescence/ Flower	Inflorescence	1	A			1	D			2	D/A
	Placentation			1	A						
Fruit/Seed	Type of Fruit							1	A		
	Edible Part							1	E	2	A/E
Families - Fabaceae/ Solanaceae/ Liliaceae	Characteristics									1	D
	Floral Formula										

LOD - Level of Difficulty | E - Easy | A - Average | D - Difficult | Qns - No. of Questions

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Topic 1: Root

1. Pneumatophores occur in *[2018]*
   (a) Halophytes
   (b) Free-floating hydrophytes
   (c) Submerged hydrophytes
   (d) Carnivorous plants
2. Plants which produce characteristic pneumatophores and show vivipary belong to: *[2017]*
   (a) Halophytes (b) Psammophytes
   (c) Hydrophytes (d) Mesophytes
3. Sweet potato is homologous to *[2011M]*
   (a) Potato (b) *Colocasia*
   (c) Ginger (d) Turnip
4. Roots of which plant contains an oxidising agent?
   (a) Carrot (b) Soyabean *[2001]*
   (d) Mustard (d) Radish
5. The plant, which bears clinging roots, is *[1999]*
   (a) trapa (b) orchid
   (c) screw pine (d) podostemon
6. Buttress roots are found in *[1995]*
   (a) sorghum (b) banyan
   (c) Terminalia (d) Pandanus
7. Velamen is found in *[1991]*
   (a) roots of Screwpine
   (b) aerial and terrestrial roots of orchids
   (c) leaves of *Ficus elastica*
   (d) aerial roots of orchids

Topic 2: Stem

8. In Bougainvillea thorns are the modifications of :
   (a) Adventitious root (b) Stem *[2017]*
   (c) Leaf (d) Stipules
9. Which of the following is not a stem modification?
   (a) Pitcher of Nepenthes *[2016]*
   (b) Thorns of citrus
   (c) Tendrils of cucumber
   (d) Flattened structures of Opuntia

10. An example of edible underground stem is: *[2014]*
(a) Carrot (b) Groundnut
(c) Sweet potato (d) Potato

11. What is eye of potato? *[2001]*
(a) Axillary bud (b) Acessory bud
(c) Adventitious bud (d) Apical bud

Topic 3: Leaf

12. Stems modified into flat green organs performing the functions of leaves are known as *[2016]*
(a) Cladodes (b) Phyllodes
(c) Phylloclades (d) Scales

13. Leaves become modified into spines in:- *[2015 RS]*
(a) Pea (b) Onion
(c) Silk Cotton (d) Opuntia

14. How many plants among China rose, *Ocimum*, sunflower, mustard, *Alstonia, guava*, *Calotropis* and *Nerium* (Oleander) have opposite phyllotaxy? *[NEET Kar. 2013]*
(a) Two (b) Three
(c) Four (d) Five

15. Phyllode is present in : *[2012]*
(a) *Asparagus* (b) *Euphorbia*
(c) *Australian Acacia* (d) *Opuntia*

16. Whorled, simple leaves with reticulate venation are present in *[2011M]*
(a) Calotropis (b) Neem
(c) China rose (d) Alstonia

17. Heterospory and seed habit are often discussed in relation to a structure called *[1997]*
(a) spathe (b) bract
(c) petiole (d) ligule

Topic 4 : Inflorescence / Flower

18. Ray florets have *[2020]*
(a) Superior ovary (b) Hypogynous ovary
(c) Half inferior ovary (d) Inferior ovary

19. The ovary is half inferior in : *[2020]*
(a) Mustard (b) Sunflower
(c) Plum (d) Brinjal

20. Match the placental types (column-I) with their examples (column-II). *[2019]*

Column-I	Column-II
(A) Basal	(i) Mustard
(B) Axile	(ii) China rose
(C) Parietal	(iii) *Dianthus*
(D) Free central	(iv) Sunflower

Choose the correct answer from the following options :
(a) (A)-(iii), (B)-(iv), (C)-(i), (D)-(ii)
(b) (A)-(ii), (B)-(iii), (C)-(iv), (D)-(i)
(c) (A)-(i), (B)-(ii), (C)-(iii), (D)-(iv)
(d) (A)-(iv), (B)-(ii), (C)-(i), (D)-(iii)

21. Bicarpellary ovary with obliquely placed septum is seen in : *[2019]*
(a) *Sesbania* (b) *Brassica*
(c) *Aloe* (d) *Solanum*

22. Placentation, in which ovules develop on the inner wall of the ovary or in peripheral part, is: *[2019]*
(a) Basal (b) Axile
(c) Parietal (d) Free central

23. Winged pollen grains are present in *[2018]*
(a) Mustard (b) Cycas
(c) Pinus (d) Mango

24. The standard petal of a papilionaceous corolla is also called *[2016]*
(a) Carina (b) Pappus
(c) Vexillum (d) Corona

25. Proximal end of the filament of stamen is attached to the *[2016]*
(a) Anther (b) Connective
(c) Placenta (d) Thalamus or petal

26. Perigynous flowers are found in :- *[2015 RS]*
(a) Cucumber (b) China rose
(c) Rose (d) Guava

27. Axile placentation is present in *[2015 RS]*
(a) Lemon (b) Pea
(c) Argemone (d) Dianthus

28. When the margins of sepals or petals overlap one another without any particular direction, the condition is termed as: *[2014]*
(a) Vexillary (b) Imbricate
(c) Twisted (d) Valvate

29. Among bitter gourd, mustard, brinjal, pumpkin, china rose, lupin, cucumber, sunhemp, gram, guava, bean, chilli, plum, petunia, tomato, rose, withania, potato, onion, aloe and tulip how many plants have hypogynous flower? *[NEET 2013]*
(a) Ten (b) Fifteen
(c) Eighteen (d) Six

30. Among flowers of *Calotropis*, tulip, *Sesbania, Asparagus,* Colchicine, Sweet pea, *Petunia, Indigofera,* Mustard, Soyabean, Tobacco and groundnut how many plants have corolla with valvate aestivation? *[NEET Kar. 2013]*
(a) Five (b) Six
(c) Seven (d) Eight

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31. In a cymose inflorescence the main axis
    (a) Terminates in a flower ***[NEET Kar. 2013]***
    (b) Has unlimited growth
    (c) Bears a solitary flower
    (d) Has unlimited growth but lateral branches end in flowers
32. Inflorescence is racemose in ***[NEET Kar. 2013]***
    (a) Soyabean (b) Brinjal
    (c) Tulip (d) *Aloe*
33. Placentation in tomato and lemon is ***[2012]***
    (a) Parietal (b) Free central
    (c) Marginal (d) Axile
34. Cymose inflorescence is present in : ***[2012]***
    (a) *Solanum* (b) *Sesbania*
    (c) *Trifolium* (d) *Brassica*
35. The gynoecium consists of many free pistils in flowers of ***[2012]***
    (a) Aloe (b) Tomato
    (c) Papaver (d) Michelia
36. How many plants in the list given below have marginal placentation?
    Mustard, Gram, Tulip, Asparagus, Arhar, Sun hemp, Chilli, Colchicine, Onion, Moong, Pea, Tobacco, Lupin ***[2012M]***
    (a) Four (b) Five
    (c) Six (d) Three
37. Flowers are zygomorphic in : ***[2011]***
    (a) mustard (b) gulmohur
    (c) tomato (d) datura
38. Which one of the following diagrams represents the placentation in *Dianthus*? ***[2011M]***
    (a) (b)
    (c) (d)
39. In unilocular ovary with a single ovule the placentation is : ***[2010]***
    (a) Marginal (b) Basal
    (c) Free Central (d) Axile
40. Ovary is half-inferior in the flowers of: ***[2010]***
    (a) guava (b) plum
    (c) brinjal (d) cucumber
41. The technical term used for the androecium in a flower of China rose (*Hibiscus rosa sinensis*) is: ***[2010]***
    (a) Monadelphous (b) Diadelphous
    (c) Polyandrous (d) Polyadelphous
42. An example of axile placentation is: ***[2009]***
    (a) Dianthus (b) Lemon
    (c) Marigold (d) Argemone
43. Replum is present in the ovary of flower of ***[2008]***
    (a) Lemon (b) Mustard
    (c) Sun flower (d) Pea
44. Which of the following is a flowering plant with nodules containing filamentous nitrogen-fixing micro-organism ***[2007]***
    (a) Crotalaria juncea
    (b) Cycas revoluta
    (c) Cicer arietinum
    (d) Casuarina equisetifolia
45. Long filamentous threads protruding at the end of the young cob of maize are ***[2000, 06]***
    (a) styles (b) ovaries
    (c) hairs (d) anthers
46. Angiosperm to which the largest flowers belong is? ***[1999]***
    (a) total stem parasite (b) partial stem parasite
    (c) total root parasite (d) partial root parasite
47. The type of placentation in which ovary is syncarpous, unilocular and ovules on sutures is called ***[1999]***
    (a) apical placentation
    (b) parietal placentation
    (c) marginal placentation
    (d) superficial placentation
48. Floral features are chiefly used in Angiosperms identification because ***[1998]***
    (a) flowers are of various colours
    (b) flowers can be safely pressed
    (c) reproductive parts are more stable and conservative than vegetative parts
    (d) flowers are nice to work with
49. Hypanthodium is ***[1994]***
    (a) thalamus (b) fruit
    (c) inflorescence (d) ovary
50. Epipetalous stamens with free filaments and fused anthers occur in ***[1991, 92]***
    (a) Asteraceae (b) Solanaceae
    (c) Liliaceae (d) Poaceae

Topic 5: Fruit / Seed

51. Coconut fruit is a : ***[2017]***
    (a) Berry (b) Nut
    (c) Capsule (d) Drupe
52. The morphological nature of the edible part of coconut is: ***[2017]***
    (a) Cotyledon (b) Endosperm
    (c) Pericarp (d) Perisperm

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53. The coconut water from tender coconut represents
(a) endocarp *[2016]*
(b) fleshy mesocarp
(c) free nuclear proembryo
(d) free nuclear endosperm

54. Cotyledon of maize grain is called *[2016]*
(a) plumule (b) coleorhiza
(c) coleoptile (d) scutellum

55. Coconut water from a tender coconut is *[2015 RS]*
(a) Free nuclear endosperm
(b) Innermost layers of the seed coar
(c) Degenerated nucellus
(d) Immature emryo

56. Which one of the following fruits is parthenocarpic? *[2015 RS]*
(a) Apple (b) Jackfruit
(c) Banana (d) Brinjal

57. The wheat grain has an embryo with one, large, shield-shaped cotyledon known as: *[2015 RS]*
(a) Coleorrhiza (b) Scutellum
(c) Coleoptile (d) Epiblast

58. Placenta and pericarp are both edible portions in: *[2014]*
(a) Apple (b) Banana
(c) Tomato (d) Potato

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59. Which one of the following statements is correct? *[2014]*
(a) The seed in grasses is not endospermic.
(b) Mango is a parthenocarpic fruit.
(c) A proteinaceous aleurone layer is present in maize grain.
(d) A sterile pistil is called a staminode.

60. An aggregate fruit is one which develops from: *[2014]*
(a) Multicarpellary syncarpous gynoecium
(b) Multicarpellary apocarpus gynoecium
(c) Complete inflorescence
(d) Multicarpellary superior ovary

61. How many plants in the list given below have composite fruits that develop from an inflorescence: Walnut, poppy, radish, fig, pineapple, apple, tomato, mulberry *[2012]*
(a) Four (b) Five
(c) Two (d) Three

62. The coconut water and the edible part of coconut are equivalent to : *[2012]*
(a) Endosperm (b) Endocarp
(c) Mesocarp (d) Embryo

63. Which one of the following statements is correct?
(a) In tomato, fruit is a capsule *[2011]*
(b) Seeds of orchids have oil-rich endosperm
(c) Placentation in primose is basal
(d) Flower of tulip is a modified shoot

64. What would be the number of chromosomes of the aleurone cells of a plant with 42 chromosomes in its root tip cells ? *[2011]*
(a) 42 (b) 63
(c) 84 (d) 21

65. In a cereal grain the single cotyledon of embryo is represented by *[2006]*
(a) scutellum (b) prophyll
(c) coleoptile (d) coleorhiza

66. Pineapple (ananas) fruit develops from *[2006]*
(a) a multipistillate syncarpous flower
(b) a cluster of compactly borne flowers on a common axis
(c) a multilocular monocarpellary flower
(d) a unilocular polycarpellary flower

67. Aril represents the edible part of *[1997, 99, 2005, 06]*
(a) banana (b) litchi
(c) mango (d) apple

68. Mango juice is got from *[1989, 2002, 04]*
(a) epicarp
(b) mesocarp
(c) endocarp
(d) pericarp and thalamus

69. Juicy hair–like structures observed in the lemon fruit develop from *[2003]*
(a) mesocarp and endocarp
(b) exocarp
(c) mesocarp
(d) endocarp

70. The aleurone layer in maize grain is specially rich in *[2003]*
(a) auxins (b) proteins
(c) starch (d) lipids

71. Edible part of banana is *[2001]*
(a) epicarp
(b) mesocarp and less developed endocarp
(c) endocarp and less developed mesocarp
(d) epicarp and mesocarp

72. Which is correct pair for edible part? *[2001]*
(a) Tomato - Thalamus
(b) Maize - Cotyledons
(c) Guava - mesocarp
(d) Data palm - Mesocarp

73. The embryo in sunflower has *[1998]*
(a) one cotyledon (b) two cotyledons
(c) many cotyledons (d) no cotyledon

74. Which one of the following statements is correct with respect to the plant species and its use? *[1997]*
(a) *Oryza sativa* – rich source of protein
(b) *Manihot utilissima* – root tubers eaten especially in Kerala
(c) *Ricinus communis* – important edible cereal
(d) *Hibiscus esculentus* – flowers eaten throughout the country.

75. Which one of the following is a true fruit? *[1996]*
(a) Apple (b) Pear
(c) Cashew nut (d) Coconut

76. Which part of the coconut produces coir? *[1996]*
(a) Seed coat (b) Mesocarp
(c) Epicarp (d) Pericarp.

77. Vivipary is *[1992]*
(a) seed germination with subterranean cotyledons
(b) seed germination with epiterranean cotyledons
(c) fruit development without pollination
(d) seed germination inside the fruit while attached to the plant

78. Germination of seed within fruit is *[1992]*
(a) ovipary (b) vivipary
(c) hypogeal (d) epigeal

79. Fruit of *Mangifera indica* is *[1991]*
(a) Berry (b) Drupe
(c) Capsule (d) Siliqua

80. New Banana plants develop from *[1990]*
(a) rhizome (b) sucker
(c) stolon (d) seed

81. In Groundnut the food/oil reserve is present in
(a) epicarp (b) mesocarp *[1990]*
(c) endosperm (d) cotyledons

82. Perisperm is *[1988, 89]*
(a) remnant of endosperm
(b) persistent nucellus
(c) peripheral part of endosperm
(d) disintegrated secondary nucleus

83. Fruit of Groundnut is *[1988]*
(a) Legume (b) Caryopsis
(c) Berry (d) Nut

Topic 6: Families - Fabaceae / Solanaceae Liliaceae

84. Tricarpellary syncarpous gynoecium is found in flowers of *[2016]*
(a) Liliaceae (b) Solanaceae
(c) Fabaceae (d) Poaceae

85. $\oplus \circ\!\!\!\!\!\!\nearrow\!\!\!\!\!\!\circ\!\!\!\!\!\!

93. The ovary is half inferior in flowers of *[2011]*
(a) peach (b) cucumber
(c) cotton (d) guava

94. Keel is characteristic of the flowers of:
(a) Gulmohur (b) Cassia *[2010]*
(c) Calotropis (d) Bean

95. The floral formula *[2009]*
$\oplus ⚥ K_{(5)} \widehat{C_{(5)} A_5} \underline{G(2)}$
is that of:
(a) Soyabean (b) Sunhemp
(c) Tobacco (d) Tulip

96. What type of placentation is seen in sweet pea? *[2006]*
(a) Axile (b) Free central
(c) Marginal (d) Basal

97. Pentamerous, actinomorphic flowers, bicarpellate ovary with oblique septa and fruit a capsule of berry, are characteristic features of *[2006]*
(a) Brassicaceae (b) Solanaceae
(c) Liliaceae (d) Asteraceae

98. Bicarpellary gynoecium and oblique ovary occures in *[2001]*
(a) Mustard (b) Banana
(c) Pisum (d) Brinjal

99. Tetradynamous stamens are found in family *[1995, 01]*
(a) Malvaceae (b) Solanaceae
(c) Cruciferae (d) Liliaceae

100. Match the following and indicate which is correct *[2000]*
(a) Cucurbitaceae – Orange
(b) Malvaceae – Cotton
(c) Brassicaceae – Wheat
(d) Leguminosae – Sunflower

101. Pulses are obtained from *[1993]*
(a) Fabaceae (b) Asteraceae
(c) Poaceae (d) Solanaceae

102. Floral formula of Tomato/Tobacco is *[1989, 92]*
(a) $\ominus ⚥ K_{4-5} A_{10} \underline{G_{(2)}}$
(b) $\oplus ⚥ K_{2+2} C_4 A_{2+4} \underline{G_1}$
(c) $\oplus ⚥ P_2 A_3 \underline{G_1}$
(d) $\ominus ⚥ K_{(5)} \widehat{C_{(5)} A_5} \underline{G_{(2)}}$

103. Syngenesious condition is found in *[1991]*
(a) Asteraceae (b) Labiate
(c) Solanaceae (d) Fabaceae

104. $\oplus ⚥ K_5 \widehat{C_5 A_5} \underline{G_{(2)}}$ is floral formula of *[1991]*
(a) Liliaccae (b) Solanaceae
(c) Asteraceae (d) Fabaceae

105. Botanical name of Cauliflower is *[1991]*
(a) Brassica oleracea var. capitata
(b) Brassica campesteris
(c) Brassica oleracea var. botrytis
(d) Brassica oleracea var. gemmifera

106. A family delimited by head type of inflorescence is
(a) Fabaceae (b) Asteraceae *[1990]*
(c) Solanaceae (d) Liliaceae

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ANSWER KEY

1	(a)	12	(c)	23	(c)	34	(a)	45	(a)	56	(c)	67	(b)	78	(b)	89	(d)	100	(b)
2	(a)	13	(d)	24	(c)	35	(d)	46	(c)	57	(b)	68	(b)	79	(b)	90	(a)	101	(a)
3	(d)	14	(b)	25	(d)	36	(c)	47	(b)	58	(c)	69	(d)	80	(b)	91	(c)	102	(d)
4	(b)	15	(c)	26	(c)	37	(b)	48	(c)	59	(c)	70	(b)	81	(d)	92	(b)	103	(a)
5	(b)	16	(d)	27	(a)	38	(b)	49	(c)	60	(b)	71	(b)	82	(b)	93	(a)	104	(d)
6	(c)	17	(d)	28	(b)	39	(b)	50	(a)	61	(d)	72	(d)	83	(a)	94	(d)	105	(c)
7	(d)	18	(d)	29	(b)	40	(b)	51	(d)	62	(a)	73	(b)	84	(a)	95	(c)	106	(b)
8	(b)	19	(c)	30	(c)	41	(a)	52	(b)	63	(d)	74	(b)	85	(b)	96	(c)		
9	(a)	20	(d)	31	(a)	42	(b)	53	(d)	64	(b)	75	(d)	86	(a)	97	(b)		
10	(d)	21	(d)	32	(a)	43	(b)	54	(d)	65	(a)	76	(b)	87	(a)	98	(d)		
11	(a)	22	(c)	33	(d)	44	(d)	55	(a)	66	(b)	77	(d)	88	(a)	99	(c)		

Hints & Solutions

1. (a) Some lateral roots of mangroves become specialised as pneumatophores in saline mud flats. These are lateral roots that grow upward (negative geotropism) for varying distances and function as the site of oxygen intake for the submerged primary root system.
2. (a) Halophytes growing in saline soils show vivipary for seed germination and have pneumatophores for gaseous exchange.

NOTES

Psammophytes are plant that thrives in shifting sands, primarily in deserts. They are marked by a number of adaptations that enable them to exist on wind-blown sands. In such an environment, the plants are often covered with sand, or their root system is exposed.

3. (d) Sweet potato and turnip both are roots that become modified for special functions, the most common being the formation of tuberous roots for food storage.
4. (b) In the roots of soyabean plant, leghaemoglobin, a pigment with affinity for oxygen, is found.

NOTES

Symbiotic hemoglobin (leghemoglobin) is a hemeprotein found in micromolar concentrations in infected cells of legume roots. This is an essential component for nitrogen fixation by legumes. Leghemoglobin is produced as a result of symbiotic association between bacteroid and plant.

5. (b) Screw pine (*Pandanus*) bear stilt roots. *Trapa* bears assimilatory roots. Orchid bears clinging roots.

NOTES

Clinging roots are observed in epiphytes or space parasites, they are entities dwelling on the surface of other plants such as branches, and tree trunks etc. for space and shelter only. Clinging Roots entered the crevices of some support and fix the plant. Examples: Epiphytes orchids.

6. (c) Buttress roots are asymmetrically thickened prop roots found at the base of certain trees. They render additional mechanical support to the trees. *e.g. Salmalia, Terminalia* etc.
7. (d) Aerial roots of orchids hang freely in the air and absorb moisture with the help of special sponge like tissue called velamen.
8. (b) Thorns are hard, pointed straight structures for protection against grazing animal. These are modified stem.
9. (a) Pitcher of *Nepenthes* or pitcher plant is modification of leaf whereas thorns in citrus tendrils of cucumber and flattened structure of *Opuntia* are all stem modification.
10. (d) Potato is an example of edible underground stem.
    - It is differentiated into nodes and internodes. The 'eyes' on potato tuber indicate axillary buds at the nodes.
    - It bears scaly leaves. The leaves do not store food.
    - Axillary buds arise at the nodes.
    - It does not bear roots.
11. (a) Axillary bud is the bud arising in the axil of branch. Apical bud arises at the apex. Adventitious bud arises from any location other than its usual location.
12. (c) Phylloclade refers to a portion of a flattened leaf-like stem or branch with multiple nodes and internodes, and cladode for a single internode of a phylloclade. In some plants, the petioles are flattened and widened, to become phyllodes or phyllodia.
13. (d) In *Opuntia*, leaves become modified into spines to avoid transpiration so as to save water for desert adaptation. The stems of this plant appear like-leaf, termed as- phylloclades which perform the process of photosynthesis.
14. (b) Phyllotaxy is the pattern of arrangement of leaves on the stem or branch.
    - *Ocimum,* Guava, *Calotropis* → Opposite phyllotaxy
    - China rose, Sunflower, mustard → Alternate phyllotaxy
    - *Alstonia, Nerium* (Oleander) → whorled phyllotaxy
15. (c) Phyllode is present in Australian *Acacia*. It is modification of leaf in which lamina is absent and petiole becomes flattened and perform the function of food synthesis.
16. (d) Whorled phyllotaxy is a feature of *Nerium* and *Alstonia*. In *Alstonia* five leaves are present in a whorl while in *Nerium* three leaves are present in a whorl.

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17. (d) Heterospory, development of seed habit and ligulate leaves are important features of *Selaginella*. The reproductive structure in *Selaginella* is strobilus. A strobilus has many ligulate sporophylls. Two types of spores are produced megasporophylls and microsporophylls. Ligule is a small leaf like outgrowth at the base of leaf.

18. (d) Ray floret have inferior ovary. Ray floret is condition in flower where any of a number of strap-shaped and typically sterile florets that form the ray e.g., Sunflower Epigynous flower are formed in family Asteraceae.

NOTES

Neuter flowers have undeveloped or nonfunctional sexual organs. They have pistils and stamens that are nonfunctional or absent. Ray florets of sunflower are neuter flowers; disc florets are bisexual, also in some more Asteraceae, e.g. *Centaurea*.

19. (c) The ovary is half inferior in Plum. A half-inferior ovary is embedded or surrounded by the receptacle. Such flowers are termed perigynous or half-epigynous. In some classifications, half-inferior ovaries are not recognized and are instead grouped with either the superior or inferior ovaries.

NOTES

The apple is a pome (fleshy) fruit, in which the ripened ovary and surrounding tissue both become fleshy and edible. The apple flower of most varieties requires cross-pollination for fertilization.

20. (d)

Basal	:	Sunflower
Axile	:	China rose
Parietal	:	Mustard
Free central	:	*Dianthus*

In flowering plants, placentation is the attachment of ovules inside the ovary. The ovules inside a flower's ovary (which later become the seeds inside a fruit) are attached via funiculi, the plant part equivalent to an umbilical cord. The part of the ovary where the funiculus attaches is referred to as the placenta.

21. (d) Bicarpellary ovary with obliquely placed septum is seen in the members of family *Solanaceae.*
e.g. *Solanum tuberosum.*

22. (c) In parietal placentation the ovules develop on the inner wall of ovary or in peripheral part and number of placentae corresponds to the number of carpels. It occurs in bicarpellary or multicarpellary but unilocular ovary, e.g. mustard, *Argemone* etc.

Parietal placentation

23. (c) Winged pollen grains are present in Pinus. Each pollen grain has two wing-like structures which enables it to float in air, as an adaptation for dispersal by the wind.

24. (c) Papilionaceous flowers are flowers with the characteristic irregular and butterfly-like corolla. A single, large upper petal is known as the banner or vexillum and the name has been derived from an ancient military standard.

25. (d) The proximal end is attached to the thalamus whereas the distal end bears anther.

26. (c) Ovary is partly superior and partly inferior in perigynous flower.

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27. (a) In a multilocular ovary, when the placenta is axial and ovules are attached to it is known as axile placentation.

28. (b) If the margins of sepals or petals overlap one another but not in any particular direction as in *Cassia* and gulmohur, the aestivation is called imbricate.

29. (b) Mustard (cruciferae) , brinjal (solanaceae) china rose (malvaceae), lupin (leguminosae), gram (leguminosae), bean (leguminosae), chilli, *Petunia*, potato, tomato, *Withania* (solanaceae), onion, *Aloe,* tulip (liliaceae) have hypogynous flower while bittergourd, cucumber (cucurbitaceae), guava (myrtaceae) have epigynous flower and rose has perigynous flower.

30. (c) *Calotropis,* tulip, *Asparagus,* colchicine, *Petunia,* mustard, tobacco have valvate aestivation while sweet pea, groundnut, soyabean, *Indigofera, Sesbania* have vexillary aestivation.

31. (a) In cymose inflorescence, the growth of the main axis is definite because the growing point of peduncle is used up in the formation of a flower. Further growth of flowering axis is continued by one or more lateral branches which also end in flower.

32. (a) • Inflorescence in family fabaceae (e.g., soyabean) is racemose.
    - Inflorescence in family liliaceae (e.g., tulip, *Aloe*) is solitary/cymose; often umbellate.
    - Inflorescence in family solanaceae (e.g., brinjal) is solitary, axillary or cymose as in *Solanum*.

33. (d)

Parietal	Ex. -	Mustard
Free central	Ex. -	*Primula* & *Dianthus*
Marginal	Ex. -	Pea
Axile	Ex. -	Tomato, lemon, Chinarose

34. (a) Cymose infloresence is present in *Solanum*. Cymose inflorescence is the name of determinate or definite inflorescence in which the tip of the main axis terminates in a flower and further growth continues by one or more lateral branches which also behaves like the main axis.
35. (d) The female reproductive part of a flower is gynoecium. It is syncarpous or fused in tomato.
36. (c) Marginal placentation is a placentation with ovules borne on the wall along the ventral suture of a simple ovary. Gram, Arhar, Sun hemp, Moong, Pea & Lupin belong to fabaceae family that bear marginal placentation.
37. (b) When a flower can be divided into two similar halves only in one particular vertical plane, it is zygomorphic, e.g. pea, gulmohar, bean, etc.
38. (b) Free central placentation occurs in *Dianthus* and *Primula* in which ovules are borne on central axis and septa are absent.
39. (b) In basal type of placentation, the ovary is unilocular with a single ovule. In this, the placenta is at the base of the ovary. It is seen in *Polygonum*.
40. (b) A flower in which floral parts arise from around the ovary is called perigynous. In this, the ovary is half inferior and half superior. It can be seen in the flowers of plum, peach etc.
41. (a) *Hibiscus* belongs to family Malvaceae. It possess numerous stamens that are called monadelphous.
42. (b) In flowering plants, placentation occurs where the ovules are attached inside the ovary. An example of axile placentation is citrus. In this type of placentation the ovary is sectioned by radial spokes with placentas in separate locules.
43. (b) Replum is present in the ovary of flower of mustard. A false septun called replum develops between the two parietal placentae in mustard and other members of family Brassicaceae. The ovary becomes bilocular.
44. (d) It is also know as Australian pine, which is a deciduous tree with a soft, wispy, pine-like appearance that can grow to 100 feet or more in height.

> **NOTES**
> Also known as ironwood, or beefwood. It bears a superficial resemblance to the conifer genus *Pinus* because of its small, round, cone-like fruits and its branchlets of scale-like leaves that look like pine needles.

45. (a) Long filamentous threads of maize are the styles of the ovaries. In fact, these are the longest styles in plants.
46. (c) *Rafflessia* is an angiosperm, which produces the largest flowers. It is also a total root parasite.

> **NOTES**
> *Rafflesia* is a genus of parasitic flowering plants in the family Rafflesiaceae. It contains approximately 28 species, all found in Southeast Asia, mainly in Indonesia, Malaysia, Thailand and the Philippines.

47. (b) The arrangement of ovules inside the ovary of a flowering plant is called placentation. In marginal placentation, the ovule develop from a longitudinal suture where the margins of the ovary wall fuse. *e.g.*. Pea, gram. In apical placentation a single ovule is born near the apex of the ovary. Here ovary is unilocular (*Cannabis*). In superficial placentation the ovary is unilocular simple or syncarpous *e.g. Nymphaea*.
48. (c) Reproductive parts (floral features) are more stable and conservative than vegetative parts, which exhibit changes due to the environmental factors quite readily. So floral features are more reliable.
49. (c) Hypanthodium is a special kind of inflorescence where the receptacle is usually fleshy and flask-shaped. *e.g. Ficus*.

> **NOTES**
> In angiosperms, a hypanthium or floral cup is a structure where basal portions of the calyx, the corolla, and the stamens form a cup-shaped tube. It is sometimes called a floral tube, a term that is also used for corolla tube and calyx tube. It often contains the nectaries of the plant.

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50. (a) Asteraceae possess five stamens with free filaments but anthers are united forming a tube around the style (syngenesious).
51. (d) Coconut fruit is a drupe. A drupe is a fleshy fruit with thin skin and central stone containing the seed.
52. (b) The edible part of coconut is its endosperm. Coconut has double endosperm, liquid endosperm and cellular.
53. (d) Coconut water is the clear liquid inside young green coconuts (fruits of the coconut palm). In early development, it serves as a suspension for the endosperm of the coconut during the nuclear phase of development. As growth continues, the endosperm matures into its cellular phase and deposits into the rind of the coconut meat.
54. (d) The cotyledons are known as seed leaves, they are attached to the embryonic axis. Dicotyledons typically have two cotyledons and monocotyledons have only one cotyledon. The single shield-shaped cotyledon in grains known as scutellum.
55. (a) Coconut water is the free nuclear endosperm which is used.
56. (c) Parthenocarpic fruits (eg - banana) are produced without fertilization of ovule.

NOTES

Parthenogenesis is a natural form of asexual reproduction in which growth and development of embryos occur without fertilization by sperm. In animals, parthenogenesis means development of an embryo from an unfertilized egg cell. In plants parthenogenesis is a component process of apomixis.

57. (b) Scutellum is large, shield shaped cotyledon that helps in the absorption of nutrients from endosperm during germination.
58. (c) In tomato the edible part is pericarp and placenta.
59. (c) Generally, monocotyledonous seeds (*e.g.,* grasses) are endospermic but some as in orchids are non-endospermic. Mango is a drupe fruit that develops from multicarpellary, syncarpous, superior ovary having one or many seeds. A sterile stamen is called a staminode. In monocots, outer covering of endosperm separates the embryo by a proteinous layer called aleurone layer.
60. (b) Aggregate fruits (etaerio) develop from the multicarpellary apocarpous ovary. They are of following types; etaerio of follicles, etaerio of achenes, etaerio of berries, etaerio of drupes.
61. (d) Fig-develops from hypanthodium inflorescence; pineapple- develops from spike inflorescence; Mulberry-develops from catkin inflorescence.
62. (a) Liquid endosperm is the edible part of coconut.
63. (d) Tulips are most popular and wildly grown flowers. Tulips are bulbs, possessing modified stems and leaves.
64. (b) Aleurone cells are the outer cell layer of the endosperm, usually only one cell thick in wheat and the only endosperm tissue alive at maturity. The cell layers of this layer are responsible for the de-novo synthesis of enzyme needed during germination. The chromosome number is 63 of a plant with 42 chromosome in its root tip cells.
65. (a) Single cotyledon of embryo in cereal grain is represented by scutellum. Coleoptile represents the covering of stem. Coleorrhiza represents the covering of root.

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NOTES

Prophyll is a plant structure resembling a leaf (as a bracteole) or consisting of a modified or rudimentary leaf (as a foliar primordium).

66. (b) Pineapple (*Ananas sativus*) is a sorosis fruit developed from a composite inflorescence which is actually a cluster of compactly borne flowers on a common axis.
67. (b) Aril develops from outer seed coat and is the edible part of litchi.

NOTES

An aril (or arillus) is a fleshy covering of certain seeds formed from the funiculus attachment point of the seed .The aril may create a fruit-like structure called a false-fruit and is produced by a few species of gymnosperms, notably the yews and related conifers in the families Taxaceae and Cephalotaxaceae.

68. (b) Mesocarp is the edible part of *Mangifera indica* (Mango).
69. (d) The juicy hair – like structures in the lemon fruit develop from the inner side of endocarp (from the placenta).
70. (b) The aleurone layer in maize grain is specially rich in proteins.
Aleurone is a protein found in the endosperm of many seeds. It forms the outermost layer

of the seed coat in some grains. During seed germination, hydrolysis in the seed causes the aleurone cells to break down into amino acids.

NOTES

Once triggered by hormones released from the embryo, the aleurone synthesises enzymes in order to break down the starchy endosperm supplying sugars to drive the growth of roots and germination. Aleurones can have two different morphological features, homogenous and heterogenous. The homogenous aleurone is consists of similar protein bodies (e.g. *Phaseolus vulgaris*) while the heterogenous aleurone consists of different shape and type of proteins covered with a membrane (e.g. *Riccinus communis*).

71. (b) Banana (*Musa paradisica*) is a fleshly fruit with rich sugar content. Edible part is fleshy mesocarp and rudimentary endocarp, develops from trilocular, inferior ovary.
72. (d) In guava, mesocarp and endocarp form the edible part. In maize seed coat is fused with fruit wall.
73. (b) Sunflower is a dicotyledonous plant. Hence its embryo has two cotyledons. Plants like maize are monocotyledonous and hence have a single cotyledon in the embryo.
74. (b) *Oryza sativa* is rice. *Ricinus communis* is castor, a source of castor oil that acts as a purgative. *Manihot* is the scientific name for tapioca, a tuber rich in starch. *Hibiscus esculentus* is okra (bhindi).
75. (d) The fruit is a mature or ripened ovary. When a fruit develops exclusively from the ovary, it is said to be true fruit. When in addition to the ovary, some other floral part also participates in the formation of fruits, then it is known as false fruit. Apple, pear, cashewnut, mulberry etc. are all false fruits.
76. (b) Coir (Etymological origin: from Tamil and Malayalam - kayar - cord) is a coarse fibre extracted from the fibrous outer shell of a coconut. Coir fibres are found between the husk and the outer shell of a coconut. The individual fibre cells are narrow and hollow, with thick walls made of cellulose. They are pale when immature but later become hardened and yellowed as a layer of lignin is deposited on their walls.
77. (d) Vivipary germination is the characteristic mode of seed germination in *Rhizophora* (Mangrove).
78. (b) In plants, vivipary occurs when seeds or embryos begin to develop before they detach from the parent. Plants such as some Iridaceae and Agavoideae grow cormlets in the axils of their inflorescences. These fall and in favourable circumstances they have effectively a whole season's start over fallen seeds. Similarly, some Crassulaceae, such as Bryophyllum, develop and drop plantlets from notches in their leaves, ready to grow. Such production of embryos from somatic tissues is asexual vegetative reproduction that amounts to cloning.
79. (b) Drupe is a fleshy one seeded, indehiscent fruit *eg. Mangifera indica*.
80. (b) Each pseudostem produces a single bunch of bananas, before dying and are replaced by a new pseudostem. The base of the plant is a rhizome (known as a corm).

NOTES

Corms are perennial, with a productive lifespan of 15 years or more . Cultivated bananas are parthenocarpic, which makes them sterile and unable to produce viable seeds. Lacking seeds, another form of propagation is required. This involves removing and transplanting part of the underground stem (called a corm). Usually this is done by carefully removing a sucker with some roots intact.

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81. (d) Groundnut is economically important plant as edible oil is obtained from the cotyledons. Peanuts are a rich source of protein (roughly 30 grams per cup after roasting) and monounsaturated fat.

NOTES

Recent research on peanuts and nuts in general has found anti-oxidants and other chemicals that may provide health benefits. Peanuts are a significant source of resveratrol, a chemical studied for potential anti-aging effects.

82. (b) Normally endosperm formation is accompanied by degeneration of nucellus. Persistent nucellus is termed as perisperm.
The dust-like seeds of orchids have no endosperm. Orchid seedlings are mycoheterotrophic in their early development. In some other species, such as coffee, the endosperm also does not develop. Instead the nucellus produces a nutritive tissue termed perisperm.

83. (a) Legume is a dehiscent dry fruit produced from a monocarpellary superior ovary. Caryopsis is dry and one seeded fruit which developed from a superior monocarpellary ovary. In this the pericarp is closed and fused with seed coat. It is the characteristics of family Poaceae.

84. (a) The Liliaceae are a huge variety, comprising about 280 genera and 4000 species of perennial herbs mostly. It includes starchy rhizomes, corms or bulbs, characterized by alternate leaves which are whorled. The flowers are often showy, mostly bisexual and actinomorphic. Also, they exhibit tricarpellary syncarpous gynoecium. Example of such a class is the *Erythronium montanum*, the alpine fawn lily.

85. (b) Floral formula of *Petunia* (solanaceae) is

$\oplus$ ⚥ $K_{(5)}\overset{\frown}{C_{(5)}A_5}\underline{G(2)}$.

NOTES

Solanaceae, the nightshade, or potato, family of flowering plants (order Solanales), with 102 genera and nearly 2,500 species, are of considerable economic importance as food and drug plants.

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86. (a) *Indigofera* is a member of family fabaceae. It has keel type of floral structure in which two anterior fused petals are present.

87. (a) Superior ovary is found in china rose, mustard brinjal, potato, onion and tulip. Guava and cucumber have inferior ovary.

88. (a) The flowers of cucumber are unisexual, it means they have only male flowers or only female flowers.

89. (d) In china rose (*Hibiscus rosa-sinensis*) flowers are actinomorphic , hypogynous with twisted aestivation in corolla.

90. (a) This type of aestivation is seen in fabaceae. Here, the posterior largest petal overlaps the petals that are lateral, which in turn overlap the two anterior petals.

91. (c) Onion - Bulb - Underground stems -Imbricate aestivation -Axile placentation - Member of Liliaceae.

92. (b) Floral formula of chilli is

$\oplus$ ⚥ $K_{(5)}\overset{\frown}{C_{(5)}A_5}\underline{G_{(2)}}$

NOTES

The chili pepper is the fruit of plants from the genus *Capsicum* which are members of the nightshade family, Solanaceae. Chili peppers are widely used in many cuisines as a spice to add heat to dishes. The substances giving chili peppers their intensity when ingested or applied topically are capsaicin and related compounds known as capsaicinoids.

93. (a) The ovary is half-inferior in flowers of peach.

94. (d) Keel is the characteristic of the flowers of family papilionaceae. For example, bean, gram, pea etc.

NOTES

The flowers of this family have butterfly shaped corolla. The outermost petals of these flowers are the largest and is called vexillum, the two largest petals are similar and have wings and the two anterior petals called keel are fused enclosing stamens and carpels.

95. (c) The given floral formula is of tobacco. It belong to the family Solanaceae. The flower is actinomorphic, bisexual and has superior ovary. Soyabean and sunhemp have monocarpellary pistil and tulip has trimerous flower and perianth.

96. (c) In sweet pea, the gynoecium is monocarpellary and bears a single placenta along the junction of two fused margins, this is called marginal placentation.

97. (b) Pentamerous, actinomorphic flowers, bicarpillary ovary with oblique septa, fruit either capsule or berry are the characteristic features of family solanaceae.

In brassicaceae – dimerous or tetramerous, actinomorphic but sometimes zygomorphic flower, bicarpellary ovary with a false septum (called replum), fruit is siliqua or silicula is present.

In Lilicaeae – Trimerous, actinomorphic flower, tricarpillary, syncarpous ovary, fruit is berry or capsula is present.

In Asteraceae – Pentamerous, actinomorphic or zygomorphic flower, bicarpillary, syncarpous, unilocular ovary, fruit is cypsella is present.

98. (d) In mustard, bicarpellary gynoecium with oblique ovary is present.

99. (c) Tetradynamous stamens consist of four long-sized stamens and two short-sized stamens. Such kind of stamens are found in family Cruciferae *e.g.* Sarsoo. Tetradynamous condition is characteristic of this family.

100. (b) Malvaceae - Cotton

NOTES

Malvaceae, or the mallows, is a family of flowering plants estimated to contain 244 genera with 4225 known species. Well-known members of economic importance include okra, cotton, cacao and durian. There are also some genera containing familiar ornamentals, such as Alcea (hollyhock), Malva (mallow) and Lavatera (tree mallow), as well as Tilia (lime or linden tree).

101. (a) Pulses which are economically important belong to the family Fabaceae.

102. (d) Tomato and Tobacco both belong to the family Solanaceae. Solanaceae has some identifying characteristics that include bicarpellary syncarpous superior ovary, axile plancentation, fruit is berry or capsule.

103. (a) When stamens are united by their anthers and filaments are free the condition is called syngenesious. It is found in family Asteraceae (Compositae). The condition is an adaptation for entomophily.

104. (d) Fabaceae.

NOTES

The Fabaceae or Leguminosae, commonly known as the legume, pea, or bean family, are a large and economically important family of flowering plants. It includes trees, shrubs, and perennial or annual herbaceous plants, which are easily recognized by their fruit (legume) and their compound, stipulate leaves. Many legumes have characteristic flowers and fruits. The family is widely distributed, and is the third-largest land plant family in number of species, behind only the Orchidaceae and Asteraceae.

105. (c) Cauliflower has the scientific name *Brassica oleracea* belonging to the variety botrytis.

106. (b) Asteraceae possesses head or capitulum inflorescence which is racemose and is surrounded by an involucre of bracts.

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6 Anatomy of Flowering Plants

Trend Analysis with Important Topics & Sub-Topics

Topic	Sub-Topics	2020 Qns.	2020 LOD	2019 Qns.	2019 LOD	2018 Qns.	2018 LOD	2017 Qns.	2017 LOD	2016 Qns.	2016 LOD
Meristematic Tissue/Simple and Complex Tissue								2	A/A		
Tissue System (Epidermis/Ground Vascular)	Stomatal Opeing/ Closure							1	A		
Dicot/Monocot (Root/Stem/Leaf)	Characteristics	1	A								
Secondary Growth	Heart Wood/Sap Wood	1	A					1	E		
	Cambium							1	D		

LOD - Level of Difficulty | E - Easy | A - Average | D - Difficult | Qns - No. of Questions

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Topic 1: Meristmatic Tissue/Simple and Complex Tissue

1. Regeneration of damaged growing grass following grazing is largely due to: *[2019]*
   (a) Secondary meristem
   (b) Lateral meristem
   (c) Apical meristem
   (d) Intercalary meristem
2. Xylem translocates: *[2019]*
   (a) Water only
   (b) Water and mineral salts only
   (c) Water, mineral salts and some organic nitrogen only
   (d) Water, mineral salts, some organic nitrogen and hormones
3. Root hairs develop from the region of : *[2017]*
   (a) Elongation
   (b) root cap
   (c) Meristematic activity
   (d) Maturation
4. Which of the following is made up of dead cells?
   (a) Collenchyma (b) Phellem *[2017]*
   (c) Phloem (d) Xylem parenchyma
5. Transmission tissue is characteristic feature of: *[2015 RS]*
   (a) Solid style (b) Dry stigma
   (c) Wet stigma (d) Hollow style
6. In a ring girdled plant: *[2015 RS]*
   (a) The root dies first
   (b) The shoot and root die together
   (c) Neither root nor shoot will die
   (d) The shoot dies first
7. Tracheids differ from other tracheary elements in:
   (a) having casparian strips *[2014]*
   (b) being imperforate
   (c) lacking nucleus
   (d) being lignified
8. Meristematic tissue responsible for increase in girth of tree trunk is *[NEET Kar. 2013]*
   (a) Apical meristem
   (b) Intercalary meristem
   (c) Lateral meristem
   (d) Phellogen

9. Companion cells are closely associated with: ***[2012]***
   (a) Sieve elements (b) Vessel elements
   (c) Trichomes (d) Guard cells
10. Function of companion cells is ***[2011M]***
   (a) providing energy to sieve elements for active transport
   (b) providing water to phloem
   (c) loading of sucrose into sieve elements by passive transport
   (d) loading of sucrose into sieve elements
11. The chief water conducting elements of xylem in gymnosperms are: ***[2010]***
   (a) vessels (b) fibres
   (c) transfusion tissue (d) tracheids
12. Reduction in vascular tissue, mechanical tissue and cuticle is dcharacteristic of: ***[2009]***
   (a) mesophytes (b) epiphytes
   (c) hydrophytes (d) xerophytes
13. The length of different internodes in a culm of sugarcane is variable because of ***[2008]***
   (a) shoot apical meristem
   (b) position of axillary buds
   (c) size of leaf lamina at the node below each internode
   (d) intercalary meristem
14. Passage cells are thin walled cells found in ***[2007]***
   (a) phloem elements that serve as entry points for substance for transport ot other plant parts
   (b) testa of seeds to enable emergence of growing embryonic axis during seed germination
   (c) central region of style through which the pollen tube grows towards the ovary
   (d) endodermis of roots facilitating rapid transport of water from cortex to pericycle.
15. A common structural feature of vessel elements and sieve tube elements are ***[2006]***
   (a) pores on lateral walls
   (b) presence of p-protein
   (c) enucleate condition
   (d) thick secondary walls
16. In a woody dicotyledonous tree, which of the following parts will mainly consist of primary tissues? ***[2005]***
   (a) All parts
   (b) Stem and root
   (c) Flowers, fruits and leaves
   (d) Shoot tips and root tips
17. In a longitudinal section of a root, starting from the tip upward, the four zones occur in the following order: ***[2004]***
   (a) Root cap, cell division, cell enlargement, cell maturation
   (b) Root cap, cell division, cell maturation, cell enlargement
   (c) Cell division, cell enlargement, cell maturation, root cap
   (d) Cell division, cell maturation, cell enlargement, root cap
18. The cells of the quiescent centre are characterised by ***[2003]***
   (a) dividing regularly to add to tunica
   (b) having dense cytoplasm and prominent nuclei
   (c) having light cytoplasm and small nuclei
   (d) dividing regularly to add to the corpus
19. The apical meristem of the root is present
   (a) in all the roots ***[2003]***
   (b) only in radicals
   (c) only in tap roots
   (d) only in adventitious roots
20. Chlorenchyma is known to develop in the
   (a) pollen tube of *Pinus* ***[2003]***
   (b) cytoplasm of *Chlorella*
   (c) mycelium of a green mould such as Aspergillus
   (d) spore capsule of a moss
21. Vessels are found in ***[2002]***
   (a) all angiosperms and some gymnosperms
   (b) most of angiosperms and few gymnosperms
   (c) all angiosperms, all gymnosperms and some pteriodophyta
   (d) all pteridophyta
22. Axillary bud and terminal bud are derived from the activity of ***[2002]***
   (a) lateral meristem
   (b) intercalary meristem
   (c) apical meristem
   (d) parenchyma
23. Which of the following statements is true? ***[2002]***
   (a) Vessels are multicellular with narrow lumen
   (b) Tracheids are multicellular with narrow lumen
   (c) Vessels are unicellular with wide lumen
   (d) Tracheids are unicellular with wide lumen

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24. Loading of pholem is related to *[2001]*
(a) increase of sugar in phloem
(b) elongation of phloem cell
(c) separation of phloem parenchyma
(d) strengthening of phloem fibre

25. A leaf primordium grows into the adult leaf lamina by means of *[1998]*
(a) apical meristem
(b) lateral meristem
(c) marginal meristems
(d) at first by apical meristem and later largely by marginal meristems.

26. At maturity which of the following is enucleate? *[1997]*
(a) Sieve cell (b) Companion cell
(c) Palisade cell (d) Cortical cell

27. What is not true about sclereids? *[1996]*
(a) These are parenchyma cells with thickened lignified walls
(b) These are elongated and flexible with tapered ends
(c) These are commonly found in the shells of nuts and in the pulp of guava, pear, etc
(d) These are also called the stone cells

28. Bordered pits are found in *[1993]*
(a) Sieve cells (b) Vessel wall
(c) Companion cells (d) Sieve tube wall

29. Angular collenchyma occurs in *[1991]*
(a) Cucurbita (b) *Helianthus*
(c) *Althaea* (d) *Salvia*

30. An organised and differentiated cellular structure having cytoplasm but no nucleus is *[1991]*
(a) Vessels (b) Xylemparenchyma
(c) Sieve tubes (d) Tracheids

31. Collenchyma occurs in *[1990]*
(a) herbaceous climbers
(b) woody climbers
(c) climbing stems
(d) water plants

32. For union between stock and scion in grafting which one is the first to occur? *[1990]*
(a) Formation of callus
(b) Production of plasmodesmata
(c) Differentiation of new vascular tissues
(d) Regeneration of cortex and epidermis

33. Organisation of stem apex into corpus and tunica is determined mainly by *[1989]*
(a) planes of cell division
(b) regions of meristematic activity
(c) rate of cell growth
(d) rate of shoot tip growth

34. Sieve tubes are suited for translocation of food because they possess *[1989]*
(a) bordered pits
(b) no ends walls
(c) broader lumen and perforated cross walls
(d) no protoplasm

35. Tunica corpus theory is connected with *[1988]*
(a) root apex (b) root cap
(c) shoot apex (d) secondary growth

36. Which meristem helps in increasing girth? *[1988]*
(a) Lateral meristem
(b) Intercalary meristem
(c) Primary meristem
(d) Apical meristem

37. Which one yields fibres? *[1988]*
(a) Coconut (b) Oak
(c) Teak (d) Sisso

Topic 2: Tissue System (Epidermis/Ground Vascular)

38. Casparian strips occur in *[2018]*
(a) Epidermis (b) Pericycle
(c) Endodermis (d) Cortex

39. Which of the following facilitates opening of stomatal aperture? *[2017]*
(a) Decrease in turgidity of guard cells
(b) Radial orientation of cellulose microfibrils in the cell wall of guard cells
(c) Longitudinal orientation of cellulose microfibrils in the cell wall of guard cells
(d) Contraction of outer wall of guard cells

40. Which of the following statements is **not** true for stomatal apparatus? *[NEET Kar. 2013]*
(a) Inner walls of guard cells are thick
(b) Guard cells invariably possess chloroplasts and mitochondria
(c) Guard cells are always surrounded by subsidiary cells
(d) Stomata are involved in gaseous exchange

41. Ground tissue includes *[2011]*
(a) all tissues external to endodermis
(b) all tissues except epidermis and vascular bundles
(c) epidermis and cortex
(d) all tissues internal to endodermis

42. In land plants, the guard cells differ from other epidermal cells in having : *[2011]*
(a) cytoskeleton
(b) mitochondria
(c) endoplasmic reticulum
(d) chloroplasts

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43. Palisade parenchyma is absent in leaves of:
(a) mustard (b) soybean *[2009]*
(c) gram (d) sorghum

44. Vascular tissues in flowering plants develop from: *[2008]*
(a) phellogen (b) plerome
(c) periblem (d) dermatogen

45. What happens during vascularization in plants? *[2000]*
(a) Differentiation of procambium is immediately followed by the development of secondary xylem and phloem
(b) Differentiation of procambium followed by the development of xylem and phloem
(c) Differentiation of procambium , xylem and phloem is simultaneous
(d) Differentiation of procambium followed by the development of primary phloem and then by primary xylem

Topic 3: Dicot/Monocot (Root/Stem/Leaf)

46. Identify the incorrect statement. *[2020]*
(a) Sapwood is involved in conduction of water and minerals from root to leaf
(b) Sapwood is the innermost secondary xylem and is lighter in colour
(c) Due to deposition of tannins, resins, oils etc., heart wood is dark in colour
(d) Heart wood does not conduct water but gives mechanical support

47. The roots that originate from the base of the stem are *[2020]*
(a) Primary roots (b) Prop roots
(c) Lateral roots (d) Fibrous roots

48. The transverse section of a plant shows following anatomical features : *[2020]*
(i) Large number of scattered vascular bundles surrounded by bundle sheath
(ii) Large conspicuous parenchymatous ground tissue
(iii) Vascular bundles conjoint and closed
(iv) Phloem parenchyma absent Identify the category of plant and its part :
(a) Monocotyledonous root
(b) Dicotyledonous stem
(c) Dicotyledonous root
(d) Monocotyledonous stem

49. In the dicot root the vascular cambium originates from : *[2019, Odisa]*
(a) Intrafascicular and interfascicular tissue in a ring.
(b) Tissue located below the phloem bundles and a portion of pericycle tissue above protoxylem.
(c) Cortical region
(d) Parenchyma between endodermis and pericycle.

50. Secondary xylem and phloem in dicot stem are produced by *[2018]*
(a) Apical meristems
(b) Vascular cambium
(c) Axillary meristems
(d) Phellogen

51. A major characteristic of the monocot root is the presence of : *[2015 RS]*
(a) Scattered vascular bundles
(b) Vasculature without cambium
(c) Cambium sandwiched between phloem and xylem along the radius
(d) Open vascular bundles

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52. Vascular bundles in monocotyledons are considered closed because: *[2015 RS]*
(a) Cambium is absent
(b) There are no vessels with perforations
(c) Xylem is surrounded all around by phloem
(d) A bundle sheath surrounds each bundle

53. You are given a fairly old piece of dicot stem and a dicot root. Which of the following anatomical structures will you use to distinguish between the two? *[2014]*
(a) Secondary xylem (b) Secondary phloem
(c) Protoxylem (d) Cortical cells

54. Closed vascular bundles lack *[2012]*
(a) Ground tissue (b) conjunctive tissue
(c) Cambium (d) Pith

55. Water containing cavities in vascular bundles are found in : *[2012]*
(a) Sunflower (b) Maize
(c) *Cycas* (d) *Pinus*

56. As compared to a dicot root, a monocot root has *[2012M]*
(a) many xylem bundles.
(b) relatively thicker periderm.
(c) inconspicuous annual rings.
(d) more abundant secondary xylem.

57. Which one of the following is wrongly matched?
(a) Root pressure - Guttation *[2011]*
(b) *Puccinia* - Smut
(c) Root - Exarch protoxylem
(d) *Cassia* - Imbricate aestivation

58. Some vascular bundles are described as open because these *[2011M]*
(a) are surrounded by pericycle but not endodermis
(b) are capable of producing secondary xylem and phloem
(c) possess conjunctive tissue between xylem and phloem
(d) are not surrounded by pericycle

59. Anatomically fairly old dicotyledonous root is distinguished from the dicotyledonous stem by
(a) absence of secondary phloem *[2009]*
(b) presence of cortex
(c) position of protoxylem
(d) absence of secondary xylem

60. The annular and spirally thickened conducting elements generally develop in the protoxylem when the root or stem is: *[2009]*
(a) elongating (b) widening
(c) differentiating (d) maturing

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61. In barley stem vascular bundles are: *[2009]*
(a) closed and scattered
(b) open and in a ring
(c) closed and radial
(d) open and scattered

62. Four radial vascular bundles are found in *[2002]*
(a) dicot root (b) monocot root
(c) dicot stem (d) monocot stem

63. Transition of radial vascular bundle in root to conjoint vascular bundle in stem occurs in which zone? *[1999]*
(a) Epicotyl (b) Hypocotyl
(c) Meristem (d) At base of stem

64. Where do the casparian bands occur? *[1990, 94]*
(a) Epidermis (b) Endodermis
(c) Pericycle (d) Phloem

65. Plant having column of vascular tissues bearing fruits and having a tap root system is *[1994]*
(a) monocot
(b) dicot
(c) gymnosperm of dicot
(d) gymnosperm or monocot

66. A bicollateral vascular bundle is characterised by *[1992]*
(a) Phloem being sandwiched between xylem
(b) Transverse splitting of vascular bundle
(c) Longitudinal splitting of vascular bundle
(d) Xylem being sandwiched between phloem

67. Monocot leaves possess *[1990]*
(a) intercalary meristem (b) lateral meristem
(c) apical meristem (d) mass meristem

68. Collenchyma occurs in the stem and petioles of
(a) Xerophytes (b) Monocots *[1990]*
(c) Dicot herbs (d) Hydrophytes

69. Pericycle of roots produces *[1990]*
(a) mechanical support (b) lateral roots
(c) vascular bundles (d) adventitious buds

70. What is true about a monocot leaf? *[1990]*
(a) Reticulate venation
(b) Absence of bulliform cells from epidermis
(c) Mesophyll not differentiated into palisade and spongy tissues
(d) Well differentiated mesophyll

71. Pith and cortex do not differentiate in *[1988]*
(a) monocot stem (b) dicot stem
(c) monocot root (d) dicot root

Topic 4: Secondary Growth

72. Which of the statements given below is not true about formation of annual rings in trees? *[2019]*
(a) Annual ring is a combination of spring wood and autumn wood produced in a year.
(b) Differential activity of cambium causes light and dark bands of tissue - early and late wood respectively.
(c) Activity of cambium depends upon variation in climate.
(d) Annual rings are not prominent in trees of temperate region.

73. Plants having little or no secondary growth are
(a) Grasses *[2018]*
(b) Deciduous angiosperms
(c) Cycads
(d) Conifers

74. The vascular cambium normally gives rise to: *[2017]*
(a) Primary phloem (b) Secondary xylem
(c) Periderm (d) Phelloderm

75. Identify the wrong statement in context of heartwood: *[2017]*
(a) It is highly durable
(b) It conducts water and minerals efficiently
(c) It comprises dead elements with highly lignified walls
(d) Organic compounds are deposited in it

76. Read the different components from (a) to (D) in the list given below and tell the correct order of the components with reference to their arrangement from outer side to inner side in a woody dicot stem. ***[2015 RS]***
(A) Secondary cortex (B) Wood
(C) Secondary phloem (D) Phellem
The correct order is:
(a) (A), (B), (D), (C) (b) (D), (A), (C), (B)
(c) (D), (C), (A), (B) (d) (C), (D), (B), (A)

77. Age of a tree can be estimated by :
(a) biomass ***[NEET 2013]***
(b) number of annual rings
(c) diameter of its heartwood
(d) its height and girth

78. Lenticels are involved in : ***[NEET 2013]***
(a) Gaseous exchange (b) Food transport
(c) Photosynthesis (d) Transpiration

79. Interfascicular cambium develops from the cells of : ***[NEET 2013]***
(a) Xylem parenchyma
(b) Endomermis
(c) Pericycle
(d) Medullary rays

80. The common bottle cork is a product of: ***[2012]***
(a) Dermatogen (b) Phellogen
(c) Xylem (d) Vascular Cambium

81. Gymnosperms are also called soft wood spermatophytes because they lack : ***[2012]***
(a) Cambium
(b) Phloem fibres
(c) Thick-walled tracheids
(d) Xylem fibres

82. The cork cambium, cork and secondary cortex are collectively called: ***[2011]***
(a) phelloderm' (b) phellogen
(c) periderm (d) phellem

83. Which one of the following is not a lateral meristem? ***[2010]***
(a) Intrafascicular cambium
(b) Interfascicular cambium
(c) Phellogen
(d) Intercalary meristem

84. Heartwood differs from sapwood in: ***[2010]***
(a) presence of rays and fibres
(b) absence of vessels and parenchyma
(c) having dead and non-conducting elements
(d) being susceptible to pests and pathogens

85. Which one of the following is resistant to enzyme action? ***[2008]***
(a) Cork (b) Wood fibre
(c) Pollen exine (d) Leaf cuticle

86. For a critical study of secondary growth in plants. Which one of the following pairs is suitable?
(a) teak and pine ***[2007]***
(b) deodar and fern
(c) wheat and maiden hair fern
(d) sugarcane and sunflower.

87. Ectophloic siphonostele is found in ***[2004]***
(a) *Osmunda* and *Equisetum*
(b) *Marsilea* and *Botrychium*
(c) *Adiantum* and Cucurbitaceae
(d) *Dicksonia* and Maidenhair fern

88. Main function of lenticel is ***[2002]***
(a) transpiration (b) guttation
(c) gaseous exchange (d) bleeding

89. Which of the following meristems is responsible for extrastelar secondary growth in dicotyledonous stem? ***[1998]***
(a) Intrafascicular cambium
(b) Interfascicular cambium
(c) Intercalary meristem
(d) Phellogen

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90. Procambium forms ***[1994]***
(a) only primary vascular bundles
(b) only vascular cambium
(c) only cork cambium
(d) primary vascular bundles and vascular cambium

91. As the secondary growth takes place (proceeds) in a tree, thickness of ***[1994]***
(a) heart wood increases
(b) sap-wood increases
(c) both increase
(d) both remain the same

92. Abnormal/anomalous secondary growth occurs in ***[1993]***
(a) *Dracaena* (b) Ginger
(c) Wheat (d) Sunflower

93. Which exposed wood will decay faster? ***[1993]***
(a) Sapwood
(b) Softwood
(c) Wood with lot of fibres
(d) Heartwood

94. A narrow layer of thin walled cells found between phloem/bark and wood of a dicot is ***[1993]***
(a) Cork cambium (b) Vascular cambium
(c) Endodermis (d) Pericycle

95. Periderm is produced by *[1993]*
(a) Vascular cambium
(b) Fascicular cambium
(c) Phellogen
(d) Intrafascicular cambium

96. Vascular cambium produces *[1990, 92]*
(a) primary xylem and primary phloem
(b) secondary xylem and secondary phloem
(c) primary xylem and secondary phloem
(d) secondary xylem and primary phloem

97. Commercial cork is obtained from *[1991]*
(a) *Berberis/Barberry* (b) *Salix/Willow*
(c) *Quercus/Oak* (d) *Betula/Birch*

98. Cork cambium and vascular cambium are *[1990, 95]*
(a) parts of secondary xylem and phloem
(b) parts of pericycle
(c) lateral meristems
(d) apical meristems

99. Which is the correct fact about diffuse or ring porous wood? *[1989]*
(a) Ring porous wood, carries more water for short period
(b) Diffuse porous wood carries more water
(c) Ring porous wood carries more water when need is higher
(d) Diffuse porous wood is less specialised but conducts water rapidly throughout

100. Cork is formed from *[1988]*
(a) cork cambium (phellogen)
(b) vascular cambium
(c) phloem
(d) xylem

ANSWER KEY

1	(d)	11	(d)	21	(b)	31	(c)	41	(b)	51	(b)	61	(a)	71	(a)	81	(d)	91	(a)
2	(d)	12	(c)	22	(c)	32	(a)	42	(d)	52	(a)	62	(a)	72	(d)	82	(c)	92	(a)
3	(d)	13	(d)	23	(d)	33	(a)	43	(d)	53	(c)	63	(b)	73	(a)	83	(d)	93	(a)
4	(b)	14	(d)	24	(a)	34	(c)	44	(b)	54	(c)	64	(b)	74	(b)	84	(c)	94	(b)
5	(a)	15	(c)	25	(d)	35	(c)	45	(b)	55	(b)	65	(b)	75	(b)	85	(c)	95	(c)
6	(a)	16	(d)	26	(a)	36	(a)	46	(b)	56	(a)	66	(d)	76	(b)	86	(a)	96	(b)
7	(b)	17	(a)	27	(a)	37	(a)	47	(d)	57	(b)	67	(a)	77	(b)	87	(a)	97	(c)
8	(c)	18	(c)	28	(b)	38	(c)	48	(d)	58	(b)	68	(c)	78	(a)	88	(a)	98	(c)
9	(a)	19	(a)	29	(a)	39	(b)	49	(b)	59	(c)	69	(b)	79	(d)	89	(d)	99	(c)
10	(d)	20	(d)	30	(c)	40	(c)	50	(b)	60	(d)	70	(c)	80	(b)	90	(a)	100	(a)

MOTIVATION

Hints & Solutions

1. (d) Intercalary meristems are capable of cell division and they allow for rapid growth and regrowth of many monocots. Intercalary meristem, found in grasses, help to regenerate the parts removed by the grazing herbivores.

NOTES

Intercalary meristem is a type of meristematic tissue associated with the growth in length in the middle position, thus the name. In particular, it is made up of meristematic cells that divide mitotically in the stem at the base of nodes and leaf blades. The growth at this point is referred to as intercalary growth.

2. (d) Xylem is a type of complex tissue . it translocates water, mineral salts, organic nitrogen and hormones.

3. (d) In roots, the root hairs develops from zone of maturation. This zone is differentiated zone thus bearing root hairs.

NOTES

The occurrence of the root hair at the zone of maturation is because it is region from where the root is differentiated into tissue of the primary body. The root hair develop in this region and lives for a day. The root hair develops form the single epidermal cells and help to absorb water from the soil.

4. (b) Cork cambium undergoes periclinal division and cuts off thick walled suberised dead cells towards outside i.e. phellem (cork) and it cuts off thin walled living cells i.e., phelloderm on inner side.

NOTES

A mature cork cell is non-living and has cell walls that are composed of a waxy substance that is highly impermeable to gases and water called suberin. The layer of dead cells formed by the cork cambium provides the internal cells of the plants with extra insulation and protection.

5. (a) A solid style has transmission tissue which has large intercellular spaces. It allows growth of pollen tube in pistil.
6. (a) In a ring girdled plant, roots die first due to damage of phloem causing inhibition of translocation of food.
7. (b) The walls of vessels (tracheary elements) are lignified and less thicker than tracheids. The lumen is wider. Vessels differ from tracheids in having cell fusions arising through the dissolution of end walls.
8. (c) Lateral meristems are meristems which occur parallel to the circumference of the organs in which they develop. They undergo periclinal divisions producing secondary tissues on the outer and inner sides and increase the girth of the plant organs. Examples are vascular cambium and cork-cambium.
9. (a) Companion cells are narrow, elongated and thin walled **living cells**. They lie on the **sides** of the sieve tubes and are closely associated with them through **compound plasmodesmata**.

NOTES

It is supposed that the nuclei of the companion cells control the activities of the sieve tube through plasmodesmata. Companion cells also help in maintaining a proper **pressure gradient** in the sieve tube elements.

10. (d) Function of companion cell is to load sugar and amino acids into sieve elements. These cells use transmembrane proteins for uptake by active transport.
11. (d) Tracheids are chief water conducting elements of xylem in gymnosperms. They are devoid of protoplasm and hence dead. The wall constituting the tracheids is hard, thick and lignified. These are elongated cells with tapering ends.
12. (c) Reduction in vascular tissue, mechanical tissue and cuticle is characteristic of hydrophytes.
13. (d) The length of different internodes in a culm of sugarcane is variable because of intercalary meristem. Intercalary meristem is not a part of apical meristem. It occurs in the internodes of grasses (sugarcane) between leaf nodes and enables longitudinal growth of the stem.
14. (d) The innermost layer of the cortex is called endodermis. It comprises a single layer of barrel shaped cells without any intercellular spaces. In roots thick walled endodermal cells are interrupted by thin walled passage cells or transfusion tissue.
15. (c) In plants, conducting tissue xylem has an important integral cell as xylem vessel which is enucleate. The phloem on other hand has a row of sieve tubes which are also enucleate at maturity.
16. (d) Primary Meristems : They are those meristematic tissues which are dervied directly from the meristems of the embryo and retain their meristematic activity. They are present at root, shoot tip and leaf primordia.

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17. (a) Root shows the following regions
Root cap or calyptra - caplike protective covering over tip of the root
Meristematic region is the subapical position
Zone of elongation - receives new cells from the growing point
Root hair zone - is the zone of differentiation
Zone of mature cells - having thick walled impermeable cells.
18. (c) The cells of queiscent centre have lower concentration of DNA, RNA and protein as compared to other cells in the root apex. These cells do not divide, hence cytoplasm is light and nuclei are small in them. This concept is based upon quiescent centre theory proposed by Clowes (1961).
19. (a) The apical meristem of the root is present at all the root tips. Apical meristem is subterminal in position of the growing root tips and responsible for terminal growth of the root in plants.
20. (d) Chlorenchyma cells are those parenchymatous cell which contain chloroplast in them. They are capable of photosynthesis. A spore capsule of moss can perform photosynthesis, thus chlorenchyma are present in them.

21. (b) Generally gymnosperms do not have vessels but a few gymnosperms with vessels are *Ephedra*, *Smilax* etc. Most of angiosperms have vessels except of few e.g., *Trochodendron*.
22. (c) Apical meristem is located at the apex of stem, root and branches, and forms axillary and terminal bud. Intercalary meristems take part in linear growth. Lateral meristem occurs parallel to the circumference of the organs. They increase the girth of the plant.

NOTES

The axillary bud is an embryonic or organogenic shoot located in the axil of a leaf. Each bud has the potential to form shoots, and may be specialized in producing either vegetative shoots or reproductive shoots. Once formed, a bud may remain dormant for some time, or it may form a shoot immediately.

23. (d) Vessels are elongated, multicellular water conducting channels with wide lumen formed by end to end fusion of a large number of vessel elements. Tracheids are elongated dead cells with tapering ends having lignified walls and large or wide lumen. Their main function is conduction of water and minerals from root to leaf.
24. (a) Phloem is involved in transport of organic food. According to mass flow hypothesis organic substances flow in the form of solution in sieve elements due to development of an osmotically generated pressure gradient.
25. (d) A leaf primordium grows into the adult leaf lamina by means of apical meristem first and later marginal meristems.
26. (a) Sieve tubes members do not have ribosomes or a nucleus and thus need companion cells to help them function as transport molecules. Companion cells provide Sieve tube members with proteins necessary for signalling and ATP in order to help them transfer molecules between different parts of the plant.
27. (a) Sclereids are small bundles of sclerenchyma tissue in plants that form durable layers, such as the cores of apples and the gritty texture of pears. Sclereids are variable in shape.

NOTES

The cells can be isodiametric, prosenchymatic, forked or fantastically branched. The cell walls fill nearly all the cell's volume. The shell of many seeds like those of nuts as well as the stones of drupes like cherries or plums are made up from sclereid.

28. (b) The walls of xylem vessels are lignified and bordered pits are common in the walls
29. (a) Along with providing mechanical strength, collenchyma also provides flexibility to the organ and allows their bending eg. : *Cucurbita*.
30. (c) Internally, sieve tubes possess peripheral layer of cytoplasm and are devoid of nucleus. They are living cells. Cell walls of sieve tubes are thickened than surrounding parenchyma cells.
31. (c) Collenchyma is abundant in climbing stems providing mechanical strength.
32. (a) In grafting, union between stock and scion produces undifferentiated mass of cells called callus.

NOTES

Grafting is a method of plant propagation widely used in horticulture, where the tissues of one plant are encouraged to fuse with those of another. It is most commonly used for the propagation of trees and shrubs grown commercially. Grafting is limited to dicots and gymnosperms. Monocots lack the vascular cambium required.

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33. (a) Cells of tunica divide anticlinally to form the outer layer, cells of corpus undergo division in different planes.
34. (c) Sieve tubes are elongated tubular conducting channels of phloem. The end walls possess many small pores and have thin cellulosic wall. The lumen is broad in nature.
35. (c) The shoot apex or stem apical meristem has two zones, outer tunica and inner corpus. This theory was given by Schmidt 1924.
36. (a) Lateral meristems occur on the sides of stem and help in increasing girth of stem and root. It divides only periclinally or radially and is responsible for increase in girth or diameter.
37. (a) Commercial fibres are obtained from *Cocos nucifera* (coconut) also called surface fibres and occur on surface of seeds.
38. (c) Casparian strip is a band of cell wall material deposited in the radial and transverse walls of the endodermis. Casparian strip is made of suberin and sometimes lignin.
39. (b) Cellulose microfibrils are arranged radially rather than longitudinally which makes easy for the stomata to open.
40. (c) Sometimes, a few epidermal cells in the vicinity of the guard cells become specialised in their shape and size and are known as subsidiary cells or accessory cells.

41. (b) Ground tissue includes all tissues except epidermis and vascular bundles. The ground tissue comprises the bulk of the primary plant body. Parenchyma, collenchyma and sclerenchyma cells are common in the ground tissue.
42. (d) Guard cells differ from epidermal cells in having chloroplast. The cell wall of guard cells are not uniform, inner walls are thicker than the outer walls, epidermal cells are uniformly thin.
43. (d) Palisade parenchyma is absent in leaves of sorghum. It is a leaf tissue composed of columnar cells containing numerous chloroplasts in which the long axis of each cell is perpendicular to the leaf surface. The palisade parenchyma is usually directly beneath the epidermis of the upper surface of the leaf.

NOTES

The cells of the palisade parenchyma are cylindrical. Neighbouring cells look like the stakes of a palisade. Cells of the palisade parenchyma contain three to five times as many chloroplasts as those of the spongy parenchyma. The chloroplasts are usually present near the cell wall, since this adjustment guarantees optimal use of light.

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44. (b) Vascular tissues in flowering plants develop from plerome. Plerome is a central core of primary meristem which gives rise to all cells of the stele from the pericycle inward.
45. (b) Vascularization of plant means the development of vascular bundle in the plant, which develops from the cambium.
46. (b) Correct statement: Sapwood is outermost secondary xylem. Outer secondary xylem or sapwood serves in water conduction, while the inner part called heartwood is composed of dead but structurally strong primary xylem.

NOTES

Xylem formation begins when the actively dividing cells of growing root and shoot tips (apical meristems) give rise to primary xylem.

47. (d) The roots that originate from the base of the stem are fibrous roots. A **fibrous root** system is the opposite of a taproot system. It is usually formed by thin, moderately branching **roots** growing from the stem. A **fibrous root** system is universal in monocotyledonous plants and ferns. The **fibrous root** systems look like a mat made out of **roots** when the tree has reached full maturity.

NOTES

Advantages of fibrous root systems include that they allow the plant to absorb water and minerals over a large surface area closer to the surface of the soil. They are also useful in helping prevent or reduce soil erosion since these root systems help hold the soil particles together.

48. (d) The monocot stem is characterised by conjoint, collateral, and closed vascular bundles, scattered in the ground tissue containing the parenchyma. Each vascular bundle is surrounded by sclerenchymatous bundle-sheath cells. Phloem parenchyma and medullary rays are absent in monocot stems.

NOTES

The dicot stem does not have a bundle sheath on the outside of a vascular bundle. The monocot stem has a sclerenchymatous bundle sheath on the outside of a vascular bundle.

49. (b) Vascular cambium is a secondary meristematic tissue, in dicot roots. It is originated from tissue located below the phloem bundles and a portion of pericycle tissue above the protoxylem.

NOTES

The vascular cambium produces secondary xylem on the inside of the ring, and secondary phloem on the outside, pushing the primary xylem and phloem apart. The vascular cambium usually consists of two types of cells: Fusiform initials (tall, axially oriented) Ray initials (smaller and round to angular in shape)

50. (b) Secondary tissues are generated from the growth of a cambium. Vascular cambium gives rise to secondary xylem to the inside, and to secondary phloem to the outside.
51. (b) Monocot root shows radial and closed vascular bundle (xylem & phloem).
52. (a) Vascular bundles in monocotyledons are considered closed due to absence of cambium.
53. (c) Anatomically fairly old dicotyledonous root is distinguished from the dicotyledonous stem by position of the protoxylem. In dicot root, the protoxylem is located near the periphery of the vascular cylinder while in dicot stem the protoxylem is located near the centre of vascular bundle *i.e.,* the xylem is endarch.
54. (c) In closed vascular bundle cambium is absent between xylem and phloem.
55. (b) Stem of maize has water containing cavities in vascular bundles.

56. (a) The vascular bundles are arranged in a loose circle inside the endodermis of a monocot root. In a monocot root, more than six vascular bundles are present. It shows polyarch condition.

57. (b) Smut is a disease of cereals, corn, grasses and sorghum caused by many species of fungi.

NOTES

The smuts are multicellular fungi characterized by their large numbers of teliospores. The smuts get their name from a Germanic word for dirt because of their dark, thick-walled, and dust-like teliospores. They are mostly Ustilaginomycetes and can cause plant disease.

58. (b) Open vascular bundles means presence of cambium during secondary growth. Vascular cambium divides to form secondary xylem towards inner side while secondary phloem towards outside.

59. (c) Anatomically fairly old dicotyledonous root is distinguished from the dicotyledonous stem by position of protoxylem. In dicot root the protoxylem is located near the periphery of the vascular cylinder while in dicot stem the protoxylem is located near the centre of vascular bundle i.e. the xylem is endarch.

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60. (d) The annular and spirally thickened conducting elements generally develop in the protoxylem when the root or stem is maturing.

61. (a) In barley stem, vascular bundles are closed and scattered. They are open only for a hours in the day time and never open at night. e.g Cereals.

62. (a) When xylem and phloem strands are present at different radii the vascular bundles are radial and 4 radial vascular bu ndles (tetrach condition) are present in dicot root. This is called tetrach conditions.

63. (b) Transition of radial vascular bundle in root to conjoint vascular bundle in stem occurs in transition zone which is generally hypocotyl. Hypocotyl is the part of embryonal axis below the level of cotyledons.

64. (b) Endodermis or innermost layer of cortex has casparian strips in roots. It is called starch sheath in dicot stems. It separates cortex from stele. The cell walls are thickened at the corners in angular collenchyma.

65. (b) Dicots prossess tap root system

66. (d) Bicollateral vascular bundles have phloem in both outer and inner side of xylem. These type of bundles occur in cucurbitaceae.

67. (a) Intercalary meristems are derived from apical meristems and separated from the same by permanent cells. They are responsible for localised growth.

68. (c) Collenchyma provides mechanical strength to young dicot stems, petioles and leaves.

69. (b) Pericycle in roots is active in the formation of root branches or lateral roots.

70. (c) In monocot leaves, the mesophyll cells are undifferentiated.

71. (a) The ground tissue in monocot stem do not show distinction into cortex, endodermis, pericycle, pith and pith rays.

72. (d) Growth rings are formed by the seasonal activity of cambium. In plants of temperate regions, cambium is more active in spring (less lignin deposition in xylem) and less active in autumn (more lignin deposition in xylem) seasons. In temperate regions climatic conditions are not uniform throughout the year. However in tropics climatic conditions are uniform throughout the year.

73. (a) Grasses are monocots and monocots usually do not have secondary growth. Palm like monocots have anomalous secondary growth.

74. (b) During secondary growth in plants vascular cambium gives rise to secondary xylem and secondary phloem. Phelloderm is formed by cork cambium. Periderm is the corky outer layer formed in secondary thickening.

75. (b) Heartwood is inactive physiologically due to deposition of organic compounds and formation of tyloses so it will not conduct water and minerals..

76. (b) The correct sequence from outerside to inner side in a woody dicot stem is as follows: Phellem → Secondary cortex → Secondary phloem → Wood , [(D) → (A) → (C) → (B)]

77. (b) Age of a tree can be estimated by number of annual rings. Annual ring constitute alternate concentric rings of spring wood and autumn wood.

78. (a) Lenticels are lens shaped openings occuring in stems of most of the woody trees. It permits the exchange of gases between the outer atmosphere and the internal tissue of the stem.

79. (d) At the time of secondary growth interfascicular cambium is formed by parenchymatous medullary rays.
Interfascicular cambium along with intrafascicular cambium (formed from cambium cells present between xylem and phloem) constitute continuous cambium ring. If new cells are cut off in both directions it causes secondary growth in most dicotyledonous plants.

80. (b) The common bottle cork is the product of phellogen. Phellogen produces cork or phellem on the outer side. It consists of dead and compactly arranged rectangular cells that possess suberised cell walls.

NOTES
The cork cells contain tannins. Hence, they appear brown or dark brown in colour. The cork cells of some plants are filled with air *e.g.*, *Quercus suber* (Cork Oak or Bottle Cork).

81. (d) Xylem fibres provide rigidity to the plant.

82. (c) Phellem, phellogen and phelloderm are collectively called periderm.

83. (d) Meristem is divided on the basis of position in plant bodies into apical meristem, lateral meristem and intercalary meristem. Lateral meristem is present on the lateral sides, that is fascicular and interfascicular cambium and cork cambium (phellogen).

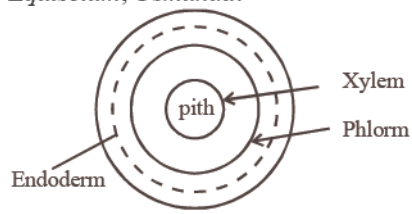
84. (c) Heartwood differs from sapwood in having dead and non-conducting elements. In old trees, the inner region that comprises dead elements with highly lignified walls is called heartwood.

NOTES
Heartwood does not conduct water but gives mechanical support to the stem. On the other hand, the peripheral region, which is lighter in colour is called sapwood. It is involved in the conduction of water and minerals from root to leaf.

85. (c) Pollen exine is resistant to enzyme action. The hard outer layer called the exine is made up of sporopollenin which is one of the most resistant organic material known. It can withstand high temperatures and strong acids and alkali. No enzymes that degrade sporopollenin are so far known.

86. (a) Teak and pine are most suitable for the study of critical secondary growth because in secondary growth, secondary tissues are formed from lateral meristem which is well developed in these two cases and secondary growth occurs in gymnosperms and dicots.

87. (a) The central pith is surrounded by xylem, phloem, pericycle and endodermis . The phloem occurs only outside the xylem e.g *Equisetum*, *Osmunda*.



88. (a) Lenticels are pores present in woody stem through which transpiration or loss of water vapour takes place. Lenticel formation begins during the development of the first periderm.

NOTES
In the stem, they usually appear below a stoma or group of stomata. It should also be noted that lenticels can be present on fruits such as apples and pears.

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89. (d) Intrafascicular cambium occurs inside the vascular bundles in between xylem and phloem. Interfascicular cambium develops in the form of strips at the level of intrafascicular cambium of vascular bundles. Intercalary meristem lie in between areas of permanent tissues.

90. (a) Procambium is the derivative of shoot apical meristem and forms vascular strand.

91. (a) Heartwood is the central wood of mature dicot stem and is the nonfunctional part of secondary xylem.

92. (a) Abnormal secondary growth occurs in some arborescent monocots (eg. : *Dracaena*, *Yucca*)

93. (a) Sapwood is less durable because it is susceptible to attack by pathogen and insects. It is physiologically active and conduction of water takes place through it. Heartwood is not attacked by pathogens and insects as it is physiologically inactive. It is filled with tannins, resins and gums which are not preferred by insects and pathogens.

94. (b) Vascular cambium is produced by two types of meristems, fascicular and interfascicular cambium.

95. (c) Secondary ground tissue or periderm is formed from phellogen or cork cambium. The phellogen forms phellem on the outer face and phelloderm on the inner. The three layers i.e., phellem, phellogen and phelloderm jointly constitute the periderm.

96. (b) Vascular cambium produces secondary xylem on the inner side and secondary phloem to the outer side.

97. (c) *Quercus suber* (cork oak or bottle cork) possess cork cells. Cork cells are dead, suberized and impervious to water and air, compactly arranged with no intercellular spaces.

98. (c) Cork cambium and vascular cambium are responsible for secondary growth which increases the girth of the stem.

99. (c) Ring porous wood is more advanced than diffuse porous wood as it provides for better translocation when requirement of plant is high.

100. (a) Phellogen present in outer cortical cells produce cork or phellem on the outer side which consists of dead and compactly arranged rectangular cells that possess suberised cell walls which causes them to become buoyant. Phellogen also cuts off cells on innerside called as phelloderm or secondary cortex.

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7 Structural Organisation in Animals

Trend Analysis with Important Topics & Sub-Topics

		2020		2019		2018		2017		2016	
Topic	Sub-Topics	Qns.	LOD	Qns.	LOD	Qns.	LOD	Qns.	LOD	Qns.	LOD
Tissue/ Epithelial Tissue	Columar Epithelium			1	A						
	Cuboidal Epithelium	1	A								
Connective Tissue	Loose Connective Tissue									1	A
Neural Tissue											
Cockroach/ Earthworm/ Frog	Circulatory system of frog			1	D	1	A			1	A
	Cockroach										

LOD - Level of Difficulty | E - Easy | A - Average | D - Difficult | Qns - No. of Questions

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Topic 1: Tissue/Epithelial Tissue

1. Cuboidal epithelium with brush border of microvilli is found in *[2020]*
   (a) Ducts of salivary gland
   (b) Proximal convoluted tubule of nephron
   (c) Eustachian tube
   (d) Lining of intestine
2. Choose the correctly matched pair: *[2014]*
   (a) Inner lining of salivary ducts – Ciliated epithelim
   (b) Moist surface of buccal cavity – Glandular epithelium
   (c) Tubular parts of nephrons – Cuboidal epithelium
   (d) Inner surface of bronchioles – Squamous epithelium
3. The ciliated columnar epithelial cells in humans are known to occur in : *[2011]*
   (a) eustachian tube and stomach lining
   (b) bronchioles and fallopian tubes
   (c) bile duct and oesophagus
   (d) fallopian tubes and urethra
4. The kind of epithelium which forms the inner walls of blood vessels is : *[2010]*
   (a) cuboidal epithelium
   (b) columnar epithelium
   (c) ciliated columnar epithelium
   (d) squamous epithelium
5. The epithelial tissue present on the inner surface of bronchioles and fallopian tube is: *[2009]*
   (a) glandular (b) ciliated
   (c) squamous (d) cuboidal
6. The cell junctions called tight, adhering and gap junctions are found in *[2009]*
   (a) connective tissue (b) epithelial tissue
   (c) neural tissue (d) muscular tissue
7. Simple epithelium is a tissue in which the cells are *[2000]*
   (a) hardened and provide support to the organs
   (b) cemented directly to one another to form a single layer
   (c) continuously dividing to provide form to an organ
   (d) loosely connected to one another to form an irregular organ

8. Stratum germinativum is an example of which kind of epithelium? *[1997]*
   (a) Cuboidal (b) Ciliated
   (c) Columnar (d) Squamous
9. Basement membrane is made up of *[1997]*
   (a) epidermal cells only
   (b) endodermal cells only
   (c) both epidermal and endodermal cells
   (d) no cell at all, but is a product of epithelial cells
10. Epithelial tissue with thin flat cells appearing like packed tiles occurs on *[1994]*
   (a) inner lining of cheek
   (b) inner lining of stomach
   (c) inner lining of fallopian tubes
   (d) inner lining of ovary
11. The layer of actively dividing cells of skin is termed as *[1993]*
   (a) stratum compactum
   (b) stratum corneum
   (c) stratum malpighii/stratum germinativum
   (d) stratum lucidum
12. Hair present in the skin are *[1993]*
   (a) epidermal in origin and made of dead cells
   (b) epidermal in origin and made of living cells
   (c) dermal in origin and made of living cells
   (d) dermal in origin and made of dead cells

Topic 2: Connective Tissue

13. Match the following cell structure with its characteristic feature : *[2019]*

Column-I	Column-II
(a) Tight junctions	(i) Cement neighbouring cells together to form sheet.
(b) Adhering junctions	(ii) Transmit information through chemical to another cells.
(c) Gap junctions	(iii) Establish a barrier to prevent leakage of fluid across epithelial cells.
(d) Synaptic junctions	(iv) Cytoplasmic channels to facilitate communication between adjacent cells.

Select correct option from the following :
   (a) (a)-(iv), (B)-(iii), (C)-(i), (D)-(ii)
   (b) (a)-(ii), (B)-(iv), (C)-(i), (D)-(iii)
   (c) (a)-(iv), (B)-(ii), (C)-(i), (D)-(iii)
   (d) (a)-(iii), (B)-(i), (C)-(iv), (D)-(ii)
14. Which type of tissue correctly matches with its location ? *[2016]*

	Tissue	Location
(a)	Smooth muscle	Wall of intestine
(b)	Areolar tissue	Tendons
(c)	Transitional epithelium	Tip nose
(d)	Cuboidal epithelium	Lining of stomach

15. Choose the correctly matched pair: *[2014]*
   (a) Tendon–Specialized connective tissue
   (b) Adipose tissue – Dense connective tissue
   (c) Areolar tissue – Loose connective tissue
   (d) Cartilage–Loose connective tissue
16. Given below is the diagrammatic sketch of a certain type of connective tissue. Identify the parts labeled A, B, C and D, and select the correct answer from the given option. *[2012M]*

	Part-A	Part-B	Part-C	Part - D
(a)	Macro-phage	Fibro-blast	Collagen fibres	Mast cells
(b)	Mast cell	Macro-phage	Fibroblast	Collagen fibres
(c)	Macro-phage	Collagen fibres	Fibroblast	Mast cell
(d)	Mast cell	Collagen fibres	Fibroblast	Macrophage

17. The supportive skeletal structures in the human external ears and in the nose tip are examples of *[2012M]*
   (a) ligament (b) areolar tissue
   (c) bone (d) cartilage
18. The cells lining the blood vessels belong to the category of: *[2011M]*
   (a) smooth muscle tissue
   (b) squamous epithelium
   (c) columnar epithelium
   (d) connective tissue

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19. The kind of tissue that forms the supportive structure in our pinna (external ears) is also found in: ***[2009]***
    (a) nails (b) ear ossicles
    (c) tip of the nose (d) vertebrae
20. In which one of the following preparations are your likely to come across cell junctions most frequently ? ***[2007]***
    (a) Thrombocytes (b) Tendon
    (c) Hyaline cartilage (d) Ciliated epithelium.
21. Areolar connective tissue joins ***[2006]***
    (a) integument with muscles
    (b) bones with muscles
    (c) bones with bones
    (d) fat body with muscles
22. Mast cells secrete ***[2006]***
    (a) myoglobin (b) histamine
    (c) hemoglobin (d) hippurin
23. Which cartilage is present at the end of long bones? ***[2002]***
    (a) Calcified cartilage (b) Hyaline cartilage
    (c) Elastic cartilage (d) Fibrous cartilage
24. During an injury nasal septum gets damaged and for its recovery which cartilage is preferred? ***[2001]***
    (a) Hyaline cartilage (b) Elastic cartilage
    (c) Calcified cartilage (d) Fibrous cartilage
25. The polysaccharide present in the matrix of cartilage is known as ***[2000]***
    (a) cartilagin (b) ossein
    (c) chondriotin (d) casein
26. Protein present in the matrix of cartilage is known as ***[1997]***
    (a) chondrin (b) casein
    (c) cartilagin (d) ossein
27. Formation of cartilage bones involves ***[1993]***
    (a) deposition of bony matter by osteoblasts and resorption chondroblasts
    (b) deposition of bony matter by osteoclasts and resorption by chondroblasts
    (c) deposition of bony matter by osteoclasts only
    (d) deposition of bony matter by osteoblasts only
28. Blood capillary consists of ***[1993]***
    (a) endothelium only
    (b) endothelium and thin coat of connective tissue
    (c) endothelium and thin coat of muscle fibres
    (d) endothelium and thin coat of connective tissue plus muscle fibres
29. Histamine secreting cells are found in ***[1989]***
    (a) connective tissues (b) lungs
    (c) muscular tissue (d) nervous tissue

Topic 3: Muscular Tissue

30. Identify the tissue shown in the diagram and match with its characteristcs and its location ***[NEET Kar. 2013]***

    (a) Skeletal muscle, shows striations and closely attached with the bones of the limbs
    (b) Smooth muscles, show branching, found in the walls of the heart
    (c) Cardiac muscles, unbranched muscles, found in the walls of the heart
    (d) Striated muscles, tapering at both-ends, attached with the bones of the ribs
31. The four sketches (1, 2, 3 and 4) given below, represent four different types of animal tissues. Which one of these is correctly identified in the options given, along with its correct location and function? ***[2012M]***

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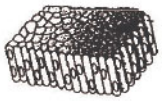
(1) 
(2)
(3)
(4)

		Tissue	Location	Function
(a)	(2)	Glandular epithelium	Intestine	Secretion
(b)	(3)	Collagen fibres	Cartilage	Attach skeletal muscles to bones
(c)	(4)	Smooth muscle tissue	Heart	Heart contraction
(d)	(1)	Columnar epithelium	Nephron	Secretion and absorption

32. The type of muscles present in our : *[2011M]*
(a) heart are involuntary and unstriated smooth muscles
(b) intestine are striated and involuntary
(c) thigh are striated and voluntary
(d) upper arm are smooth muscle fibres fusiform in shape

33. Which one of the following is correct pairing of a body part and the kind of muscle tissue that moves it ? *[2009]*
(a) Biceps of upper arm–Smooth muscle fibres
(b) Abdominal wall–Smooth muscle
(c) Iris–Involuntary smooth muscle
(d) Heart wall–Involuntary unstriated muscle

34. Which of the following is not exclusively supplied with involuntary muscles ? *[1998]*
(a) Muscular coats of blood vessels
(b) Muscles of the ducts of glands
(c) Muscles of iris
(d) Muscles of urethra

Topic 4: Neural Tissue

35. Which one of the following contains the largest quantity of extracellular material? *[2003]*
(a) Myelinated nerve fibres
(b) Striated muscle
(c) Areolar tissue
(d) Stratified epithelium

36. Which cells do not form layer and remain structurally separate? *[2001]*
(a) Epithelial cells (b) Muscle cells
(c) Nerve cells (d) Gland cells

Topic 5: Cockroach/Earthworm/Frog

37. Which of the following statements is INCORRECT ? *[2019]*
(a) Female cockroach possesses sixteen ovarioles in the ovaries.
(b) Cockroaches exhibit mosaic vision with less sensitivity and more resolution.
(c) A mushroom-shaped gland is present in the 6th-7th abdominal segments of male cockroach.
(d) A pair of spermatheca is present in the 6th segment of female cockroach.

38. Frog's heart when taken out of the body continues to beat for sometime. *[2017]*
Select the best option from the following statements.
(a) Frog is a poikilotherm.
(b) Frog does not have any coronary circulation.
(c) Heart is "myogenic" in nature.
(d) Heart is autoexcitable
Options:
(a) Only (D) (b) (a) and (B)
(c) (c) and (D) (d) Only (c)

39. Which of the following features is not present in *Periplaneta americana* ? *[2016]*
(a) Schizocoelom as body cavity
(b) Indeterminate and radial cleavage during embryonic development
(c) Exoskeleton composed of N-acetylglucos-amine
(d) Metamerically segmented body

40. The body cells in cockroach discharge their nitrogenous waste in the haemolymph mainly in the form of : *[2015 RS]*
(a) Potassium urate (b) Urea
(c) Calcium carbonate (d) Ammonia

41. The terga, sterna and pleura of cockroach body are joined by : *[2015 RS]*
(a) Muscular tissue
(b) Arthrodial membrane
(c) Cartilage
(d) Cementing glue

42. What external changes are visible after the last moult of a cockroach nymph? *[NEET 2013]*
(a) Anal cerci develop
(b) Both fore wings and hind wings develop
(c) Labium develops
(d) Mandibles become harder

43. Select the correct option with respect to cockroaches *[NEET Kar. 2013]*
(a) The fore wings are tegmina which are used in flight
(b) Malpighian tubules convert nitrogenous wastes into urea
(c) Males bear short anal styles not present in females
(d) Nervous system comprises of a dorsal nerve cord and ten pairs of ganglion

44. Compared to those of humans, the erythrocytes in frog are *[2012]*
(a) Without nucleus but with haemoglobin
(b) nucleated and with haemoglobin
(c) very much smaller and fewer
(d) nucleated and without haemoglobin.

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45. Select the correct statement from the ones given below with respect to *Periplaneta americana*. ***[2012]***
    (a) Nervous system located dorsally, consists of segmentally arranged ganglia joined by a pair of longitudinal connectives.
    (b) Males bear a pair of short thread like anal styles.
    (c) There are 16 very long Malpighian tubules present at the junctions of midgut and hindgut.
    (d) Grinding of food is carried out only by the mouth parts.
46. One very special feature in the earthworm Pheretima is that ***[2011]***
    (a) fertilisation for eggs occurs inside the body
    (b) the typhlosole greatly increases the effective absorption area of the digested food in the intestine
    (c) the S-shaped setae embedded in the integument are the defensive weapons used against the enemies
    (d) it has a long dorsal tubular heart
47. Which of the following is correctly stated as it happens in the common cockroach ? ***[2011]***
    (a) Malpighian tubules are excretory organs projecting out from the colon
    (b) Oxygen is transported by haemoglobin in blood
    (c) Nitrogenous excretory product is urea
    (d) The food is ground by mandibles and gizzard
48. Consider the following four statements (A-D) related to the common frog *Rana tigrina*, and select the correct option stating which ones are true (T) and which ones are false (F)
    Statements : ***[2011M]***
    (A) On dry land it would die due to lack of O_2 its mouth is forcibly kept closed for a few days
    (B) It has four- chambered heart
    (C) On dry land it turns uricotelic from ureotelic
    (D) Its life-history is carried out in pond water
    Options:

	(A)	(B)	(C)	(D)
(a)	T	F	F	T
(b)	T	T	F	F
(c)	F	F	T	T
(d)	F	T	T	F

49. Which one of the following structures in *Pheretima* is correctly matched with its function? ***[2011M]***
    (a) Clitellum - secretes cocoon
    (b) Gizzard - absorbs digested food
    (c) Setae- defence against predators
    (d) Typhlosole - storage of extra nutrients
50. If a live earthworm is pricked with a needle on it outer surface without damaging its gut, the fluid that comes out is : ***[2009]***
    (a) coelomic fluid (b) haemolymph
    (c) slimy mucus (d) excretory fluid
51. Which one of the following correctly describes the location of some body parts in the earthworm *Pheretima* ? ***[2009]***
    (a) Four pairs of spermathecae in 4 - 7 segments.
    (b) One pair of ovaries attached at intersegmental septum of 14th and 15th segments.
    (c) Two pairs of testes in 10th and 11th segments.
    (d) Two pairs of accessory glands in 16 - 18 segments.
52. Earthworms have no skeleton but during burrowing, the anterior end becomes turgid and acts as a hydraulic skeleton. It is due to
    (a) coelomic fluid (b) blood ***[2008]***
    (c) gut peristalsis (d) setae
53. A piece of bone such as femur of frog if kept in dilute HCl for about a week will ***[2000]***
    (a) assume black colour (b) shrink in size
    (c) turn flexible (d) crack into pieces
54. A. *Periplaneta americana* is nocturnal, omnivorous, household pest. ***[1992]***
    R. It is because it acts as scavenger
    (a) A is true but R is false
    (b) A is false but R is true
    (c) Both A and R are true and R is correct explanation of A
    (d) Both A and R are true but R is not correct explanation of A
55. Earthworm possesses hearts ***[1991]***
    (a) 6 pairs (b) 4 pairs
    (c) 2 pairs (d) 1
56. Male and female cockroaches can be distinguished externally through ***[1991]***
    (a) anal styles in male
    (b) anal cerci in female
    (c) anal style and antennae in females
    (d) both b and c

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ANSWER KEY																			
1	(b)	7	(b)	13	(d)	19	(c)	25	(c)	31	(a)	37	(b)	43	(c)	49	(a)	55	(b)
2	(c)	8	(c)	14	(a)	20	(d)	26	(a)	32	(c)	38	(c)	44	(b)	50	(a)	56	(a)
3	(b)	9	(d)	15	(c)	21	(a)	27	(a)	33	(b)	39	(b)	45	(b)	51	(c)		
4	(d)	10	(a)	16	(a)	22	(b)	28	(a)	34	(d)	40	(a)	46	(b)	52	(a)		
5	(b)	11	(c)	17	(d)	23	(b)	29	(a)	35	(c)	41	(b)	47	(d)	53	(c)		
6	(b)	12	(a)	18	(b)	24	(a)	30	(a)	36	(c)	42	(b)	48	(a)	54	(c)		

Hints & Solutions

1. (b) Cuboidal epithelium with brush border of microvilli is found in proximal convoluted tubule of nephron (PCT).
2. (c) (i) Inner lining of salivary ducts - Compound epithelum
   (ii) Moist surface of buccal cavity - Compound epithelium
   (iii) Tubular parts of nephorns - Cuboidal epithelium.
   (iv) Inner surface of bronchioles – Ciliated epithelium.
3. (b) Ciliated epithelium is usually found in the respiratory tract of fallopian tubes. Ciliated epithelium is a thin tissue that has hair-like structures on it. These hairs, called cilia, move back and forth to help move particles out of our body. We find ciliated epithelial tissue in our respiratory tract and in the fallopian tubes of women. Ciliated epithelium performs the function of moving particles or fluid over the epithelial surface in such structures as the trachea, bronchial tubes, and nasal cavities. It often occurs in the vicinity of mucus-secreting goblet cells.
4. (d) Squamous epithelium is formed of thin discoidal and polygonal cells that fit like tiles in a floor, so is also called pavement epithelium. It is found in the walls of blood vessels, in the alveoli of lung for exchange of gas, and in Bowman's capsule of nephron for ultra filtration.
5. (b) Ciliated epithelium has simple columnar epithelial cells, but in addition, they posses fine hair-like outgrowths, cilia on their free surfaces. These cilia are capable of rapid, rhythmic, wavelike beatings in a certain direction. This movement of the cilia in a certain direction causes the mucus, which is secreted by the goblet cells, to move (flow or stream) in that direction.

NOTES: Ciliated epithelium is usually found in the air passages like the nose. It is also found in the uterus and fallopian tubes of females. The movement of the cilia propel the ovum to the uterus.

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6. (b) The cell junctions known as tight, adhering and gap junctions are found in epithelial tissue. Epithelial tissue covers the whole surface of the body. It is made up of cells closely packed and ranged in one or more layers. This tissue is specialised to form the covering or lining of all internal and external body surfaces.

NOTES: Epithelial tissue that occurs on surfaces of the interior of the body is known as endothelium.

7. (b) Simple epithelium is a tissue made of a single layer of compactly arranged cells all of which rest over a noncellular basement membrane.
8. (c) The simple cuboidal epithelium consists of a single layer of polygonal cells which appear cuboidal in vertical section. Cuboidal epithelium occurs in terminal respiratory bronchioles. Columnar epithelium is made of tall cylindrical cells and it occurs in the lining of stomach. In ciliated epithelium, the cells bear cilia on their free surface and it occurs in the respiratory tract.

9. (d) Basement membrane is a delicate noncellular layer made of extracellular material that lies below the epithelium in contact with its basal surface. Basement membrane is a delicate noncellular layer made of extracellular material that lies below the epithelium in contact with its basal surface. Besides this the basal lamina consists of mucopoly saccharides and very fine fibres.
10. (a) Squamous epithelial cells have the appearance of thin, flat plates. The shape of the nucleus usually corresponds to the cell form and helps to identify the type of epithelium. Squamous cells, for example, tend to have horizontal flattened, elliptical nuclei because of the thin flattened form of the cell. They form the lining of cavities such as the mouth, blood vessels, heart and lungs and make up the outer layers of the skin.
11. (c) It is the innermost one celled thick layer made up of columnar epithelial cells. It lies on a basement. These cells are active & continuously produce new cells by mitotic division and is thus called germinative layer or stratum germinativum.

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NOTES

The division rate of these cells is highest during sleep or rest and lowest during muscular activity & stress.

12. (a) Each hair is present in a tubular pit called hair follicle. Living cells are only present at the base of hair known as hair papilla, rest of the hair is dead and divisible into outer cuticle, middle cortex & inner medulla.
13. (d) *Tight junctions* provide a barrier which prevents leakage of fluid across epithelial cells. *Adherens junctions* aid to cement adjacent cells to form a sheet.
    Gap junctions provide cytoplasmic channels to facilitate communication between adjacent cells.
    Synaptic junctions help in transmission of information through chemicals.
14. (a) Wall of intestine is made of smooth muscle. Tendons consist of dense regular connective tissue fascicles encased in dense irregular connective tissue sheaths. Tip of nose consists of squamous epithelium. Lining of epithelium is made of columnar epithelium.
15. (c) Tendon is dense regular connective tissue. Adipose tissue is a type of loose connective tissue located mainly beneath the cells. Cartilage is a type of specialised connetive tissue.
16. (a) Connective tissue is the most diverse of the four tissue types with a wide variety of functions. Connective tissue is made up of cells and fibers in a "jelly-like" ground substance.
17. (d) Cartilage is a type of connective tissue which is present in external ears and in the nose tip of humans.
18. (b) The lining of a blood vessel is with simple squamous epithelium. Inner most lining of blood vessels is called endothelium. "Squamous" refers to the fact that the cells are flat.
19. (c) The kind of tissue that forms the supportive structure in our pinna (external ears) is also found in tip of the nose. External pinna is made up of elastic cartilage. It is the passage towards middle ear.
20. (d) It is ciliated epithelium which bears numerous delicate hair like outgrowths, the cilia, arising from basal granules. The cilia remains in rhythmic motion and creates current to transport the materials which comes in contact with them.
21. (a) Areolar connective tissue has rich supply of nerve fibres and blood vessels. It joins skin epithelia with muscles, nerves & blood vessels. Binding of body parts together is the main function of areolar connective tissue.
22. (b) At the site of infection, the infectious organisms release some chemical to increase the flow of mast cells towards the inflammation site. Mast cell release histamine which increases the permeability of blood vessels at the site of inflammation so that more blood supply takes place. The site gets warm and red due to this.
23. (b) Hyaline cartilage is present at the end of long articular bones. It provides a smooth articular surface to permit movement at joints. Elastic cartilage is found where support with flexibility is needed such as in external ears.
    Fibro cartilage is a very tough substance and is used in places of the body where shock absorbers are needed.
    Examples – Discs between vertebrate and in the knee joints.

24. (a) Hyaline cartilage is firm but slightly elastic with clear matrix. It is present in larynx, trachea, bronchi, nose. Elastic cartilage occurs in external ear. Calcified cartilage occurs in suprascapula. Fibrous cartilage occurs in intervertebral discs.
25. (c) The chief component of ground substance of cartilage is chondromuco protein which is formed of chondriotin sulphate, keratin sulphate and hyaluronic acid.
26. (a) Chondrin is a gelatin-like substance and can be obtained by boiling cartilage in water. The cartilage is a connective tissue that contains cells embedded in a matrix of chondrin.

NOTES

Chondrin is a bluish-white gelatin-like substance, being a protein-carbohydrate complex and can be obtained by boiling cartilage in water. The cartilage is a connective tissue that contains cells embedded in a matrix of chondrin. Chondrin is made up of two proteins chondroalbunoid and chondromucoid.

27. (a) Deposition of bony matter by osteoblasts and resorption chondroblasts.
28. (a) The wall of blood vessels (arteries & veins) are made up of mainly 3 layers – the outer most tunica externa has a loose connective tissue, collagen fibres, lymph vessels and the middle tunica media has circular smooth muscle fibres, some elastic fibres and the inner most tunica interna is a single layered endothelium of polyhedral squamous cells.

NOTES

If the arteries reach organs they form arterioles which are thinner and mainly consist smooth muscles and when they subdivide in the tissues they make capillaries. The wall of capillaries are very thin (usually less than one micron) and have numerous minute pores and made up of only endothelium. Exchange of material takes place between blood and tissue fluid across the endothelial membrane of capillaries through active diffusion.

29. (a) In connective tissues, histamine is an organic nitrogen compound involved in local immune responses and regulating physiological function in the gut and it acts as a neurotransmitter. Histamine is produced by basophils and mast cells found in nearby connective tissues.
30. (a) Skeletal muscle tissue is closely attached to sketetal bones. In a typical muscle such as the biceps, striated (striped) skeletal muscle fibres are bundled together in a parallel fashion.
31. (a) Glandular epithelium invaginates epithelia into connective tissue which differentiate into secretory units. Examples include sebaceous glands of the skin and glands in the intestinal lining (exocrine glands), and many endocrine glands releasing hormones, such as the thyroid follicle.
32. (c) Thigh muscles are skeletal muscles that are striated and voluntary.
33. (b) The structure of the abdominal wall is similar in principle to the thoracic wall. There are three layers, an external, internal and innermost layer. The vessels and nerves lie between the internal and innermost layers. The abdomen can be divided into quadrants or nine abdominal regions.
34. (d) Voluntary muscles - under control of our will. Involuntary muscles - Not under the control of our will. Muscles of urethra also remain under voluntary control after infancy.
35. (c) Areolar tissue is the least specialized connective tissue. It has a large amount of ground substance (extracellular material) and possesses rich blood and nerve supplies. It spreads extensively throughout the body, under the skin and epithelia, in between and around muscles, nerves and blood vessels and in the submucosa of respiratory and gastrointestinal tract.
36. (c) Only nerve cells do not form layers. These also remain structurally separate from each other. Nerve cells or neurons are the cells specialized to conduct an electrochemical current. Nerve tissue is made up of these cells and supporting cells. Epithelial tissue is made of one or a few layers of compactly arranged cells overlying a basement membrane. Glands are epithelial cells specialized to elaborate and release chemicals for use in the body. Muscle tissue is made of elongated and contractile cells called myocytes.
37. (b) Cockroaches receive several images of an object with the help of ommatidia. This kind of vision possessed by cockroaches is known as mosaic vision which has more sensitivity but less resolution.

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38. (c) The vertebrates process myogenic heart which is self contractile system or autoexcitable; it will thus keep working outside the body for some time.
39. (b) *Periplanata americana* shows spiral and determinate types of cleavage during embryonic development which is a feature of Protostomes.
40. (a) The body cells in cockroach discharge their nitrogenous waste in the haemolymph as a solution of sodium or potassium urate (a weak alkaline fluid).
41. (b) Between the various sclerite, a flexible membrane exists which is known as arthrodial membrane.
42. (b) The development of cockroach is paurometabolous meaning that their development is through nymphal stage. The nymphs look very much like adults. The nymph grows by moulting about 13 times to reach adult form. The last nymphal stage has wingpads while adult cockroaches have wings.
43. (c) In cockroaches, males bear a pair of short, thread like anal styles which are absent in females.
44. (b) The erythrocytes or RBCs in frog are large, oval and biconvex nucleated cells with respiratory red pigment haemoglobin in its cytoplasm.
45. (b) The anal styles in males cockroaches help in copulation.

NOTES The tenth abdominal segment carries two pairs of abdominal appendage in male cockroach as segmented anal cerci and unsegmented anal styles or caudal styles. In case of females, the tenth abdominal segment carries only one pair of abdominal appendages and many segmented anal cerci.

46. (b) The intestine of an earthworm has a peculiar fold of tissue that forms a pocket in the intestine that is visible when viewing a cross section. This space, which runs almost the whole length of the body dorsally is known as the typhlosole and it serves to increase the surface area of the intestine for absorption.
47. (d) Cockroach intake the food after grounding it by its mandibles and gizzard.
48. (a) (A) Dry skin causes ceased cutaneous respiration
    (B) Three chambered heart.
    (C) Frog never becomes uricotelic
    (D) External fertilization occurs in water
49. (a) Clitellum - secretes cocoon during breading season of earthworm. Gizzard is used for- grinding of food particles. Setae help in locomotion. Typhlosole increases the absorption area in intestine.
50. (a) If a live earthworm is pricked with a needle on its outer surface without damaging its gut, the fluid that comes out is coelomic fluid because coelomic fluid lies between body wall and alimentary canal.

NOTES Earthworms are helpful to man as bait for fishing and loosen the soil for roots to grow as well. A earthworm's wastes help to fertilize the soil.

51. (c) In *Pheretima* two pairs of testes sacs are situated in the 10th and 11th segments. Each testes sac of the 10th segment encloses a testes and a seminal funnel. Each testes sac of the 11th segment encloses a testes, a seminal vesicle and a seminal funnel.
52. (a) Earthworms have no skeleton but during burrowing, anterior end becomes turgid and acts as a hydraulic skeleton. It is due to coelomic fluid.

NOTES The coelom is filled with an alkaline milky coelomic fluid. This coelomic fluid contains water, salts, proteins and 4 types of cells namely amoebocytes, mucocytes, circular cells and chloragogen cells.

53. (c) When a bone is kept in dilute acids like HCl for a few days, the Ca^{2+} salts get dissolved leaving only the soft and flexible organic matrix. This process is called decalcification. If a bone is kept in KOH it remains unaffected and only the surrounding muscles and connective tissues get dissolved so that the bone now appears clean.
54. (c) *Periplaneta americana* (cockroach) cannot act as a scavanger, it does not feed upon dead animals.
55. (b) Earthworm has 4 pairs of heart i.e., 2 pairs-Lateral hearts and 2 pairs-Lateral oesophageal hearts present in 7th and 9th and 12th and 13th segments respectively.
56. (a) Sexual dimorphism is found in cockroach. A pair of anal style are present in male cockroach only. Female has broader abdomenal segments.

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8 Cell: The Unit of Life

Trend Analysis with Important Topics & Sub-Topics

		2020		2019		2018		2017		2016	
Topic	Sub-Topics	Qns.	LOD	Qns.	LOD	Qns.	LOD	Qns.	LOD	Qns.	LOD
Cell	Cell Theory			1	A						
Prokaryotic Cells: Cell Envelope and its Modifications, Ribosomes and Inclusion Bodies	Inclusion Bodies	1	A								
Eukaryotic Cells- Cell Organelles	Semi-Autonomous Organelle			2	A			1	A	1	E
	Cillia and Flagella									1	E
	Single Membranous organelle									1	E
	Nucleus					2	E				
	Ribosomes					1	A				
	Endomembrane system	1	A	1	A	2	A				
	Chromosome			1	E	1	D				

LOD - Level of Difficulty	E - Easy	A - Average	D - Difficult	Qns - No. of Questions

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Topic 1: Cell

1. Identify the correct order of organisation of genetic material from largest to smallest : *[2015 RS]*
   (a) Genome, chromosome, nucleotide, gene
   (b) Genome, chromosome, gene, nucleotide
   (c) Chromosome, genome, nucleotide, gene
   (d) Chromosome, gene, genome, nucleotide
2. A protoplast is a cell : *[2015 RS]*
   (a) without nucleus
   (b) undergoing division
   (c) without cell wall
   (d) without plasma membrane
3. A major break through in the studies of cells came with the development of electron microscope. This is because *[2006]*
   (a) the resolving power of the electron microscope is 200 – 350 nm as compared to 0.1 – 0.2 for the light microscope
   (b) electron beam can pass through thick materials, whereas light microscopy requires thin sections
   (c) the electron microscope is more powerful than the light microscope as it uses a beam of electrons which has wavelength much longer than that of photons

(d) the resolution power of the electron microscope in much higher than that of the light microscope

4. A student wishes to study the cell structure under a light microscope having 10X eyepice and 45X objective. He should illuminate the object by which one of the following colours of light so as to get the best possible resolution? *[2005]*
(a) Blue (b) Green
(c) Yellow (d) Red

5. Names of Schleiden and Schwann are associated with *[1993]*
(a) protoplasm as the physical basis of life
(b) cell theory
(c) theory of cell lineage
(d) nucleus functions as control centre of cell

6. Which is correct about cell theory in view of current status of our knowledge about cell structure *[1993]*
(a) It needs modification due to discovery of subcellular structures like chloroplasts and mitochondria
(b) Modified cell theory means that all living beings are composed of cells capable of reproducing
(c) Cell theory does not hold good because all living beings (*e.g.*, viruses) do not have cellular organisation
(d) Cell theory means that all living objects consist of cells whether or not capable of reproducing

7. Angstrom (Å) is equal to *[1992]*
(a) 0.01 μm (b) 0.001 μm
(c) 0.0001 μm (d) 0.00001 μm

8. Electron microscope has a high resolution power. This is due to *[1992]*
(a) electromagnetic lenses
(b) very low wavelength of electron beam
(c) low wavelength of light source used
(d) high numerical aperture of glass lenses used

9. Resolution power is the ability to *[1991]*
(a) distinguish two close points
(b) distinguish two close objects
(c) distinguish amongst organelles
(d) magnify image

10. Magnification of compound microscope is not connected with *[1990]*
(a) numerical aperture
(b) focal length of objective
(c) focal length of eye piece
(d) tube length

11. Organelles can be separated from cell homogenate through *[1989]*
(a) chromatography
(b) X-rays diffraction
(c) differential centrifugation
(d) auto-radiography

Topic 2: Prokaryotic Cells – Cell Envelope and its Modifications, Ribosomes and Inclusion Bodies

12. Which of the following statements about inclusion bodies is incorrect? *[2020]*
(a) These are involved in ingestion of food particles
(b) They lie free in the cytoplasm
(c) These represent reserve material in cytoplasm
(d) They are not bound by any membrane

13. Which of the following nucleic acids is present in an organism having 7°S ribosomes only? *[2019]*
(a) Double stranded circular DNA with histone proteins.
(b) Single stranded DNA with protein coat.
(c) Double stranded circular naked DNA.
(d) Double stranded DNA enclosed in nuclear membrane.

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14. Which one of the following is not an inclusion body found in prokaryotes ? *[2015 RS]*
(a) Cyanophycean granule
(b) Glycogen granule
(c) Polysome
(d) Phosphate granule

15. Cell wall is absent in : *[2015 RS]*
(a) *Funaria* (b) Mycoplasma
(c) *Nostoc* (d) *Aspergillus*

16. Which structures perform the function of mitochondria in bacteria? *[2014]*
(a) Nucleoid (b) Ribosomes
(c) Cell wall (d) Mesosomes

17. The term 'glycocalyx' is used for *[NEET Kar. 2013]*
(a) A layer surrounding the cell wall of bacteria
(b) A layer present between cell wall and membrane of bacteria
(c) Cell wall of bacteria
(d) Bacterial cell glyco-engineered to possess N-glycosylated proteins

18. Why is a capsule advantageous to a bacterium? *[NEET Kar. 2013]*
(a) It allows the bacterium to attach to the surface
(b) It protects the bacterium from desiccation
(c) It provides means of locomotion
(d) It allows bacterium to "hide" from host's immune system

19. Which one of the following does not differ in *E.coli* and *Chlamydomonas*? *[2012]*
(a) Ribosomes
(b) Chromosomal Organization
(c) Cell wall
(d) Cellmembrane

20. Nuclear mebrane is absent in *[2012]*
(a) *Penicillium* (b) *Agaricus*
(c) *Volvox* (d) *Nostoc*

21. Which of the following statements regarding cilia is not correct ? *[2006]*
(a) Cilia are hair-like cellular appendages
(b) Microtubules of cilia are composed of tubulin
(c) Cilia contain an outer ring of nine doublet microtubules surrounding two single microtubules
(d) The organized beating of cilia is controlled by fluxes of $Ca2^{+}$ across the membrane

20. The prokaryotic flagella possess *[1995]*
(a) unit membrane enclosed fibre
(b) protein membrane enclosed fibre
(c) '9 + 2' membrane enclosed structure
(d) helically arranged protein molecule

23. Golgi apparatus is absent in *[1993]*
(a) higher plants
(b) yeast
(c) bacteria and Blue-green algae
(d) none

24. Experiments on *Acetabularia* by Hammerling proved the role of *[1992]*
(a) cytoplasm in controlling differentiation
(b) nucleus in heredity
(c) chromosomes in heredity
(d) nucleo-cytoplasmic ratio

Topic 3: Eukaryotic Cells – Cell Organelltes

25. Which is the important site of formation of glycoproteins and glycolipids in eukaryotic cells? *[2020]*
(a) Peroxisomes
(b) Golgi bodies
(c) Polysomes
(d) Endoplasmic reticulum

26. Match the column I with column II. *[2019]*

	Column I		Column II
(a)	Golgi apparatus	(i)	Synthesis of protein
(b)	Lysosomes	(ii)	Trap waste and excretory products
(c)	Vacuoles	(iii)	Formation of glycoproteins and glycolipids
(d)	Ribosomes	(iv)	Digesting biomolecules

Choose the right match from options given below:
(a) (a)-(i), (B)-(ii), (C)-(iv), (D)-(iii)
(b) (a)-(iii), (B)-(iv), (C)-(ii), (D)-(i)
(c) (a)-(iv), (B)-(iii), (C)-(i), (D)-(ii)
(d) (a)-(iii), (B)-(ii), (C)-(iv), (D)-(i)

27. Which of the following cell organelles is present in the highest number in secretory cells? *[2019]*
(a) Lysosome
(b) Mitochondria
(c) Golgi complex
(d) Endoplasmic reticulum

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28. Which of the following cell organelles is responsible for extracting energy from carbohydrates to form ATP? *[2017]*
(a) Ribosome (b) Chloroplast
(c) Mitochondrion (d) Lysosome

29. Mitochondria and chloroplast are *[2016]*
(a) semi-autonomous organelles
(b) formed by division of pre-existing organelles and they contain DNA but lack protein synthesizing machinery
Which one of the following options is correct?
(a) Both (a) and (b) are correct
(b) (b) is true but (a) is false
(c) (a) is true but (b) is false
(d) Both (a) and (b) are false

30. Microtubules are the constituents of *[2016]*
(a) Cilia, Flagella and Peroxisomes
(b) Spindle fibres, Centrioles and Cilia
(c) Centrioles, Spindle fibres and Chromatin
(d) Centrosome, Nucleosome and Centrioles

31. Which one of the following cell organelles is enclosed by a single membrane ? *[2016]*
(a) Mitochondria (b) Chloroplasts
(c) Lysosomes (d) Nuclei

32. DNA is not present in : *[2015 RS]*
(a) Ribosomes (b) Nucleus
(c) Mitochondria (d) Chloroplast

33. Nuclear envelope is a derivative of : ***[2015 RS]***
(a) Membrane of Golgi complex
(b) Microtubules
(c) Rough endoplasmic reticulum
(d) Smooth endoplasmic reticulum

34. Select the correct matching in the following pairs: ***[2015 RS]***
(a) Smooth ER – Synthesis of lipids
(b) Rough ER – Synthesis of glycogen
(c) Rough ER – Oxidation of fatty acids
(d) Smooth ER – Oxidation of phospholipids

35. Which of the following are not membrane-bound? ***[2015 RS]***
(a) Ribosomes (b) Lysosomes
(c) Mesosomes (d) Vacuoles

36. The function of the gap junction is to ***[2015 RS]***
(a) facilitate communication between adjoining cells by connecting the cytoplasm for rapid transfer of ions, small molecules and some large molecules.
(b) separate two cells from each other.
(c) stop substance from leading across a tissue
(d) performing cementing to keep neighbouring cells together

37. Balbiani rings are sites of : ***[2015 RS]***
(a) Nucleotide synthesis
(b) Polysaccharide synthesis
(c) RNA and protein synthesis
(d) Lipid synthesis

38. Match the columns and identify the correct option. ***[2015 RS]***

	Column-I		Column-II
(1)	Thylakoids	(i)	Disc-shaped sacs in Golgi apparatus
(2)	Cristae	(ii)	Condensed structure of DNA
(3)	Cisternae	(iii)	Flat membranous sacs in stroma
(4)	Chromatin	(iv)	Infoldings in mitochondria

	(1)	(2)	(3)	(4)
(a)	(iii)	(iv)	(i)	(ii)
(b)	(iii)	(i)	(iv)	(ii)
(c)	(iii)	(iv)	(ii)	(i)
(d)	(iv)	(iii)	(i)	(ii)

39. Cellular organelles with membranes are : ***[2015 RS]***
(a) chormosomes, ribosomes and endoplasmic reticulum
(b) endoplasmic reticulum, ribosomes and nuclei
(c) lysosomes, Golgi apparatus and mitochondria
(d) nuclei, ribosomes and mitochondria

40. The solid linear cytoskeletal elements having a diameter of 6 nm and made up of a single type of monomer are known as: ***[2014]***
(a) Microtubules
(b) Microfilaments
(c) Intermediate filaments
(d) Lamins

41. The osmotic expansion of a cell kept in water is chiefly regulated by: ***[2014]***
(a) Mitochondria (b) Vacuoles
(c) Plastids (d) Ribosomes

42. Match the following and select the correct answer: ***[2014]***

(1)	Centriole	(i)	Infoldings in mitochondria
(2)	Chlorophyll	(ii)	Thylakoids
(3)	Cristae	(iii)	Nucleic acids
(4)	Ribozymes	(iv)	Basal body cilia or fiagella

	(1)	(2)	(3)	(4)
(a)	(iv)	(ii)	(i)	(iii)
(b)	(i)	(ii)	(iv)	(iii)
(c)	(i)	(iii)	(ii)	(iv)
(d)	(iv)	(iii)	(i)	(ii)

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43. Which one of the following organelle in the figure correctly matches with its function ? ***[NEET 2013]***

(a) Golgi apparatus, protein synthesis
(b) Golgi apparatus, formation of glycolipids
(c) Rough endoplasmic reticulum, protein synthesis
(d) Rough endoplasmic reticulum, formation of glycoproteins

44. The Golgi complex plays a major role ***[NEET 2013]***
(a) in digesting proteins and carbohydrates
(b) as energy transferring organelles
(c) in post translational modification of proteins and glycosidation of lipids
(d) in trapping the light and transforming it into chemical energy

45. A major site for synthesis of lipids is : *[NEET 2013]*
(a) SER (b) Symplast
(c) Nucleoplasm (d) RER

46. Which of the following type of plastids does not contain stored food material? *[NEET Kar. 2013]*
(a) Amyloplasts (b) Chromoplasts
(c) Elaioplasts (d) Aleuroplasts

47. Select the alternative giving correct identification and function of the organelle 'A' in the diagram *[NEET Kar. 2013]*

(a) Endoplasmic reticulum-synthesis of lipids
(b) Mitochondria-produce cellular energy in the form of ATP
(c) Golgi body-provides packaging material
(d) Lysosomes - secrete hydrolytic enzymes

48. Ribosomal RNA is actively synthesized in *[2012]*
(a) Lysosomes (b) Nucleolus
(c) Nucleoplasm (d) Ribosomes

49. What is true about ribosomes? *[2012]*
(a) The prokaryotic ribosomes are 80S, where "S" stands for sedimentation coefficient
(b) These are composed of ribonucleic acid and proteins
(c) These are found only in eukaryotic cells
(d) These are self-splicing introns of some RNAs.

50. Select the correct statement from the following regarding cell membrane. *[2012]*
(a) Na^+ and K^+ ions move across cell membrane by passive transport
(b) Proteins make up 60 to 70% of the cell membrane.
(c) Lipids are arranged in a bilayer with polar heads towards the inner part.
(d) Fluid mosaic model of cell membrane was proposed by Singer and Nicolson

51. Which one of the following structures is an organelle within an organelle? *[2012M]*
(a) Ribosome (b) Peroxisome
(c) ER (d) Mesosome

52. Which one of the following cellular parts is correctly described? *[2012M]*
(a) Centrioles - Sites for active RNA synthesis.
(b) Lysosomes - Optimally active at a pH of about 8.5.
(c) Thylakoids - Flattened membranous sacs forming the grana of chloroplasts.
(d) Ribosomes - Those on chloroplasts are larger (80s) while those in the cytoplasm are smaller (70s).

53. Important site for formation of glycoproteins and glycolipids is *[2011]*
(a) vacuole (b) golgi apparatus
(c) plastid (d) lysosome

54. Peptide synthesis inside a cell takes place in: *[2011]*
(a) chloroplast (b) mitochondria
(c) chromoplast (d) ribosomes

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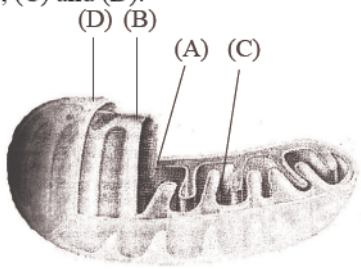
55. What are those structures that appear as beads - on- string in the chromosomes when viewed under electron microscope ? *[2011]*
(a) Genes (b) Nucleotides
(c) Nucleosomes (d) Base pairs

56. The figure below shows the structure of a mitochondrion with its four parts labelled (A), (B), (C) and (D).



Select the part correctly matched with its function. *[2011M]*
(a) Part (D): Outer membrane – gives rise to inner membrane by splitting
(b) Part (B): Inner membrane – forms infoldings called cristae
(c) Part (C): Cristae – possess single circular DNA molecule and ribosomes
(d) Part (A): Matrix – major site for respiratory chain enzymes

56. In mitochondria, proteins accumulate in the
(a) outer membrane *[2011M]*
(b) inner membrane
(c) intermembrane space
(d) matrix

58. Which one of the following is not considered as a part of the endomembrane system ? *[2011M]*
(a) Golgi complex (b) Peroxisome
(c) Vacuole (d) Lysosome

59. Which one of the following structures between two adjacent cells is an effective transport pathway? *[2010]*
(a) Plasmodesmata
(b) Plastoquinones
(c) Endoplasmic reticulum
(d) Plasmalemma

60. Which one of the following has its own DNA? *[2010]*
(a) Mitochondria (b) Dictyosome
(c) Lysosome (d) Peroxisome

61. The main arena of various types of activities of a cell is: *[2010]*
(a) plasma membrane (b) mitochondrian
(c) cytoplasm (d) nucleus

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62. The plasma membrane consists mainly of: *[2010]*
(a) phospholipids embedded in a protein bilayer
(b) proteins embedded in a phospholipid bilayer
(c) proteins embedded in a polymer of glucose molecules
(d) proteins embedded in a carbohydrate bilayer

63. Plasmodesmata are: *[2009]*
(a) locomotary structures
(b) membranes connecting the nucleus with plasmalemma
(c) connections between adjacent cells
(d) lignified cemented layers between cells

64. Cytoskeleton is made up of: *[2009]*
(a) callose deposits
(b) cellulosic microfibrils
(c) proteinaceous filaments
(d) calcium carbonate granules

65. Stroma in the chloroplasts of higher plant contains: *[2009]*
(a) light-dependent reaction enzymes
(b) ribosomes
(c) chlorophyll
(d) light– independent reaction enzymes

66. Middle lamella is composed mainly of: *[2009]*
(a) muramic acid (b) calcium pectate
(c) phosphoglycerides (d) hemicellulose

67. Keeping in view the fluid mosaic model for the structure of cell membrane, which one of the following statements is correct with respect to the movement of lipids and proteins from one lipid monolayer to the other (described as flipflop movement)? *[2008]*
(a) Both lipids and proteins can flip-flop
(b) While lipids can rarely flip-flop, protein can not
(c) While proteins can flip-flop, lipids can not
(d) Neither lipids, nor proteins can flip-flop

68. Cellulose is the major component of cell walls of *[2008]*
(a) *Pythium* (b) *Xanthomonas*
(c) *Pseudomonas* (d) *Saccharomyces*

69. The two sub-units of ribosome remain united a critical ion level of *[2008]*
(a) copper (b) manganese
(c) magnesium (d) calcium

70. Vacuole in a plant cell *[2008]*
(a) is membrane-bound and contains storage proteins and lipids
(b) is membrane-bound and contains water and excretory substances
(c) lacks membrane and contains air
(d) lacks membrane and contains water and excretory substances

71. Select the wrong statement from the following *[2007]*
(a) Both chloroplasts and mitochondria have an internal compartment, the thylakoid space bounded by the thylakoid membrane
(b) Both chloroplasts and mitochondria contain DNA
(c) The chloroplasts are generally much large than mitochondria
(d) Both chloroplasts and mitochondria contain an inner and an outer membrane.

72. Which one of the following is not a constituent of cell membrane? *[2007]*
(a) glycolipids (b) proline
(c) phospholipids (d) cholesterol.

73. Which of the following statement regarding mitochondrial membrane is not correct ? *[2006]*
(a) The enzymes of the electron transfer chain are embedded in the outer membrane
(b) The inner membrane is highly convoluted forming a series of infoldings

(c) The outer membrane resembles a sieve
(d) The outer membrane is permeable to all kinds of molecules

74. The main organelle involved in modification and routing of newly synthesized proteins to their destinations is *[2005]*
(a) chloroplast
(b) mitochondria
(c) lysosome
(d) endoplasmic Reticulum

75. According to widely accepted "fluid mosaic model" cell membranes are semi-fluid, where lipids and integral proteins can diffuse randomly. In recent years, this model has been modified in several respects. In this regard, which of the following statements is incorrect? *[2005]*
(a) Proteins in cell membranes can travel within the lipid bilayer.
(b) Proteins can also undergo flip-flop movements in the lipid bilayer.
(c) Proteins can remain confined within certain domains of the membrane.
(d) Many proteins remain completely embedded within the lipid bilayer.

76. Centromere is required for: *[2005]*
(a) movement of chromosomes towards poles
(b) cytoplasmic cleavage
(c) crossing over
(d) transcription

77. Protein synthesis in an animal cell occurs *[2005]*
(a) only on the ribosomes present in cytosol
(b) only on ribosomes attached to the nuclear envelope and endoplasmic reticulum
(c) on-ribosomes present in the nucleolus as well as in cytoplasm
(d) on ribosomes present in cytoplasm as well as in mitochondria

78. Flagella of prokaryotic and eukaryotic cells differ in *[2004]*
(a) type of movement and placement in cell
(b) location in cell and mode of functioning
(c) microtubular organization and type of movement
(d) microtubular organization and function

79. In chloroplasts, chlorophyll is present in the *[2004]*
(a) outer membrane (b) inner membrane
(c) thylakoids (d) stroma

80. In fluid mosaic model of plasma membrane *[2002]*
(a) upper layer is non-polar and hydrophilic
(b) upper layer is polar and hydrophobic
(c) phospholipids form a bimolecular layer in middle part
(d) proteins form a middle layer

81. Which of the following occurs more than one and less than five in a chromosome? *[2002]*
(a) Chromatid (b) Chromosome
(c) Centromere (d) Telomere

82. Ribosomes are produced in *[2002]*
(a) nucleolus (b) cytoplasm
(c) mitochondria (d) golgi body

83. Mitotic spindle is mainly composed of which protein? *[2002]*
(a) Actin (b) Myosin
(c) Tubulin (d) Myoglobin

84. Microtubules absent in *[2001]*
(a) mitochondria (b) centriole
(c) flagella (d) spindle fibres

85. Element necessary for middle lamella is
(a) Ca (b) Zn *[2001]*
(c) K (d) Cu

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86. The cell organelle involved in glyco-sylation of protein is *[2000]*
(a) ribosome
(b) peroxisome
(c) endoplasmic reticulum
(d) mitochondria

87. Lysosomes have a high content of *[2000]*
(a) hydrolytic enzymes (b) lipoproteins
(c) polyribosomes (d) DNA ligases

88. Some of the enzymes,which are associated in converting fats into carbhoydrates, are present in *[1999]*
(a) liposomes (b) golgi bodies
(c) microsomes (d) glyoxysomes

89. Which of the following organ has single membrane? *[1999]*
(a) Nucleus (b) Cell Wall
(c) Mitochondria (d) Spherosomes

90. The proteins are synthesised at *[1999]*
(a) ribosomes (b) mitochondria
(c) centrosomes (d) golgi bodies

91. Genes located on mitochondrial DNA *[1997]*
(a) generally show maternal inheritance
(b) are always inherited from the male parent
(c) show biparental inheritance like the nuclear genes
(d) are not inherited

92. The function of rough endoplasmic reticulum is *[1995]*
(a) fat synthesis (b) lipid synthesis
(c) protein synthesis (d) steroid synthesis

93. The point, at which polytene chromosomes appears to be attached together, is called *[1995]*
(a) centriole (b) centromere
(c) chromomere (d) chromocentre

94. The desmosomes are concerned with *[1995]*
(a) cytolysis (b) cell division
(c) cell adherence (d) cellular excretion

95. Inner membrane convolutions of a mitochondrion are known as *[1994]*
(a) lamellae (b) thylakoids
(b) grana (d) cristae

96. Mitochondrial cristae are sites of *[1994]*
(a) breakdown of macromolecules
(b) protein synthesis
(c) phosphorylation of flavoproteins
(d) oxidation-reduction reactions

97. Organelle having flattened membrane bound cisternae and lying near the nucleus is *[1994]*
(a) golgi apparatus (b) mitochondrion
(c) centriole (d) nucleolus

98. Membranous bag with hydrolytic enzymes which is used for controlling intracellular digestion of macro -molecules is *[1994]*
(a) endoplasmic reticulum
(b) nucleosome
(c) lysosome
(d) phagosome

99. In salivary gland chromosomes/polytene chromosomes, pairing is *[1993]*
(a) absent
(b) occasional
(c) formed between nonhomologous chromosomes
(d) formed between homologous chromosomes

100. Cell recognition and adhesion occur due to biochemicals of cell membranes named *[1993]*
(a) proteins
(b) lipids
(c) proteins and lipids
(d) glycoproteins and glycolipids

101. In plant cells, peroxisomes are associated with *[1993]*
(a) photorespiration (b) phototropism
(c) photoperiodism (d) photosynthesis

102. Balbiani rings (puffs) are sites of *[1993]*
(a) DNA replication
(b) RNA and protein synthesis
(c) synthesis of polysaccharides
(d) synthesis of lipids

103. Ribosomes are the centre for *[1992]*
(a) respiration (b) photosynthesis
(c) protein synthesis (d) fat synthesis

104. Oxysomes of $F_0 - F_1$ particles occur on *[1992]*
(a) thylakoids
(b) mitochondrial surface
(c) inner mitochondrial membrane
(d) chloroplast surface

105. All plastids have similar structure because they can *[1992]*
(a) store starch, lipids and proteins
(b) get transformed from one type to another
(c) perform same function
(d) be present together

106. An outer covering membrane is absent over
(a) nucleolus (b) lysosome *[1992]*
(c) mitochondrion (d) plastid

107. Which one is apparato reticolare? *[1992]*
(a) Golgi apparatus
(b) Endoplasmic reticulum
(c) Microfilaments
(d) Microtubules

108. Fluid mosaic model of cell membrane was put forward by *[1991]*
(a) Danielli and Davson
(b) Singer and Nicolson
(c) Garner and Allard
(d) Watson and Crick

109. Ribosomes were discovered by *[1991]*
(a) Golgi (b) Porter
(c) De Robertis (d) Palade

110. Cell wall shows *[1991]*
(a) complete permeability
(b) semipermeability
(c) differential permeability
(d) impermeability

111. Addition of new cell wall particles amongst the existing ones is *[1991]*
(a) deposition (b) apposition
(c) intussusception (d) aggregation

112. The latest model for plasma membrane is
(a) lamellar model *[1990]*
(b) unit membrane model
(c) fluid mosaic model
(d) molecular lipid model

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113. Hammerling's experiments of *Acetabularia* involved exchanging *[1990]*
(a) cytoplasm (b) nucleus
(c) rhizoid and stalk (d) gametes

114. Plasma membrane is made of *[1989]*
(a) proteins and carbohydrates
(b) proteins and lipids
(c) proteins, lipids and carbohydrates
(d) proteins, some nucleic acid and lipids

115. Polyribosomes are aggregates of *[1989]*
(a) ribosomes and rRNA
(b) only rRNA
(c) peroxisomes
(d) several ribosomes held together by string of mRNA

116. Nucleoproteins are synthesised in *[1989]*
(a) nucleoplasm (b) nuclear envelope
(c) nucleolus (d) cytoplasm

117. A bivalent consists of *[1989]*
(a) two chromatids and one centromere
(b) two chromatids and two centromeres
(c) four chromatids and two centromeres
(d) four chromatids and four centromeres

118. According of fluid mosaic model, plasma membrane is composed of *[1988]*
(a) phospholipids and oligosaccharides
(b) phospholipids and hemicellulose
(c) phospholipids and integral proteins
(d) phospholipids, extrinsic proteins and intrinsic proteins

119. *Acetabularia* used in Hammerling's nucleocytoplasmic experiments is *[1988]*
(a) unicellular fungus
(b) multicellular fungus
(c) unicellular uninucleate green algae
(d) unicellular multinucleate green algae

ANSWER KEY

1	(b)	13	(c)	25	(b)	37	(c)	49	(b)	61	(c)	73	(a)	85	(a)	97	(a)	109	(d)
2	(c)	14	(c)	26	(b)	38	(a)	50	(d)	62	(b)	74	(d)	86	(c)	98	(c)	110	(a)
3	(d)	15	(b)	27	(c)	39	(c)	51	(a)	63	(c)	75	(b)	87	(a)	99	(d)	111	(c)
4	(a)	16	(d)	28	(c)	40	(b)	52	(c)	64	(c)	76	(a)	88	(d)	100	(d)	112	(c)
5	(b)	17	(a)	29	(c)	41	(b)	53	(b)	65	(d)	77	(d)	89	(d)	101	(a)	113	(c)
6	(c)	18	(d)	30	(b)	42	(a)	54	(d)	66	(b)	78	(c)	90	(a)	102	(b)	114	(c)
7	(c)	19	(d)	31	(c)	43	(c)	55	(c)	67	(b)	79	(c)	91	(a)	103	(c)	115	(d)
8	(b)	20	(d)	32	(a)	44	(c)	56	(b)	68	(a)	80	(c)	92	(c)	104	(c)	116	(d)
9	(b)	21	(a)	33	(c)	45	(a)	57	(b)	69	(c)	81	(a)	93	(d)	105	(b)	117	(c)
10	(a)	22	(d)	34	(a)	46	(b)	58	(b)	70	(b)	82	(a)	94	(c)	106	(a)	118	(d)
11	(c)	23	(c)	35	(a)	47	(b)	59	(a)	71	(a)	83	(c)	95	(d)	107	(a)	119	(c)
12	(a)	24	(b)	36	(a)	48	(b)	60	(a)	72	(b)	84	(a)	96	(d)	108	(b)		

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Hints & Solutions

1. (b) Genome > chromosomes > gene > nucleotide.
2. (c) Cell wall is absent in a protoplast.

NOTES

Protoplast is a biological term coined by Hanstein in 1880 to refer to the entire cell, excluding the cell wall. Protoplasts can be generated by stripping the cell wall from plant, bacterial, or fungal cells by mechanical, chemical or enzymatic means. All the content of the cell along with nucleus is known as protoplasm (i.e. cytoplasm + nucleus = protoplasm). However, a plant cell without cell wall is known as protoplast (i.e. cell membrane + cytoplasm + nucleus = protoplast).

3. (d) A major break through in cell studies came with the development of EM having great resolution power due to which we can see the ultrastructures of cell organelles.

NOTES

There are several different types of electron microscopes, including the transmission electron microscope (TEM), scanning electron microscope (SEM), and reflection electron microscope (REM). The electron microscope uses a beam of electrons and their wave-like characteristics to magnify an object's image, unlike the optical microscope that uses visible light to magnify images. This stream is confined and focused using metal apertures and magnetic lenses into a thin, focused, monochromatic beam.

4. (a) Resolving power or limit of resolution is the ability of the eye to distinguish two close objects as separate. Its value is calculated by Abbe's equation, $L_m = \frac{0.61\lambda}{NA}$ where λ is the wavelength of light.

NA or numerical apperture is multiple of refractive index and sine of angle subtended by optical axis and outer ray covered by objective ($\sin\alpha$).

5. (b) Cell theory was proposed by Schleiden and Schwann (1839) according to which "All living organisms are composed of cells." Cell theory is also known as cell principle, cell doctrine etc.

NOTES

Schleiden and Schwann, as well as Virchow, are generally seen as the founders of the cell theory, due to their pioneering scientific work in the 1800s. The cell theory is important because it affects nearly every aspect of biology, from our understanding of life and death, to how we manage diseases, and more.

6. (c) The exceptions to cell theory are viruses which do not possess a cellular machinery. They consists of DNA or RNA core surrounded by a protein sheath and lack cellular organisation.

7. (c) Angstrom Å = 0.0001 μm

$1Å = 10^{-10}$ m $= 10^{-8}$cm

$= 10^{-7}$ mm $= 10^{-4}$ μm

8. (b) Resolution is a power of a microscope to distinguish between two particles that are closely situated. Electron microscope has high resolution power due to very low wavelength of electron beam.

9. (b) The ability to distinguish two close objects is called power of resolution.

10. (a) Magnification is defined as the power of enlargement. Magnification of compound microscope is the product of magnification of objective lens and magnification of ocular lens.

Magnification

$$= \frac{\text{Size of the image with the instrument}}{\text{Size of the image with the unaided eye}}$$

Objective lens × Ocular lens

40 x 10 x

Magnification = 400 times.

Magnification is defined as the power of enlargement.

Magnification

$$= \frac{\text{Size of the image with the instrument}}{\text{Size of the image with the unaided eye}}$$

11. (c) Centrifuge is an instrument used to create a centrifugal force. The homogenate of the cell organelles is allowed to undergo centrifugation by which different cell organelles get separated. This process is known as differential centrifugation.

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12. (a) Inclusion bodies are nuclear or cytoplasmic aggregates which are stainable substances, usually proteins, and formed due to viral multiplication or genetic disorders in human beings these bodies are either intracellular or extracellular abnormalities and they are specific to certain diseases. These are not involved in ingestion of food particles.

NOTES

Hereditary inclusion body myopathies (hIBM) are a rare group of genetic muscle disorders. As with individuals with sIBM, the muscle tissue of affected individuals contains numerous sub-cellular compartments called vacuoles. The age of onset of these disorders is generally between 20 and 40 years of age.

13. (c) The organisms which have ribosomes of 70 S type are prokaryotes. Prokaryotes have double stranded DNA which is not enclosed in membrane.

14. (c) Polysomes are defined as a cluster of ribosomes attached to a mRNA molecule.

15. (b) Mycoplasma lacks cell wall.

NOTES

Mycoplasma's lack of cell wall characteristic makes them naturally resistant to antibiotics that target cell wall synthesis. They can be parasitic or saprotrophic. Mycoplasma usually colonizes the throat, bacterial biofilm, or tartar found in the oral cavity. Mycoplasma pneumoniae is one of the common causes of acute respiratory infections.

16. (d) In some bacteria (*e.g., Bacillus subtilis*) the plasma membrane form certain invaginations or infoldings called mesosomes in the cytoplasm. The mesosomes have various functions, viz., respiratory, secretory etc.

17. (a) Glycocalyx or mucilage is the outermost coating of bacterial cells/cell wall which is rich in polysaccharides. A thick and tougher mucilage is called capsule which gives gummy or sticky trait to cells. It protects the cells from dessication, toxins and preventing attachment to foreign invaders.

18. (d) Capsule is a layer that lies outside the cell wall of bacteria. The capsule can protect cells from engulfment by eukaryotic cells, such as macrophages. They also exclude bacterial viruses and most hydrophobic toxic materials such as detergents.

19. (d) Cell membrane of *E.coli*, a bacteria and *Chlamydomonas* a unicellular green alga does not differ. As in both cell membrane is composed of lipids and proteins.

20. (d) *Nostoc* is a prokaryote while rest are eukaryotes. Nuclear membrane is absent in prokaryotes.

21. (a) Eukaryotic cilia are made up of tubulin protein. Cilia have a core of 2 microtubules and around there are 9 doublet microtubules. These are not at all hair like structures.

NOTES

Microtubules are polymers of tubulin that form part of the cytoskeleton and provide structure and shape to eukaryotic cells. Microtubules can grow as long as 50 micrometres and are highly dynamic. The outer diameter of a microtubule is between 23 and 27 nm while the inner diameter is between 11 and 15 nm.

22. (d) The prokaryotic flagellum is single stranded made up of several parallel protein fibrils and helical in shape while in eukaryotes it is made up of axonema and sheath.

23. (c) Golgi complex is absent in prokaryotic cell *i.e* (PPLO, bacteria and blue green algae). It is present in all eukaryotic cells except sieve tubes of plants, sperms of bryophytes and pteridophytes and red blood corpuscles.

24. (b) Presence of hereditary information in the nucleus was proved by the work of Hammerling on single celled alga *Acetabularia*.

NOTES

In his experiments, Hammerling grafted the stalk of one species of Acetabularia onto the foot of another species. In all cases, the cap that eventually developed on the grafted cell matched the species of the foot rather than that of the stalk. In this example, the cap that is allowed to grow on the grafted stalk looks like the base species.

25. (b) Golgi bodies are site of formation of glycoproteins and glycolipids in eukaryotic cells.

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NOTES

Glycolipids are lipids with a carbohydrate attached by a glycosidic (covalent) bond. Their role is to maintain the stability of the cell membrane and to facilitate cellular recognition, which is crucial to the immune response and in the connections that allow cells to connect to one another to form tissues.

26. (b) *Golgi apparatus* is involved in the formation of glycoproteins and glycolipids.
Lysosomes are membrane enclosed organelle. It contains digestive enzymes, which digest excess or worn out organelles, food particles etc.
Vacuoles is a membrane enclosed fluid filled sac which traps waste and excretory products.
Ribosomes is a minute particle consisting of RNA and associated proteins. They bind mRNA and tRNA to synthesise polypeptides and proteins.

27. (c) The important function of Golgi apparatus is to process, package and transport the materials for secretion. Therefore secretory cells have Golgi apparatus in highest number.

28. (c) The site of aerobic oxidation of carbohydrates in cells to generate ATP are mitochondria.
29. (c) Mitochondria & chloroplast are semi-autonomous cell organelle which are formed by division of pre-existing organelle & contain DNA but they also contain protein synthesizing machinery, thus (a) is true & (b) is false.
30. (b) Roles of the microtubule cytoskeleton include mechanical support, organization of the cytoplasm, transport, motility and chromosome segregation so they are present in cilia and flagella for cellular movement, centrioles for chromosomal movement and spindle fibres for structural organization as well as chromosomal movement during nuclear division.

NOTES

Microtubules are long, hollow cylinders made up of polymerised α- and β-tubulin dimers. Microtubules are part of a structural network (the cytoskeleton) within the cell's cytoplasm.

31. (c) Double Membrane bound Organelles: Mitochondria, Chloroplasts, Endoplasmic Reticulum, Golgi Body, and Nucleus. Single Membrane bound Organelles: Lysosomes, Peroxisomes, and Vacuoles. Organelles lacking any membrane: Ribosomes, Centrioles, Nucleolus.
32. (a) Ribosomes are composed of ribonucleic acid and proteins and are not surrounded by any membrane. These are the site for protein synthesis.
33. (c) In late prophase, nuclear envelope disappears and reappears in late telophase from rough endoplasmic reticulum (RER).
34. (a) Lipid synthesis takes place in smooth endoplasmic reticulum.

NOTES

The outer membrane of the rER is studded with ribosomes. This gives a basophilic staining to cytoplasm in H&E stains (due to the RNA content). The rER plays a major role in protein synthesis. It synthesises secretory proteins, and lysosomal enzymes.

35. (a) Ribosomes are not membrance-bound cell organelle.

NOTES

Ribosomes are not organelles and this is very important. They are not membrane-enclosed, instead they are macromolecules made of both RNA and proteins. If you ever have trouble remembering, just recall that there are ribosomes found in bacteria even though bacteria do not contain organelles. Moreover, not all ribosomes are located at the ER in eukaryotes (remember there is no ER in bacteria). Many of the ribosomes are free-floating in the cytoplasm. The ribosomes that are at the ER are only there temporarily. They are not technically part of the RER.

36. (a) The function of the gap junction is to facilitate communication between adjoining cells by connecting the cytoplasm for rapid transfer of ions, small molecules and some large molecules.
37. (c) RNA and protein synthesis occur in Balbiani rings.

NOTES

Balbiani rings are exceptionally large puffs on the polytene chromosomes in the dipteran *Chironomus tentans*. These puffs are particularly well suited for studies of the structure of active genes and the synthesis and transport of specific RNA-protein (RNP) particles. The Balbiani ring RNP particle consists of a ribbon bent into a ring-like structure, the ribbon being built from a tightly folded 7 nm RNP filament. The assembly of the particle takes place concomitant with transcription and occurs in a stepwise fashion. As the particle is transported through the nuclear pore the, ribbon straightens out, with the 5' end of the transcript leading. During translocation the tightly packed RNP filament is gradually unfolded, and on the cytoplasmic side the mRNA is immediately engaged in polysome formation.

38. (a) **(a)** → (iii), **(b)** → (iv), **(c)** → (i), **(d)** → (ii)
39. (c) Lysosomes, golgi apparatus and mitochondria are the cell organelles which have membranes.
40. (b) Microtubule, microfilament and intermediate filaments along with ER form cytoskeleton. Microfilaments are non-living, solid and consist of actin protein. They are 4-6 nm in diameter.

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41. (b) The vacuole is bound by a single membrane called tonoplast. It also functions as semipermeable membrane. It segregates vacuolar contents from cytoplasm, allows osmotic entry or exit of water, concentration and storage of nutrients as well as wastes.

42. (a) Centrosome is an organelle usually containing two cylindrical structures called centrioles. The centrioles form the basal body of cilia or flagella. In chloroplast a number of organised flattened membranous sacs called the thylakoids are present in the stroma. Chlorophyll pigments are present in the thylakoids. Each mitochondrion is a double membrane bound structure. The inner membrane forms a number of infoldings called the cristae towards the matrix. The cristae increase the surface area.

43. (c) rough endoplasmic reticulum is a network or reticulum of tiny tubular structures scattered in the cytoplasm and bear ribosomes on their outer surface. These are involved in protein synthesis and secretion. They are extensive and continuous with the outer membrane of the nucleus.

44. (c) Golgi apparatus plays a major role in post translational modification of proteins forming glycoprotein and glycosidation of lipid forming glycolipids. A number of proteins and lipids synthesised on endoplasmic reticulum (rough and smooth respectively) are modified in the cisternae of the Golgi apparatus before they are released from the trans face.

45. (a) The smooth endoplasmic reticulum is the major site for synthesis of lipid. In animal cells lipid like steroidal hormones are synthesised in SER.

46. (b) Chromoplasts are non-photosynthetic coloured plastids which synthesise and store carotenoid pigmentes. They, therefore, appear orange red and yellow whereas amyloplast (store starch), aleuroplast (store proteins) and elaioplast (store oil droplets and fats) are leucoplasts colourless plastids.

47. (b) Fig., (A) shows the cell organelle mitochondria. The mitochondria are bounded by two membranes, *i.e.,* outer membrane and inner membrane. Mitochondria are referred as "powerhouse" of the cell as they produce 95% of ATP. This energy is produced during the break down of food molecules which involve glycolysis, oxidative decarboxylation and oxidative phosphorylation (Kreb's cycle and respiratory chain).

48. (b) Ribosomal RNA is actively synthesized in nucleolus. Nucleolus is also known as ribosomal factory.

49. (b) Ribosomes are amembraneous (*ie.* without membrane) cell organelle composed of rRNA and protein. These are found in both prokaryotic and eukaryotic cells. In prokaryotes, ribosomes are 70S type while in eukaryotes, it is 80S type.

50. (d) Fluid mosaic membrane model was proposed by Singer and Nicholson in 1972. It is most accepted model of structure of biomembrane.

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NOTES

The fluid mosaic model of the cell membrane is how scientists describe what the cell membrane looks and functions like, because it is made up of a bunch of different molecules that are distributed across the membrane. The movement of the mosaic of molecules makes it impossible to form a completely impenetrable barrier.

51. (a) Ribosome are small naked (non membrane bound) particles made of r-RNA and proteins. Ribosomes are also seen in the organelles like mitochondria and chloroplasts. They are the cell's protein factories and are found on RER and scattered in the cytoplasm as polyribosomes. Ribosomes are the sites at which information carried in the genetic code is converted into protein molecules.

52. (c) Centrioles serve as basal bodies for cilia and flagella. They are concerned with spindle formation during cell division. Lysosomes are membrane-bound organelles containing many hydrolytic enzymes, which are optimally

active at an acid pH (near pH 5). Thylakoids are membrane-bound organelles found within chloroplasts. The thylakoid membrane, forms many flattened, fluid-filled tubules that enclose a single convoluted compartment. These tubules tend to stack on top of each other to form a structure called a granum.

53. (b) Golgi apparatus is the important site for formation of glycoprotein and glycolipid.
54. (d) Peptide synthesis takes place in ribosome of the cell.
55. (c) Under electron microscope the nucleosomes appear as beads on a string in chromosome, due to a short length of DNA wrapped around a core of histone proteins.

NOTES

The nucleosome is the fundamental subunit of chromatin. Each nucleosome is composed of a little less than two turns of DNA wrapped around a set of eight proteins called histones, which are known as a histone octamer. Each histone octamer is composed of two copies each of the histone proteins H2A, H2B, H3, and H4.

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56. (b) The mitochondrial inner membrane forms infoldings known as cristae, which allow greater surface area for protein such as cytochrome to function properly and efficiently.
57. (b) The inner membrane of mitochondria contains more than 151 different polypeptides, and has a very high protein-to- phospholipid ratio.
58. (b) Except peroxisome the remaining three and ER are the parts of endomembrane system.
59. (a) Plasmodesmata are the structures present between two adjacent cells that permits the transport and communication between them. They are the fine cytoplasmic strands that connect the protoplasts of adjacent plant cells by passing through the cell walls.
60. (a) Mitochondria has its own DNA. It is a structure within cytoplasm of eukaryotic cells that carries out aerobic respiration. It is the site of Kreb's cycle and ETS.
    Therefore, it is also called as cell's energy production site.
61. (c) The main arena of various types of activities of a cell is cytoplasm. It forms the living protoplasm of a cell excluding the nucleus. It consists of proteins, fats, carbohydrates, nucleic acids, vitamins, waste metabolites and all organelles.
62. (b) Plasma membrane comprises of mainly proteins embedded in a phospholipid bilayer. Protein molecules occur at places both inside and outer side of the lipid bilayer.
63. (c) Plasmodesmata are connections between adjacent cells. Plasmodesmata are narrow channels that act as intercellular cytoplasmic bridges to facilitate communication and transport of materials between plant cells.

NOTES

Plasmodesmata are formed during cell division, when traces of the endoplasmic reticulum become caught in the new wall that divides the parent cell.

64. (c) The cytoskeleton is made up of three kinds of protein filaments actin filaments (also called microfilaments), intermediate filaments and microtubules whose major constituents are actin and tubulin respectively.
65. (d) Stroma in the chloroplasts of higher plant contains light independent reaction enzymes. Within the stroma are stacks of thylakoids, the sub-organelles which are the site of photosynthesis.
66. (b) Middle lamella is mainly composed of calcium pectate. Calcium is deposited in plants cell walls during their formation - it is required for the stability and function of cell membranes and acts as a type of 'cementing agent' in the cell walls in the form of calcium pectate'.

NOTES

Calcium pectate is like a glue binding adjacent cells together so if inadequate calcium is not transported during cell formation, tissues become less stable and prone to disintegration.

67. (b) Keeping in view of the 'Fluid mosaic model" for the structure of cell membrane, the movement of lipids and proteins from one lipid monolayer to the other, lipid can rarely flip-flop, protein can not. The fluid mosaic model is the most important and widely accepted latest model for plasma membrane was given by Singer and Nicolson in 1972. According the them it resembles "protein iceberg in a sea of lipids".

68. (a) Cellulose is a major component of cell wall of *Pythium*. *Pythium* is a genus of parasitic Oomycete. Because this group of organisms were once classified as fungi, they are sometimes still treated as such. *Pythium*, like others in the family Pythiaceae, are usually characterized by their production of coenocytic hyphae, hyphae without separations. Oogonia generally contain a single oospore. Antheridia contain an elongated and club shaped antheridium.

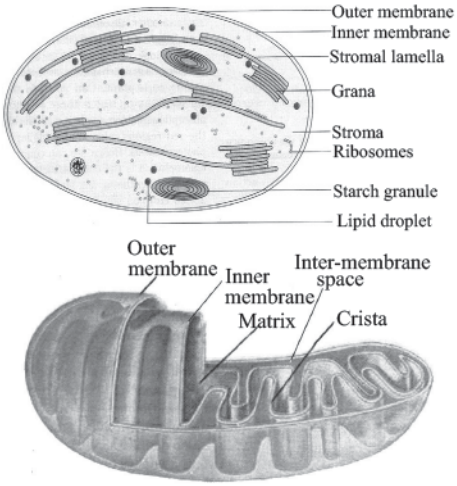
69. (c) The two subunits of ribosome remain united at a critical ion level of magnesium. The presence of magnesium and its amount plays an important role in the appearance and structure of the ribosomes.

NOTES

If magnesium is absent in the medium, the large particles fall apart to display a group of smaller particles.

70. (b) Vacuole in a plant cell is membrane bound and contains water and excretory substance. Vacuole is a space within the cytoplasm of living cell that is filled with air, water or other liquid, cell sap or food particles. In plant cells, there is usually one large vacuole bounded by a single layered membrane (tonoplast or vacuole membrane); animal cells usually have several small vacuoles.

71. (a) Both chloroplasts and mitochoridria have an internal compartment, the thylakoid space bounded by double membrane



72. (b) Proline (symbol Pro or P) is a proteinogenic amino acid that is used in the biosynthesis of proteins.

NOTES

Proline is the only proteinogenic amino acid with a secondary amine, in that the alpha-amino group is attached directly to the main chain, making the α carbon a direct substituent of the side chain. Proline is unique in that it is the only amino acid where the side chain is connected to the protein backbone twice, forming a five-membered nitrogen-containing ring. In this sense, it can be considered to be an opposite of Glycine, which can adopt many more main-chain conformations.

73. (a) The enzymes of electron transport system are present in inner mitochondrial membrane.

74. (d) Endoplasmic reticulum transport proteins and enzymes to their destinations i.e. within the cell and outside the cell.

75. (b) Flip-Flop movement is due to migration of lipid molecules from one lipid monolayer to other monolayer of lipid bilayer.

76. (a) During anaphase APC (anaphase promoting complex) develops. It degenerates proteins binding the two chromatids in the region of centromere.

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As a result, the centromere of each chromosome divides. This converts the two chromatids into daughter chromosomes.

77. (d) Protein synthesis in an animal cell occurs on ribosomes present in cytoplasm as well as in mitcohondria because mitochondria and chloroplast also have their own DNA, RNA and ribosome so can synthesize half of their required proteins.

78. (c) Prokaryotes have simple flagella without microtubules whereas eukaryotes have complex cilia and flagella which consists of microtubules arranged in 9+2 fashion (an outer ring of nine pairs surrounding 1 center pair).

79. (c) The thylakoid membranes possess the chlorophylls. The outer membrane is permeable to a number of solutes. Inner membrane has a number of carrier proteins. Stroma forms the matrix containing the enzyme for Calvin cycle.

80. (c) Fluid mosaic model of plasma membrane proposes that plasma membrane comprises of a phospholipid bilayer wherein icebergs of proteins float in the sea of phospholipids.

81. (a) A chromatid is one of two identical strands of DNA making up a chromosome that are joined at their centromeres, for the process of nuclear division (mitosis or meiosis). The term is used till the centromeres remain in contact. When they separate (during anaphase of mitosis and anaphase 2 of meiosis), the strands are called daughter-chromosomes. The tips of the chromatid are called telomeres. They prevent the ends of the chromosome from attaching to other chromosomes.

NOTES

It has been said that after repeated cell replication, the telomeres get shorter resulting in cell death. Thus, this means that the way telomeres work could play a role in determining the lifespan of a cell.

82. (a) Golgi bodies take part in elaboration and secretion of complex biochemicals. Mitochondria are the site of ATP synthesis. Ribosomes are produced in nucleolus.

83. (c) Mitotic spindles are composed of microtubules which are made of tubulin dimers. Actin and myosin are the contractile proteins of muscle fibres. Myoglobin is oxygen carrying pigment found in muscle.

84. (a) Microtubules are formed of dimers of tubulin. Microtubules are present in centriole, flagella, spindle fibres but not in mitochondria.

85. (a) Zinc is an activator of enzymes like carbonic anhydrase. Copper takes part in electron transport as plastocyanin. Potassium maintains membrane permeability.

86. (c) Glycosylation is the process or result of addition of saccharides to proteins and lipids. The process is one of four principal co-translational and post-translational modification steps in the synthesis of membrane and secreted protein. The majority of proteins synthesized in the rough ER undergo glycosylation. It is an enzyme-directed site-specific process, as opposed to the non-enzymatic chemical reaction of glycation.

87. (a) Lysosomes are single membrane bound vesicular organelles rich in acid hydrolases. They are involved in phagocytosis.

88. (d) Golgi bodies are cytoplasmic organelle which take part in elaboration and secretion of complex biochemicals. Microsomes are small single membraned cell organelles that absorb oxygen and perform direct oxidation of substrates. Glyoxisomes contain enzymes for β-oxidation of fatty acids.

89. (d) Nucleus is enclosed by a double layered envelope. Sphaerosomes are small spherical single membrane bound cell organelles specialized to synthesize and store fat. Mitochondria is also surrounded by a two layered membrane - outer membrane and inner membrane.

90. (a) Ribosomes are the sites of protein synthesis. Mitochondria is the site of ATP synthesis. Golgi complex takes part in elaboration and secretion of complex biochemicals. The distinctly staining region of cytoplasm surrounding the pair of centrioles together with the centrioles is called centrosome.

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91. (a) Genes located on the mitochondrial DNA are inherited through the cytoplasm. The zygote receives cytoplasm from the female gamete, hence it involves maternal inheritance.

NOTES

Maternal Inheritance is caused by the genes in mitochondrial DNA. The egg passes on a lot of mitochondria, whereas the sperm passes a few or zero. Maternal effects result because of the maternal parent produces the egg and further, the genes control production of eggs.

92. (c) Rough endoplasmic reticulum bears ribosomes on its outer surface. These ribosomes take part in protein synthesis.

93. (d) Granules of condensed chromatin (heterochromatin), are found scattered in interphase nuclei. At chromocentre, the polytene chromosomes appear attached.

94. (c) Desmosomes are cementing substances, which adhere to each other and keep the latter tightly packed and they also prevent leakage of fluid from interphase.

95. (d) The inner membrane of mitochondria is infolded to form involutions called cristae. They are meant for increasing the active area of the inner membrane.

96. (d) Mitochondrial cristae possess small particles called elementary particles which contain ATP- ase. Therefore, they are the centes of ATP synthesis during oxidative - phosphorylation.
97. (a) Organelle that has flattened membrane bound cisternae and lies near the nucleus is Golgi apparatus.
98. (c) Lysosomes are membranous bag with hydrolytic enzymes used for controlling intracellular digestion of macro-molecules.
99. (d) In salivary gland chromosomes / polytene chromosomes, somatic pairing is formed between homologous chromosomes and repeated replication of their chromonemata.
100. (d) Cell recognition and adhesion occurs due to biochemicals named glycoproteins and glycolipids of cell membranes. These are formed due to the small carbohydrate molecules present on lipids and extrinsic protein.
101. (a) In plant peroxisomes are associated with photorespiration. Peroxisomes are ubiquitous organelles in eukaryotes that function to rid the cell of toxic substances. They have a single membrane that separates their contents from the cytosol (the internal fluid of the cell) and that contains membrane proteins critical for various functions, such as importing proteins into the organelles and aiding in proliferation.

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NOTES

Unlike lysosomes, which are formed in the secretory pathway, peroxisomes usually self-replicate by enlarging and then dividing, although there is some indication that new ones may be formed directly. Peroxisomes were discovered by the Belgian cytologist Christian de Duve in 1965.

102. (b) In the region of Balbiani ring the DNA strands uncoil, become active and produce number of copies of messenger RNA.
103. (c) Ribosomes are the workhouses of protein biosynthesis, the process of translating *messenger* RNA (mRNA) into protein. The mRNA comprises a series of codons that dictate, to the ribosome, the sequence of the amino acids needed to make the protein. Using the mRNA as a template, the ribosome translates each codon of the mRNA, pairing it with the appropriate amino acid. This is done using molecules of *transfer* RNA (tRNA) containing a complementary anticodon on one end and the appropriate amino acid on the other. Protein synthesis begins at a start codon near the 5' end of the mRNA.
104. (c) The inner membrane of mitochondria possess small tennis racket like particles called elementary particle, $F_0 - F_1$ particles or oxysomes. There are $1 \times 10^4 - 1 \times 10^5$ oxysomes in a mitochondria.
105. (b) All plastids are similar in structure. So they can easily get transformed from one type to another. Depending upon the colours there are three types of plastids- leucoplasts, chromoplasts and chloroplasts.
106. (a) A covering membrane is absent around nucleolus. Calcium seems to be essential for maintaining its configuration.
107. (a) Apparato reticolare interno means 'internal reticular apparatus'. Camillo Golgi referred the Golgi apparatus as 'apparato reticolare' after observing the cellular organelle under the microscope.
108. (b) Fluid Mosaic Model of cell membrane was put forward by Singer and Nicolson.
109. (d) Ribosomes were discovered by Robinson and Brown in plant cell and Palade in animal cell.
110. (a) Cell wall shows complete permeability because it helps in the transport of substances in and out of the cell.
111. (c) Growth of cell wall occurs by two methods:
    (i) Intussusception : When the primary wall is stretched, the materials of secondary wall are secreted by protoplam deposited within it.
    (ii) Apposition : Materials of secondary wall secreted by protoplam are deposited in the form of thin layer one above the other.

112. (c) Fluid mosaic model is the most recent model of a biomembrane proposed by Singer and Nicolson (1972, 74). According to this model, the membrane does not have a uniform deposition of lipids which are present as highly viscous fluid matrix of two layers of phospholipid molecules and proteins arranged in a symetrical pattern.

113. (c) J. Hammerling (1934) conducted experiments using two species of green algae *Acetabularia crenulata* and *A. mediterranea*. They differ in the shapes of their caps. The nucleus in both species is situated in rhizoids at the bottom of stalk. After removing cap, if stalk of one species is grafted on rhizoid of the other species, shape of the cap will be determined by nucleus, not by the stalk. This experiment makes clear that the characters of an individual are controlled by nucleus.

114. (c) Plasma membrane is made up of proteins, lipids and carbohydrates. Carbohydrates are covalently linked to both lipid and protein.

115. (d) Polyribosomes consists of 4-8 ribosomes which are attached to a single strand of mRNA. This mechanism helps in synthesis of several copies of the same protein.

116. (d) Nucleoproteins are conjugated proteins. They are deoxyribonucleoproteins and ribonucleoproteins synthesised in cytoplasm of the cell.

117. (c) A pair of homologus chromosomes lying together in the zygotene stage of Prophase I of first meiotic division is called a bivalent.

118. (d) According to fluid mosaic model proposed by Singer and Nicolson (1972, 74), plasma membrane is composed of a phospholipid bilayer and protein. Protein molecules occur at places both inside and outside of lipid bilayer. The internal proteins are called intrinsic proteins and the external proteins are called extrinsic proteins.

119. (c) *Acetabularia* used in Hammerling's nucleocytoplasmic experiments is unicellular, uninucleate, marine green alga.

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9 Biomolecules

Trend Analysis with Important Topics & Sub-Topics

Topic	Sub-Topics	2020		2019		2018		2017		2016	
		Qns.	LOD	Qns.	LOD	Qns.	LOD	Qns.	LOD	Qns.	LOD
Essential Molecules Of Biological System											
Fats/ Lipids	Fat									1	E
	Lipid			1	E						
Protein/ Amino Acids	Insulin									1	A
	Neutral Amino Acids									1	E
	Bonds	1	A								
	Basic Amino Acids	1	E								
	Others	1	D								
Nucleic acids/ Nucleotides	Purines	1	A								
Enzymes / Cofactors	Enzymes							1	A		
	Coenzyme			1	A						
Saccharides	disaccharides			1	E			1	E	1	E
	Transporter										

LOD - Level of Difficulty	E - Easy	A - Average	D - Difficult	Qns - No. of Questions

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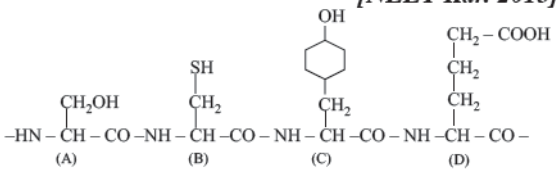
Topic 1: Essential Molecules of Biological System

1. Identify the substances having glycosidic bond and peptide bond, respectively in their structure *[2020]*
   (a) Glycerol, trypsin (b) Cellulose, lecithin
   (c) Inulin, insulin (d) Chitin, cholesterol
2. The two functional groups characteristic of sugars are *[2018]*
   (a) Hydroxyl and methyl
   (b) Carbonyl and methyl
   (c) Carbonyl and hydroxyl
   (d) Carbonyl and phosphate
3. About 98 percent of the mass of every living organism is composed of just six elements including carbon, hydrogen, nitrogen, oxygen and *[2007]*
   (a) sulphur and magnesium
   (b) magnesium and sodium
   (c) calcium and phosphorus
   (d) phosphorus and sulphur.
4. Enzymes, vitamins and hormones can be classified into a single category of biological chemicals, because all of these *[2005]*
   (a) help in regulating metabolism
   (b) are exclusively synthesized in the body of a living organism as at present
   (c) are conjugated proteins
   (d) enhance oxidative metabolism
5. Carbohydrates, the most abundant bio-molecules on earth, are produced by : *[2005]*
   (a) some bacteria, algae and green plant cells
   (b) fungi, algae and green plant cells
   (c) all bacteria, fungi and algae
   (d) viruses, fungi and bacteria
6. Most abundant organic compound on earth is
   (a) Protein (b) Cellulose *[2001]*
   (c) Lipids (d) Steroids
7. Most diverse macromolecules, found in the cell both physically and chemically are *[1996]*
   (a) proteins (b) carbohydrates
   (c) nucleic acids (d) lipids.

8. The four elements making 99% of living system are *[1994]*
   (a) C, H, O, S (b) C, H, O, P
   (c) C, H, O, N (d) C, N, O, P
9. Living cell contains 60 – 75% water. Water present in human body is *[1992]*
   (a) 60 – 65% (b) 50 – 55%
   (c) 75 – 80% (d) 65 – 70%

Topic 2: Proteins/Amino Acids

10. "Ramachandran plot" is used to confirm the structure of *[2019, Odisa]*
    (a) DNA (b) RNA
    (c) Proteins (d) Triacylglycerides
11. The two polypeptides of human insulin are linked together by *[2016]*
    (a) hydrogen bonds
    (b) phosphodiester bond
    (c) covalent bond
    (d) disulphide bridges
12. The amino acid Tryptophan is the precursor for the synthesis of *[2016]*
    (a) Melatonin and Serotonin
    (b) Thyroxine and Triiodothyronine
    (c) Estrogen and Progesterone
    (d) Cortisol and Cortisone
13. The figure shows a hypothetical tetrapeptide portion of a protein with parts labelled A-D. Which one of the following option is correct? *[NEET Kar. 2013]*



    (a) A is the sulphur containing amino acid - methionine
    (b) D is the acidic amino acid - glutamic acid`
    (c) C is an aromatic amino acid - tryptophan
    (d) A is the C - terminal amino acid and D is N terminal amino acid
14. Which one is the most abundant protein in the animal world *[2012]*
    (a) Trypsin (b) Haemoglobin
    (c) Collagen (d) Insulin

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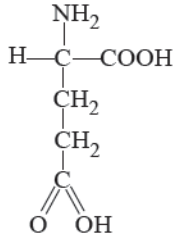
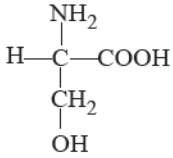
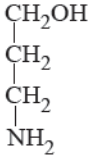
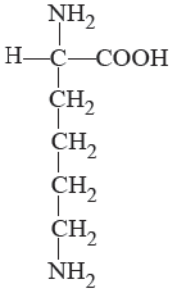
15. Which one out of A-D given below correctly respresents the structural formula of the basic amino acid *[2012]*

A	B	C	D
			

    (a) C (b) D
    (c) A (d) B

16. Which one of the following biomolecules is correctly characterized? *[2012M]*
    (a) Lecithin - A phosphorylated glyceride found in cell membrane.
    (b) Palmitic acid - An unsaturated fatty acid with 18 carbon atoms.
    (c) Adenylic acid - Adenosine with a glucose phosphate molecule.
    (d) Alanine amino acid - Contains an amino group and an acidic group anywhere in the molecule.
17. Which of the following is the simplest amino acid? *[2005]*
    (a) Alanine (b) Asparagine
    (c) Glycine (c) Tyrosine

18. Collagen is *[2002]*
(a) fibrous protein (b) globular protein
(c) lipid (d) carbohydrate

19. Conjugated proteins containing carbohydrates as prosthetic group are known as *[2000]*
(a) Chromoproteins (b) Glycoproteins
(c) Lipoproteins (d) Nucleoproteins

20. Which is an essential amino acid? *[2000]*
(a) Serine (b) Aspartic acid
(c) Glycine (d) Phenylalanine

21. The secondary structure of that portion of an integral protein that is buried in the lipid bilayer of a cell membrane is *[1999]*
(a) b-strand (b) b-bend
(c) random coil (d) a-helix

22. The enormous diversity of protein molecules is due mainly to the diversity of *[1998]*
(a) amino groups on the amino acids
(b) R groups on the amino acids
(c) amino acid sequences within the protein molecule
(d) peptide bonds

23. Genes are packed into a bacterial chromosome by *[1997]*
(a) histones (b) basic proteins
(c) acidic proteins (d) actin

24. Protein synthesis in an animal cell takes place
(a) only in the cytoplasm *[1997]*
(b) in the nucleolus as well as in cytoplasm
(c) in cytoplasm as well as in mitochondria
(d) only on ribosomes attached to the nuclear envelope

25. Amino acids are produced from *[1992]*
(a) Proteins (b) Fatty acids
(c) Essential oils (d) a-keto acids

Topic 3: Fats/Lipids

26. Which one of the following is the most abundant protein in the animals? *[2020]*
(a) Collagen (b) Lectin
(c) Insulin (d) Haemoglobin

27. Which of the following organic compounds is the main constituent of lecithin? *[2019, Odisa[*
(a) Phosphoprotein (b) Arachidonic acid
(c) Phospholipid (d) Cholesterol

28. Concanavalin A is: *[2019]*
(a) an alkaloid (b) an essential oil
(c) a lectin (d) a pigment

29. A typical fat molecule is made up of *[2016]*
(a) three glycerol molecules and one fatty acid molecule
(b) one glycerol and three fatty acid molecules
(c) one glycerol and one fatty acid molecule
(d) three glycerol and three fatty acid molecules

30. A phosphoglycerate is always made up of : *[NEET 2013]*
(a) only an unsaturated fatty acid esterified to a glycerol molecule to which a phosphate group is also attached
(b) a saturated or unsaturated fatty acid esterified to a glycerol molecule to which a phosphate group is also attached
(c) a saturated or unsaturated fatty acid esterified to a phosphate group which is also attached to a glycerol molecule.
(d) only a saturated fatty acid esterified to a glycerol molecule to which a phosphate group is also attached

31. Lipids are insoluble in water because lipid molecules are *[2002]*
(a) hydrophilic (b) hydrophobic
(c) neutral (d) zwitter ions

32. Spoilage of oil can be detected by which fatty acid? *[2001]*
(a) Oleic acid (b) Linolenic acid
(c) Linoleic acid (d) Erucic acid

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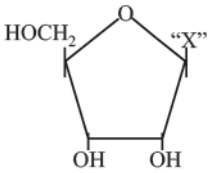
Topic 4: Nucleic acids/Nucleotides

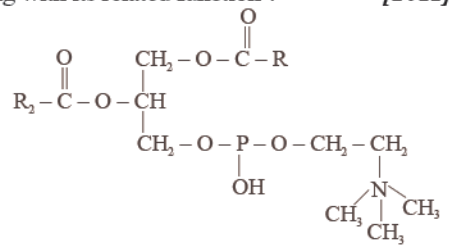
33. Purines found both in DNA and RNA are:
(a) Adenine and thymine *[2019]*
(b) Adenine and guanine
(c) Guanine and cytosine
(d) Cytosine and thymine

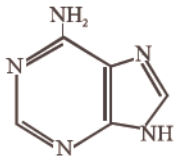
34. Given below is the diagrammatic representation of one of the categories of small molecular weight organic compounds in the living tissues. Identify the category shown and the one blank component "X" in it. *[2012]*



	Category	Component
(a)	Cholesterol	Guanine
(b)	Amino acid	NH_2
(c)	Nucleotide	Adenine
(d)	Nucleoside	Uracil

35. Which one of the following structural formulae of two organic compounds is correctly identified along with its related function ? *[2011]*

A 

B 

(a) B : Adenine — a nucleotide that makes up nucleic acids
(b) A: Triglyceride — major source of energy
(c) B : Uracil — a component of DNA
(d) A: Lecithin — a component of cell membrane

36. Length of one turn of the helix in a β-form DNA is approximately *[2000, 06]*
(a) 3.4 nm (b) 2 nm
(c) 0.34 nm (d) 20 nm

37. Which one of the following hydrolyses internal phosphodiester bonds in a polynucleotide chain? *[2005]*
(a) Lipase (b) Protease
(c) Endonuclease (d) Exonuclease

38. Antiparallel strands of a DNA molecule means that *[2005]*
(a) the phosphate groups of two DNA strands, at their ends. share the same position
(b) the phosphate groups at the start of two DNA strands are in opposite position (pole)
(c) one strand turns clockwise
(d) one strand turns anti-clockwise

39. A nucleotide is formed of *[1991, 05]*
(a) Purine, pyrimidine and phosphate
(b) Purine, sugar and phosphate
(c) Nitrogen base, sugar and phosphate
(d) Pyrimidine, sugar and phosphate

40. One of the similarities between DNA and RNA is that both *[2000]*
(a) are polymers of nucleotides
(b) are capable of replicating
(c) have similar sugars
(d) have similar pyrimidine bases

41. DNA synthesis can be specifically measured by estimating the incorporation of radio labelled
(a) uracil (b) adenine *[1997]*
(c) thymidine (d) deoxyribose sugar

42. The nitrogenous organic base purine occuring in RNA is *[1996]*
(a) cytosine (b) thymine
(c) guanine (d) uracil

43. Two free ribonucleotide units are interlinked with *[1995]*
(a) peptide bond
(b) covalent bond
(c) hydrogen bond
(d) phosphodiester bond

44. Which one contains four pyrimidine bases ? *[1994]*
(a) GATCAATGC (b) GCUAGACAA
(b) UAGCGGUAA (d) TGCCTAACG

45. Which is wrong about nucleic acids ? *[1993]*
(a) DNA is single stranded in some viruses
(b) RNA is double stranded occasionally
(c) Length of one helix is 45Å in B-DNA
(d) One turn of Z-DNA has 12 bases

46. Adenine is *[1992]*
(a) Purine (b) Pyrimidine
(c) Nucleoside (d) Nucleotide

47. Which is distributed more widely in a cell ?
(a) DNA (b) RNA *[1992]*
(c) Chloroplasts (d) Sphaerosomes

48. In RNA, thymine is replaced by *[1991, 92]*
(a) Adenine (b) Guanine
(c) Cytosine (d) Uracil

49. The basic unit of nucleic acid is *[1991]*
(a) Pentose sugar (b) Nucleoid
(c) Nucleoside (d) Nucleotide

50. A segment of DNA has 120 adenine and 120 cytosine bases. The total number of nucleotides present in the segment is *[1991]*
(a) 120 (b) 240
(c) 60 (d) 480

51. DNA is composed of repeating units of *[1991]*
(a) Ribonucleosides
(b) Deoxyribonucleosides
(c) Ribonucleotides
(d) Deoxyribonucleotides

52. Which is not consistent with double helical structure of DNA ? *[1990]*
(a) A = T, C = G
(b) Density of DNA decreases on heating
(c) A + T/C + G is not constant
(d) Both A and B

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53. In double helix of DNA, the two DNA strands are *[1988]*
(a) coiled around a common axis
(b) coiled around each other
(c) coiled differently
(e) coiled over protein sheath

54. RNA does not possess *[1988]*
(a) Uracil (b) Thymine
(c) Adenine (d) Cytosine

Topic 5: Enzymes/Cofactors

55. Match the following *[2020]*

(a)	Inhibitor of catalytic activity	(i)	Ricin
(b)	Possess peptide bonds	(ii)	Malonate
(c)	Cell wall material in fungi	(iii)	Chitin
(d)	Secondary metabolite	(iv)	Collagen

Choose the correct option from the following

	(a)	(B)	(C)	(D)
(a)	(iii)	(i)	(iv)	(ii)
(b)	(iii)	(iv)	(i)	(ii)
(c)	(ii)	(iii)	(i)	(iv)
(d)	(ii)	(iv)	(iii)	(i)

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56. Prosthetic groups differ from co-enzymes in that- *[2019, Odisa]*
(a) They can serve as co-factors in a number of enzyme - catalysed reactions.
(b) They require metal ions for their activity.
(c) They (prosthetic groups) are tightly bound to apoenzymes.
(d) Their association with apoenzymes is transient.

57. Which one of the following statements is correct, with reference to enzymes ? *[2017]*
(a) Holoenzyme = Apoenzyme + Coenzyme
(b) Coenzyme = Apoenzyme + Holoenzyme
(c) Holoenzyme = Coenzyme + Co-factor
(d) Apoenzyme = Holoenzyme + Coenzyme

58. Which one of the following statements in incorrect? *[2015 RS]*
(a) In competitive inhibition, the inhibitor molecule is not chemically changed by the enzyme.
(b) The competitive inhibitor does not affect the rate of breakdown of the enzyme-substrate complex.
(c) The presence of the competitive inhibitor decreases the Km of the enzyme for the substrate.
(d) A competitive inhibitor reacts reversibly with the enzyme to form an enzyme-inhibitor complex.

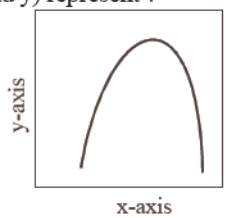
59. Select the option which is not correct with respect to enzyme action: *[2014]*
(a) Substrate binds with enzyme at its active site.
(b) Addition of lot of succinate does not reverse the inhibition of succinic dehydrogenase by malonate.
(c) A non-competitive inhibitor binds the enzyme at a site distinct from that which binds the substrate.
(d) Malonate is a competitive inhibitor of succinic dehydrogenase.

60. The essential chemical components of many coenzymes are : *[NEET 2013]*
(a) Nucleic acids (b) Carbohydrates
(c) Vitamins (d) Proteins

61. Transition state structure of the substrate formed during an enzymatic reaction is :
(a) permanent but unstable *[NEET 2013]*
(b) transient and unstable
(c) permanent and stable
(d) transient but stable

62. Which of the following statements about enzymes is **wrong**? *[NEET Kar. 2013]*
(a) Enzymes require optimum pH and temperature for maximum activity
(b) Enzymes are denatured at high temperatures
(c) Enzymes are mostly proteins but some are lipids also
(d) Enzymes are highly specific

63. The curve given below shows enzymatic activity with relation to three conditions (pH, temperature and substrate concentration.) What do the two axes (x and y) represent ? *[2011]*



	x - axis	y-axis
(a)	enzymatic activity	pH
(b)	temperature	enzyme activity
(c)	substrate concentration	enzymatic activity
(d)	enzymatic activity	temperature

64. A competitive inhibitor of succinic dehydrogenase is *[2008]*
(a) Malonate (b) Oxaloacetate
(c) m-ketoglutarate (d) Malate

65. An organic substance bound to an enzyme and essential for its activity is called *[2006]*
(a) Holoenzyme (b) Apoenzyme
(c) Isoenzyme (d) Coenzyme

66. Which of the following statements regarding enzyme inhibition is correct? *[2005]*
(a) Competitive inhibition is seen when a substrate competes with an enzyme for binding to an inhibitor protein.
(b) Competitive inhibition is seen when the substrate and the inhibitor compete for the active site on the enzyme.
(c) Non-competitive inhibition of an enzyme can be overcome by adding large amount of substrate.
(d) Non-competitive inhibitors often bind to the enzyme irreversibly.

67. The catalytic efficiency of two different enzymes can be compared by the *[2005]*
(a) formation of the product
(b) pH optimum value
(c) K_m value
(d) molecular size of the enzyme

68. In which one of the following enzymes, is copper necessarily associated as an activator? *[2004]*
(a) Carbonic anhydrase
(b) Tryptophanase
(c) Lactic dehydrogenase
(d) Tyrosinase

69. Feedback inhibition of an enzymatic reaction is caused by *[2000]*
(a) End product (b) Substrate
(c) Enzyme (d) Rise in temperature

70. Enzymes enhance the rate of reaction by *[2000]*
(a) forming a reactant-product complex
(b) changing the equilibrium point of the reaction
(c) combining with the product as soon as it is formed
(d) lowering the activation energy of the reaction

71. An enzyme brings about *[1993]*
(a) decrease in reaction time
(b) increase in reaction time
(c) increase in activation energy
(d) reduction in activation energy

72. Enzymes having slightly different molecular structure but performing identical activity are *[1991]*
(a) Holoenzymes (b) Isoenzymes
(c) Apoenzymes (d) Coenzymes

Topic 6: Saccharides

73. Which of the following glucose transporters is insulin-dependent? *[2019]*
(a) GLUT I (b) GLUT II
(c) GLUT III (d) GLUT IV

74. Consider the following statements: *[2019]*
(a) Coenzyme or metal ion that is tightly bound to enzyme protein is called prosthetic group.
(b) A complete catalytic active enzyme with its bound prosthetic group is called apoenzyme.
Select the **correct** option.
(a) Both **(a)** and **(B)** are true.
(b) **(a)** is true but **(B)** is false.
(c) Both **(a)** and **(B)** are false.
(d) **(a)** is false but **(B)** is true.

75. Which of the following are not polymeric ? *[2017]*
(a) Proteins (b) Polysaccharides
(c) Lipids (d) Nucleic acids

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76. Which one of the following statements is wrong? *[2016]*
(a) Sucrose is a disaccharide.
(b) Cellulose is a polysaccharide.
(c) Uracil is a pyrimidine.
(d) Glycine is a sulphur containing amino acid.

77. Which of the following biomolecules does have phosphodiester bond ? *[2015 RS]*
(a) Monosaccharides in a polysaccharide
(b) Amino acids in a polypeptide
(c) Nucleic acids in a nucleotide
(d) Fatty acids in a diglyceride

78. The introduction of t-DNA into plants involves: *[2015 RS]*
(a) Altering the pH of the soil, then heat shocking the plants
(b) Exposing the plants to cold for a brief period
(c) Allowing the plant roots to stand in water
(d) Infection of the plant by *Agrobacterium tumefaciens*

79. Which one of the following is a non - reducing carbohydrate? *[2014]*
(a) Maltose
(b) Sucrose
(c) Lactose
(d) Ribose 5 - phosphate

80. Macro molecule chitin is : *[NEET 2013]*
(a) Phosphorus containing polysaccharide
(b) Sulphur containing polysaccharide
(c) Simple polysaccharide
(d) Nitrogen containing polysaccharide

81. Which of the following is a reducing sugar? *[2002]*
(a) galactose
(b) gluconic acid
(c) β -methyl galactoside
(d) sucrose

82. As the age advances, there is a gradual thinning of hair in human males. This is mainly because of lowered *[2000]*
(a) blood supply
(b) synthesis of proteins
(c) synthesis of glycogen
(d) availability of energy

83. Cellulose, the most important constituent of plant cell wall is made of *[1998]*
(a) unbranched chain of glucose molecules linked by α-1, 4 glycosidic bond
(b) branched chain of glucose molecules linked by β-1, 4 glycosidic bond in straight chain and α-1, 6 glycosidic bond at the site of branching
(c) unbranched chain of glucose molecules linked by β-1, 4 glycosidic bond
(d) branched chain of glucose molecules linked by α-1, 6 glycosidic bond at the site of branching.

84. Lactose is composed of *[1998]*
(a) Glucose + Glucose
(b) Glucose + Fructose
(c) Fructose + Galactose
(d) Glucose + Galactose.

85. In which one of the following groups, all the three are examples of polysaccharides? *[1996]*
(a) Starch, glycogen, cellulose
(b) Sucrose, maltose, glucose
(c) glucose, fructose, lactose
(d) Galactose, starch, sucrose

86. A polysaccharide, which is synthesized and stored in liver cells, is *[1995]*
(a) lactose (b) galactose
(c) arabinose (d) glycogen

ANSWER KEY

1	(c)	10	(c)	19	(b)	28	(c)	37	(c)	46	(a)	55	(d)	64	(a)	73	(d)	82	(b)
2	(c)	11	(d)	20	(d)	29	(b)	38	(a)	47	(b)	56	(c)	65	(d)	74	(b)	83	(c)
3	(c)	12	(a)	21	(d)	30	(b)	39	(c)	48	(d)	57	(a)	66	(b)	75	(c)	84	(d)
4	(a)	13	(b)	22	(c)	31	(b)	40	(a)	49	(d)	58	(c)	67	(c)	76	(d)	85	(a)
5	(a)	14	(c)	23	(b)	32	(d)	41	(c)	50	(d)	59	(b)	68	(d)	77	(c)	86	(d)
6	(b)	15	(b)	24	(c)	33	(b)	42	(c)	51	(d)	60	(c)	69	(a)	78	(d)		
7	(a)	16	(a)	25	(d)	34	(d)	43	(d)	52	(c)	61	(b)	70	(d)	79	(b)		
8	(c)	17	(c)	26	(a)	35	(d)	44	(a)	53	(a)	62	(c)	71	(d)	80	(d)		
9	(d)	18	(a)	27	(c)	36	(a)	45	(c)	54	(b)	63	(b)	72	(b)	81	(a)		

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Hints & Solutions

1. (c) Inulin is a mixture of linear fructose polymers with different chain length and a glucose molecule at each C2 end. Adjacent fructose units are linked through glycosidic bond. The inulin that is used for medicine is most commonly obtained by soaking chicory roots in hot water.
Insulin is a protein composed of 51 amino acids and acts as a hormone which is secreted by beta-cells of pancreas. Adjacent amino acids are attached through peptide bond.

NOTES
Insulin is the first protein which is sequenced by Fredrick Sanger. He was awarded the 1958 Nobel Prize for Chemistry. Inulin is commonly used by mouth for high blood fats, including cholesterol and triglycerides and is also used for weight loss, constipation, diarrhea, and diabetes.

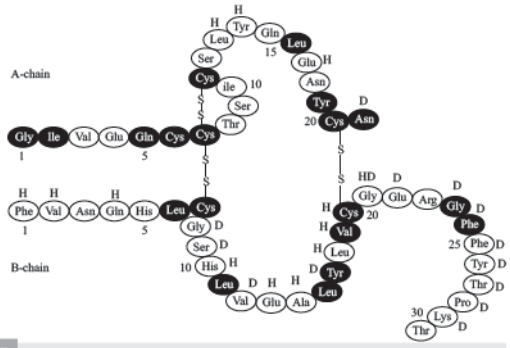
2. (c) Sugar is a carbohydrate. These are polyhydroxy aldehyde, ketone or their derivatives, which means they have carbonyl and hydroxyl groups in its structure.

3. (c) Calcium and phosphorus are the remaining elements.
4. (a) The major life processes are controlled by enzymes as they enhance the rate of biological reactions.
   Vitamins are required in limited amounts by organisms for regulation of metabolism and growth.
   Hormones are organic compounds produced by certain organs in small quantities. They act physiologically far from their site of origin.
5. (a) Some bacteria (such as *Rhodopseudomonas*), algae and green plants cell produce carbohydrates.
6. (b) Cellulose is the most abundant organic compound, polysaccharide and biopolymer found on earth.
7. (a) Proteins are polymers of amino acids. There are only 20 amino acids which can be arranged in different orders in a polypeptide chain to form a wide array of proteins.
8. (c) Principal or major elements include oxygen, carbon, hydrogen and nitrogen. They are so named because they alone constitute 99% of living system.
9. (d) Water is the most abundant compound in the most majority of cells. About 65-70% of human body is water. Major portion of water found in human body occurs in the cells as intracellular water.
10. (c) A Ramachandran plot, is a way to visualise energetically allowed regions for backbone dihedral angles ψ against ϕ of amino acid residues to protein structure. It is used to analyse the structure of a protein, the conformation of the amino acids present in the protein and close contacts between the atoms.

NOTES

Ramachandran was an Indian physicist who was known for his work that led to his creation of the Ramachandran plot for understanding peptide structure. He was the first to propose a triple-helical model for the structure of collagen.

11. (d) Insulin is a hormone consisting of 2 polypeptide chains. Each chain is composed of a specific sequence of amino acid residues connected by peptide bonds. In humans, chain A has 21 amino acids, and chain B has 30. Post translational modifications result in the connection of these two chains by disulfide bridges.



NOTES

Cysteine residues on A7 and B7, as well as A20 to B19 are covalently connected by disulfide bridges.

12. (a) Tryptophan is a precursor to neuro-transmitters serotonin and melatonin. Thyroxine (3,5,3',5'-tetraiodothyronine) is produced by follicular cells of the thyroid gland. It is produced as the precursor thyroglobulin. Estrogen is biosynthesized from progesterone (in two steps from cholesterol, via intermediate pregnenolone). Cortisone is one of several end-products of a process called steroidogenesis. Cortisol is produced in the adrenal cortex of kidney.

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13. (b) Glutamic acid and aspartic acid are acidic amino acids with two carboxylic groups and one amino group.
14. (c) Collagen is the most abundant protein in the animal world. *Rubisco* (ribulose biphosphte carboxylase - oxygenase) is not only the most abundant protein in plants but also in the whole biosphere.
15. (b) It is structural formula of basic amino acid lysine.

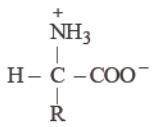
NOTES

Lysine is an α-amino acid that is used in the biosynthesis of proteins. It contains an α-amino group, an α-carboxylic acid group, and a side chain lysyl, classifying it as a basic, charged, aliphatic amino acid. It is encoded by the codons AAA and AAG. Lysine is an amino acid (building block of protein). People use it to make medicine. Lysine is used for preventing and treating cold sores (caused by the virus called herpes simplex labialis).

16. (a) Palmitic acid is one of the most common, saturated fatty acids found in animals and plants. It has 16 carbons including the carboxyl carbon. Adenylic acid is a nucleotide

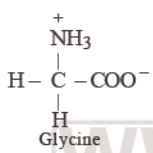
consisting of adenine, ribose or deoxyribose, and a phosphate group. It is a constituent of DNA or RNA. It is also called adenosine monophosphate. Amino acids are organic acids (with carboxylic group COOH) having amino group ($-NH_2$) generally attached to Carbon or carbon next to carboxylic group. The carbon also bears a variable alkyl group (R) or hydrogen or hydrocarbon. In alanine (R) is represented by methyl group.

17. (c) The general structure of an amino acid is

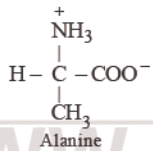


where R is an alkyl or aryl group.

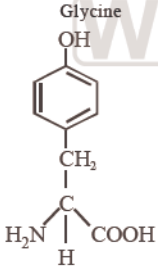
In Glycine, R is also a hydrogen atom. Therefore glycine is the simplest amino acid.



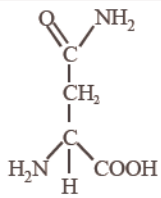
Glycine



Alanine



Tyrosine



Asparagine

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18. (a) Collagen is a major fibrous protein of connective tissue occuring as white fibres produced by fibroblast.

19. (b) Besides polypeptides, conjugated proteins posses additional groups, metals or ions. Nucleoproteins are proteins associated with nucleic acids. Lipoproteins are proteins associated with lipids.

Chromoproteins are proteins associated with pigments. Glycoproteins are proteins with a simple or complex sugar residue at their n-terminal.

20. (d) Essential amino acids are those which cannot be synthesized in the body from precursors. These amino acids must be present in our diet. They are valine, leucine, isoleucine, lysine, methionine, phenylalanine, tryptophan and threonine.

21. (d) Secondary structure is development of new stearic relationships amongst the amino acids through formation of intra and inter polypeptide hydrogen bonds.

NOTES

Secondary structure refers to regular, recurring arrangements in space of adjacent amino acid residues in a polypeptide chain. It is maintained by hydrogen bonds between amide hydrogens and carbonyl oxygens of the peptide backbone. The major secondary structures are α-helices and α-structures.

22. (c) There are only 20 amino acids . These can be arranged in different order in the polypeptide chain to form a diverse array of proteins.

23. (b) In bacteria the chromosome or nucleoid is a naked double stranded DNA. The bacterial DNA is folded with the help of RNAs forming a super coiled circular complex. The coiling is stabilized with the help of non-histonic polyamines and a number of positively charged ions. Eukaryotic DNA is associated with histone proteins that are helpful in its coiling to form chromatin fibres.

24. (c) In the cytoplasm protein synthesis is restricted to the ribosomes. Mitochondria being a semiautonomous organelle, has its own genetic machinery to synthesize its proteins.

25. (d) An amino acid molecule consists of a central carbon bonded to an amino group ($-NH_2$), a carboxylic group (–COOH), a hydrogen atom and a carbon chain or ring on its sides.

26. (a) Collagen is the most abundant protein in animal world. Collagen is the major insoluble fibrous protein found in the extracellular matrix and in connective tissue. RuBisCO is the most abundant protein in the whole of the Biosphere.

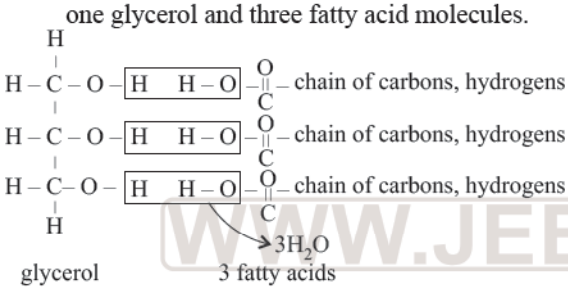
NOTES

The most common mutations are substitutions of glycine residues, which are crucial to formation and function of the collagen triple helix, by larger amino acids. Although type I collagen is the major structural protein of both bone and skin, the mutations in type I collagen genes cause a bone disease.

27. (c) Lecithin (phosphatidylcholine) a naturally occurring fatty substance referred to as phospholipid. It is important in cell structure and metabolism.

28. (c) Concanavalin A is a secondary metabolite, e.g. lectin. Lectin is a mannose/ glucose-binding protein isolated from Jack beans (*Canavalia ensiformis*). They are not antibodies and do not originate in an immune system but bind specifically to carbohydrate-containing receptors on cell surfaces (as of red blood cells).

29. (b) Fat molecules are made of atoms of carbon, hydrogen and oxygen. The hydrogen and oxygen atoms binds to the carbon, as pictorially depicted. A typical fat molecule has one glycerol and three fatty acid molecules.



30. (b) A saturated or unsaturated fatty acid esterified to a glycerol molecule to which a phosphate group is also attached forms phosphoglycerides.

> **NOTES** Phosphoglycerides are major structural components of cell membranes. They are, therefore, called membrane lipids. Lecithin is one such example.

31. (b) Water attracting molecules are called hydrophilic. Water repelling molecules are called hydrophobic. Amino acids simultaneously carry positive and negative charges. Such substances are called zwitter ions. Lipids are compounds of C, H, O but the ratio of H and O is more than 2 : 1, that is, the ratio of oxygen is lesser than carbohydrates. Lipids are insoluble in water but soluble in non-polar solvents such as benzene, chloroform etc.

> **NOTES** The most common lipid found in a cell is phospholipid. It contains a hydrophilic (polar) head and a hydrophobic (non- polar tail).

32 (d) Erucic acid is a monounsaturated omega-9 fatty acid, denoted 22 : 1 ω-9. It is prevalent in rapeseed, wallflower seed, and mustard seed, making up 40 to 50 percent of their oils. Erucic acid is also known as cis-13-docosenoic acid and the trans isomer is known as brassidic acid.

33. (b) Purines, a heterocyclic compound, such as adenine and guanine are found both in DNA and RNA.

34. (d) A combination of a nitrogen base with a pentose sugar is known as **nucleoside**. The nitrogen base combines with the sugar molecule at its 1' carbon atom in a glycosidic bond (C – N – C) by one of its nitrogen atoms (usually 1 in pyrimidines and 9 in purines). Depending upon the type of pentose sugar, nucleosides are differentiated into **ribonucleosides** and **deoxyribonucleosides**.

35. (d) Lecithin is a fat like substance (a phospholipid), which is a part of plasma membrane.

36. (a) Length of one turn of DNA helix is 34Å. $1Å = 10^{-1}$ nm

$$\therefore\ 34^{-} = 10^{-1} \times 34 = \frac{34 \times 1}{10} = 3.4 \text{ nm}$$

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37. (c) Endonucleases hydrolyse internal phosphodiester bonds in a polynucleotide chain (DNA). While exonucleases hydrolyse terminal phosphodiester bonds in a polynucleotide chain (DNA).

38. (a) Antiparallel strands of DNA have two strands having phosphate groups at same positions in space.

> **NOTES** The antiparallel structure of DNA is important in DNA replication because it replicates the leading strand one way and the lagging strand the other way. During DNA replication the leading strand is replicated continuously whereas the lagging strand is replicated in segments known as Okazaki fragments.

39. (c) The nucleic acid (DNA and RNA) are repeating units of nucleotides i.e. polynucleotides. Each nucleotide comprises of nitrogenous heterocyclic bases viz. purines or pyrimidines, pentose sugar and phosphoric acid.

40. (a) DNA and RNA are both polymers of nucleotides. DNA has deoxyribose sugar while RNA has ribose sugar. DNA has thymine while RNA has uracil in place of thymine.

41. (c) Thymidine is used to assess the rate of DNA synthesis, since thymine is unique to DNA.

NOTES

In the prokaryotic bacterium E. coli, replication can occur at a rate of 1,000 nucleotides per second. In comparison, eukaryotic human DNA replicates at a rate of 50 nucleotides per second. In both cases, replication occurs so quickly because multiple polymerases can synthesize two new strands at the same time by using each unwound strand from the original DNA double helix as a template.

42. (c) The nitrogenous bases forming the nucleoside in RNA are adenine, guanine (purines) and cytosine and uracil (pyrimidines).
43. (d) In a phosphodiester bond, linkage takes place between the phosphate group of one nucleotide and the hydroxyl group of sugar (ribose or deoxyribose) of the adjacent nucleotide.
44. (a) The pyrimidine bases include cytosine, thymine and uracil.
45. (c) Length of one helix is 34Å in B-DNA.
46. (a) The nitrogenous bases are constituents of DNA. The nitrogenous bases may be purines or pyrimidines. Purines are 9 membered, double winged structures eg. adenine or guanine.
47. (b) Bulk of RNA occurs in the cytoplasm and a small amount in the nucleus in eukaryotic cells. In prokaryotic cell RNA is found in the cytoplasm.
48. (d) RNA is a single chain of ribonucleotides. Each ribonucleotide consists of nitrogenous bases (adenine, guanine, cytosine and uracil), ribose sugar and phosphoric acid.
49. (d) Nucleic acid (DNA and RNA) comprise of polynucleotides. Each nucleotide consist of nitrogenous bases, pentose sugar and phosphoric acid.
50. (d) According to Chargaff's rule, the amount of adenine is always equal to thymine and that of guanine equal to cytosine. Moreover, A + G = T + C.
    120 + 120 = 120 + 120
    240 = 240
    So there will be 480 nucleotides in all.
51. (d) DNA is a long, double helix consisting of repeating units of deoxyribonucleotides.
52. (c) The ratios for the (A+ G)/ (T+C) are constant at approximately 1.0 for the different organisms. Each of these organisms contain a double stranded genome. The percentage of Guanine and Cytosine are almost equal to each other, similarly the percentages of Adenine and Thymine are almost equal to each other as well. In other words, the percentage of purines should be equal to the percentage of pyrimidines for double stranded DNA. This means that
    (A + G) = (C + T)
    The (A + T) / (C + G) ratios are not constant for all the species The relative numbers of (A + T) base pairs and (G + C) base pairs are unique to each organism and can vary between the different species.
53. (a) The two chains comprising the DNA are sprially coiled around a common axis to form a regular, right handed double helix.
54. (b) In RNA, pyrimidine thymine is replaced by uracil.

NOTES

Uracil is energetically less expensive to produce than thymine, which may account for its use in RNA. In DNA, however, uracil is readily produced by chemical degradation of cytosine, so having thymine as the normal base makes detection and repair of such incipient mutations more efficient.

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55. (d) Option (d) is the correct answer because malonate is the competitive inhibitor of catalytic activity of succinic dehydrogenase, Collagen is proteinaceous in nature and possesses peptide bonds, Chitin is a homopolymer present in the cell wall of fungi and exoskeleton of arthropods, Abrin and Ricin are toxins, secondary metabolites.
56. (c) Prosthetic groups are non-peptide (non-protein) compounds that mostly attach to proteins and assist them in different ways. They can be inorganic (like metals) or organic (carbon-containing). Prosthetic groups are tightly bound to the apoenzyme but coenzymes associated with the apoenzyme last for a short period of time i.e. transiently.

NOTES

Prosthetic groups assist cellular function by participating in cellular respiration and fatty acid synthesis. When bound to proteins, prosthetic groups are called holoproteins. Some examples of prosthetic groups are heme, biotin, flavin, iron sulphides, copper and ubiquinone.

57. (a) Holoenzyme is conjugated enzyme which consists of a protein part called apoenzyme and a non-protein called cofactor. Coenzyme are also organic compounds but their association with apoenzyme is only transient and acts as cofactors.
58. (c) K_m increases but V_{max} remains the same in competitive inhibition. This is because, on slightly increasing the substrate concentration, the effect of inhibitor is removed.
59. (b) Inhibitions of succinic dehydrogenase by malonate is an example of competitive inhibition. Thus it is a reversible reaction. On increasing the substrate (succinate) concentration the effect of inhibitor is removed and Vmax remains same.
60. (c) The essential chemical components of many enzymes are vitamins, e.g., coenzyme nicotinamide adenine dinucleotide (NAD) and NADP contain vitamin niacin.
61. (b) Transition state structure formed during an enzymatic reaction is transient and unstable.

NOTES

All chemical reactions must go through the transition state to form a product from a substrate molecule. The transition state is the state corresponding to the highest energy along the reaction coordinate. It has more free energy in comparison to the substrate or product; thus, it is the least stable state.

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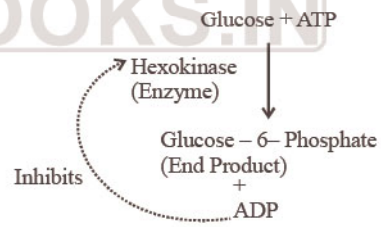
62. (c) Almost all enzymes are proteins. There are some nucleic acids that behave like enzymes. There are called ribozyme (also called RNA enzyme or catalytic RNA).
63. (b) In the given curve, the relation between temperature and enzyme activity is shown.
64. (a) Malonate is a powerful inhibitor of cellular respiration, because it binds to the active site of succinate dehydrogenase in the citric acid cycle but does not react. It thereby competes with succinate, since it does not have the $-CH_2-CH_2-$ group (as in succinate which is required for dehydrogenation). For the oxidative phosphorylation reaction, malonate is an inhibitor for complex II which again contains succinate dehydrogenase.
65. (d) Coenzyme is an organic substance that enhances the action of an enzyme by binding with the protein molecule. Holoenzyme is a biochemically active compound formed by the combination of an enzyme with a coenzyme. Apoenzyme is the protein part of an enzyme to which the coenzyme attaches to form an active enzyme. Isoenzyme is one of the several forms of an enzyme that catalyse the same reaction but differ from each other in such properties as substrate affinity and maximum rates of enzyme substrate reaction.
66. (b) In competitive inhibition the inhibitor resembles the substrate in structure and hence compete for the active site of the enzyme.
67. (c) K_m (Michealis Menten constant). It is defined as that substrate concentration at which, under optimum conditions, the rate of an enzyme catalysed reaction reaches half the maximum rate. K_m is inversely proportional to affinity of enzyme far its substrate.
68. (d) Tyrosinase (polyphenol oxidase, catecholase) is a copper-containing oxidase which is widely distributed in plants, animals and man. It oxidizes tyrosine to the pigment melanin in mammals and causes the cut surfaces of many fruits and vegetables to darken (browning reactions).
69. (a)



70. (d) Activation energy is the energy required to overcome energy barrier of the reactants and make them reactive to start a chemical reaction. Enzymes lower the requirement of activation energy.
71. (d) Enzymes accelerate chemical reaction by lowering the activation energy.

NOTES

The activation energy of a chemical reaction is closely related to its rate. Specifically, the higher the activation energy, the slower the chemical reaction will be. This is because molecules can only complete the reaction once they have reached the top of the activation energy barrier.

72. (b) There are certain enzymes which have slightly different molecular structure but have similar catalytic function such enzymes are known as isoenzymes. Holoenzyme is the active compound formed by combination of a

coenzyme and an apoenzyme. Apoenzyme is the protein component of an enzyme, to which the coenzyme attaches to form an active enzyme. Coenzymes are organic non-protein molecules that bind with the protein molecule (apoenzyme) to form the active enzyme (holoenzyme).

73. (d) GLUT1 and GLUT4 are glucose transport proteins which facilitate glucose transport into insulin-sensitive cells. GLUT1 is insulin-independent and is widely distributed in different tissues. GLUT4 is insulin-dependent and is responsible for the majority of glucose transport into muscle and adipose cells in anabolic conditions.

74. (b) Coenzyme or metal ion that is tightly bound to enzyme protein is called prosthetic group. A complete catalytic active enzyme with its bound prosthetic group is called holoenzyme

A protein that forms an active enzyme system by combination with a coenzyme and determines the specificity of this system for a substrate is called apoenzyme.

75. (c) – Nucleic acids are polymers of nucleotides
– Proteins are polymers of amino acids
– Polysaccharides are polymers of monosaccharides
– Lipids are the tri-esters of fatty acids with glycerol.

76. (d) Glycine (abbreviated as Gly or G) is the smallest of the 20 amino acids commonly found in proteins, and indeed is the smallest possible (having a hydrogen substituent as its side-chain). The formula is NH_2CH_2COOH. Its codons are GGU, GGC, GGA, GGG of the genetic code.

77. (c) Nucleic acids have phophodiester bond in a nucleotide.

78. (d) *Agrobacterium tumefaciens* introduces t-DNA into the plant.

NOTES

Agrobacterium tumefaciens is a soil bacterium that has the ability to infect plant cells and transfer a defined sequence of their DNA to the plant cell by infection and a causative agent of crown gall disease. Agrobacterium tumefaciens cell contains a plasmid known as the Ti (tumor-inducing) plasmid (140–235 kb).

79. (b) Sucrose is classified under non reducing sugars because it does not have any free aldehyde or keto group.

80. (d) Chitin or fungal cellulose is a nitrogen containing polysaccharide and hetero-polymer of NAG.

81. (a) Reducing sugar is any sugar that has an aldehyde group or is capable of forming one, in solution through isomerisation. Reducing monosaccharides include glucose, fructose, glyceraldehyde and galactose. Many disaccharides, like lactose and maltose also have a reducing form, as one of the two units may have an open- chain form with an aldehyde group.

However, sucrose and trehalose, in which the anomeric carbons of the two units are linked together, are non reducing disaccharides since neither of the rings is capable of opening.

82. (b) Reduced protein synthesis causes thinning of hairs.

NOTES

Any reduction in protein synthesis leads to a reduction of hair shaft diameter which is easily discovered on the hair shaft, The second property is linear growth which enables the bulb date of any point along a hair to be estimated by dividing the distance of the point from the hair bulb by the rate of hair growth.

83. (c) Cellulose is the structural polysaccharide of plant cell walls. They are long chain polymers of β-glucose units. The adjacent β-glucose units are joined by linkages.

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84. (d) Lactose is a disaccharide that consists of β-D-galactose and β-D-glucose molecules bonded through a β1-4 glycosidic linkage. Lactose makes up around 2-8% of the solids in milk. The name comes from the Latin word for milk, plus the -ose ending used to name sugars.

85. (a) Polysaccharides are complex carbohydrates formed by polymerization of a large number of units called monosaccharides, starch is a glucosan polysaccharide and is the major reserve food of animals. Cellulose is the structural polysaccharide of plant cell wall. Sucrose is a disaccharide comprised of one unit of D-glucose and one unit of D-fructose. Maltose is a disaccharide formed of two molecules of glucose held together, lactose is disaccharide formed through condensation of D-glucose and D-glucose. Glucose and fructose are monosaccharides.

86. (d) Glycogen is a polysaccharide, which is synthesized and stored in the liver. It is released into the blood by breakdown of simple glucose, and energy is released.

10 Cell Cycle and Cell Division

Trend Analysis with Important Topics & Sub-Topics

Topic	Sub-Topics	2020		2019		2018		2017		2016	
		Qns.	LOD	Qns.	LOD	Qns.	LOD	Qns.	LOD	Qns.	LOD
Phases of Cell Cycle-Interphase	Interphase	2	A	1	E			1	A		
M-Phase/ Cytokinesis	Mitosis							1	D		
	Anaphase										
	Metaphase									2	A
	Cytokinesis			1	A						
Meiosis- I/II	Prophase I	2	A/D			1	A			1	A

LOD - Level of Difficulty | E - Easy | A - Average | D - Difficult | Qns - No. of Questions

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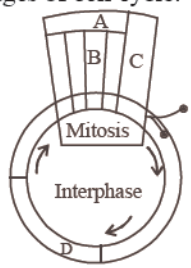
Topic 1: Phases of cell cycle – Interphase

1. Some dividing cells exit the cell cycle and enter vegetative inactive stage. This is called quiescent stage (G_0). This process occurs at the end of *[2020]*
   (a) G_1 phase (b) S phase
   (c) G_2 phase (d) M phase
2. Identify the correct statement with regard to G_1 phase (Gap 1) of interphase. *[2020]*
   (a) Reorganisation of all cell components takes place.
   (b) Cell is metabolically active, grows but does not replicate its DNA.
   (c) Nuclear Division takes place.
   (d) DNA synthesis or replication takes place.
3. Cells in G_0 phase : *[2019]*
   (a) exit the cell cycle
   (b) enter the cell cycle
   (c) suspend the cell cycle
   (d) terminate the cell cycle
4. The **correct** sequence of phases of cell cycle is:
   (a) $M \rightarrow G_1 \rightarrow G_2 \rightarrow S$ *[2019]*
   (b) $G_1 \rightarrow G_2 \rightarrow S \rightarrow M$
   (c) $S \rightarrow G_1 \rightarrow G_2 \rightarrow M$
   (d) $G_1 \rightarrow S \rightarrow G_2 \rightarrow M$
5. DNA replication in bacteria occurs: *[2017]*
   (a) Within nucleolus
   (b) Prior to fission
   (c) Just before transcription
   (d) During S phase
6. A somatic cell that has just completed the S phase of its cell cycle, as compared to gamete of the same species, has : *[2015 RS]*
   (a) same number of chromosomes but twice the amount of DNA
   (b) twice the number of chromosomes and four times the amount of DNA
   (c) four times the number of chromosomes and twice the amount of DNA
   (d) twice the number of chromosomes and twice the amount of DNA

7. During which phase(s) of cell cycle, amount of DNA in a cell remains at 4C level if the initial amount is denoted as 2C? *[2014]*
   (a) G_0 and G_1 (b) G_1 and S
   (c) Only G_2 (d) G_2 and M
8. In 'S' phase of the cell cycle: *[2014]*
   (a) Amount of DNA doubles in each cell.
   (b) Amount of DNA remains same in each cell.
   (c) Chromosome number is increased.
   (d) Amount of DNA is reduced to half in each cell.
9. Given below is a schematic break-up of the phases / stages of cell cycle:



   Which one of the following is the correct indication of the stage/phase in the cell cycle?
   (a) C - Karyokinesis *[2009]*
   (b) D - Synthetic phase
   (c) A - Cytokinesis
   (d) B - Metaphase
10. At what stage of the cell cycle are histone proteins synthesized in a eukaryotic cell?
   (a) During G 2 stage of prophase *[2005]*
   (b) During S-phase
   (c) During entire prophase
   (d) During telophase
11. In the somatic cell cycle *[2004]*
   (a) In G_1 phase DNA content is double the amount of DNA present in the original cell
   (b) DNA replication takes place in S-phase
   (c) a short interphase is followed by a long mitotic phase
   (d) G_2 phase follows mitotic phase
12. In cell cycle, DNA replication takes place in *[1996, 2000]*
   (a) G1 phase (b) G2 phase
   (c) Mitotic metaphase (d) S phase
13. A bacterium divides every 35 minutes. If a culture containing 10^5 cells per ml is grown for 175 minutes, what will be the cell concentration per ml after 175 minutes? *[1998]*
   (a) 5×10^5cells (b) 35×10^5cells
   (c) 32×10^5cells (d) 175×10^5cells
14. Which one of the following structures will not be common to mitotic cells of higher plants?
   (a) cell plate (b) centriole *[1997]*
   (c) centromere (d) spindle fibres

Topic 2: M - phase / cytokinesis

15. Match the following with respect to meiosis *[2020]*

(A) Zygotene	(i) Terminalization
(B) Pachytene	(ii) Chiasmata
(C) Diplotene	(iii) Crossing over
(D) Diakinesis	(iv) Synapsis

   Select the correct option from the following

	(A)	(B)	(C)	(D)
(a)	(iv)	(iii)	(ii)	(i)
(b)	(i)	(ii)	(iv)	(iii)
(c)	(ii)	(iv)	(iii)	(i)
(d)	(iii)	(iv)	(i)	(ii)

16. Dissolution of the synaptonemal complex occurs during *[2020]*
   (a) Zygotene (b) Diplotene
   (c) Leptotene (d) Pachytene
17. Which of the following options gives the correct sequence of events during mitosis? *[2017]*
   (a) Condensation → nuclear membrane disassembly → arrangement at equator → centromere division → segregation → telophase
   (b) Condensation → crossing over→ nuclear membrane disassembly → segregation → telophase
   (c) Condensation → arrangement at equator → centromere division → segregation → telophase
   (d) Condensation → nuclear membrane disassembly → crossing over → segregation → telophase
18. Anaphase Promoting Complex (APC) is a protein degradation machinery necessary for proper mitosis of animal cells. If APC is defective in a human cell, which of the following is expected to occur? *[2017]*
   (a) Chromosomes will be fragmented
   (b) Chromosomes will not segregate
   (c) Recombination of chromosome arms will occur
   (d) Chromosomes will not condense

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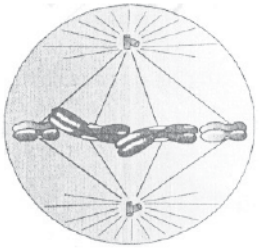
19. Spindle fibres attach on to ***[2016]***
    (a) Telomere of the chromosome
    (b) Kinetochore of the chromosome
    (c) Centromere of the chromosome
    (d) Kinetosome of the chromosome
20. Which of the following is not a characteristic feature during mitosis in somatic cells ? ***[2016]***
    (a) Spindle fibres
    (b) Disappearance of nucleolus
    (c) Chromosome movement
    (d) Synapsis
21. A stage in cell division is shown in the figure. Select the answer which gives correct identification of the stage with its characteristics. ***[NEET 2013]***

(a)	Late anaphase	Chromosomes move away from equatorial plate, Golgi complex not present
(b)	Cytokinesis	Cell plate formed, mitochondria distributed between two daughter cells
(c)	Telophase	Endoplasmic reticulum and nucleolus not reformed yet
(d)	Telophase	Nuclear envelop reforms, golgi complex reforms

22. The complex formed by a pair of synapsed homologous chromosomes is called ***[NEET 2013]***
    (a) Kinetochore (b) Bivalent
    (c) Axoneme (d) Equatorial plate
23. During the metaphase stage of mitosis spindle fibres attach to chromosomes at ***[NEET Kar. 2013]***
    (a) Centromere
    (b) Kinetochore
    (c) Both centromere and kinetochore
    (d) Centromere, kinetochore and areas adjoining centromere
24. A stage of mitosis is shown in the diagram. Which stage is it and what are its characteristics? ***[NEET Kar. 2013]***



    (a) Late prophase – chromosomes move to spindle equator
    (b) Metaphase – spindle fibres attached to kinetochores, centromeres split and chromatids separate
    (c) Metaphase – chromosomes moved to spindle equator chromosomes made up of two sister chromatids
    (d) Anaphase – centromeres split and chromatids separate and start moving away
25. Select the correct option with respect to mitosis. ***[2011]***
    (a) Chromatids separate but remain in the centre of the cell in anaphase.
    (b) Chromatids start moving towards opposite poles in telophase.
    (c) Golgi complex and endoplasmic reticulum are still visible at the end of prophase.
    (d) Chromosomes move to the spindle equator and get aligned along equatorial plate in metaphase
26. At metaphase, chromosomes are attached to the spindle fibres by their: ***[2011M]***
    (a) satellites
    (b) secondary constrictions
    (c) kinetochores
    (d) centromere
27. During mitosis ER and nucleolus begin to disappear at: ***[2010]***
    (a) late prophase (b) early metaphase
    (c) late metaphase (d) early prophase

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28. Which stages of cell division do the following figures A and B represent respectively? *[2010]*

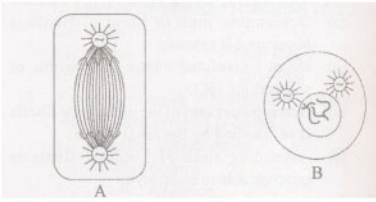

	Fig. A		Fig. B
(a)	Metaphase	-	Telophase
(b)	Telophase	-	Metaphase
(c)	Late Anaphase	-	Prophase
(d)	Prophase	-	Anaphase

29. Synapsis occurs between: *[2009]*
(a) mRNA and ribosomes
(b) spindle fibres and centromere
(c) two homologous chromosomes
(d) a male and a female gamete

30. If you are provided with root-tips of onion in your class and are asked to count the chromosomes, which of the following stages can you most conveniently look into? *[2004]*
(a) Metaphase (b) Telophase
(c) Anaphase (d) Prophase

31. Which one of the following precedes re-formation of the nuclear envelope during M phase of the cell cycle *[2004]*
(a) Decondensation from chromosomes, and reassembly of the nuclear lamina
(b) Transcription from chromosomes, and reassembly of the nuclear lamina
(c) Formation of the contractile ring, and formation of the phragmoplast
(d) Formation of the contractile ring, and transcription from chromosomes

32. Best material for the study of mitosis in laboratory is *[2002]*
(a) anther (b) root tip
(c) leaf tip (d) ovary

33. If a diploid cell is treated with colchicine then it becomes *[2002]*
(a) triploid (b) tetraploid
(c) diploid (d) monoploid

34. During cell division, the spindle fibres attach to the chromosome at a region called *[2000]*
(a) chromocentre (b) kinetochore
(c) centriole (d) chromomere

35. Microtubule is involved in the *[1998]*
(a) cell division
(b) muscle contraction
(c) membrane architecture
(d) DNA recognition

36. How many mitotic divisions are needed for a single cell to make 128 cells? *[1997]*
(a) 7 (b) 14
(c) 28 (d) 64

37. During cell division in apical meristem the nuclear membrane appears in *[1997]*
(a) metaphase (b) anaphase
(c) telophase (d) cytokinesis

38. Colchicine is employed to diploidize a haploid cell as it *[1996]*
(a) inhibits mitosis
(b) inhibits formation of mitotic spindle
(c) allows replication of DNA twice in one cell cycle
(d) inhibits formation of centromere

39. Best stage to observe shape, size and number of chromosomes is *[1994]*
(a) interphase (b) metaphase
(c) prophase (d) telophase

40. Number of chromatids at metaphase is *[1992]*
(a) two each in mitosis and meiosis
(b) two in mitosis and one in meiosis
(c) two in mitosis and four in meiosis
(d) one in mitosis and two in meiosis

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41. Mitotic anaphase differs from metaphase in possessing *[1991]*
(a) same number of chromosomes and same number of chromatids
(b) half number of chromosomes and half number of chromatids
(c) half number of chromosomes and same number of chromatids
(d) same number of chromosomes and half number of chromatids

Topic 3: Meiosis - I/II

42. Match the following with respect to meiosis *[2020]*

(a)	Zygotene	(i)	Terminalization
(b)	Pachytene	(ii)	Chiasmata
(c)	Diplotene	(iii)	Crossing over
(d)	Diakinesis	(iv)	Synapsis

Select the correct option from the following

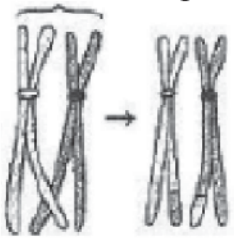
	(A)	(B)	(C)	(D)
(a)	(iv)	(iii)	(ii)	(i)
(b)	(i)	(ii)	(iv)	(iii)
(c)	(ii)	(iv)	(iii)	(i)
(d)	(iii)	(iv)	(i)	(ii)

43. Meiotic division of the secondary oocyte is completed *[2020]*
    (a) At the time of copulation
    (b) After zygote formation
    (c) At the time of fusion of a sperm with an ovum
    (d) Prior to ovulation
44. Crossing over takes place between which chromatids and in which stage of the cell cycle? *[2019, Odisa]*
    (a) Non-sister chromatids of non-homologous chrom-osomes at Pachytene stage of prophase I.
    (b) Non-sister chromatids of non-homologous chrom-osomes at Zygotene stage of prophase I.
    (c) Non-sister chromatids of homologous chromosomes at Pachytene stage of prophase I.
    (d) Non-sister chromatids of homologous chromosomes at Zygotene stage of prophase I.
45. After meiosis I, the resultant daughter cells have *[2019, Odisa]*
    (a) four times the amount of DNA in comparison to haploid gamete.
    (b) same amount of DNA as in the parent cell in S phase.
    (c) twice the amount of DNA in comparison to haploid gamete.
    (d) same amount of DNA in comparison to haploid gamete.
46. The stage during which separation of the paired homologous chromosomes begins is *[2018]*
    (a) Pachytene (b) Diplotene
    (c) Zygotene (d) Diakinesis
47. In meiosis crossing over is initiated at *[2016]*
    (a) Pachytene (b) Leptotene
    (c) Zygotene (d) Diplotene
48. Select the correct option : *[2015 RS]*

	I		II
A	Synapsis aligns homologous chromosomes	(i)	Anaphase-II
B	Synthesis of RNA and protein	(ii)	Zygotene
C	Action of enzyme recombinase	(iii)	G2-phase
D	Centromeres do not separate but chromatids move towards opposite poles	(iv)	Anaphase-I
		(v)	Pachytene

	A	B	C	D
(a)	(ii)	(iii)	(v)	(iv)
(b)	(i)	(ii)	(v)	(iv)
(c)	(ii)	(iii)	(iv)	(v)
(d)	(ii)	(i)	(iii)	(iv)

49. Choose the correct option for the following events of meiosis in correct sequence: *[2015 RS]*
    (A) Crossing over
    (B) Synapsis
    (C) Terminalisation of chiasmata
    (D) Disappearance of nucleolus
    (a) $B \rightarrow A \rightarrow C \rightarrow D$
    (b) $A \rightarrow B \rightarrow C \rightarrow D$
    (c) $A \rightarrow B \rightarrow D \rightarrow C$
    (d) $D \rightarrow C \rightarrow B \rightarrow A$
50. The enzyme recombinase is required at which stage of meiosis: *[2014]*
    (a) Pachytene (b) Zygotene
    (c) Diplotene (d) Diakinesis
51. During meiosis I, the chromosomes start pairing at *[NEET Kar. 2013]*
    (a) Leptotene (b) Zygotene
    (c) Pachytene (d) Diplotene
52. During gamete formation, the enzyme recombinase participates during *[2012]*
    (a) Metaphase - I (b) Anaphase - II
    (c) Prophase - I (d) Prophase - II
53. Given below is the representation of a certain event at a particular stage of a type of cell division. Which is this stage? *[2012]*



    (a) Prophase I during meiosis
    (b) Prophase II during meiosis
    (c) Prophase of Mitosis
    (d) Both prophase and metaphase of mitosis

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54. Identify the meiotic stage in which the homologous chromosomes separate while the sister chromatids remain associated at their centromeres? *[2012M]*
(a) Metaphase I (b) Metaphase II
(c) Anaphase I (d) Anaphase II

55. Genetic map is one that *[2003]*
(a) shows the distribution of various species in a region
(b) establishes sites of the genes on a chromosome
(c) establishes the various stages in gene evolution
(d) show the stages during the cell division

56. The exchange of genetic material between chromatids of paired homologous chromosomes during first meiotic division is called *[1996]*
(a) transformation (b) chiasmata
(c) crossing over (d) synapsis

57. Lampbrush chromosomes occur during *[1996]*
(a) prophase of mitosis
(b) diplotene of meiosis
(c) metaphase of meiosis
(d) interphase

58. Meiosis is evolutionary significant because it result in *[1994]*
(a) genetically similar daughters
(b) four daughter cells
(c) eggs and sperms
(d) recombinations

59. Meiosis II performs *[1993]*
(a) separation of sex chromosomes
(b) synthesis of DNA and centromere
(c) separation of homologous chromosomes
(d) separation of chromatids

60. In meiosis, the daughter cells differ from parent cell as well as amongst themselves due to *[1991]*
(a) segregation, independent assortment and crossing over
(b) segregation and crossing over
(c) independent assortment and crossing over
(d) segregation and independent assortment

61. Segregation of mendelian factor (Aa) occurs during *[1990]*
(a) Diplotene
(b) Anaphase I
(c) Zygotene/Pachytene
(d) Anaphase II

62. Meiosis I is reductional division. Meiosis II is equational division due to *[1988]*
(a) pairing of homologous chromosomes
(b) crossing over
(c) separation of chromatids
(d) disjunction of homologous chromosomes

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ANSWER KEY

1	(d)	8	(a)	15	(a)	22	(b)	29	(c)	36	(a)	43	(c)	50	(a)	57	(b)
2	(b)	9	(b)	16	(b)	23	(b)	30	(a)	37	(c)	44	(c)	51	(b)	58	(d)
3	(a)	10	(b)	17	(a)	24	(c)	31	(a)	38	(b)	45	(c)	52	(c)	59	(d)
4	(d)	11	(b)	18	(b)	25	(d)	32	(b)	39	(b)	46	(b)	53	(a)	60	(a)
5	(b)	12	(d)	19	(b)	26	(c)	33	(b)	40	(a)	47	(a)	54	(c)	61	(b)
6	(b)	13	(c)	20	(d)	27	(d)	34	(b)	41	(d)	48	(a)	55	(b)	62	(c)
7	(c)	14	(b)	21	(d)	28	(c)	35	(a)	42	(a)	49	(a)	56	(c)		

Hints & Solutions

1. (d) Some dividing cells exit the cell cycle and enter vegetative inactive stage, called quiescent stage (G_0). This process occurs at the end of M-phase and beginning of G_1 phase.

NOTES

Human cancers have an apparent low growth fraction, the bulk of cells presumed to being out of cycle in a G_0 quiescent state due to the inability in the past to distinguish G_0 from G_1 cells. Thus, human cancers are blocked in transition in G_1 and are not predominantly in a G_0 or quiescent differentiated state.

2. (b) During G_1 phase the cell is metabolically active and continuously grows but does not replicate its DNA. DNA synthesis takes place in S phase. Nuclear division occurs during Karyokinesis. Reorganization of all cell components takes place in M-Phase.

NOTES

In some organisms, karyokinesis is not followed by cytokinesis as a result of which, multinucleate condition arises leading to the formation of syncytium.

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3. (a) G_0 or resting phase is a non-growing state distinct from interphase. It is a period in the cell cycle in which cells exist in a quiescent state. It is viewed as either an extended G_1 phase, where the cell is neither dividing nor preparing to divide, or a distinct quiescent stage that occurs outside of the cell cycle.
4. (d) Cell cycle is the complete series of events from one cell division to the next. The correct sequence of phases of cell cycle is
$G_1 \rightarrow S \rightarrow G_2 \rightarrow M$.
5. (b) In bacteria DNA replication occurs in cytoplasm prior to fission. Prokaryotes due to their primitive nature do not show well marked S-phase.
6. (b) When S-phase completes, a somatic cell contains 2n number of chromosomes and 4C content of DNA.

NOTES

During DNA replication, the unwinding of strands leaves a single strand vulnerable. During S phase, any problems with DNA replication trigger a "checkpoint" — a cascade of signaling events that puts the phase on hold until the problem is resolved.

7. (c) In M-phase both 4C and 2C of DNA are present in different stages.
8. (a) During S or synthesis phase, replication or duplication of chromosomal DNA and synthesis of histone proteins takes place. During this time the amount of DNA per cell doubles.
9. (b) In schematic break-up of the phases/stages of cell cycle, D synthetic phase is the correct indication of the stage/phase in the cell cycle.
10. (b) Histone proteins are synthesized during S-phase of cell cycle. S-phase or synthetic phase is when synthesis of DNA takes place.
11. (b) DNA replication is restricted to S-phase of interphase. G_2 phase is followed by the mitotic phase which is shorter than the interphase. In G_2 phase, DNA content is double than the amount present in the original cell.
12. (d) G1 phase, also called Gap I phase is characterized by increase in cell size. In the S phase or synthetic phase DNA molecules replicate. G2 is the second growth phase. Gap II is the phase where in there is intensive formation of RNAs and proteins. In the mitotic metaphase, the chromosomes are arranged at the equatorial plate.
13. (c) $\frac{175}{35}$ min = 5 divisions
Number of cells formed
$= (2)^5 \times 10^5 = 32 \times 10^5$
14. (b) Plants cells do not have centrioles. Cell plate appears during cytokinesis in dividing cells. Centromere holds the sister chromatids in a chromosome. Spindle fibres appear during metaphase.
15. (a) Zygotene $\rightarrow$ Synapsis
Pachytene $\rightarrow$ Crossing over
Diplotene $\rightarrow$ Chiasmata formation
Diakinesis $\rightarrow$ Terminalisation
16. (b) Dissolution of the synaptonemal complex occurs during diplotene stage of Prophase-I of Meiosis-I. The beginning of diplotene

is recognised by the dissolution of the synaptonemal complex and the tendency of the recombined homologous chromosomes of the bivalents to separate from each other except at the sites of crossovers. These X-shaped structures are called chiasmata.

17. (a) The correct sequence of events occur during mitosis would be as follows :
(i) DNA condensation occurs so that chromosomes become visible during early to mid-prophase.
(ii) Disassembly of nuclear membrane begins at late prophase or transition to metaphase.
(iii) Chromosomes align at equator during metaphase.
(iv) Centromere division occurs during anaphase forming daughter chromosomes.
(v) During anaphase segregation also occurs in which daughter chromosomes separate and move to opposite poles.
(vi) Telophase finally leads to formation of two daughter nuclei.

18. (b) During anaphase, Anaphase Promoting Complex (APC) is a protein necessary for separation of daughter chromosomes. A defective APC will cause the chromosomes fail to segregate during anaphase.

NOTES

The APC gene provides instructions for making the APC protein, which plays a critical role in several cellular processes. The APC protein acts as a tumor suppressor, which means that it keeps cells from growing and dividing too fast or in an uncontrolled way. People with mutations in the APC gene have familial adenomatous polyposis (FAP) or attenuated FAP (AFAP). You have an increased chance to develop multiple gastrointestinal polyps, colorectal cancer, and possibly other cancers. There are risk management options to detect cancer early or lower the risk to develop cancer.

19. (b) Attachment of microtubules to chromosomes is mediated by kinetochores, which actively monitor spindle formation and prevent premature anaphase onset during mitosis.

20. (d) Synapsis is the pairing of two homologous chromosomes that occurs during meiosis. It allows matching-up of homologous pairs prior to their segregation, and possible chromosomal crossover between them. Synapsis takes place during prophase I, of zygotene of meiosis.

21. (d) Telophase is the stage of reconstitution of nuclei. The chromosomes that have reached their respective poles decondense and lose their individuality and collect in a mass in the two poles. Nuclear envelope assemble around chromatin mass. Nucleolus, Golgi complex and ER reform.

22. (b) During zygotene, second stage of meiosis I, homologous chromosomes start pairing together forming a complex structure called synaptonemal complex. The complex formed by a pair of synapsed homologous chromosome is called a bivalent or a tetrad. Crossing over occurs between non sister chromatids of bivalent in the next stage.

23. (b) Kinetochores are small disc-shaped structures at the surface of the centromeres which serve as the sites of attachment of spindle fibres to the chromosomes that are moved into position at the centre of the cell. Hence, the metaphase is characterised by all the chromosomes that proceed to lie at the equator.

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24. (c) Metaphase chromosome is made up of two sister chromatides which are held together by the centromere. Chromosomes are moved to spindle equator and get aligned along metaphase plate through spindle fibres to both poles.

25. (d) In mitosis, chromosomes move to the equator and get aligned along equatorial plate in metaphase.

26. (c) Kinetochores are large protein complexes that bind the centromeres of chromosomes to the microtubules of mitotic spindle fibres, during metaphase in the cell cycle.

27. (d) During mitosis, endoplasmic reticulum and nucleus begin to disappear at early prophase. Also, nucleus and cell become spherical and DNA molecules condense to form shortened chromosome.

28. (c) The figure A represents late anaphase while figure B represents prophase stage of mitosis.

29. (c) Synapsis is the pairing of two homologous chromosomes that occurs during

prophase I (zygotene stage) of meiosis. The two chromosomes move together and pair corresponding along their lengths as they lie side to side. The resulting structure is called a bivalent.

30. (a) Chromosomes are most distinct in the metaphase stage. In the telophase stage they regain their coiled composition. In anaphase the chromatids separate and move towards opposite poles. In prophase stage the chromosomes appear thread like and individual chromatids cannot be seen.
31. (a) At the telophase of M phase or mitotic phase, the nuclear membrane and nucleolus appear. The decondensation of chromosomes occur.
32. (b) Anther cells are used to study meiosis.
33. (b) Colchicine inhibits spindle formation, due to which chromatids are unable to separate during anaphase which results in doubling of chromosomes. So, if a diploid cell is treated with colchicine, there is doubling of chromosomes and it becomes tetraploid,. It is an alkaloid obtained from *Colchicum autumnale*.
34. (b) Kinetochore is the proteinaceous covering of centriole, to which spindle fibers attach.

NOTES

Kinetochores form in the central region, or centromere, of a duplicated chromosome. A kinetochore consists of an inner region and an outer region. The inner region is bound to chromosomal DNA. The outer region connects to spindle fibers. The kinetochore assembles on the centromere and links the chromosome to microtubule polymers from the mitotic spindle during mitosis and meiosis. Its proteins also help to hold the sister chromatids together and play a role in chromosome editing.

35. (a) The spindle fibres involved in cell division is made of microtubules
36. (a) In mitosis a single cell divides to form two daughter cells. It is an equational division.
37. (c) Metaphase is characterized by the appearance of spindle fibres. Anaphase involves movement of chromatids towards the poles. Cytokinesis marks the division of the cytoplasm of the parent cell into daughter cells.
38. (b) Colchicine is a mitotic poison which inhibits the formation of spindle fibres.
39. (b) During metaphase, the centromeres of the chromosome lie on the equatorial plate according to their size and spatial arrangement. So it is the best time to count the number and study the morphology of chromosomes.
40. (a) In both mitotic and meiotic metaphase, the number of chromatids per chromosome is two.
41. (d) In mitotic anaphase, the sister chromatids separate from each other and begin to move towards the opposite poles.
42. (a) Zygotene → Synapsis
    Pachytene → Crossing over
    Diplotene → Chiasmata formation
    Diakinesis → Terminalisation
43. (c) Meiotic division of secondary oocyte is completed after the entry of sperm in secondary oocyte which lead to the formation of a large ovum and a tiny 2nd polar body.
44. (c) Crossing over is the exchange of gene which takes place between non-sister chromatids of homologous chromosomes at pachytene stage of meiosis I resulting in new allelic combinations in the daughter cells.

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NOTES

Crossing over is essential for the normal segregation of chromosomes during meiosis. Crossing over also accounts for genetic variation, because due to the swapping of genetic material during crossing over, the chromatids held together by the centromere are no longer identical.

45. (c) Meiosis I is reductional division thus the resultant cell just after meiosis I will have half the number of chromosomes as compared to diploid parent cells. Therefore if the parent cell has 4C amount of DNA the daughter cell will have 2C amount of DNA and each gamete will have 1C amount of DNA.
46. (b) Diplotene is a stage of meiotic prophase which follows the pachytene and during which the paired homologous chromosomes begin to separate and chiasmata become visible.
47. (a) Meiosis is a process (discovered by German biologist, Oscar Hertwig) where a single cell divides twice to produce four cells containing half the original amount of genetic information. These cells are our sex cells - sperm in males, eggs in females. Crossing over

is the process by which two chromosomes, exchange some distal part of their DNA. This process occurs in the Pachytene stage of Prophase I of meiosis.

48. (a) Pachytene - Crossing over mediated by recombinase enzyme.
Zygotene - Pairing of homologous chromosomes
G_2 phase - Synthesis of RNA and protein
Anaphase I - Centromeres do not separate but chromatids move towards opposite poles.

49. (a) Synapsis → Crossing over → Terminalisation of chiasmata → Disappearance of nucleolus.

50. (a) The enzyme recombinase is required at Pachytene stage of meiosis. It catalyzes the exchange of short pieces of DNA between two long DNA strands, particularly the exchange of homologous regions between the paired maternal and paternal chromosomes.

51. (b) During zygotene, a substage of Prophase I of meiosis I, chromosomes start pairing together by a process called synapsis. Such paired chromosomes are called as homologous chromosomes. A complex structure *i.e.*, synaptonemal complex is formed by a pair of synapsed homologous chromosomes called a bivalent or a tetrad.

52. (c) Recombinase enzyme catalyzes the exchange of short pieces of DNA between two long DNA strands, particularly the exchange of homologous regions between the paired maternal and paternal chromosome in prophase - I of meiosis I.

53. (a) The given diagram represents crossing over that takes place in pachytene stage of prophase - I during meiosis.

54. (c) Anaphase I begins when the two chromosomes of each bivalent (tetrad) separate and start moving toward opposite poles of the cell as a result of the action of the spindle. In anaphase I, the sister chromatids remain attached at their centromeres and move together toward the poles.

NOTES

Anaphase is a very important stage of cell division. It ensures that duplicated chromosomes, or sister chromatids, separate into two equal sets. This separation of chromosomes is called disjunction. Each set of chromosomes will become part of a new cell.

55. (b) Genetic mapping help in studying the architecture of the chromosomes and of entire genome.

NOTES

Genetic mapping - also called linkage mapping - can offer firm evidence that a disease transmitted from parent to child is linked to one or more genes. Mapping also provides clues about which chromosome contains the gene and precisely where the gene lies on that chromosome.

56. (c) The points of attachment between homologous chromosomes after their separation in diplotene are called chiasmata. The process of pairing of homologous chromosomes is called synapsis. The phenomenon by which DNA isolated from one type of cell, when introduced into another type, is able to bestow some of the properties of the former to the latter, is known as transformation.

57. (b) Lampbrush chromosomes are highly elongated bivalent chromosomes of diplotene stage, which are held together by chiasmata and have a large number of lateral loops for rapid transcription.

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58. (d) Meiosis provides a chance for new combinations of chromosomes mainly by the phenomenon of crossing over and random distribution of homologous chromosomes between daughter cells.

59. (d) Meiosis II is homotypic division specially for maintanence of the haploid number, separating the chromatids from each other in a chromosome.

60. (a) Due to segregation, independent assortment and crossing over at the time of meiosis, daughter cells exhibit variation.

61. (b) The paired homologous chromosomes separate in Anaphase I of meiosis I so that each gamete receives one chromosome of each homologous pair.

62. (c) Meiosis II is an equational division which is meant for maintaining the haploid number produced by meiosis I and separating the two chromatids of a chromosome.

11 Transport in Plants

Trend Analysis with Important Topics & Sub-Topics

		2020		2019		2018		2017		2016	
Topic	Sub-Topics	Qns.	LOD	Qns.	LOD	Qns.	LOD	Qns.	LOD	Qns.	LOD
Diffusion/ Active Transport	Diffusion									1	D
Water Potential/ Osmosis	Turgor Pressure					1	E				
	Water Potential							1	E		
Transport of Water in Plants	Root Pressure	1	A								
	Xylem Transport			1	A						
Transpiration											
Phloem Transport	Direction			1	E						

LOD - Level of Difficulty | E - Easy | A - Average | D - Difficult | Qns - No. of Questions

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Topic 1: Diffusion/Active Transport

1. The process responsible for facilitating loss of water in liquid form from the tip of grass blades at night and in early morning is *[2020]*
   (a) Root pressure (b) Imbibition
   (c) Plasmolysis (d) Transpiration
2. Which of the following is not a feature of active transport of solutes in plants ? *[2019]*
   (a) Requires ATP
   (b) Occurs against concentration gradient
   (c) Non-selective
   (d) Occurs through membranes
3. What will be the direction of flow of water when a plant cell is placed in a hypotonic solution ? *[2019]*
   (a) No flow of water in any direction.
   (b) Water will flow in both directions.
   (c) Water will flow out of the cell.
   (d) Water will flow into the cell.
4. The main difference between active and passive transport across cell membrane is : *[2019]*
   (a) active transport occurs more rapidly than passive transport.
   (b) passive transport is non-selective whereas active transport is selective.
   (c) passive transport requires a concentration gradient across a biological membrane whereas active transport requires energy to move solutes.
   (d) passive transport is confined to anionic carrier proteins whereas active transport is confined to cationic channel proteins.
5. Water vapour comes out from the plant leaf through the stomatal opening. Through the same stomatal opening carbon dioxide diffuses into the plant during photosynthesis. Reason out the above statements using one of following options *[2016]*

(a) Both processes cannot happen simultaneously.
(b) Both processes can happen together because the diffusion coefficient of water and CO_2 is different.
(c) The above processes happen only during night time.
(d) One process occurs during day time, and the other at night.

6. Which of the following criteria does not pertain to facilitated transport? *[NEET 2013]*
(a) High selectivity
(b) Transport saturation
(c) Uphill transport
(d) Requirement of special membrane proteins

7. Movement of ions or molecules in a direction opposite to that of prevailing electrochemical gradient is known as *[2000]*
(a) diffusion
(b) active transport
(c) pinocytosis
(d) brownian movement

8. If a cell A with DPD 4 bars is connected to cell B, C, D whose OP and TP are respectively 4 and 4, 10 and 5 and 7 and 3 bars, the flow of water will be *[1998]*
(a) A and D to B and C
(b) A to B, C and D
(c) B to A, C and D
(d) C to A, B and D

9. The movement of mineral ions into plant root cells as a result of diffusion is called *[1996]*
(a) osmosis
(b) active absorption
(c) passive absorption
(d) endocytosis

10. Active and passive transports across cell membrane differ in *[1993]*
(a) passive transport is nonselective
(b) passive transport is along the concentration gradient while active transport is due to metabolic energy
(c) active transport is more rapid
(d) passive transport is confined to anions while active transport in confined to cations

Topic 2: Water Potential/Osmosis

11. The water potential of pure water is : *[2017]*
(a) Less than zero
(b) More than zero but less than one
(c) More than one
(d) Zero

12. Which one gives the most valid and recent explanation for stomatal movements?
(a) Potassium influx and efflux *[2015 RS]*
(b) Starch hydrolysis
(c) Guard cell photosynthesis
(d) Transpiration

13. When a fresh-water protozoan possessing a contractile vacuole, is placed in a glass containing marine water, the vacuole will
(a) increase in number *[2004]*
(b) disappear
(c) increase in size
(d) decrease in size

14. Two cells A and B are contiguous. Cell A has osmotic pressure 10 atm, turgor pressure 7 atm and diffusion pressure deficit 3 atm. Cell B has osmotic pressure 8 atm, turgor pressure 3 atm and diffusion pressure deficit 5 atm. The result will *[2007]*
(a) no movement of water
(b) equilibrium between the two
(c) movement of water from cell A to B.
(d) movement of water from cell B to A.

15. When water moves through a semi permeable membrane then which of the following pressure develops? *[2001]*
(a) O. P. (b) S. P
(c) T. P. (d) W. P

16. Water potential of actively absorbing cells is *[1999]*
(a) always + ve (b) always – ve
(c) always 0 (d) always > 1

17. The water potential and osmotic potential of pure water are *[1998]*
(a) zero and zero (b) 100 and 100
(c) zero and 100 (d) 100 and zero

18. With increase in the turgidity of a cell surrounded by water the wall pressure will *[1997]*
(a) increase (b) decrease
(c) fluctuate (d) remain unchanged

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19. Water potential in the leaf tissue is positive (+) during *[1997]*
    (a) excessive transpiration
    (b) low transpiration
    (c) excessive absorption
    (d) guttation
20. A bottle filled with previously moistened mustard seeds and water was screw capped tightly and kept in a corner. It blew up suddenly after about half an hour. The phenomenon involved is *[1990]*
    (a) diffusion (b) imbibition
    (c) osmosis (d) d.P.D
21. Water potential is equal to *[1988]*
    (a) ψ_s + O.P. (b) ψ_s = T.P.
    (c) $\psi_p + \psi_w$ (d) $\psi_s + \psi_p$

Topic 3: Transport of Water in Plants

22. What is the direction of movement of sugars in phloem? *[2019]*
    (a) Non-multidirectional
    (b) Upward
    (c) Downward
    (d) Bi-directional
23. A column of water within xylem vessels of tall trees does not break under its weight because of: *[2015 RS]*
    (a) Tensile strength of water
    (b) Lignification of xylem vessels
    (c) Positive root pressure
    (d) Dissolved sugars in water
24. Root pressure develops due to : *[2015 RS]*
    (a) Low osmotic potential in soil
    (b) Passive absorption
    (c) Increase in transpiration
    (d) Active absorption
25. Roots play insignificant role in absorption of water in : *[2015 RS]*
    (a) Pistia (b) Pea
    (c) Wheat (d) Sunflower
26. Guttation is the result of : *[2011M]*
    (a) diffusion (b) transpiration
    (c) osmosis (d) root pressure
27. The rupture and fractionation do not usually occur in the water column in vessel/ tracheids during the ascent of sap because of *[2008]*
    (a) lignified thick walls
    (b) cohesion and adhesion
    (c) weak gravitational pull
    (d) transpiration pull
28. The ability of the Venus fly trap to capture insects is due to: *[2005]*
    (a) specialised "muscle-like" cells
    (b) chemical stimulation by the prey
    (c) a passive process requiring no special ability on the part of the plant
    (d) rapid turgor pressure changes
29. Minerals absorbed by roots move to the leaf through *[1988]*
    (a) xylem (b) phloem
    (c) sieve tubes (d) none of the above
30. In soil, the water available for root absorption is *[1991, 99]*
    (a) gravitational water (b) capillary water
    (c) hygroscopic water (d) combined water
31. The closure of lid of pitcher in a pitcher plant, is due to *[1995]*
    (a) turgor movement
    (b) tropic movement
    (c) paratonic movement
    (d) autonomous movement
32. Water movement between cells is due to *[1992]*
    (a) T.P.
    (b) W.P.
    (c) D.P.D
    (d) Incipient plasmolysis
33. Guttation is mainly due to *[1992]*
    (a) root pressure (b) osmosis
    (c) transpiration (d) imbibition
34. The most widely accepted theory for ascent of sap in trees is *[1991]*
    (a) capillarity
    (b) role of atmospheric pressure
    (c) pulsating action of living cell
    (d) transpiration pull and cohesion theory of Dixon and Jolly
35. The principal pathway of water translocation in angiosperms is *[1990]*
    (a) sieve cells
    (b) sieve tube elements
    (c) xylem vessel system
    (d) xylem and phloem

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Topic 4: Transpiration

36. Grass leaves curl inwards during very dry weather. Select the most appropriate reason from the following: *[2019]*
    (a) Closure of stomata
    (b) Flaccidity of bulliform cells
    (c) Shrinkage of air spaces in spongy mesophyll
    (d) Tyloses in vessels
37. Stomatal movement is not affected by *[2018]*
    (a) Temperature (b) Light
    (c) CO_2 concentration (d) O_2 concentration
38. Stomata in grass leaf are *[2018]*
    (a) Dumb-bell shaped (b) Kidney shaped
    (c) Barrel shaped (d) Rectangular
39. Transpiration and root pressure cause water to rise in plants by : *[2015 RS]*
    (a) Pulling and pushing it, respectively
    (b) Pushing it upward
    (c) Pushing and pulling it, respectively
    (d) Pushing it upward
40. Guard cells help in: *[2009]*
    (a) transpiration
    (b) guttation
    (c) fighting against infection
    (d) protection against grazing
41. Potometer works on the principle of *[2005]*
    (a) osmotic pressure
    (b) amount of water absorbed equals the amount transpired
    (c) root pressure
    (d) potential difference between the tip of the tube and that of the plant
42. Stomata of a plant open due to *[2003]*
    (a) influx of calcium ions
    (b) influx of potassium ions
    (c) efflux of potassium ions
    (d) influx of hydrogen ions
43. Stomata open and close due to *[2002]*
    (a) circadian rhythm
    (b) genetic clock
    (c) pressure of gases inside the leaves
    (d) turgor pressure of guard cells
44. Which of the following plant is found to have minimum transpiration *[2001]*
    (a) Nerium (b) Hydrilla
    (c) Mango (d) Guava
45. Plants die from prolonged water-logging because *[1997]*
    (a) soil nutrients become very dilute
    (b) root respiration stops
    (c) cell sap in the plants becomes too dilute
    (d) nutrients leach down due to excess water
46. Which is produced during water stress that brings stomatal closure *[1993]*
    (a) ethylene (b) abscisic acid
    (c) ferulic acid (d) coumarin
47. An adaptation for better gaseous exchange in plant leaves is *[1993]*
    (a) hair on lower surface
    (b) multiple epidermis
    (c) waxy cuticle
    (d) stomata on lower surface away from direct sun rays.
48. Which of the following is used to determine the rate of transpiration in plants? *[1992]*
    (a) Porometer/hygrometer
    (b) Potometers
    (c) Auxanometer
    (d) Tensiometer / Barometer
49. In terrestrial habitats, temperature and rainfall conditions are influenced by *[1992]*
    (a) water transformations
    (b) transpiration
    (c) thermoperiodism
    (d) translocation
50. Conversion of starch to organic acids is required for *[1992]*
    (a) stomatal opening
    (b) stomatal closing
    (c) stomatal formation
    (d) stomatal activity
51. At constant temperature, the rate of transpiration will be higher at *[1992]*
    (a) Sea level
    (b) 1 km below sea level
    (c) 1 km above sea level
    (d) 1.5 km above sea level
52. In guard cells when sugar is converted into starch, the stomatal pore *[1992]*
    (a) closes completely
    (b) opens partially
    (c) opens fully
    (d) remains unchanged

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53. Transpiration is least in *[1988]*
    (a) good soil moisture
    (b) high wind velocity
    (c) dry environment
    (d) high atmospheric humidity
54. Phenyl mercuric acetate (PMA) results in
    (a) reduced photosynthesis *[1988]*
    (b) reduced transpiration
    (c) reduced respiration
    (d) killing of plants

Topic 5: Phloem Transport

55. Carbohydrates are commonly found as starch in plant storage organs. Which of the following five properties of starch (A-E) make it useful as a storage material? *[2008]*
    (A) Easily translocated
    (B) Chemically non-reactive
    (C) Easily digested by animals
    (D) Osmotically inactive
    (E) Synthesized during photosynthesis
    The useful properties are
    (a) (B) and (C) (b) (B) and (D)
    (c) (A), (C) and (E) (d) (A) and (E)
56. The translocation of organic solutes in sieve tube members is supported by *[2006]*
    (a) P-proteins
    (b) mess flow involving a carrier and ATP
    (c) cytoplasmic streaming
    (d) root pressure and transpiration pull
57. Bidirectional translocation of minerals takes place in *[1997]*
    (a) xylem (b) phloem
    (c) parenchyma (d) cambium
58. Translocation of carbohydrate nutrients usually occurs in the form of *[1992]*
    (a) Glucose (b) Maltose
    (c) Starch (d) Sucrose

ANSWER KEY

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1	(a)	7	(b)	13	(d)	19	(d)	25	(a)	31	(c)	37	(d)	43	(d)	49	(b)	55	(b)
2	(c)	8	(c)	14	(c)	20	(b)	26	(d)	32	(c)	38	(a)	44	(a)	50	(a)	56	(a)
3	(d)	9	(c)	15	(c)	21	(d)	27	(b)	33	(a)	39	(a)	45	(b)	51	(d)	57	(b)
4	(c)	10	(b)	16	(b)	22	(d)	28	(d)	34	(d)	40	(a)	46	(b)	52	(a)	58	(d)
5	(b)	11	(d)	17	(a)	23	(a)	29	(a)	35	(c)	41	(b)	47	(d)	53	(d)		
6	(c)	12	(a)	18	(a)	24	(d)	30	(b)	36	(b)	42	(b)	48	(b)	54	(b)		

Hints & Solutions

1. (a) Root pressure is positive hydrostatic pressure. It develops in tracheary element at night and in early morning. Root pressure is caused by active distribution of mineral nutrient ions into the root xylem. Without transpiration to carry the ions up the stem, they accumulate in the root xylem and lower the water potential. Water then diffuses from the soil into the root xylem due to osmosis.
2. (c) Active transport is uphill transport. This transport takes place against the electrochemical potential gradient and requires additional input of energy that chiefly comes from hydrolysis of ATP. It is highly selective.

NOTES

There are two types of active transport: primary active transport that uses adenosine triphosphate (ATP), and secondary active transport that uses an electrochemical gradient. An example of active transport in human physiology is the uptake of glucose in the intestines.

3. (d) When a plant cell is placed in hypotonic solution water will flow into the cell as water moves from high water potential to low water potential.

4. (c) In active transport, materials are transported across a membrane with the help of mobile carrier protein and ATP.
In passive transport, substances move along the concentration gradient, *i.e.*, from its higher concentration to its lower concentration.

5. (b) In actively growing plants, water is continuously evaporating from the surface of leaf cells through stomatal opening exposed to air. This is called transpiration. Through the same stomatal opening carbon dioxide diffuses into the plant during photosynthesis simultaneously as both are the process of simple diffusion occurs in order of diffusion pressure gradient or diffusion coefficient.

6. (c) Substances that have a hydrophilic moiety, find it difficult to pass through the membrane, their movement has to be facilitated by the membrane protein without expenditure of ATP energy. Facilitated diffusion cannot cause net transport of molecules from a low to a high concentration or uphill transport.

NOTES
Transport rate reaches a maximum when all of the protein transporters are being used (saturation). Facilitated diffusion is very specific.

7. (b) Movement of ions against concentration gradient involves the expenditure of energy. Diffusion involves the movement of solute particles from region of higher concentration to a region of lower concentration. Pinocytosis is cell drinking. Brownian movement is the random to and fro movement of atoms and molecules.

8. (c) D.P.D. or suction pressure (S.P.)
= O.P. – T. P.
Hence D.P.D. for A = 4 bars, B = 0 bars, C = 5 bars, D = 4 bars
We know that direction of movement of water is from lower D.P.D. (S.P.) to higher D.P.D. (S.P.).
Thus flow will be from B to A, C, and D.

9. (c) Osmosis is the movement of solvent particles from a region of low solute concentration to a region of high solute concentration through a selectively permeable membrane. Active absorption involves use of ATP.

10. (b) Active transport always involves the expenditure of energy for the movement of substances against concentration gradient.

11. (d) By convention, the water potential of pure water at standard temperature, which is not under any pressure, is taken to be zero. ($\Psi_w = 0$)

12. (a) The opening and closing of stomata are caused by influx and efflux of potassium ions (K^+). The increase of K^+ results in opening of stoma and decrease of K^+ causes closing of stoma. The turgidity of guard cells induces the opening of the pores of stomata found on the surface of leaves.

13. (d) A fresh water protozoan when placed in marine water medium, loss of water takes place i.e., exosmosis. Hence the contractile vacuole will decrease in size.

14. (c) Movement of water will be from low DPD to high DPD i.e from A to B

NOTES
The term diffusion pressure deficit (DPD) was coined by B.S Meyer in 1938. Originally DPD was described as suction pressure by Renner (1915). It is a reduction in the diffusion pressure of water in solution or cell over its pure state due to the presence of solutes in it and forces opposing diffusion. Diffusion pressure deficit (DPD) is the amount by which two solutions differ in their diffusion pressure. It is defined as the amount by which the diffusion pressure of water or solvent in a solution is lower than that of pure water or solvent. It allows easy absorption of water due to diffusion pressure gradient.

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15. (c) The hydrostatic pressure developed inside the cell wall due to endosmosis is called turgor pressure. Due to turgor pressure, the rigid cell wall offers resistance. This resistance which works in a direction opposite to turgor pressure is the wall pressure.

16. (b) Water potential is regarded as the tendency of water to leave a system. Pure water has the highest possible water potential which is zero. All solutions have a water potential lower than that of pure water.

17. (a) Osmotic potential is the potential of a solution to cause movement of water into it across a semi- permeable membrane. Water potential is the tendency of water to leave a system.

18. (a) Wall pressure is equal and opposite to the turgor pressure.

NOTES

Wall pressure (WP) may be defined as 'the pressure exerted by the cell wall over the protoplast to counter the turgor pressure. Normally wall pressure is equal and opposite of turgor pressure (WP = TP) except when the cell become flaccid.

19. (d) Pure water has maximum water potential. Water potential in the leaf tissue becomes greater than pure water under conditions of excessive humidity when the leaves cannot lose water by transpiration. Hence, water is lost as droplets via hydathodes by the process of guttation.

20. (b) Imbibition pressures developed during germination of seeds and spores are of higher magnitude.

NOTES

Imbibition is the first step in germination of seeds. When the seeds are soaked in water, they imbibe water and swell. The water is imbibed by the seed coat and then by other tissues of embryo and endosperm. Thus, the process of imbibition initiates the seed germination.

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21. (d) Water potential is defined as the difference between the chemical potential of water at any point in a system and that of pure water under standard conditions. The unit of measurement of water potential is pascal, Pa (1 mega pascal, Mpa = 10 bars). It is represented by greek letter PSi (Ψ). Water potential has two components- solute potential which is always negative and pressure potential which is usually positive. Therefore water potential Ψw is expressed as: $\Psi w = \Psi s + \Psi p$

22. (d) The direction of movement of sugar in phloem is bi-directional.

The Pressure Flow Hypothesis, also known as the Mass Flow Hypothesis, is the best-supported theory to explain the movement of sap through the phloem. It was proposed by Ernst Munch, a German plant physiologist in 1930. A high concentration of organic substances, particularly sugar, inside cells of the phloem at a source, such as a leaf, creates a diffusion gradient (osmotic gradient) that draws water into the cells from the adjacent xylem. This creates turgor pressure, also known as hydrostatic pressure, in the phloem. Movement of phloem sap occurs by bulk flow (mass flow) from sugar sources to sugar sinks. The movement in phloem is bidirectional, whereas, in xylem cells, it is unidirectional (upward). Because of this multi-directional flow, coupled with the fact that sap cannot move with ease between adjacent sieve-tubes, it is not unusual for sap in adjacent sieve-tubes to be flowing in opposite directions.

23. (a) Due to tensile strength of water, a column of water within xylem vessels of tall trees does not break under its weight.

24. (d) Active absorption creates root pressure. In this process, the expenditure of energy takes place for the movement of substances against concentration gradient.

25. (a) Pistia is a hydrophyte plant where absorption of water by root is not important.

26. (d) The main cause of guttation in plants is root pressure. During night when root pressure is high, water drops ooze out with the assistance of special structures called hydathodes which help in guttation.

27. (b) Rupture and fractionation do not usually occur in the water column in vessel/ tracheids during the ascent of sap because of cohesion and tension.

NOTES

The water molecules have a great mutual attraction to each other or tremendous cohesive power which is sometimes as much as 350 atmospheres. Thus, the transpiration pull develops a negative pressure in the uppermost xylem cells. It is transmitted from there into the xylem of stems, and then to the roots.

28. (d) Bending of tentacles in Venus fly trap or *Drosera* after coming in contact with an insect is thigmonastic or chemonastic movement of variation or turgor movement.

The mechanism by which the trap snaps shut involves a complex interaction between elasticity, turgor and growth. In the open, untripped state, the lobes are convex , but in the closed state, the lobes are concave

NOTES

It is the rapid flipping of this bistable state that closes the trap, but the mechanism by which this occurs is still poorly understood. When the trigger hairs are stimulated, an action potential involving calcium ions is generated, which propagates across the lobes and stimulates cells in the lobes and in the midrib between them.

29. (a) Minerals move upwards along with water, through the tracheary elements of xylem.
30. (b) After rain a portion of water percolates downward under the influence of gravity. It is not available to plants. Hygroscopic water is also not available for plants because soil particles hold water by strong attractive forces. Chemically bound water is water combined with chemicals. Capillary water is present in narrow spaces of soil and is held in soil by capillary forces and is absorbed by root.
31. (c) Pitcher plant is an insectivorous plant which catches insects. The paratonic movements are induced in response to an external stimulus caused by insects due to which lids close and the insects are trapped inside the pitcher.
32. (c) Water is absorbed by a system having higher DPD from another system with lower DPD. The net force with which water is drawn into a cell is equal to the difference of osmotic pressure (OP) and turgor pressure known as diffusion pressure deficit (DPD).
DPD = OP – TP
33. (a) Loss of water from margins of leaves is called guttation. Guttation occurs when transpiration rate is very low as compared to rate of water absorption. Thus root pressure is developed and water is pushed out through stomata like pores called hydathodes. It occurs in more saturated atmosphere.
34. (d) Transpiration pull and cohesion theory was put forward by Dixon and Jolly in 1894. According to this theory water rises due to the transpiration pull, continuity of water column and the cohesive power of water molecules from the lower part of the roots to the higher peaks of the trees.
35. (c) Water movement occurs through the tracheary elements of xylem.
36. (b) Bulliform cells are large, bubble-shaped epidermal cells that occur in groups on the upper surface of the leaves of many grasses. These cells become flaccid due to water loss. Loss of turgor pressure in these cells causes leaves to "roll up" during water stress.
37. (d) Light, temperature and concentration of CO_2 affect opening and closing of stomata. They are not affected by O_2 concentration.
38. (a) Grass being a monocot, has dumb-bell shaped stomata in their leaves.
39. (a) Transpiration creates pulling (Negative pressure) force. Root pressure creates positive pressure developed in xylem. It is measured by manometer.
40. (a) Guard cells help in transpiration. Transpiration is the evaporation of water from the aerial parts of plants, especially leaves but also stems, flowers and roots. Stomatal opening allows the diffusion of carbon dioxide and oxygen during photosynthesis.
41. (b) Potometer : It is an apparatus for measuring the rate of transpiration.
42. (b) During day time, due to photosynthesis, malic acid forms, which breaks into H+ and malate. H^+ ions move out of guard cells and K^+ ions enter forming potassium malate which makes guard cells turgid and stomata opens.
43. (d) Turgor pressure is the pressure that develops in a cell due to osmotic diffusion of water inside it and is responsible for pushing the membrane against cell wall. Stomata open under conditions of increased turgor pressure in guard cells and stomata close under conditions of decreased turgor pressure of guard cells. When turgid, they swell and bend outward. As a result, the stomatal aperture opens. When they are flaccid, the tension from the wall is released and stomatal aperture closes.
44. (a) *Nerium* is a xerophytic plant and has sunken stomata, confined to lower epidermis to reduce the rate of transpiration.

NOTES

Nerium oleander L. (Apocynaceae), the only species currently classified in the genus *Nerium,* is an evergreen shrub or small with all parts of the plant being toxic . It is cultivated worldwide and is one of the most poisonous of commonly grown garden plants.

45. (b) Under water logged conditions, roots die due to lack of air for respiration.

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46. (b) During scarcity of water in the soil, stress hormone abscisic acid is produced which brings about stomatal closure. ABA inhibits the uptake of K^+ by the guard cells and promotes leakage of malic acid from guard cell. This results in loss of water from guard cell due to its lower osmotic potential. Guard cell becomes flaccid leading to closure of stomatal aperture. ABA also causes stomatal closure under high concentration of CO_2 in the guard cells.
47. (d) Stomata present on lower surface of plant leaves effectively exchange gases without allowing much loss of water from the leaves.
48. (b) Potometer is an apparatus used for measuring the rate of transpiration.

NOTES

The potometer does not measure the rate of transpiration accurately because not all of the water that is taken by the plant is used for transpiration (water taken might be used for photosynthesis or by the cells to maintain turgidity). The potometer measures the rate of uptake of water. To measure transpiration rate directly, rather than the rate of water uptake, utilize a scientific instrument which quantifies water transfer at the leaves.

49. (b) Transpiration is responsible for saturation of the atmosphere.
50. (a) Starch is converted to malic acid (organic acid) through the action of an enzyme phosphoenol pyruvate carboxylase (PEPC) under condition of high pH when most of the CO_2 is utilized due to high photosynthetic rate during daytime.
51. (d) The rate of transpiration is inversely proportional to the atmospheric pressure. Increased height above the sea level lowers the atmospheric pressure and increases the rate of evaporation.
52. (a) When sugar is converted into starch, the osmotic concentration of guard cells fall and they lose water to adjacent cells and stomata closes.
53. (d) Transpiration is a process of loss of water in the form of vapours from the aerial parts of the plants. Transpiration is inversely proportional to the atmospheric humidity. The rate of transpiration would be higher when humidity is low.
54. (b) Phenyl Mercuric Acetate (PMA) is an antitranspirant. Antitranspirants are compounds applied to the leaves of plants to reduce transpiration without affecting gaseous exchange. They are used on christmas trees, cut flowers, newly transplanted shrubs, and in other applications to preserve and protect plants from drying out too quickly. They have 'also been reportedly used to protect leaves from salt burn and fungal diseases.
Anti Transpirants are of two types:
1. Metabolic inhibitors
2. Film forming antitranspirants
55. (b) Carbohydrates are commonly found as starch in plant storage organs. It is a chemically non-reactive and osmotically inactive polysaccharide with a molecular weight. Carbohydrates perform a vital role in living organisms. Starch and other polysaccharides serve as energy storage in plants, particularly in seeds, tubers, *etc.* which provide a major energy source for animals, including humans.
56. (a) P-protein is the supporting factor for the translocation of organic solutes in sieve tubes.
57. (b) Minerals can move upward and downward (bidirectional movement) as well as laterally in phloem. Phloem plays an important role in translocation of minerals.
58. (d) Translocation of organic solutes occur through sieve tubes in the form of sucrose. Transportable form of sugar is sucrose.

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12 Mineral Nutrition

Trend Analysis with Important Topics & Sub-Topics

		2020		2019		2018		2017		2016	
Topic	Sub-Topics	Qns.	LOD	Qns.	LOD	Qns.	LOD	Qns.	LOD	Qns.	LOD
Mineral Elements	Macronutrients									1	A
	Role in Plants	1	A								
Plant Diseases/ Mineral Absorption	Absorption of Iron					1	E				
Metabolism of Nitrogen	Products of Nitrogen Metabolism	1	A								
	Nitrogen Fixation			1	A						

LOD - Level of Difficulty | E - Easy | A - Average | D - Difficult | Qns - No. of Questions

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Topic 1: Mineral Elements

1. Match the following concerning essential elements and their functions in plants *[2020]*
   (a) Iron (i) Photolysis of water
   (b) Zinc (ii) Pollen germination
   (c) Boron (iii) Required for chlorophyll biosynthesis
   (d) Manganese (iv) IAA biosynthesis
   Select the correct option

	(A)	(B)	(C)	(D)
(a)	(iv)	(iii)	(ii)	(i)
(b)	(iii)	(iv)	(ii)	(i)
(c)	(iv)	(i)	(ii)	(iii)
(d)	(ii)	(i)	(iv)	(iii)

2. In which of the following forms is iron absorbed by plants? *[2018]*
   (a) Ferric
   (b) Ferrous
   (c) Both ferric and ferrous
   (d) Free element
3. Which of the following elements is responsible for maintaining turgor in cells? *[2018]*
   (a) Magnesium (b) Sodium
   (c) Calcium (d) Potassium
4. In which of the following, all three are macronutrients? *[2016]*
   (a) Boron, zinc, manganese
   (b) Iron, copper, molybdenum
   (c) Molybdenum, magnesium, manganese
   (d) Nitrogen, calcium, phosphorus
5. Minerals known to be required in large amounts for plant growth include : *[2015 RS]*
   (a) calcium, magnesium, manganese, copper
   (b) potassium, phosphorus, selenium, boron
   (c) magnesium, sulphur, iron, zinc
   (d) phosphorus, potassium, sulphur, calcium
6. Which of the following elements is a constituent of biotin? *[NEET Kar. 2013]*
   (a) Sulphur
   (b) Magnesium
   (c) Calcium
   (d) Phosphorus
7. Best defined function of Manganese in green plants is : *[2012]*
   (a) Photolysis of water
   (b) Calvin cycle
   (c) Nitrogen fixation
   (d) Water absorption

8. Which one of the following is correctly matched ? *[2012]*
   (a) Passive transport of nutrients - ATP
   (b) Apoplast - Plasmodesmata
   (c) Potassium - Readily immobilisation
   (d) Bakane of rice seedlings - F. Skoog
9. For its activity, carboxypeptidase requires *[2012M]*
   (a) zinc (b) iron
   (c) niacin (d) copper
10. Which one of the following elements in plants is not remobilised? *[2011]*
   (a) Phosphorus (b) Calcium
   (c) Potassium (d) Sulphur
11. Which one of the following is not an essential mineral element for plants while the remaining three are? *[2011M]*
   (a) Iron (b) Manganese
   (c) Cadmium (d) Phosphorus
12. Which one of the following is essential for photolysis of water ? *[2011M]*
   (a) Manganese (b) Zinc
   (c) Copper (d) Boron
13. Which one of the following is not a micronutrient? *[2010]*
   (a) Molybdenum (b) Magnesium
   (c) Zinc (d) Boron
14. Manganese is required in: *[2009]*
   (a) plant cell wall formation
   (b) photolysis of water during photosynthesis
   (c) chlorophyll synthesis
   (d) nucleic acid synthesis
15. A plant requires magnesium for *[2007]*
   (a) protein synthesis
   (b) chlorophyll synthesis
   (c) cell wall development
   (d) holding cells together.
16. Which one of the following elements is not an essential micronutrient for plant growth?
   (a) Zn (b) Cu *[2007]*
   (c) Ca (d) Mn
17. The most abundant element present in the plants is *[2004]*
   (a) Carbon (b) Nitrogen
   (c) Manganese (d) Iron
18. The major role of minor elements inside living organisms is to act as *[2003]*
   (a) binder of cell structure
   (b) co-factors of enzymes
   (c) building blocks of important amino acids
   (d) constituent of hormones
19. The major portion of the dry weight of plants comprises of *[2003]*
   (a) Carbon, hydrogen and oxygen
   (b) Nitrogen, phosphorus and potassium
   (c) Calcium, magnesium and sulphur
   (d) Carbon, nitrogen and hydrogen
20. Boron in green plants assists in *[2003]*
   (a) sugar transport
   (b) activation of enzymes
   (c) acting as enzyme cofactor
   (d) photosynthesis
21. Passive absorption of minerals depend on
   (a) temperature *[2001]*
   (b) temperature and metabolic inhibitor
   (c) metabolic inhibitor
   (d) humidity
22. Which one of the following is a micronutrient for plants? *[1996]*
   (a) Calcium (b) Magnesium
   (c) Manganese (d) Nitrogen
23. Which one of the following is not an essential element for plants ? *[1996]*
   (a) Potassium (b) Iron
   (c) Iodine (d) Zinc
24. Phosphorous and nitrogen ions generally get depleted in soil because they usually occur as
   (a) neutral ions *[1989]*
   (b) negatively charged ions
   (c) positively charged ions
   (d) both positively and negatively charged but disproportionate mixture
25. Which one is an essential mineral, not constituent of any enzyme but stimulates the activity of many enzymes *[1989]*
   (a) Zn (b) Mn
   (c) K (d) Mg

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Topic 2: Plant diseases/mineral absorption

26. Deficiency symptoms of nitrogen and potassium are visible first in: *[2014]*
   (a) Senescent leaves (b) Young leaves
   (c) Roots (d) Buds
27. The deficiencies of micronutrients, not only affects growth of plants but also vital functions such as photosynthetic and mitochondrial electron flow. Among the list given below, which group of three elements shall affect most, both photosynthetic and mitochondrial electron transport: *[2005]*
   (a) Co, Ni, Mo (b) Ca, K, Na
   (c) Mn, Co, Ca (d) Cu, Mn, Fe

28. Grey spots of oat are caused by deficiency of *[2003]*
(a) Fe (b) Cu
(c) Zn (d) Mn

29. The plants grown in magnesium-deficient but urea sprayed soil would show *[2000]*
(a) deep green foliage
(b) early flowering
(c) yellowing of leaves
(d) loss of pigments in petals

30. Which of the following is not caused by deficiency of mineral nutrition? *[1997]*
(a) Necrosis
(b) Chlorosis
(c) Etiolation
(d) Shortening of internodes

31. Mycorrhiza is a symbiotic relationship between roots of higher plants and *[1995]*
(a) virus (b) fungi
(c) bacteria (d) blue green algae

32. The association between blue-green algae and fungi occurs in *[1995]*
(a) lichens (b) symbiosis
(c) cannibism (d) mycorrhiza

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Topic 3: Metabolism of Nitrogen

33. The product(s) of reaction catalyzed by nitrogenase in root nodules of leguminous plants is/are *[2020]*
(a) Nitrate alone
(b) Ammonia and oxygen
(c) Ammonia and hydrogen
(d) Ammonia alone

34. Which of the following bacteria reduce nitrate in soil into nitrogen ? *[2019]*
(a) *Nitrosomonas* (b) *Nitrobacter*
(c) *Nitrococcus* (d) *Thiobacillus*

35. *Thiobacillus* is a group of bacteria helpful in carrying out: *[2019]*
(a) Nitrogen fixation
(b) Chemoautotrophic fixation
(c) Nitrification
(d) Denitrification

36. The first stable product of fixation of atmospheric nitrogen in leguminous plants is : *[NEET 2013]*
(a) Ammonia (b) NO_3^-
(c) Glutamate (d) NO_2^-

37. Which two distinct microbial processes are responsible for the release of fixed nitrogen as dinitrogen gas (N_2) to the atmosphere? *[NEET Kar. 2013]*
(a) Anaerobic ammonium oxidation, and denitrification
(b) Aerobic nitrate oxidation, and nitrite reduction
(c) Decomposition of organic nitrogen, and conversion of dinitrogen to ammonium compounds
(d) Enteric fermentation in cattle, and nitrogen fixation by *Rhizobium* in root nodules of legumes

38. Which one of the following is wrong statement? *[2012]*
(a) *Anabaena* and *Nostoc* are capable of fixing nitrogen in free living state also
(b) Root nodule forming nitrogen fixers live as aerobes under free-living conditions.
(c) Phosphorus is a constituent of cell membranes, certain nucleic acids and cell proteins.
(d) *Nitrosomonas* and *Nitrobacter* are chemoautotrophs.

39. Read the following four statements (A-D).
(a) Both, photophosphorylation and oxidative phosphorylation involve uphill transport of protons across the membrane.
(b) In dicot stems, a new cambium originates from cells of pericycle at the time of secondary growth.
(c) Stamens in flowers of Gloriosa and Petunia are polyandrous.
(d) Symbiotic nitrogen-fixers occur in free-living state also in soil.
How many of the above statements are correct? *[2012M]*
(a) Two (b) Three
(c) Four (d) One

40. For its action, nitrogenase requires *[2012M]*
(a) Mn^{2+}
(b) light
(c) high input of energy
(d) super oxygen radicals

41. A prokaryotic autotrophic nitrogen fixing symboint is found in : *[2011]*
(a) *Alnus* (b) *Cycas*
(c) *Cicer* (d) *Pisum*

42. Nitrifying bacteria : ***[2011]***
(a) oxidize ammonia to nitrates
(b) convert free nitrogen to nitrogen compounds
(c) convert proteins into ammonia
(d) reduce nitrates to free nitrogen

43. The function of leg haemoglobin in the root nodules of legumes is : ***[2011]***
(a) inhibition of nitrogenase activity
(b) oxygen removal
(c) nodule differentiation
(d) expression of nif gene

44. An element playing important role in nitrogen fixation is : ***[2010]***
(a) Molybdenum (b) Copper
(c) Manganese (d) Zinc

45. One of the free -living, anaerobic nitrogen - fixer is: ***[2010]***
(a) *Beijernickia* (b) *Rhodospirillum*
(c) *Rhizobium* (d) *Azotobacter*

46. Which of the following is a symbiotic nitroger fixer? ***[2009]***
(a) *Azotobacter* (b) *Frankia*
(c) *Azolla* (d) *Glomus*

47. Nitrogen fixation in root nodules of Alnus is brought about by: ***[2008]***
(a) *Bradyrhizobium* (b) *Clostridium*
(c) *Frankia* (d) *Azorhizobium*

48. A free living nitrogen-fixing cyanobacterium which can also form symbiotic association with the water fern *Azolla* is ***[2004]***
(a) *Tolypothrix* (b) *Chlorella*
(c) *Nostoc* (d) *Anabaena*

49. Which one of the following mineral elements plays an important role in biological nitrogen fixation ? ***[2003]***
(a) Molybdenum (b) Copper
(c) Manganese (d) Zinc

50. Enzyme involved in nitrogen assimilation ***[2001]***
(a) nitrogenase
(b) nitrate reductase
(c) transferase
(d) transaminase

51. Which aquatic fern performs nitrogen fixation? ***[2001]***
(a) *Azolla* (b) *Nostoc*
(c) *Salvia* (d) *Salvinia*

52. In plants inulin and raphides ***[2001]***
(a) reserved food material
(b) wastes
(c) secretory material
(d) insect attracting material

53. Which of the following is a free living aerobic nonphotosynthetic nitrogen-fixer? ***[1997]***
(a) *Rhizobium* (b) *Azotobacter*
(c) *Azospirillum* (d) *Nostoc*

54. Which of the following can fix atmospheric nitrogen ? ***[1995]***
(a) *Albugo* (b) *Cystopus*
(c) *Saprolegnia* (d) *Anabaena*

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ANSWER KEY

1	(b)	7	(a)	13	(b)	19	(a)	25	(c)	31	(b)	37	(a)	43	(b)	49	(a)
2	(a)	8	(c)	14	(b)	20	(a)	26	(a)	32	(a)	38	(c)	44	(a)	50	(a)
3	(d)	9	(a)	15	(b)	21	(a)	27	(d)	33	(c)	39	(c)	45	(b)	51	(a)
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5	(d)	11	(c)	17	(a)	23	(c)	29	(c)	35	(d)	41	(b)	47	(c)	53	(b)
6	(a)	12	(a)	18	(b)	24	(d)	30	(c)	36	(a)	42	(a)	48	(d)	54	(d)

Hints & Solutions

1. (b) Iron is essential for the formation of chlorophyll. Zinc is needed for synthesis of auxin. Boron plays a role in pollen grain germination. Manganese is involved in the splitting of water to liberate O_2 during photosynthesis.

NOTES

Iron (Fe) deficiency is a plant disorder also known as "lime-induced chlorosis". Zinc deficiency occurs when plant **growth** is limited because the plant cannot take up sufficient quantities of this essential micronutrient from its growing medium. boron deficiency are expressed at growing tips of the root or shoot, and generally include stunting and distortion of the growing tip that can lead to tip death, brittle foliage, and yellowing of lower leaf tips. Manganese deficiency causes yellowing of leaves and undergoes interveinal chlorosis.

2. (a) Iron is absorbed by plants in the form of ferric ions.

NOTES

Plants uptake iron in its oxidized forms, Fe^{2+} (ferrous form) or Fe^{3+} (ferric form). Another mechanism involves the release of protons (H^+) and reductants by the plant roots, to lower pH levels in root zone. Iron is considered a micro-nutrient because only small amounts are required to aid in normal plant growth. Plants can suffer iron deficiency with symptoms of chlorosis and stunted growth, but plants can also take in too much iron, especially under certain growing conditions.

3. (d) Plants require potassium ions (K+) for protein synthesis and for the opening and closing of stomata, which is regulated by proton pumps to make surrounding guard cells either turgid or flaccid.

4. (d) Nitrogen, phosphorus, potassium, calcium, sulfur and magnesium are the macronutrients.
The essential elements can be divided into macronutrients and micronutrients. Nutrients that plants require in larger amounts are called macronutrients. About half of the essential elements are considered macronutrients: carbon, hydrogen, oxygen, nitrogen, phosphorus, potassium, calcium, magnesium, and sulfur.

NOTES

Macronutrients are essential for plant growth and a good overall state of the plant. The primary macronutrients are Nitrogen (N), Phosphorus (P), and Potassium (K). Nitrogen is essential for plant development, since it plays a fundamental role in energy metabolism and protein synthesis.

5. (d) Phosphorus, potassium, sulphur and calcium play an important role in plants growth. These minerals are required in large amount. Phosphorus is required for all phosphorylation reactions and constitution of cell membrane, nucleic acids and some proteins. Potassium is related with protein synthesis, closing and opening of stomata and activation of enzyme. Calcium regulates metabolic activities, function of cell membrane and stabilizes the structure of chromosomes. Sulphur is the main constituent of the amino acids, cystine and methionine, coenzymes and vitamins.

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6. (a) Biotin, also known as vitamin H, is a water-soluble B-vitamin. It is a coenzyme for carboxylase enzymes, involved in the synthesis of fatty acids, isoleucine, valine and in gluconeogenesis. Sulphur is a constituent of biotin.

7. (a) The best defined function of manganese is in the splitting of water to liberate oxygen during photosynthesis. It is absorbed in the form of manganese ions (Mn^{2+}). It activates many enzymes involved in photosynthesis, respiration and nitrogen metabolism.

8. (c) Potassium immobilisation is the conversion of water soluble potassium into water insoluble form. Readily available potassium constitutes about 1% of total potassium available in soil, whereas slightly soluble potassium accounts for about 98%.

9. (a) Carboxypeptidase is an exopeptidase enzyme secreted by the pancreas that acts only on the peptide linkage of a terminal amino acid containing a free carboxyl group. Zinc is a cofactor for carboxypeptidase. In Digestion of carboxypeptidase, requires zinc for its protein degrading action.

10. (b) Calcium is not remobilized from the leaves to the fruits, like potassium, phosphorus and sulphur. It occurs abundantly in a non-exchangeable form such as anorthite ($CaAl_2Si_2O_8$).

11. (c) Cadmium is not an essential element for plants. Phosphorus is a macronutrient and iron and manganese are micronutrients for plants.

> **NOTES** Among all the heavy metals, cadmium is considered to be the one that is most toxic for plants. Hence, cadmium concentrations in the plants can be measured by the effects it has on plant growth. It inhibits the photosynthetic rate and production of chlorophyll and its activity.

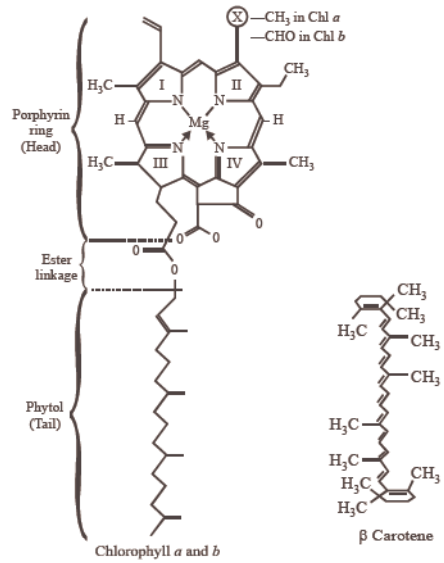
12. (a) Photolysis is catalysed by the protein-bound inorganic complex containing manganese ions (oxygen evolving complex) of photosystem II.

> **NOTES** Photolysis is the process by which water is split into oxygen, which is released into the atmosphere, and hydrogen. The hydrogen then becomes bonded to the coenzyme NADP to form NADPH and is transferred to the Calvin Cycle along with ATP.

13. (b) Magnesium is a macronutrient. Micronutrients are essential elements that are required by plants in small amounts. They include Fe, Cu, B, Mo, Mn, Cl, and Ni. Macronutrients, on the other hand, are those essential elements that are required by plants in larger amounts. The examples include C, H, O, N, S, P, K, Ca and Mg.

14. (b) Manganese is essential for many plant functions. Some of them are:
    - The assimilation of carbon dioxide in photosynthesis.
    - It is involved in the Hill Reaction where water is split during photosynthesis.
    - It aids in the synthesis of chlorophyll and in nitrate assimilation.
    - Manganese activates fat forming enzymes.
    - It functions in the formation of riboflavin, ascorbic acid, and carotene.
    - It functions in electron transport during photosynthesis.

15. (b)



A plant requires magnesium for chlorophyll synthesis. All four rings bind with metal atom magnesium (Mg^{++}), which remain present at the center of chlorophyll molecule.

16. (c) Essential micro elements are Fe, Mn, Zn, B, Cu, Mo and essential macronutrionts are C,H, N, P, S, Ca, K, Mg.

17. (a) Manganese and iron are micronutrients required in trace amounts. Concentration of nitrogen in dry matter is 15000 mg./gm. Concentration of carbon in dry matter is 45,000 mg / gm.

18. (b) Minor elements are those which are required by plants in very small amounts. These elements have a significant role in enzyme activities (zinc activates carboxylases, carbonic anhydrase and various dehydrogenases).

19. (a) The major portion of the dry weight of plants comprises of carbon, hydrogen and oxygen.

> **NOTES** Dry weight = Weight recorded after drying the plant or part of a plant at temperatures higher than the ambient air temperature (e.g., around 65 - 100 degrees C), to drive off the water.

20. (a) Manganese is an activator of enzymes. Copper is essential for photosynthesis. Molybdenum is a cofactor of enzymes. Boron assists in sugar transport.

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21. (a) Roots do not spend any energy on this type of mineral absorption. So application of a metallic inhibitor will not retard the process.

22. (c) Nutrients which are required in large amounts in functioning of plant are known as macronutrients eg. Ca, Mg, N. Nutrients required in trace amounts are known as micronutrients. Manganese is a micronutrient for plants essential for synthesis of chlorophyll. It is also required for activation of enzymes of respiration and nitrogen metabolism.

23. (c) Iodine is the only such element which is an essential mineral for animals but is not required by plants.

NOTES

The natural iodine content in soil is low. While iodine is not an essential nutrient for plant growth, fertilizing with iodine derivatives has been shown to aid in biomass production and increase the antioxidant levels in plants which provide drought and stress resistance.

24. (d) Phosphorus and nitrogen are essential elements normally required in large quantities by plants.

25. (c) Potassium is not a constituent of any enzyme but is an activator of enzymes. Potassium is an essential mineral and is found in more amounts in actively dividing cells such as buds, young leaves, root tips, etc. It has some other roles like regulating stomatal movement and protein synthesis.

26. (a) The parts of the plants that show the deficiency symptoms also depend on the mobility of the element in the plant. For element that are actively mobilised within the plants and exported to young developing tissues, the deficiency symptoms tend to appear first in the older tissues. *For example,* nitrogen, potassium and magnesium are visible first in the senescent leaves.

27. (d) Copper : Electron transfer

$(Cu^{+} \rightleftharpoons Cu^{2+})$

Maintenance of carbohydrate / nitrogen balance, chlorophyll synthesis.

Iron : Electron transport in photosynthesis and respirations $(Fe^{2+} \rightleftharpoons Fe^{3+})$ development of chloroplasts, chlorophyll and other pigments, protein synthesis.

Manganese : Metabolism and photolytic evolution of oxygen.

28. (d) Grey spots of oat are caused by deficiency of Manganese.

NOTES

In oats, Mn deficiency produces a condition called 'grey speck' with occurs in patches. Oats become pale green and young leaves have spots or lesions of grey/brown necrotic tissue with orange margins. These lesions will coalesce under severe Mn deficient conditions. Plants are weak, stunted, floppy and pale green-yellow and appear water-stressed even when adequate soil moisture is available. Close examination of the leaf may show slight interveinal chlorosis. The distinction between green veins and yellow interveinal areas is poor. Symptoms can be confused with red leather leaf, which is favoured by prevailing high humidity in high rainfall areas. Symptoms can also be mistaken for take-all.

29. (c) Deficiency of magnesium produces chlorosis due to breakdown of chlorophyll. Chlorosis is a condition in which plant foliage produces insufficient chlorophyll. When this happens, leaves do not have their normal green colour; they may be pale green, yellow, or yellow-white.

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NOTES

The affected plant has little or no ability to manufacture carbohydrates and may die unless the cause of its chlorophyll insufficiency is treated. Specific nutrient deficiencies (often aggravated by high pH) cause chlorosis, which may be corrected by supplemental feedings of iron, magnesium or nitrogen compounds in various combinations. Some pesticides, particularly herbicides, may also cause chlorosis, both to target weeds and occasionally to the crop being treated.

30. (c) Etiolation is the response of a plant to stimuli. When plant seeds are grown in insufficient light, (either in partial or complete absence of light) the seedlings will have long, weak stems, smaller and fewer leaves because of longer internodes, and a pale yellow colour (chlorosis). This is due to a lack of chlorophyll. The increase in height helps the plant reach a possible source of light faster.

31. (b) Symbiotic relationship between roots of higher plants and fungi is called mycorrhiza, e.g. *Pinus* roots are associated with fungal hyphae.

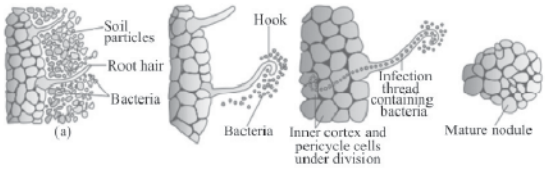
32. (a) In lichens, the association between an algae and a fungus is considered to be a symbiotic one. In this association, algae provides food to fungi.

33. (c) Ammonia and Hydrogen.

$N_2 + 8e^- + 8H^+ + 16ATP \rightarrow 2NH_3 + H_2 + 16ADP + 16Pi$

The steps involved in the process of nitrogen fixation are as follows:

- Rhizobia multiply and colonise the surroundings of roots and get attached to epidermal and root hair cells.
- The root-hairs curl and the bacteria invade the root-hair.
- An infection thread is produced carrying the bacteria into the cortex of the root, where they initiate the nodule formation in the cortex of the root.
- Then the bacteria are released from the thread into the cells which leads to the differentiation of specialised nitrogen fixing cells.
- The nodule thus formed, establishes a direct vascular connection with the host for exchange of nutrients.
- The nodule contains all the necessary biochemical components, such as the enzyme nitrogenase and leghaemoglobin.
- The enzyme nitrogenase is a Mo-Fe protein and catalyses the conversion of atmospheric nitrogen to ammonia, the first stable product of nitrogen fixation.



NOTES

The enzyme nitrogenase is highly sensitive to the molecular oxygen; it requires anaerobic conditions. The nodules have adaptations that ensure that the enzyme is protected from oxygen. To protect these enzymes, the nodule contains an oxygen scavenger called leg-haemoglobin.

34. (d) *Thiobacillus denitrificans,* a type of denitrifiers, converts nitrates in soil to free atmospheric nitrogen, thus depleting soil fertility and reducing agricultural productivity.

Nitrates (soil) $\xrightarrow{\text{Denitrification}}$ Nitrogen
↓
Pseudomonas denitrificans & *Thiobacillus denitrificans*

NOTES

Thiobacillus is a genus of Gram-negative Betaproteobacteria. Thiobacillus oxidizes thiosulfate and elemental sulphur to sulphate, and A. ferrooxidans oxidizes ferrous ions to the ferric form. This diverse oxidizing ability allows A. ferrooxidans to tolerate high concentrations of many different ions, including iron, copper, cobalt, nickel, and zinc.

35. (d) *Thiobacillus denitrificans* cause denitrification *i.e.*, conversion of oxides of nitrogen to free N_2.

36. (a) Ammonia is the first stable compound produced in fixation of atmospheric nitrogen in leguminous plant. A molecule of nitrogen is changed into two molecules of ammonia. It requires 16 ATP, a source of electron donor ferredoxin, hydrogen donor NADPH or FMNH2 and dinitrogenase enzyme.

37. (a) In the global nitrogen cycle, bacterial denitrification is recognised as important process that converts fixed nitrogen to atmospheric nitrogen gas, N_2. In marine nitrogen cycle, anaerobic oxidation of ammonium coupled to nitrate reduction, contributes substantially to N_2–production in marine sediments.

38. (c) Phosphorus is a constituent of nucleic acids of both DNA and RNA but absent in cell membranes and cell proteins.

39. (c) All the four statements are correct.

40. (c) Nitrogenases are the enzymes used by some organisms to fix atmospheric nitrogen gas. It is the only known family of enzymes that accomplish this process. Nitrogenase requires high input of energy & anaerobic condition.

41. (b) A prokaryotic autotrophic nitrogen fixing symbiont is found in *Cycas*.

NOTES

All known Cycads form mutualistic, facultative symbioses with nitrogen fixing cyanobacteria (formerly known as the blue-green algae). Cycads provide fixed carbon and a stable environment to the cyanobacteria in exchange for fixed nitrogen. These cyanobacteria are endosymbionts, living within the roots of Cycads.

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42. (a) The nitrifying bacteria bring about transformations of ammonia to nitrite and of nitrite to nitrate.
43. (b) Leghaemoglobin is the haemoglobin like red pigment found in root nodules of legumes and reported to function as an oxygen-carrying pigment in symbiotic nitrogen fixation.
44. (a) Molybdenum is a micronutrient that plays an important role in nitrogen fixation. It is a part of nitrate reductase enzyme that helps in nitrogen fixation.
45. (b) *Rhodospirillum* is a free-living, anaerobic nitrogen fixer bacteria. It can synthesize its food in presence of light under anaerobic conditions.
Beijernickia and *Azotobacter* are free living aerobic nitrogen fixing bacteria. *Rhizobium* is a symbiotic nitrogen fixing bacteria.
46. (b) *Frankia* is a symbiotic nitrogen fixer in root nodules of several non-legume plants like *Casurina* and Alnus.
47. (c) Nitrogen fixation in root nodules of *Alnus* is brought about by *Frankia*. It is a symbiotic nitrogen fixing bacteria in root nodules of several non-legume plants like *Casuarina* (Australian Pine), Myrica and *Alnus* (Alder).
48. (d) The freshwater fern *Azolla* harbours *Anabaena* (a blue green alga) in its leaf cavities. *Chlorella* is simply a green alga. *Nostoc* is a free living cyanobacteria involved in N_2 fixation and so is *Tolypothrix*.
49. (a) Molybdenum is a component of nitrogenase and nitrate reductase involved during N_2 fixation. Copper is essential for photosynthesis and respiration. Zinc is involved in synthesis of auxin. Manganese is an activator of enzymes involved in nitrogen metabolism.
50. (a) A molecule of N_2 is changed to ammonia by nitrogenase. Transaminase transfers amino group from one substrate to another.
51. (a) *Azolla* performs nitrogen fixation through its colonies of *Anabaena azollae*, which have the capacity to fix atmospheric nitrogen.
52. (a) Inulin and raphides crystals are reserve materials in plants. Inulin is a polysaccharide (a polymer of fructose) and is present in compositae. Raphides are bunches of needle like crystal of calcium oxalate found in certain plant cells.
53. (b) *Rhizobium* is a symbiotic nitrogen fixer. *Azospirillum* is a nitrogen fixing fungus and *Nostoc* is anaerobic.
54. (d) *Anabaena* is a nitrogen fixing blue-green alga composed of barrel-shaped cells held in a gelatinous matrix. So it can fix atmospheric nitrogen.

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NOTES

Anabaena may produce a few different toxins, including anatoxin and microcystin. Ingestion of small amounts of toxin can cause gastrointestinal distress. If elevated levels of the algal toxin microcystin are present in the water and ingested, serious liver damage can result.

13 Photosynthesis

Trend Analysis with Important Topics & Sub-Topics

Topic	Sub-Topics	2020 Qns.	2020 LOD	2019 Qns.	2019 LOD	2018 Qns.	2018 LOD	2017 Qns.	2017 LOD	2016 Qns.	2016 LOD
Photosynthetic Apparatus	Factors Affecting Photosynthesis					1	A			2	D/D
Light Reaction	Products					1	E				
	Photosystems									1	A
	Electron Transfer	1	A								
Calvin Cycle/C4 Pathway/ Photorespiration	C4 Plants									1	E
	Oxyegenase Activity of RuBisCo	1	D								
	Factors Affecting Rate of Photosysnthesis							1	D		

LOD - Level of Difficulty	E - Easy	A - Average	D - Difficult	Qns - No. of Questions

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Topic 1: Photosynthetic Apparatus

1. Oxygen is not produced during photosynthesis by *[2018]*
   (a) Green sulphur bacteria
   (b) *Nostoc*
   (c) *Chara*
   (d) *Cycas*
2. In a chloroplast the highest number of protons are found in *[2016]*
   (a) stroma
   (b) lumen of thylakoids
   (c) inter membrane space
   (d) antennae complex
3. Water soluble pigments found in plant cell vacuoles are *[2016]*
   (a) Xanthophylls (b) Chlorophylls
   (c) Carotenoids (d) Anthocyanins
4. The structures that are formed by stacking of organized flattened membranous sacs in the chloroplasts are : *[2015 RS]*
   (a) Grana (b) Stroma lamellae
   (c) Stroma (d) Cristae
5. Chromatophores take part in: *[2015 RS]*
   (a) Growth (b) Movement
   (c) Respiration (d) Photosynthesis
6. Anoxygenic photosynthesis is characteristic of: *[2014]*
   (a) *Rhodospirillum* (b) *Spirogyra*
   (c) *Chlamydomonas* (d) *Ulva*
7. Pigment-containing membranous extensions in some cyanobacteria are : *[2013]*
   (a) Basal bodies (b) Pneumatophores
   (c) Chromatophores (d) Heterocysts
8. Oxygenic photosynthesis occurs in: *[2009]*
   (a) *Oscillatoria* (b) *Rhodospirillum*
   (c) *Chlorobium* (d) *Chromatium*
9. The core metal of chlorophyll is *[1997]*
   (a) iron (b) magnesium
   (c) nickel (d) copper
10. Suppose an aquatic plant is placed in a test tube containing distilled water and the tube is stoppered. The tube is left outdoors for 24 hours and the pH value of the water is then measured at regular intervals. Which of the following is the most probable result? *[1997]*

(a) The pH value is lowest just before sunrise
(b) The pH value is highest just before sunrise
(c) The pH value is lowest at noon
(d) The pH value is lowest just before sunset.

11. Chlorophyll in chloroplasts is located in: *[2005]*
(a) grana
(b) pyrenoid
(c) stroma
(d) both grana and stroma

12. Photosynthesis in C_4 plants is relatively less limited by atmospheric CO_2 levels because of : *[2005]*
(a) Effective pumping of CO_2 into bundle sheath cells.
(b) Rubisco in C_4 plants has higher affinity for CO_2.
(c) Four carbon acids are the primary initial CO_2 fixation products.
(d) The primary fixation of CO_2 is mediated via PEP carboxylase.

13. Plants adapted to low light intensity have *[2004]*
(a) larger photosynthetic unit size that the sun plants
(b) higher rate of CO_2 fixation that the sun plants
(c) more extended root system
(d) leaves modified to spines

14. Which element is located at the centre of the porphyrin ring in chlorophyll ? *[2003]*
(a) Manganese (b) Calcium
(c) Magnesium (d) Potassium

15. Which fractions of the visible spectrum of solar radiations are primarily absorbed by carotenoids of the higher plants? *[2003]*
(a) Violet and blue (b) Blue and green
(c) Green and red (d) Red and violet

16. Which of the following absorb light energy for photosynthesis? *[2002]*
(a) Chlorophyll (b) Water molecule
(c) O_2 (d) RuBP

17. At a temperature above 35°C *[1992]*
(a) rate of photosynthesis will decline earlier than that of respiration
(b) rate of respiration will decline earlier than that of photosynthesis
(c) there is no fixed pattern
(d) both decline simultaneously

18. Protochlorophyll differs from chlorophyll in lacking *[1998]*
(a) 2 hydrogen atoms in one of its pyrrole rings
(b) 2 hydrogen atoms in two of its pyrrole rings
(c) 4 hydrogen atoms in one of its pyrrole rings
(d) 4 hydrogen atoms in two of its pyrrole rings

19. Chlorophyll 'a' molecule at its carbon atom 3 of the Pyrrole ring II has one of the following *[1996, 97]*
(a) aldehyde group (b) methyl group
(c) carboxyl group (d) magnesium.

20. Most plants are green in colour because *[1997]*
(a) the atmosphere filters out all the colours of the visible light spectrum except green
(b) green light is the most effective wavelength region of the visible spectrum in sunlight for photosynthesis
(c) chlorophyll is least effective in absorbing green light
(d) green light allows maximum photosynthesis

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21. The principle of limiting factors was proposed by *[1996]*
(a) Blackman (b) Hill
(c) Arnol (d) Liebig

22. Nine-tenth of all photosynthesis of world (85-90%) is carried out by *[1994]*
(a) large trees with millions of branches and levess
(b) algae of the ocean
(c) chlorophyll containing ferns of the forest
(d) scientists in the laboratories

23. Maximum solar energy is trapped by *[1993]*
(a) planting trees
(b) cultivating crops
(c) growing algae in tanks
(d) growing grasses

24. All types of plastids possess essentially the same structure because they *[1992]*
(a) perform the same function
(b) store food materials like starch, fat and protein
(c) occur in aerial parts
(d) can transform from one form to another

25. Chlorophyll a occurs in *[1992]*
(a) all photosynthetic autotrophs
(b) in all higher plants
(c) all oxygen liberating autotrophs
(d) all plants except fungi

26. Photosynthetic pigments found in the chloroplasts occur in *[1991]*
(a) thylakoid membranes
(b) plastoglobules
(c) matrix
(d) chloroplast envelope

27. A very efficient converter of solar energy with net productivity of 2-4 kg/m^2 or more is the crop of *[1989]*
(a) wheat (b) sugarcane
(c) rice (d) bajra

28. The size of chlorophyll molecule is *[1988]*
(a) Head 15 × 15 Å, tail 25 Å
(b) Head 20 × 20 Å, tail 25 Å
(c) Head 15 × 15 Å, tail 20 Å
(d) Head 10 × 12 Å, tail 25 Å

Topic 2: Light Reaction

29. In light reaction, plastoquinone facilitates the transfer of electrons from *[2020]*
(a) Cytb$_6$f complex to PS-I
(b) PS-I to NADP$^+$
(c) PS-I to ATP synthase
(d) PS-II to Cytb$_6$f complex

30. Which of the following is not a product of light reaction of photosynthesis? *[2018]*
(a) ATP (b) NADH
(c) Oxygen (d) NADPH

31. Emerson's enhancement effect and Red drop have been instrumental in the discovery of *[2016]*
(a) photophosphorylation and non-cyclic electron transport
(b) two photosystems operating simultaneously
(c) photophosphorylation and cyclic electron transport
(d) oxidative phosphorylation

32. Cytochromes are found in : *[2015 RS]*
(a) Outer wall of mitochondria
(b) Cristae of mitochondria
(c) Lysosomes
(d) Matrix of mitochondria

33. The oxygen evolved during photosynthesis comes from water molecules. Which one of the following pairs of elements is involved in this reaction? *[2015 RS]*
(a) Manganese and Potassium
(b) Magnesium and Molybdenum
(c) Magnesium and Chlorine
(d) Manganese and Chlorine

34. In photosynthesis the light-independent reactions take place at : *[2015 RS]*
(a) Photosystem-I (b) Photosystem-II
(c) Stromal matrix (d) Thylakoid lumen

35. Cyclic photophosphorylation results in the formation of *[2009]*
(a) ATP and NADPH
(b) ATP, NADPH and O_2
(c) ATP
(d) NADPH

36. Electrons from excited chlorophyll molecule of photosystem II are accepted first by: *[2008]*
(a) Cytochrome-b (b) Cytochrome-f
(c) Quinone (d) Ferredoxin

37. The first acceptor of electrons from an excited chlorophyll molecule of photosystem II is
(a) iron-sulphur protein *[2007]*
(b) ferredoxin
(c) quinone
(d) cytochrome

38. The wavelength of light absorbed by Pr form of phytochrome is *[2007]*
(a) 680 nm (b) 720 nm
(c) 620 nm (d) 640 nm

39. In photosystem-1the first electron acceptor is
(a) Cytochrome *[2006]*
(b) Plastocyanin
(c) An iron-sulphur protein
(d) Ferredoxin

40. Which pigment system is inactivated in red drop? *[2001]*
(a) PS -I and PS -II (b) PS-I
(c) PS -II (d) None of these

41. Cytochrome is *[2001]*
(a) Metallo - Flavo protein
(b) Fe-containing porphyrin pigment
(c) Glycoprotein
(d) Lipid

42. The first step of photosynthesis is *[2000]*
(a) excitation of electron of chlorophyll by a photon of light
(b) formation of ATP
(c) attachment of CO_2 to 5 carbon sugar
(d) ionisation of water

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43. Photochemical reactions in the chloroplast are directly involved in *[2000]*
(a) Formation of phosphoglyceric acid
(b) Fixation of carbon dioxide
(c) Synthesis of glucose and starch
(d) Photolysis of water and phosphorylation of ADP to ATP

44. Which one of the following statements about cytochrome P-450 is wrong? *[1998]*
(a) It contains iron
(b) It is an enzyme involved in oxidation reaction
(c) It is a coloured cell
(d) It has an important role in metabolism

45. NADPH is generated through *[1997]*
(a) photosystem I
(b) photosystem II
(c) anerobic respiration
(d) glycolysis

46. Pigment acting as a reaction centre during photosynthesis is *[1994]*
(a) Carotene
(b) Phytochrome
(c) P_{700}
(d) Cytochrome

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47. Which one occurs both during cyclic and noncyclic modes of photophosphorylation? *[1994]*
(a) Involvement of both PS I and PS II
(b) Formation of ATP
(c) Release of O_2
(d) Formation of NADPH

48. A photosynthesising plant is releasing 18O more than the normal. The plant must have been supplied with *[1993]*
(a) O_3
(b) H_2O with 18O
(c) CO_2 with 18O
(d) $C_6H_{12}O_6$ with 18O

49. Photosystem II occurs in *[1992]*
(a) Stroma
(b) Cytochrome
(c) Grana
(d) Mitochondrial surface

50. Ferredoxin is a constituent of *[1991]*
(a) PS I (b) PS II
(c) Hill reaction (d) P680

Topic 3: Calvin (C_3) cycle/C_4 Pathway/ Photorespiration

51. The oxygenation activity of RuBisCo enzyme in photorespiration leads to the formation of *[2020]*
(a) 1 molecule of 3-C compound
(b) 1 molecule of 6-C compound
(c) 1 molecule of 4-C compound and 1 molecule of 2-C compound
(d) 2 molecules of 3-C compound

52. In Hatch and Slack pathway, the primary CO2 acceptor is *[2019]*
(a) Rubisco
(b) Oxaloacetic acid
(c) Phosphoglyceric acid
(d) Phosphoenol pyruvate

53. With reference to factors affecting the rate of photosynthesis, which of the following statements is not correct ? *[2017]*
(a) Increasing atmospheric CO_2 concentration up to 0.05% can enhance CO_2 fixation rate
(b) C_3 plants respond to higher temperatures with enhanced photosynthesis while C_4 plants have much lower temperature optimum
(c) Tomato is a greenhouse crop which can be grown in CO_2 - enriched atmosphere for higher yield
(d) Light saturation for CO_2 fixation occurs at 10% of full sunlight

54. A plant in your garden avoids photorespiratory losses, has improved water use efficiency, shows high rates of photosynthesis at high temperatures and has improved efficiency of nitrogen utilisation. In which of the following physiological groups would you assign this plant? *[2016]*
(a) C_3 (b) C_4
(c) CAM (d) Nitrogen fixer

55. Bundle sheath cells *[NEET Kar. 2013]*
(a) Are rich in RUBisCo
(b) Are rich in PEP carboxylase
(c) Lack RuBisCo
(d) Lack both RuBisCo and PEP carboxylase

56. A process that makes important difference between C_3 and C_4 plants is : *[2012]*
(a) Transpiration (b) Glycolysis
(c) Photosynthesis (d) Photorespiration

57. The correct sequence of cell organelles during photorespiration is : *[2012]*
(a) Chloroplast-Golgibodies-mitochondria
(b) Chloroplast-Rough Endoplasmic reticulum, Dictyosomes
(c) Chloroplast-peroxisome-mitochondria
(d) Chloroplast-vacuole-peroxisome

58. CAM helps the plants in : *[2011]*
(a) conserving water
(b) secondary growth
(c) disease resistance
(d) reproduction

59. In Kranz anatomy, the bundle sheath cells have *[2011M]*
(a) thin walls, many intercellular spaces and no chloroplasts
(b) thick walls, no intercellular spaces and large number of chloroplasts
(c) thin walls, no intercellular spaces and several chloroplasts
(d) thick walls, many intercellular spaces and few chloroplasts

60. PGA as the first CO_2 fixation product was discovered in photosynthesis of : *[2010]*
(a) Bryophyte (b) Gymnosperm
(c) Angiosperm (d) Alga

61. C_4 plants are more efficient in photosynthesis than C_3 plants due to: *[2010]*
(a) Higher leaf area
(b) Presence of larger number of chloroplasts in the leaf cells
(c) Presence of thin cuticle
(d) Lower rate of photorespiration

62. In leaves of C_4 plants malic acid synthesis during CO_2 fixation occurs in *[2008]*
(a) epidermal cells (b) mesophyll cells
(c) bundle sheath (d) guard cells

63. In the leaves of C_4 plants, malic acid formation during CO_2 fixation occurs in the cells of
(a) bundle sheath (b) phloem *[2007]*
(c) epidermis (d) mesophyll

64. The C_4 plants are photosynthetically more efficient than C_3 plants because: *[2007]*
(a) the CO_2 compensation point is more
(b) CO_2 generated during photorespiration is trapped and recycled through PEP carboxylase
(c) the CO_2 efflux is not prevented
(d) they have more chloroplasts

65. During photorespiration, the oxygen consuming reaction(s) occur in *[2006]*
(a) stroma of chloroplasts and peroxisomes
(b) grana of chloroplasts and peroxisomes
(c) stroma of chloroplasts
(d) stroma of chloroplasts and mitochondria

66. As compared to a C_3 – plant, how many additional molecules of ATP are needed for net production of one molecule of hexose sugar by C_4 plants: *[2005]*
(a) two (b) six
(c) twelve (d) zero

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67. Photosynthetically active radiation is represented by the range of wavelength of *[1996, 2004, 05]*
(a) 340-450 nm (b) 400-700 nm
(c) 500-600 nm (d) 400-950 nm

68. In C_3 plants, the first stable product of photosynthesis during the dark reaction is
(a) Malic acid *[2004]*
(b) Oxaloacetic acid
(c) 3-phosphoglyceric acid
(d) Phosphoglyceraldehyde

69. Stomata of CAM plants *[2003]*
(a) never open
(b) are always open
(c) open during the day and close at night
(d) open during the night and close during the day

70. In sugarcane plant $14CO_2$ is fixed in malic acid, in which the enzyme that fixes CO2 is
(a) fructose phosphatase *[2003]*
(b) ribulose biphosphate carboxylase

(c) Phosphoenol pyruvic acid carboxylase
(d) ribulose phosphate kinase

71. Which one of the following is wrong in relation to photorespiration ? *[2003]*
(a) It is a characteristic of C_3 plants
(b) It occurs in chloroplasts
(c) It occurs in daytime only
(d) It is a characteristic of C_4 plants

72. Glycolate induces opening of stomata in
(a) presence of oxygen *[2001]*
(b) low CO_2 conc.
(c) high CO_2 conc.
(d) absence of CO_2

73. In photosynthesis energy from light reaction to dark reaction is transferred in the form of
(a) ADP (b) ATP *[2002]*
(c) RuDP (d) Chlorophyll

74. Which pair is wrong? *[2001]*
(a) C_3 – Maize
(b) C_4 – Kranz anatomy
(c) Calvin cycle – PGA
(d) Hatch and Slack Pathway – Oxalo acetic Acid

75. How many turns of Calvin cycle yield one molecule of glucose ? *[1996, 2000]*
(a) Eight (b) Two
(c) Six (d) Four

76. Fixation of one CO_2 molecule through Calvin cycle requires *[2000]*
(a) 1 ATP and 2NADPH$_2$
(b) 2ATP and 2NADPH$_2$
(c) 3ATP and 2NADPH$_2$
(d) 2ATP and 1NADPH$_2$

77. The enzyme which fixes CO_2 in C_4 plants is
(a) Hydrogenase *[2000]*
(b) PEP carboxylase
(c) Reductase
(d) RuBP carboxylase

78. Which enzyme is most abudantly found on earth? *[1999]*
(a) Catalase (b) Rubisco
(c) Nitrogenase (d) Invertase

79. The carbon dioxide acceptor in Calvin cycle/ C_3-plants is *[1993, 95, 96, 99]*
(a) Phospho-enol pyruvate (PEP)
(b) Ribulose 1, 5-diphosphate (RuBP)
(c) Phosphoglyceric acid (PGA)
(d) Ribulose monophosphate (RMP)

80. Photorespiration is favoured by *[1996]*
(a) high O_2 and low CO_2
(b) low light and high O_2
(c) low temperature and high O_2
(d) low O_2 and high CO_2

81. Which one of the following is represented by Calvin cycle? *[1996]*
(a) Reductive carboxylation
(b) Oxidative carboxylation
(c) Photophosphorylation
(d) Oxidative phosphorylation.

82. The specific characteristic of C_4-plants is *[1995]*
(a) bulliform cells (b) isobilateral leaf
(c) kranz anatomy (d) parallel veins

83. C_4-cycle was discovered by *[1994]*
(a) Hatch and Slack (b) Calvin
(c) Hill (d) Arnon

84. Series of reactions which can convert fatty acids to sugars in plants but not in animals is *[1994]*
(a) krebs cycle (b) glyoxylate cycle
(c) ornithine cycle (d) glycolysis

85. Which one is a C_4-plant? *[1993]*
(a) Papaya (b) Pea
(c) Potato (d) Maize/Corn

86. Formation of ATP in photosynthesis and respiration is an oxidation process which utilises the energy from *[1992]*
(a) Cytochromes (b) Ferredoxin
(c) Electrons (d) Carbon dioxide

87. The enzyme that catalyses carbon dioxide fixation in C_4 plants is *[1992]*
(a) RuBP carboxylase
(b) PEP carboxylase
(c) Carbonic anhydrase
(d) Carboxy dismutase

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88. The first carbon dioxide acceptor in C_4-plants is *[1990, 92]*
(a) Phosphoenol-pyruvate
(b) Ribulose 1, 5-diphosphate
(c) Oxalo-acetic acid
(d) Phosphoglyceric acid

89. Dark reactions of photosynthesis occur in
(a) Granal thylakoid membranes *[1991]*
(b) Stromal lamella membranes
(c) Stroma outside photosynthetic lamellae
(d) Periplastidial space

90. Which technique has helped in investigation of Calvin cycle? *[1991]*
(a) X-ray crystallography
(b) X-ray technique
(c) Radioactive isotope technique
(d) Intermittent light

91. During monsoon, the rice crop of eastern states of India show lesser yield due to limiting factor of *[1991]*
(a) CO_2 (b) light
(c) temperature (d) water

92. Kranz anatomy is typical of *[1990]*
(a) C_4 plants (b) C_3 plants
(c) C_2 plants (d) CAM plants

93. The substrate for photorespiration is *[1989]*
(a) Phosphoglyceric acid
(b) Glycolate
(c) Serine
(d) Glycine

94. In C_4 plants, Calvin cycle operates in *[1989]*
(a) Stroma of bundle sheath chloroplasts
(b) Grana of bundle sheath chloroplasts
(c) Grana of mesophyll chloroplasts
(d) Stroma of mesophyll chloroplasts

95. Carbon dioxide joins the photosynthetic pathway in *[1988]*
(a) PS I (b) PS II
(c) Light reaction (d) Dark reaction

96. $NADP^+$ is reduced to NADPH in *[1988]*
(a) PS I
(b) PS II
(c) Calvin cycle
(d) Noncyclic photophosphorylation

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ANSWER KEY

1	(a)	11	(a)	21	(a)	31	(b)	41	(b)	51	(a)	61	(d)	71	(d)	81	(a)	91	(b)
2	(b)	12	(d)	22	(b)	32	(b)	42	(a)	52	(d)	62	(b)	72	(b)	82	(c)	92	(a)
3	(d)	13	(a)	23	(c)	33	(d)	43	(d)	53	(b)	63	(d)	73	(b)	83	(a)	93	(b)
4	(a)	14	(c)	24	(d)	34	(c)	44	(c)	54	(b)	64	(d)	74	(a)	84	(b)	94	(a)
5	(d)	15	(a)	25	(c)	35	(c)	45	(a)	55	(a)	65	(a)	75	(c)	85	(d)	95	(d)
6	(a)	16	(a)	26	(a)	36	(c)	46	(c)	56	(d)	66	(c)	76	(c)	86	(c)	96	(d)
7	(c)	17	(a)	27	(b)	37	(c)	47	(b)	57	(c)	67	(b)	77	(b)	87	(b)		
8	(a)	18	(a)	28	(c)	38	(a)	48	(b)	58	(a)	68	(c)	78	(b)	88	(a)		
9	(b)	19	(b)	29	(d)	39	(c)	49	(c)	59	(b)	69	(d)	79	(b)	89	(b)		
10	(a)	20	(c)	30	(b)	40	(c)	50	(a)	60	(d)	70	(c)	80	(a)	90	(c)		

Hints & Solutions

1. (a) Green sulphur bacteria do not use H_2O as source of proton, therefore they do not evolve O_2.
2. (b) Proton concentration is higher in the lumen of thylakoid due to photolysis of water, H^+ pumping and NADP reductase activity in stroma. During the light-dependent reaction, protons are pumped across the thylakoid membrane into the lumen making it acidic down to pH 4.

NOTES

The light - included electron transfer in photosynthesis drives protons into the thylakoid lumen. The excess protons flow out of the lumen through ATP synthase to generate. ATP in the stroma.

3. (d) Many leaves produce water-soluble vacuolar pigments, which are stored within cell vacuoles (microscopic water sacs within each cell). Two major classes of leaf vacuolar pigments are anthocyanins and betalains.
4. (a) In chloroplast which are green coloured plastids, thylakoids are arranged in stacks like the pile of coins called grana.
5. (d) Chromatophores play an important role in the process of photosynthesis. They contain pigments and are found in blue green algae.
6. (a) In *Rhodospirillum*, electron donor is organic compound during photosynthesis. It helps an organisms to trap light energy and store it as chemical energy.

NOTES

Rhodospirillum bacteria are Gram-negative, motile, spiral-shaped bacteria. They can be grown under many different types of conditions including aerobic or anaerobic environments. Anaerobically, the bacterium uses fermentation or photosynthesis in order to produce energy as well as photoautotrophic growth.

7. (c) In some photoautotrophic bacteria, bacteriochlorophyll and bacteriophaeophytin or bacterioviridin pigments containing membraneous extensions called chromatophores are present. These are sites of bacterial photosynthesis.
8. (a) Oxygenic photosynthesis occurs in *Oscillatoria*. It is a genus of filamentous cyanobacteria which is named for the oscillation in its movement.

NOTES

Nitrogen fixation in marine Oscillatoria appears is associated with differentiated cells located in the center of the colony. The observations explain how Oscillatoria is able to fix N_2 without heterocysts in an aerobic environment and why it blooms virtually always occur in calm seas.

9. (b) A non ionic Mg atom is held in the centre of porphyrin (of chlorophyll) held by nitrogen atom of pyrrole ring.
10. (a) After sunrise, photosynthesis is carried out using CO_2. Hence concentration of CO_2 decreases increasing pH.
11. (a) Internally a chloroplast contains a matrix or stroma which is similar to cytoplasm in its constitution. It contains DNA, RNA, ribsomes, enzymes for CO_2 assimilation, proteins, starch grains and fat droplets or plastoglobuli.

    In the matrix or stroma are embedded a number of flattened membranous sacs called thylakoids or lamellae. At places the thylakoids are aggregated to form stacks called grana.
12. (d) In C_4 plants, initial fixation of carbon dioxide occurs in mesophyll cells. The primary acceptor of CO_2 is phosphoenol pyruvate or PEP. It combines with carbon dioxide in the presence of PEP carboxylase to form oxaloacetate.

    C_4 plants are more efficient in picking up CO_2 even when it is found in low concentration because of the high affinity of PEP case.
13. (a) They have larger photosynthetic unit size so that they can absorb maximum amount of light of the Photosynthetically Active Radiation (PAR) for photosynthesis.
14. (c) A non ionic Mg atom is held in the centre of porphyrin (of chlorophyll) held by nitrogen atom of pyrrole ring.

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NOTES

Magnesium (Mg) is needed by all crops to help capture the sun's energy for growth and production through photosynthesis. Photosynthesis takes place in chlorophyll, the green pigment in plants, and magnesium is the central atom of the chlorophyll molecule, with each molecule containing 6.7% magnesium.

15. (a) Carotenoids have three absorption peaks in the blue-violet range of the spectrum.
In photosynthetic organisms, carotenoids play a vital role in the photosynthetic reaction centre. They either participate in the energy-transfer process, or protect the reaction center from auto-oxidation. In non-photosynthesizing organisms, carotenoids have been linked to oxidation-preventing mechanisms.
16. (a) Each pigment has its own absorption spectrum, chlorophyll absorbs light energy in blue and red region.
17. (a) The optimum temperature of photosynthesis is 10°–25°C for C_3 plants and 30°–45°C for C_4 plants.
18. (a) Protochlorophyll differs from chlorophyll in lacking 2 hydrogen atoms in one of its pyrrole rings.
19. (b) Chlorophyll a has a methyl group attached to the third carbon, which is replaced by an aldehyde group in chlorophyll b.
20. (c) Plants are green because their cells contain chloroplasts which contains the pigment chlorophyll which absorbs deep-blue and red light, so that the rest of the sunlight spectrum is being reflected, causing the plant to look green.
21. (a) The principle of limiting factors was formulated by Blackman (1905). It states that when a process is conditioned as to its rapidity by a number of separate factors, the rate of process is limited by the pace of slowest factor.
22. (b) 85-90% of all photosynthesis of world is carried out by phytoplanktons in ocean. 10% of total photosynthesis is performed by land plants.
23. (c) Algae are the most efficeint photosynthesising organisms.

NOTES

Algae are believed to be a good source of renewable energy because of its rapid growth rate and its ability to be cultivated in waste water or waste land. Several companies and government agencies are making efforts to reduce capital cost and operating costs and make algae fuel production commercially viable.

24. (d) Depending upon their colour, plastids are of three main types – leucoplasts, chromoplasts and chloroplasts.
25. (c) Chlorophyll a is found in all photosynthetic plants except bacteria. Hence, it is termed as universal photosynthetic pigment.
26. (a) Photosynthetic pigments occur on photosynthetic thylakoids of chloroplasts. A stack of thylakoids is called granum.
27. (b) C_4 cycle occurs in C_4 plants like sugarcane, maize. C_4 cycle provides a more efficient way of CO_2 fixation than C_3 cycle and hence gives more productivity. The rest are C_3 plants.

NOTES

C3 Cycle needs 18 ATP molecules for synthesis of one molecule of glucose whereas the C4 cycle needs 30 ATP molecules. Due to high energy requirement C4 cycle is more energy expensive than the C3 cycle.

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28. (c) Chlorophyll has a tetrapyrrole porphyrin ring as head (15 × 15Å) and a long hydrocarbon tail called phytol (20 Å) tail attached to the ring structure.
29. (d) After excitement, e^- is passed from PS-II (P_{680}) to primary electron acceptor (Pheophytin). From primary e^- acceptor, e^- is passed to plastoquinone. Plastoquinone (PQ) in turn transfer its e^- to Cyt b_6f complex. Therefore plastoquinone facilitates the transfer of electrons from PS-II to Cyt b_6f complex.

NOTES

Plastoquinone (PQ) and ubiquinone (UQ) are two important prenylquinones, functioning as electron transporters in the electron **transport** chain of oxygenic **photosynthesis** and the aerobic respiratory chain, respectively, and play indispensable roles in plant growth and development through participating in the biosynthesis.

30. (b) The light reactions of photosynthesis take place on the thylakoid membranes of the chloroplast. During light reactions of photosynthesis, light is absorbed and the

energy is used to drive electrons from water to generate NADPH and to drive protons across a membrane. These protons return through ATP synthase to make ATP. ATP, NADPH and oxygen are products of light reaction, while NADH is a product of respiration process.

31. (b) Emerson performed photosynthetic experiment. On *Chlorella*, he provide monochromatic light of more than 680 nm and observed decrease in rate of photosynthesis known as red drop.
Later, he provides synchronised light of 680 nm and 700 nm and observed increase in rate of photosynthesis known as enhancement effect. This experiment led to discovery of two photosystems– PS-I and PS-II operating in photosynthesis.

32. (b) Cytochromes are found in mitochondria. These are located on the inner membrane of mitochondria and are related with phosphorylation.

33. (d) During photosynthesis photolysis of water is induced by Mn^{++} and Cl^{-} ions.

34. (c) Stromal matrix contains a number of flattened membranous sacs called thylakoid or lamellae.

35. (c) Cyclic photophosphorylation results in the formation of ATP. This process is called photophosphorylation, which occurs in two different ways. Adenosine triphosphate (ATP) is considered by biologists to be the energy currency of life.

NOTES

It is the high-energy molecule that stores the energy we need to do just about everything we do. It is present in the cytoplasm and nucleoplasm of every cell, and essentially all the physiological mechanisms that require energy for operation obtain it directly from the stored ATP.

36. (c) Electrons from excited chlorophyll molecule of photosystem II are accepted first by quinone. Photosystem II is a photosynthetic pigment system along with some electron carriers that are located in the appressed part of the grana thylakoids. Photosystem II has chlorophyll a, b and carotenoids. Other components of PS II are phaeophytin, plastoquinone (PQ), cytochrome complex and blue coloured copper containing plastocyanin.

37. (c) The first acceptor of electrons from an excited chlorophyll of PSII is quinone.

NOTES

Quinones represent a class of toxicological intermediates which can create a variety of hazardous effects in vivo, including acute cytotoxicity, immunotoxicity, and carcinogenesis. Quinones are Michael acceptors, and cellular damage can occur through alkylation of crucial cellular proteins and/or DNA.

38. (a) The Pr form absorbs light between 660 to 680 nm and absorbs at a peak of 666 nm. It is the form synthesized in dark-grown seedlings. When Pr absorbs red light, it is converted to the Pfr form.

39. (c) In photosystem I or photoact I electrons released by P-700 are accepted by a substance of iron-sulphur-protein complex denoted as A(FeS) which is thus reduced and it passes these high electrons to oxidised ferredoxin and it gets reduced. From reduced Fd these electrons are passed to FAD which is now reduced to $FADH_2$ and then electrons and hydrogen are accepted by NADP which makes $NADPH_2$. Here, photosystem I ends.

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40. (c) The reduction in the rate of photosynthesis in monochromatic light of more than 680 nm is called red drop.

41. (b) Cytochrome is an iron containing porphyrin pigment. These are electron transferring proteins often regarded as enzymes.

42. (a) The entire process of photosynthesis is driven by light energy coming from the sun. This energy is first captured by chlorophyll molecules and later on utilised for the synthesis of ATP (chemical energy) molecules which later utilised in the dark reaction i.e., calvin cycle.

43. (d) CO_2 is fixed in the stroma of the chloroplast leading to the synthesis of PGA from which glyceraldehyde phosphate is formed. From glyceradehyde phosphate, sugar and starch are formed. All these do not require light. However, photolysis of water and phosphorylation of ADP to ATP requires light energy.

44. (c) Cytochrome P-450 is not a coloured cell, instead this is a respiratory pigment–

mixture of iron and protein which are electron acceptors. It contains haeme groups and are primarily responsible for the generation of ATP via electron transport.

45. (a) NADPH is generated by photosystem I during non-cyclic photophosphorylation.
46. (c) P700 consists of a chl a and chl b molecules and is named as such due to maximum absorption by pigment or photocentre at that wavelength.
47. (b) Cyclic photophosphorylation can be used to produce a steady supply of ATP in the presence of sunlight. However, ATP is a highly reactive molecule and hence cannot be readily stored within the cell. Non-cyclic photophosphorylation produces NADPH in addition to ATP (this requires the presence of water).

NOTES

In the Z-scheme, electrons are removed from water (to the left) and then donated to the lower (non–excited) oxidized form of P680. Absorption of a photon excites P680 to P680*, which "jumps" to a more actively reducing species.

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48. (b) The phenomenon of breaking up of water into hydrogen and oxygen in the illuminated chloroplasts is called photolysis. Oxygen comes from photolysis of water was verified by Ruben and Kamen (1941).
49. (c) Photosystem II is a photosynthetic pigment system that is located in the appressed part of grana thylakoids.
50. (a) In PS-I, when the electron passes from ferredoxin and plastoquinone, the electron loses sufficient energy to form ATP from ADP and inorganic phosphate.
51. (a) In photorespiration, O_2 binds to RubisCo. As a result RuBP instead to being converted to 2 molecules of PGA bind with O_2 to form one molecule each of phosphoglycerate (3 carbon compound) and phosphoglycolate (2 carbon compound).

NOTES

Photorespiration is the oxygenation of RuBP by RUBISCO followed by photorespiratory glycolate metabolism. Competition between O_2 and CO_2 reduces the rate of carbon assimilation, energetic efficiency of photosynthesis, and may reduce the photosynthetic quotient (PQ = O_2 evolved/CO_2 assimilated).

52. (d) Hatch and Slack pathway is a cyclic pathway for CO_2 fixation. The primary CO_2 acceptor is a 3-carbon compound phosphoenol pyruvate (PEP) which is present in mesophyll cells.

    PEP is converted to oxaloacetic acid (OAA), which is then further converted into a 4-carbon compound such as malic acid or aspartic acid, which is then transported to the bundle sheath cells. In the bundle sheath cells, it is again broken down into a 3-carbon compound with the release of CO_2. The CO_2 released enters the Calvin cycle in the bundle sheath cells, while the 3-carbon compound is transported back to the mesophyll cells. In the mesophyll cells, the 3-carbon compound is converted back to PEP, thus completing the cycle.

NOTES

C_4 plants capture carbon dioxide in their mesophyll cells forming oxaloacetate. This oxaloacetate is then converted to malate and is transported into the bundle sheath cells, where oxygen concentration is low to avoid photorespiration. So, C_4 plants are more efficient in photosynthesis than C_3 plants.

53. (b) In C_3 plants photosynthesis decreases at higher temperature due to increased photorespiration.

    C_4 plants have higher temperature optimum because of the presence of enzyme called pyruvate phosphate dikinase, which is sensitive to low temperature.
54. (b) C_4 plants are adapted to hot and dry climate and lack photorespiration due to Kranz anatomy and have greater productivity of biomass.
55. (a) In C_4 plants, bundle sheath cells are rich in RuBisCO, but lack PEPcase. The CO_2 released in the bundle sheath cells enters the C_3 or the calvin pathway, common to all plants. Thus, the basic pathway that results in the formation of sugars, the calvin pathway is common to the C_3 and C_4 plants.
56. (d) Photorespiration is absent is C_4 plants. Photorespiration does not produce energy or reducing power. Rather, it consumes energy. Further, it undoes the work of photosynthesis. There is 25% loss of fixed CO_2. Therefore, photorespiration is a highly wasteful process. This happens only in case of C_3 plants.

57. (c) It is chloroplast followed by peroxisomes and finally mitochondria
58. (a) CAM plants are most common in arid environments. Being able to keep stomata closed during the hottest and driest part of the day reduces the loss of water through evapotranspiration.
59. (b) In Kranz anatomy, the bundle sheath cells have thick wall, no intracellular spaces and large number of chloroplasts.
60. (d) Phosphoglyceric acid (PGA) is the first stable product of photosynthesis. It was first discovered by Calvin, Benson and their colleagues in *Chlorella*, (alga).
61. (d) C_4 plants are more efficient in photosynthesis than C_3 plants due to photorespiration. Photorespiration is an inhibitory process that decreases the rate of photosynthesis. It is absent in C_4 plants and present only in C_3 plants.
62. (b) In leaves of C_4 plants, malic acid synthesis during CO_2 fixation occurs in mesophyll cells. The mesophyll cells perform C_4 cycle and the cells of bundle sheath perform C_3 cycle.

NOTES

CO_2 taken from the atmosphere is accepted by phosphoenol pyruvic acid (PEP) present in the chloroplasts of mesophyll cells of these leaves, leading to the formation of a 4-C compound, oxaloacetic acid (OAA). This acid is converted to another 4-C acid, the malic acid which enters into the chloroplast of bundle sheath cells and undergoes oxidative decarboxylation yielding pyruvic acid (3C - compound) and CO_2.

63. (d) In C_4 plants, C_4 cycle occurs in mesophyll cells and C_3 - cycle occurs in bundle sheath cells.
64. (d) The C_4 pathway allows photosynthesis to occur at very low concentrations of carbon dioxide as PEP carboxylase has an extremely high affinity for carbon dioxide. This pathway also works well at high temperatures and light intensity, enabling efficient photosynthesis in tropical plants.
65. (a) Photorespiration is the process which occurs in C_3 plants. In this process, peroxisomes, chloroplast and mitochondria take part. The oxygen consuming reactions occurs in peroxisomes and stroma of chloroplast while CO_2 releasing reaction occurs in mitochondria.
66. (c) In C_4 plants every CO_2 molecule has to be fixed twice, so these plants are needed more energy for the synthesis of hexose sugar molecules than C_3 plants in which CO_2 has to be fixed only once. 18 ATP molecules are required by C_3 plants for the synthesis of one molecule of hexose sugar while 30 ATP molecules are needed by the C_4 plants for the same. Thus C_4 plants have a need of 12 ATP molecules extra than C_3 plants for the synthesis of one molecule of hexose sugar.
67. (b) Photosynthesis takes place only in the visible part (400 - 700 nm wavelength) of electromagnetic radiations. Hence this component comprises the photosynthetically active radiation.
68. (c) 3-phosphoglyceric acid, a 3 carbon compound is the first product formed in the C_3 cycle. It is then converted to glyceraldehyde 3-phosphate. Oxaloacetic acid, 4 carbon compound is the first product formed in C_4 cycle. It is then converted to malic acid.
69. (d) To conserve water, the stomata of CAM plants open during night to take up CO_2 and store it in the form of malic acid which is utilised during the time of photosynthesis.
70. (c) Sugarcane is a C_4 plant in which CO_2 is fixed in malic acid by the enzyme phosphoenol pyruvic acid carboxylase present in mesophyll cells.
71. (d) In C_4 plants, photorespiration is absent.
72. (b) Light causes photosynthesis which leads to reduction in CO_2 concentration → oxidation of glycolate → ATP synthesis → activation of K^+ pump → movement of K^+ in guard cell → movement of water into guard cell → swelling of guard cell → opening of stomata.
73. (b) ATP molecules produced in the light reaction are used in the dark reaction to fix CO_2 to form organic compounds.
74. (a) Maize is a C_4 plant exhibiting Hatch and Slack pathway. These plants show Kranz anatomy and overcome photorespiration.
75. (c) Each turn of Calvin cycle fixes one carbon atom hence six turns of the cycle is required to generate one molecule of hexose sugar glucose.
76. (c) 2 ATP are required during conversion of PGA to 1, 3-diphosphoglyceric acid and

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1 ATP during conversion of glyceraldehyde phosphate to ribulose biphosphate. $2NADH_2$ molecules are utilised for converting 1, 3-diphosphoglyceric acid to glyceraldehyde phosphate.

77. (b) The three most important roles that PEP carboxylase plays in plants and bacteria metabolism are in the C_4 cycle, the CAM cycle and the Citric Acid Cycle biosynthesis flux. PEP carboxylase plays the key role of binding CO_2 to create oxaloacetate in the mesophyll tissue.

NOTES

C_4 plants have carboxylating enzymes that have a higher affinity for CO_2, compared to rubisco, especially at low CO_2 concentrations & high temperatures. The C_4 pathway uses PEP carboxylase, which has a much higher affinity for CO_2 than rubisco; in addition, PEP carboxylase does NOT have oxygenase activity.

78. (b) RUBISCO is the enzyme involved in Calvin cycle. Nitrogenase catalyses nitrogenation. Invertase catalyses breaking of sucrose to glucose and fructose. Catalase, catalyses the decomposition of hydrogen peroxide to water and oxygen.

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79. (b) The primary CO_2 acceptor in C_3 plants is Ribulose-1, 5-diphosphate (RuBP) which forms a 3 carbon compound 3-phosphoglyceric acid.

80. (a) Photorespiratory loss of CO_2 occurs when RUBISCO starts functioning as an oxygenase instead of carboxylase under conditions of high O_2 and low CO_2. It involves three organelles chloroplast, mitochondria and peroxisomes. Half of the photosynthetically fixed carbon (in the form of RUBP) may be lost into the atmosphere through this process and no ATP formation occurs.

81. (a) In dark phase of calvin cycle of photosynthesis, the CO_2 is reduced to glucose in stroma of chloroplast, making use of the ATP and $NADPH_2$, (available from light phase).

82. (c) Anatomy of leaves of C_4 plant is called kranz anatomy.

NOTES

In C_4 plants, the mesophyll cells cluster around the bundle-sheath cell in a wreath formation (Kranz means 'wreath or ring). Also, the number of chloroplasts observed in bundle sheath cells is more than that in the mesophyll cell. This entire structure is densely packed and plays a major role in C_4 photosynthesis.

83. (a) C_4 cycle was worked out by Hatch and Slack (1966). C_4 cycle occured in C_4 plants.

84. (b) Several plant structures *e.g.* pollen, seeds contain fats. The fats are hydrolysed and consumed as a source of energy. This is accomplished through oxidative degradation called glyoxylate cycle.

85. (d) Maize, Sugarcane, Sorghum, *Atriplex*, *Panicum* are examples of C_4 plants.

86. (c) Electrons provide energy for the formation of ATP in photosynthesis and respiration.

87. (b) In C_4 plants, the primary acceptor of CO_2 is phosphoenol pyruvate. It combines with carbon dioxide in the presence of PEP carboxylase to form oxaloacetic acid in mesophyll cells.

88. (a) The primary acceptor of CO_2 in C_4 plants is phosphoenol pyruvate or PEP. In mesophyll cells PEP combines with CO_2 and converted into a 4 carbon compound oxaloacetic acid by PEP carboxylase. In C_3 plants, ribulose 1, 5–diphosphate is the primary acceptor of CO_2.

89. (b) Dark reaction occurs in the stroma or matrix of chloroplasts. It is independent of light but depends on the products of light reaction (ATP and NADPH–assimilatory process).

90. (c) In 1954-55 Calvin traced the pathway of carbon fixation using radioactive isotope method and discovered the Calvin cycle.

NOTES

The 1961 Nobel Prize in Chemistry was awarded to the Russian-born, American scientist Melvin Calvin, for his discovery of the metabolic processes involved in photosynthesis, the assimilation of carbon dioxide in plants. During the 1950s, Calvin and his colleagues, using C14-radiolabelled CO_2, had elucidated the principal reactions by which the green alga Chlorella synthesises glucose from carbon dioxide and water, using the energy of light. These reactions were termed the Calvin Cycle.

91. (b) According to law of limiting factors given by Blackman, when a process depends upon a number of factors which are separate, the rate of the process is limited by the pace of the slowest factor. Rate of yield is dependent on light as photosynthesis is dependent on light. During monsoon, the intensity of light is less, so rate of photosynthesis is also less, hence yield is reduced.

92. (a) C_4 plants have a characteristic leaf anatomy called kranz anatomy with two distinct choloroplast containing cells, mesophyll and bundle sheath cells.

93. (b) Light dependent uptake of O_2 and release of CO_2 in C_3 photosynthetic cell is called photorespiration. Glycolate (glycolic acid) is the chief metabolite of photorespiration and also its substrate. Other important metabolities are the amino acids glycine and serine. But phosphoglyceric acid (PGA) is a lipid and is not substrate of photorespiration.

94. (a) C_4 plants are specialised plants for better CO_2 assimilation found in hot environment. They have a characteristic leaf anatomy called kranz anatomy showing two distinct choloroplast containing cells mesophyll and bundle sheath cells. Mesophyll cells are located very near to bundle sheath cells and are the site for C_4 cycle i.e. CO_2 is first fixed as a 4 carbon compound oxaloacetic acid by the action of PEP carboxylase. The second carboxylation event occurs in stroma of chloroplast of bundle sheath cell through C_3 cycle.

95. (d) Photosynthesis is completed in two phases-light and dark phases. In dark phase (Blackman's reaction or biosynthetic phase) carbohydrates are synthesised from carbon dioxide in stroma of chloroplast using ATP and NADPH products of light reactions.

96. (d) Non cyclic photophosphorylation is not only connected with ATP synthesis but also production of NADPH. It involves two photosystems—PSI and PSII. PSII (680) receives electrons from photolysis of water and transfer it to PSI (700) to form NADPH from $NADP^+$. The hydrogen required for reduction comes from breaking of water molecules.

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14 Respiration in Plants

Trend Analysis with Important Topics & Sub-Topics

		2020		2019		2018		2017		2016	
Topic	**Sub-Topics**	**Qns.**	**LOD**	**Qns.**	**LOD**	**Qns.**	**LOD**	**Qns.**	**LOD**	**Qns.**	**LOD**
Respiration/ Aerobic respiration											
Glycolysis/ Fermentation	CO_2 Acceptor							1	E		
Kreb's Cycle / ETS / Chemiosmosis	Substrate Level Phosphorylation	1	A								
	Kreb's Cycle							1	A		
	Electron Carriers					1	E				
	Site of Oxidative Phosphorylation					1	A				
Respiratory Quotient(RQ)	RQ Value			1	D						

LOD - Level of Difficulty	E - Easy	A - Average	D - Difficult	Qns - No. of Questions

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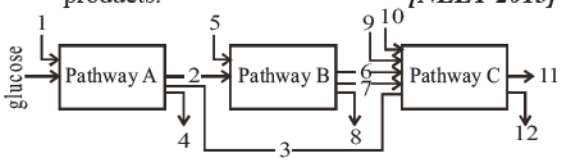
Topic 1: Respiration/Aerobic Respiration

1. Which of the metabolites is common to respiration mediated breakdown of fats, carbohydrates and proteins? *[NEET 2013]*
   (a) Fructose 1, 6 - bisphosphate
   (b) Pyruvic acid
   (c) Acetyl CoA
   (d) Glucose - 6 - phosphate
2. The three boxes in this diagram represents the three major biosynthetic pathways in aerobic respiration. Arrows represents net reactants or products. *[NEET 2013]*



   Arrows numbered 4, 8 and 12 can all be :
   (a) ATP (b) H_2O
   (c) FAD^+ or $FADH_2$ (d) NADH
3. The bacterium (*Clostridium botulinum*) that causes botulism is *[2006]*
   (a) an obligate anaerobe
   (b) an facultative aerobe
   (c) an obligate aerobe
   (d) a facultative anaerobe
4. Net gain of ATP molecules during aerobic respiration is *[1999]*
   (a) 36 molecules (b) 38 molecules
   (c) 40 molecules (d) 48 molecules
5. Site of respiration in bacteria is *[1997]*
   (a) episome (b) ribosome
   (c) mesosome (d) microsome
6. Maximum amount of energy/ATP is liberated on oxidation of *[1994]*
   (a) fats (b) proteins
   (c) starch (d) vitamins
7. Respiratory substrate yielding maximum number of ATP molecule is *[1994]*
   (a) ketogenic amino acids (b) glucose
   (c) amylose (d) glycogen

8. Life without air would be *[1993]*
   (a) reductional
   (b) free from oxidative damage
   (c) impossible
   (d) anaerobic
9. End products of aerobic respiration are *[1992]*
   (a) sugar and oxygen
   (b) water and energy
   (c) carbon dioxide, water and energy
   (d) carbon dioxide and energy

Topic 2: Glycolysis / Fermentation

10. Conversion of glucose to glucose-6-phosphate, the first irreversible reaction of glycolysis, is catalysed by: *[2019]*
    (a) Aldolase
    (b) Hexokinase
    (c) Enolase
    (d) Phosphofructokinase
11. Which of these statements is incorrect? *[2018]*
    (a) Enzymes of TCA cycle are present in mitochondrial matrix
    (b) Glycolysis occurs in cytosol
    (c) Oxidative phosphorylation takes place in outer mitochondrial membrane
    (d) Glycolysis operates as long as it is supplied with NAD that can pick up hydrogen atoms
12. Phosphoenol Pyruvate (PEP) is the primary CO_2 acceptor in: *[2017]*
    (a) C_4 plants
    (b) C_2 plants
    (c) C_3 and C_4 plants
    (d) C_3 plants
13. In which one of the following processes CO_2 in not released? *[2014]*
    (a) Aerobic respiration in plants
    (b) Aerobic respiration in animals
    (c) Alcoholic fermentation
    (d) Lactate fermentation
14. The energy - releasing metabolic process in which substrate is oxidised without an external electron acceptor is called: *[2010]*
    (a) glycolysis
    (b) fermentation
    (c) aerobic respiration
    (d) photorespiration
15. Aerobic respiratory pathway is appropriately termed: *[2009]*
    (a) parabolic (b) amphibolic
    (c) anabolic (d) catabolic
16. The energy-releasing process in which the substrate is oxidised without an external electron acceptor is called *[2008]*
    (a) fermentation
    (b) photorespiration
    (c) aerobic respiration
    (d) glycolysis
17. How many ATP molecules could maximally be generated from one molecule of glucose, if the complete oxidation of one mole of glucose to CO_2 and H_2O yields 686 kcal and the useful chemical energy available in the high energy phosphate bond of one mole of ATP is 12 kcal? *[2006]*
    (a) Thirty (b) Fifty -seven
    (c) One (d) Two
18. In glycolysis, during oxidation electrons are removed by *[2004]*
    (a) ATP
    (b) glyceraldehyde-3-phosphate
    (c) NAD+
    (d) molecular oxygen
19. In alcoholic fermentation *[2003]*
    (a) oxygen is the electron acceptor
    (b) triose phosphate is the electron donor while acetaldehyde is the electron acceptor
    (c) triose phosphate is the electron donor while pyruvic acid is the electron acceptor
    (d) there is no electron donor
20. How many ATP molecules are produced by aerobic oxidation of one molecule of glucose? *[2002]*
    (a) 2 (b) 4
    (c) 38 (d) 34
21. Maximum usable energy per mol of glucose metabolised will be generated during *[1999]*
    (a) aerobic respiration by germinating seeds
    (b) production of methanol by enteric bacteria
    (c) fermentation into ethanol by yeast
    (d) glycolysis in the skeletal muscle of a sprinter performing a hundred metre dash

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22. The enzymes hexokinase which catalyses glucose to glucose-6-phosphate in glycolysis is inhibited by glucose-6-phosphate. This is an example of *[1996]*
    (a) competitive inhibition
    (b) non-competitive inhibition
    (c) feedback allosteric inhibition
    (d) positive feedback.
23. Fermentation is anaerobic production of *[1996]*
    (a) protein and acetic acid
    (b) alcohol, lactic acid or similar compounds
    (c) ethers and acetones
    (d) alcohol and lipoproteins
24. Fermentation products of Yeast are *[1994, 97]*
    (a) $H_2O + CO_2$
    (b) methyl alcohol + CO_2
    (c) methyl alcohol + Water
    (d) ethyl alcohol + CO_2
25. In animal cells, the first stage of glucose breakdown is *[1994]*
    (a) Krebs cycle
    (b) glycolysis
    (c) oxidative phosphorylation
    (d) E.T.C.
26. Out of 38 ATP molecules produced per glucose, 32 ATP molecules are formed from NADH/ $FADH_2$ in *[1993]*
    (a) respiratory chain
    (b) Krebs cycle
    (c) oxidative decarboxylation
    (d) EMP
27. When one glucose molecule is completely oxidised, it changes *[1992]*
    (a) 36 ADP molecules into 36 ATP molecules
    (b) 38 ADP molecules into 38 ATP molecules
    (c) 30 ADP molecules into 30 ATP molecules
    (d) 32 ADP molecules into 32 ATP molecules
28. Out of 36 ATP molecules produced per glucose molecule during respiration *[1991]*
    (a) 2 are produced outside glycolysis and 34 during respiratory chain
    (b) 2 are produced outside mitochondria and 34 inside mitochondria
    (c) 2 during glycolysis and 34 during Krebs cycle
    (d) All are formed inside mitochondria
29. End product of glycolysis is *[1990]*
    (a) acetyl CoA
    (b) pyruvic Acid
    (c) glucose 1-phosphate
    (d) fructose 1-phosphate
30. EMP can produce a total of *[1990]*
    (a) 6 ATP (b) 8 ATP
    (c) 24 ATP (d) 38 ATP
31. Incomplete oxidation of glucose into pyruvic acid with several intermediate steps is known as *[1988]*
    (a) TCA-pathway (b) glycolysis
    (c) HMS-pathway (d) Krebs cycle
32. NADP+ is reduced to NADPH in *[1988]*
    (a) HMP (b) Calvin Cycle
    (c) glycolysis (d) EMP

Topic 3: Krebs cycle / ETs / Chemiosmosis

33. The number of substrate level phosphorylations in one turn of citric acid cycle is *[2020]*
    (a) One (b) Two
    (c) Three (d) Zero
34. Where is the respiratory electron transport system (ETS) located in plants ? *[2019]*
    (a) Intermembrane space
    (b) Mitochondrial matrix
    (c) Outer mitochondrial membrane
    (d) Inner mitochondrial membrane
35. What is the role of NAD^+ in cellular respiration? *[2018]*
    (a) It functions as an enzyme.
    (b) It functions as an electron carrier.
    (c) It is the final electron acceptor for anaerobic respiration.
    (d) It is a nucleotide source for ATP synthesis.
36. Which statement is wrong for Krebs' cycle ? *[2017]*
    (a) There is one point in the cycle where FAD^+ is reduced to $FADH_2$
    (b) During conversion of succinyl CoA to succinic acid, a molecule of GTP is synthesised
    (c) The cycle starts with condensation of acetyl group (acetyl CoA) with pyruvic acid to yield citric acid
    (d) There are three points in the cycle where NAD^+ is reduced to $NADH + H^+$

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37. The chemiosmotic coupling hypothesis of oxidative phosphorylation proposes that adenosine triphosphate (ATP) is formed because: *[2008]*
(a) high energy bonds are formed in mitochondrial proteins
(b) ADP is pumped out of the matrix into the intermembrane space
(c) a proton gradient forms across the inner membrane
(d) there is a change in the permeability of the inner mitochondrial membrane toward adenosine diphosphate (ADP)

38. All enzymes of TCA cycle are located in the mitochondrial matrix except one which is located in inner mitochondrial membranes in eukaryotes and in cytosol in prokaryotes. This enzyme is *[2007]*
(a) isocitrate dehydrogenase
(b) malate dehydrogenase
(c) succinate dehydrogenase
(d) lactate dehydrogenase.

39. The overall goal of glycolysis, krebs cycle and the electron transport system is the formation of *[2007]*
(a) ATP in one large oxidation reaction
(b) sugars
(c) nucleic acids
(d) ATP in small stepwise units.

40. Chemiosmotic theory of ATP synthesis in the chloroplasts and mitochondria is based on: *[2005]*
(a) membrane potential
(b) accumulation of Na ions
(c) accumulation of K ions
(d) proton gradient

41. During which stage in the complete oxidation of glucose are the greatest number of ATP molecules formed from ADP *[2005]*
(a) glycolysis
(b) krebs cycle
(c) conversion of pyruvic acid to acetyl Co-A
(d) electron transport chain

42. During anaerobic digestion of organic waste, such as in producing biogas, which one of the following is left undegraded ? *[2003]*
(a) Cellulose (b) Lipids
(c) Lignin (d) Hemi-cellulose

43. Which one of the following concerns photophosphorylation ? *[2003]*
(a) $AMP + \text{Inorganic } PO_4 \xrightarrow{\text{Light energy}} ATP$
(b) $ADP + AMP \xrightarrow{\text{Light energy}} ATP$
(c) $ADP + \text{Inorganic } PO_4 \xrightarrow{\text{Light energy}} ATP$
(d) $ADP + \text{Inorganic } PO_4 \longrightarrow ATP$

44. In which one of the following do the two names refer to one and the same thing ? *[2003]*
(a) Tricarboxylic acid cycle and urea cycle
(b) Krebs cycle and Calvin cycle
(c) Tricarboxylic acid cycle and citric acid cycle
(d) Citric acid cycle and Calvin cycle

45. The mechanism of ATP formation both in chloroplast and mitochondria is explained by *[1997]*
(a) relay pump theory of Godlewski
(b) Munch's pressure/ mass flow model
(c) chemiosmotic theory of Mitchell
(d) Cholondy-Went's Model

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46. In Krebs cycle FAD participates as electron acceptor during the conversion of *[1997]*
(a) succinyl CoA to Succinic acid
(b) alfa keto glutarate to Succinyl CoA
(c) succinic acid to Fumaric acid
(d) fumaric acid to Malic acid

47. Connecting link between glycolysis and Krebs cycle is/before entering Krebs cycle pyruvate is changed to *[1990, 92, 97]*
(a) oxaloacetate (b) PEP
(c) pyruvate (d) acetyl CoA

48. Oxidative phosphorylation involves simultaneous oxidation and phosphorylation to finally form *[1996]*
(a) pyruvate (b) NADP
(c) DPN (d) ATP

49. Krebs cycle occurs in *[1996]*
(a) mitochondria (b) cytoplasm
(c) chloroplasts (d) ribosomes

50. Which of the following is essential for conversion of pyruvic acid into acetyl Co-A? *[1995]*
(a) LAA (b) NAD
(c) TPP (d) All of these

51. Poisons like cyanide inhibit Na^+ efflux and k^+ influx during cellular transport. This inhibitary effect is reversed by an injection of ATP. This demonstrates that *[1994]*
    (a) ATP is the carrier protion in the transport system.
    (b) energy for $Na^+ - k^+$ exchange pump comes from ATP.
    (c) ATP is hydrolysed by ATP to release energy.
    (d) $Na^+ - K^+$ exchange pump eperates in the cell.
52. End product of citric acid/Krebs cycle is *[1993]*
    (a) citric acid (b) lactic acid
    (c) pyruvic acid (d) $CO_2 + H_2O$
53. Oxidative phosphorylation is production of
    (a) ATP in photosynthesis *[1992]*
    (b) NADPH in photosynthesis
    (c) ATP in respiration
    (d) NADH in respiration
54. Terminal cytochrome of respiratory chain which donates electrons to oxygen is *[1992]*
    (a) Cyt. b (b) Cyt. c
    (c) Cyt. a_1 (d) Cyt. a_3

Topic 4: Respiratory Quotient

55. Respiratory Quotient (RQ) value of tripalmitin is: *[2019]*
    (a) 0.9 (b) 0.7
    (c) 0.07 (d) 0.09
56. In germinating seeds fatty acids are degraded exclusively in the *[2008]*
    (a) proplastids (b) glyoxysomes
    (c) peroxisomes (d) mitochondria
57. Respiratory quotient (R.Q.) for fatty acid is
    (a) > 1 (b) < 1 *[1995]*
    (c) 1 (d) 0
58. Apparatus to measure rate of respiration and R.Q. is *[1992]*
    (a) Auxanometer (b) Potometer
    (c) Respirometer (d) Manometer
59. R.Q. is ratio of *[1990]*
    (a) CO_2 produced to substrate consumed
    (b) CO_2 produced to O_2 consumed
    (c) oxygen consumed to water produced
    (d) oxygen consumed to CO_2 produced
60. R.Q. is *[1988]*
    (a) C/N (b) N/C
    (c) CO_2/O_2 (d) O_2/CO_2

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ANSWER KEY

1	(c)	7	(b)	13	(d)	19	(b)	25	(b)	31	(b)	37	(c)	43	(c)	49	(a)	55	(b)
2	(a)	8	(d)	14	(b)	20	(c)	26	(a)	32	(a)	38	(c)	44	(c)	50	(d)	56	(b)
3	(a)	9	(c)	15	(b)	21	(a)	27	(b)	33	(a)	39	(d)	45	(c)	51	(a)	57	(b)
4	(a)	10	(b)	16	(d)	22	(c)	28	(b)	34	(d)	40	(d)	46	(c)	52	(d)	58	(c)
5	(c)	11	(c)	17	(b)	23	(b)	29	(b)	35	(b)	41	(d)	47	(d)	53	(c)	59	(b)
6	(a)	12	(a)	18	(c)	24	(d)	30	(b)	36	(c)	42	(c)	48	(d)	54	(d)	60	(c)

Hints & Solutions

1. (c) Acetyl CoA is common to respiration mediated breakdown of fats, carbohydrates and proteins. Fats are broken down to fatty acid and glycerol and finally are degraded to acetyl Co - A. Protein first degraded by proteases to individual amino acids which are deaminated to pyruric acid and further decarboxylised to acetyl Co- A.

2. (a) In the given diagram of aerobic respiration – pathway A is glycolysis, pathway B is Kreb's cycle and pathway C is ETS , thus 4, 8 & 12 are ATP. ATP act as energy currency. The energy is trapped in form of ATP and it is broken down whenever and wherever it needs to be utilised.

3. (a) *Clostridium botulinum* is an obligate anaerobe *i.e.* it normally lives in the absence of

oxygen. Facultative anaerobes are those who generally live in oxygen but may live without oxygen in suitable medium. Obligate aerobes can only live in the presence of oxygen while facultative aerobes generally live in oxygen but can also live without oxygen.

NOTES

Botulism is a rare and potentially fatal illness caused by a toxin produced by the bacterium *Clostridium botulinum*. The disease begins with weakness, blurred vision, feeling tired, and trouble speaking.

4. (a) 38 molecules of ATP are produced during aerobic respiration. Of these 2 ATP are used in link reaction. Hence net gain is of 36 ATP.
5. (c) Mesosomes are the invaginations of the plasma membrane that can form into vesicles. They are found to be present in both gram-positive and gram-negative bacteria.

NOTES

Mesosomes may play a role in cell wall formation during cell division and/or chromosome replication and distribution and/or electron transfer systems of respiration.

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6. (a) Fats are used as respiratory substrates by a number of organisms because they contain more energy as compared to carbohydrates.
7. (b) Firstly, amylose and glycogen are converted to glucose. Deamination of ketogenic amino acids occur and these enter respiratory catabolism as intermediates.
8. (d) In anaerobic respiration, oxygen is not used in the breakdown of respiratory substrate.
9. (c) Aerobic respiration is an enzymatically controlled release of energy in a stepwise catabolic process of complete oxidation of organic substrate into CO_2 and H_2O with O_2 acting as the terminal oxidant.
10. (b) Glycolysis is the anaerobic enzymatic conversion of glucose to lactate or pyruvate, resulting in energy stored in the form of ATP, as occurs in muscle.
The two irreversible steps in Glycolysis are:
(i) Conversion of glucose to glucose 6-phosphate, catalysed by hexokinase. It is the first step of activation phase of glycolysis.
(ii) Conversion of fructose 6-phosphate to fructose 1,6 biphosphate catalysed by phosphofructokinase-1.
11. (c) Oxidative phosphorylation takes place in inner mitochondrial membrane.
12. (a) In the mesophyll cells cytoplasm of C_4 plants like sugarcane, maize, sorghum etc. PEP is 3C compound which serves as primary CO_2 acceptor.
13. (d) Lactic acid fermentation occurs in lactic acid bacteria (*Lactobacillus*) and muscles (Human). Pyruvic acid produced in glycolysis is reduced by $NADH_2$ to form lactic acid without producing carbon dioxide.

$$CH_3COCOOH + NADH_2 \xrightarrow[FMN, Zn^{2+}]{\text{Lactate dehydrogenase}} \underset{\text{Lactic acid}}{CH_3CHOHCOOH} + NAD$$

14. (b) The energy releasing metabolic process in which substrate is oxidised without an external electron acceptor is called fermentation.
15. (b) All energy-releasing pathways whether aerobic (requiring oxygen) or anaerobic (not requiring oxygen) begin with a pathway called glycolysis, which occurs in the cytoplasm (cytosol). Aerobic respiratory pathway is thus appropriately termed as amphibolic.

NOTES

Aerobic respiration is the main energy-releasing pathway leading to ATP formation. It occurs in the mitochondria and yields thirty-six ATP.

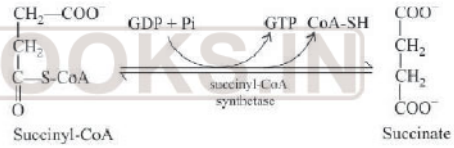
16. (d) Glycolysis takes place in all body cells and is of two types-
(a) Anaerobic glycolysis-From glycogen or glucose to lactic acid in muscles.
(b) Aerobic glycolysis- From glycogen or glucose to pyruvic acid (all cells of body)
17. (b) 12 kcal of energy present in one molecule of ATP & on oxidation of one mole of glucose into CO_2 and H_2O energy released is 686 kcal. So no. of ATP which can store this energy would be = 57.1 = 57 ATPs.
18. (c) In glycolysis, during oxidation electrons are removed by NAD^+. When 3-phosphogtyceraldehyde is converted into 1,3 diphosphoglyceric acid, two electrons and two protons are released which are utilised to convert

NAD^+ to NADH and one H^+ $NAD^+ + 2H^+ + 2e \rightarrow NADH + H^+$. ATP is the energy currency in all cells. Glyceraldehyde 3 - phosphate is reduced during glycolysis. Molecular oxygen is the terminal electron acceptor in ETS.

19. (b) In alcohol fermentation triose phosphate is the electron donor while acetaldehyde is the electron acceptor.

> **NOTES** In alcoholic fermentation, the pyruvic acid from glycolysis loses one carbon in the form of carbon dioxide to form acetaldehyde, which is reduced to ethyl alcohol by NADH. When acetaldehyde is reduced to ethyl alcohol, NADH becomes NAD+ (is oxidized). This is the fermentation that commonly occurs in yeast.

20. (c) 38 ATP molecules are produced by aerobic oxidation of glucose.
21. (a) The energy yield during aerobic respiration (36 ATP) is 18 times of that during anaerobic respiration (2 ATP).
22. (c) Competitive inhibition is the reversible inhibition of enzyme activity due to presence of substrate analogues. Non competitive inhibition is the reduction of enzyme activity by a factor that has no real structural similarity with the substrate. Allosteric inhibition is reversible noncompetitive inhibition occurring in case of allosteric enzymes. Herein, the inhibitors are the products or intermediates of reactions are catalyzed by the enzymes. Hence, it is also called end product inhibition or feedback inhibition.
23. (b) Fermentation is referred to as the decomposition of organic compounds, anaerobically by enzymes yielding alcohol, organic acids; gases etc.
24. (d) End products of fermentation are ethyl alcohol, lactic acid and CO_2.
25. (b) Glycolysis is the first step of respiration which occurs without requirement of O_2 and is common to both aerobic and anaerobic modes of respiration.
26. (a) Complete degradation of a molecule of glucose yields 38 ATP molecules.
27. (b) Complete oxidation of glucose produces 38 ATP molecules in aerobic respiration. The number of ATP molecules may however may depending upon how $NADH_2$ enters mitochondria.
28. (b) 2 ATP are produced during glycolysis in cytoplasm. 34 ATP are produced by Krebs cycle, oxidative phosphorylation, etc.
29. (b) The end product of glycolysis is pyruvic acid which is a three carbon compound.
30. (b) The net gain of energy is equal to 8 ATP in EMP pathway.
31. (b) Glycolysis involves the process of partial oxidation of glucose or similar hexose sugar into two molecules of pyruvic acid through a series of ten enzyme mediated reactions. It occurs in cytoplasm.
32. (a) Complete degradation of a molecule of glucose produces 12 molecules of $NADPH_2$ by HMP.
33. (a) One substrate level phosphorylation in one turn of citric acid cycle as per following reaction:



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Another example of substrate level phosphorylation are as follows:

1,3-*bis*phosphoglycerate + ADP → 3-phosphoglycerate + ATP

Phosphoenolpyruvate + ADP → pyruvate + ATP

Acetyl phosphate + ADP → acetate + ATP

(same mechanism for other alkanoic acids)

> **NOTES** Substrate-level phosphorylation is the production of ATP from ADP by a direct transfer of a high-energy phosphate group from a phosphorylated intermediate metabolic compound in an exergonic catabolic pathway. Oxidative phosphorylation is the process in which ATP is formed as a result of the transfer of electrons from NADH or $FADH_2$ to O_2 by a series of electron carriers. This process, which takes place in mitochondria, is the major source of ATP in aerobic organisms.

34. (d) Electron transport system is located in inner mitochondrial membrane, where it serves as the site of oxidative phosphorylation through the action of ATP synthase.

NOTES

Electron transport chains are redox reactions that transfer electrons from an electron donor to an electron acceptor. The transfer of electrons is coupled to the translocation of protons across a membrane, producing a proton gradient.
It is also found in the thylakoid membrane of the chloroplast in photosynthetic eukaryotes.

35. (b) In cellular respiration, NAD^+ act as an electron carrier.
36. (c) Krebs cycle begins with condensation of acetyl CoA (2C) with oxaloacetic acid (4C) to form citric acid (6C).

NOTES

The citric acid cycle is regulated primarily by the concentration of ATP and NADH. The key control points are the enzymes isocitrate dehydrogenase and α-ketoglutarate dehydrogenase. α-Ketoglutarate dehydrogenase is inhibited by succinyl CoA and NADH, the products of the reaction that it catalyzes.

37. (c) Chemiosmotic theory was postulated by the British biochemist Peter Mitchell (1920-22) to explain the formation of ATP in the mitochondrial electron transport chain. As electrons are transferred along the electron carrier system in the inner mitochondrial membrane, hydrogen ions (protons) are actively transported into the space between the inner and outer mitochondrial membranes, which thus contains a higher concentration of protons than the matrix. This creates an electrochemical gradient across the inner membrane, through which protons move back into the matrix.
38. (c) Succinate dehydrogenase (SDH) or succinate-coenzyme Q reductase (SQR) or respiratory Complex II is an enzyme complex, found in many bacterial cells and in the inner mitochondrial membrane of eukaryotes.

NOTES

It is the only enzyme that participates in both the citric acid cycle and the electron transport chain. Succinate dehydrogenase catalyses the oxidation of succinate to fumarate in the citric acid cycle by simultaneously reducing ubiquinone to ubiquinol in the electron transport chain.

39. (d) Glycolysis, Krebs cycle and electron transport system, they all give ATP which is the main energy currency of our body. Glycolysis takes place in cytoplasm, Krebs cycle also occurs in cytoplasm while ETS takes place in the mitochondria.
40. (d) Proton gradient is the product of the electron transport chain. Increased proton concentration is produced in the outer chamber of outer surface of inner mitochondrial membrane by the pushing of protons with the help of energy liberated by passage of electrons from one carrier to another. Photosynthesis is carried out by a specialised organelle called chloroplast. Chloroplasts carry out their energy interconversions by means of proton gradients in much the same way that mitochondria do.
41. (d) ATP molecules from ADP are generated in maximum number in electron transport chain.
42. (c) Lignin is a complex polymer of phenylpropane units, which are cross-linked to each other with a variety of different chemical bonds.

NOTES

Lignin and its related metabolism play important roles in the growth and development of plants. As a complex phenolic polymer, lignin enhances plant cell wall rigidity, hydrophobic properties and promotes minerals transport through the vascular bundles in plant.

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43. (c) Photophosphorylation refers to addition of phosphate in the presence of light.
44. (c) TCA cycle is so called because the first stable product formed in the cycle is a tricarboxylic acid molecule, that is, citric acid. Hence, the name citric acid cycle. It is also called the Krebs cycle as it was discovered by Krebs.
45. (c) According to the chemiosmotic theory the energy liberated during electron transport performs the osmotic work of accumulating H^+ ions, conserving energy in building a proton gradient, which is used to build ATP from ADP and inorganic phosphate.
46. (c) In the conversion of succinyl Co A to succinic acid, energy liberated during hydrolysis of succinyl CoA is used in synthesis of GTP. For the conversion of alfa-ketoglutarate to succinyl CoA, NAD^+ and CoA are required. Conversion of fumaric acid to malic acid involves simple hydration. FAD participates in conversion of succinic acid to fumaric acid.

47. (d) The end product of glycolysis is pyruvate. It enters mitochondria and is oxidatively decarboxylated to acetyl CoA before entering into Krebs cycle.
48. (d) Oxidative phosphorylation is the synthesis of energy rich ATP from ADP and inorganic phosphate, that is related to oxidation of reduced coenzymes produced in cellular respiration.
49. (a) Krebs cycle is the sequence of reactions by which most living cells generate energy during the process of aerobic respiration. It takes place in the mitochondria, using up oxygen and producing carbon dioxide and water as waste products, and ADP is converted to energy-rich ATP.
50. (d) During aerobic oxidation of pyruvic acid, first of all there is activation of pyruvic acid in which NAD and coenzyme react with pyruvic acid and oxidative decarboxylation takes place leading to the formation of acetyl Co-A. In this process, lipoic acid amide (LAA), thiamine pyrophosphate (TPP) and NAD are essential to perform this reaction.
51. (a) Active transport is the uphill movement of particles against their concentration gradient. Energy is utilised in the form of energy. Cyanide inhibits soluble absorption by lowering respiration rate leading to formation of less ATP.

NOTES

Addition of ATP facilities active transport. Immediate ATP supply minimise the effect of cyanide in normal aerobic respiration.

52. (d) Krebs cycle (called after Hans Krebs) is also called as the citric acid cycle, and the tricarboxylic acid cycle (TCA cycle). It is the series of chemical reactions that produces two carbon dioxide molecules, one GTP/ATP, and reduced forms of NADH and FADH2. It is used by all aerobic organisms to generate energy.
53. (c) Oxidative phosphorylation is the synthesis of energy rich ATP molecules with the help of energy liberated during oxidation of reduced co-enzymes produced in respiration. This process, which takes place in mitochondria, is the major source of ATP in aerobic organisms.
54. (d) Terminal cytochorome is cyt a_3. It posseses two copper centres. It helps in transfer of electrons to oxygen.

NOTES

2 CuA molecules functions in allowing the electrons to enter the enzyme from cytochrome c. $Heme_a$ functions in allowing the electrons to be transferred from CuA to the second heme, hemea3. The iron in $heme_{a3}$ functions in binding oxygen, with the help of CuB.

55. (b) Respiratory quotient may be defined as a ratio indicating the relation of the volume of carbon dioxide given off in respiration to that of the oxygen consumed.

Respiratory Quotient (RQ)

$$= \frac{\text{Amount of } CO_2 \text{ released}}{\text{Amount of } CO_2 \text{ consumed}}$$

$$2(C_{51}H_{98}O_6) + 145O_2 \rightarrow 102CO_2 + 98H_2O + \text{Energy}$$

Tripalmitin

$$RQ = \frac{102CO_2}{145O_2} = 0.7$$

56. (b) In germinating seeds, fatty acids are degraded exclusively in the glyoxysomes. Glyoxylate cycle occurs in tissues rich in fats, such as those of germinating seeds; the enzymes involved in the cycle, which have not been found in mammals, are contained in organelles called glyoxysomes.
57. (b) Respiratory quotient (R.Q.) is defined as the ratio of the molecules of carbon dioxide given out to the number of oxygen molecules taken in during respiration. Its value for fatty acids is always less than unity.
58. (c) Respirometer is an instrument for measuring respiratory quotient as well as rate of respiration.

NOTES

A respirometer allows measurement of changes in gas volumes as organisms respire in a sealed chamber. As they respire, organisms consume O_2 and produce CO_2, which is absorbed by potassium hydroxide (KOH) solution.

59. (b) Ratio of the volume of CO_2 produced to the volume of O_2 consumed in respiration over a period of time is known as respiratory quotient.
60. (c) Respiratory Quotient

$$RQ = \frac{\text{Volume of } CO_2 \text{ evolved}}{\text{Volume of } O_2 \text{ absorbed}}$$

The current estimate is that about 30 molecules of ATP are produced when glucose is completely oxidised to CO_2.

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15 Plant Growth and Development

Trend Analysis with Important Topics & Sub-Topics

		2020		2019		2018		2017		2016	
Topic	**Sub-Topics**	**Qns.**	**LOD**	**Qns.**	**LOD**	**Qns.**	**LOD**	**Qns.**	**LOD**	**Qns.**	**LOD**
Growth/ Differentiation, Dedifferentiation & Redifferentiation/ Development	Hormones	1	A					1	A	1	A
Plant Growth regulators	Seed Dormancy	1	D								
Photoperiodism/ Vernalisation	Flowering Inducers			1	A						

LOD - Level of Difficulty | E - Easy | A - Average | D - Difficult | Qns - No. of Questions

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Topic 1: Growth/Differentiation, Dedifferentiation & Redifferentiation/ Development

1. Typical growth curve in plants is : ***[2015 RS]***
   (a) Linear
   (b) Stair-steps shaped
   (c) Parabolic
   (d) Sigmoid
2. Coiling of garden pea tendrils around any support is an example of: ***[2010]***
   (a) thigmotaxis (b) thigmonasty
   (c) thigmotropism (d) thermotaxis
3. Senescence as an active developmental cellular process in the growth and functioning of a flowering plant, is indicated in ***[2008]***
   (a) vessels and tracheid differentiation
   (b) leaf abscission
   (c) annual plants
   (d) floral parts
4. Opening of floral buds into flowers, is a type of ***[2007]***
   (a) autonomic movement of variation
   (b) paratonic movement of growth
   (c) autonomic movement of growth
   (d) autonomic movement of locomotion.
5. Anthesis is a phenomenon which refers to
   (a) reception of pollen by stigma
   (b) formation of pollen
   (c) development of anther
   (d) opening of flower bud
6. Movement of leaves of Sensitive Plant, *Mimosa pudica* are due to ***[1988, 99]***
   (a) thermonasty (b) seismonasty
   (c) hydrotropism (d) chemonasty
7. If a tree, flowers thrice in a year (Oct., Jan. and July) in Northern India, it is said to be ***[1997]***
   (a) photosensitive but thermoinsensitive
   (b) thermosensitive but photoinsensitive
   (c) photo and thermosensitive
   (d) photo and thermoinsensitive

8. Thigmotropic movement is best shown by
   (a) movement in tendril *[1995]*
   (b) insectivorous plants
   (c) movement in roots
   (d) movement in *Mimosa pudica*
9. Klinostat is employed in the study of *[1993]*
   (a) osmosis
   (b) growth movements
   (c) photosynthesis
   (d) respiration
10. Phytohormones are : *[1990]*
   (a) chemicals regulating flowering
   (b) chemicals regulating secondary growth
   (c) hormones regulating growth from seed to adulthood
   (d) regulators synthesised by plants and influencing physiological processes
11. Leaves of many grasses are capable of folding and unfolding because they *[1989]*
   (a) are very thin
   (b) are isobilateral
   (c) have specialised bulliform cells
   (d) have parallel vascular bundles

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Topic 2: Plant Growth Regulators

12. Which of the following is not an inhibitory substance governing seed dormancy? *[2020]*
   (a) Abscisic acid (b) Phenolic acid
   (c) Para-ascorbic acid (d) Gibberellic acid
13. Name the plant growth regulator which upon spraying on sugarcane crop, increases the length of stem, thus increasing the yield of sugarcane crop. *[2020]*
   (a) Gibberellin (b) Ethylene
   (c) Abscisic acid (d) Cytokinin
14. Removal of shoot tips is a very useful technique to boost the production of tealeaves. This is because : *[2019]*
   (a) Gibberellins delay senescence of leaves.
   (b) Gibberellins prevent bolting and are inactivated.
   (c) Auxins prevent leaf drop at early stages.
   (d) Effect of auxins is removed and growth of lateral buds is enhanced.
15. In order to increase the yield of sugarcane crop, which of the following plant growth regulators should be sprayed? *[2019]*
   (a) Cytokinins (b) Ethylene
   (c) Auxins (d) Gibberellins
16. It takes very long time for pineapple plants to produce flowers. Which combination of hormones can be applied to artificially induce flowering in pineapple plants throughout the year to increase yield? *[2019]*
   (a) Auxin and Ethylene
   (b) Gibberellin and Cytokinin
   (c) Gibberellin and Abscisic acid
   (d) Cytokinin and Abscisic acid
17. Fruit and leaf drop at early stages can be prevented by the application of: *[2017]*
   (a) Ethylene (b) Auxins
   (c) Gibberellic acid (d) Cytokinins
18. The *Avena* curvature is used for bioassay of
   (a) ABA (b) GA3 *[2016]*
   (c) IAA (d) Ethylene
19. What causes a green plant exposed to the light on only one side, to bend toward the source of light as it grows ? *[2015 RS]*
   (a) Green plants seek light because they are phototropic
   (b) Light stimulates plant cells on the lighted side to grow faster
   (c) Auxin accumulates on the shaded side, stimulating greater cell elongation there.
   (d) Green plants need light to perform photosynthesis
20. Auxin can be bioassayed by : *[2015 RS]*
   (a) Hydroponics
   (b) Potometer
   (c) Lettuce hypocotyl elongation
   (d) Avena coleoptile curvature
21. Dr. F. Went noted that if coleoptile tips were removed and placed on agar for one hour, the agar would produce a bending when placed on one side of freshly-cut coleoptile stumps. Of what significance is this experiment? *[2014]*
   (a) It made possible the isolation and exact identification of auxin.
   (b) It is the basis for quantitative determination of small amounts of growth-promoting substances.
   (c) It supports the hypothesis that IAA is auxin.
   (d) It demonstrated polar movement of auxins.
22. A few normal seedlings of tomato were kept in a dark room. After a few days they were found to have become white-coloured like albinos. Which of the following terms will you use to describe them? *[2014]*
   (a) Mutated (b) Embolised
   (c) Etiolated (d) Defoliated

23. Which one of the following growth regulators is known as 'stress hormone'? *[2014]*
(a) Abscissic acid (b) Ethylene
(c) GA_3 (d) Indole acetic acid

24. During seed germination its stored food is mobilized [*NEET 2013]*
(a) Cytokinin (b) ABA
(c) Gibberellin (d) Ethylene

25. The pineapple which under natural conditions is difficult to blossom has been made to produce fruits throughout the year by application of *[NEET Kar. 2013]*
(a) IAA, IBA (b) NAA, 2, 4-D
(c) Phenyl acetic acid (d) Cytokinin

26. Which one of the following generally acts as an antagonist to gibberellins? *[2012M]*
(a) Zeatin (b) Ethylene
(c) ABA (d) IAA

27. Phototropic curvature is the result of uneven distribution of: *[2010]*
(a) gibberellin (b) phytochrome
(c) cytokinins (d) auxin

28. One of the synthetic auxin is: *[2009]*
(a) IAA (b) GA
(c) IBA (d) NAA

29. Which one of the following acids is a derivative of carotenoids ? *[2009]*
(a) Indole-3 -acetic acid
(b) Gibberellic acid
(c) Abscisic acid
(d) Indole butyric acid

30. Which one of the following pairs, is not correctly matched? *[2007]*
(a) Gibberellic acid - Leaf fall
(b) Cytokinin - Cell wall elongation
(c) IAA - Cell wall elongation
(d) Abscissic acid - Stomatal closure.

31. "Foolish seedling" disease of rice led to the discovery of *[2007]*
(a) ABA (b) 2, 4-D
(c) IAA (d) GA

32. An enzyme that can stimulate germination of barley seeds is *[2006]*
(a) lipase (b) protease
(c) invertase (d) a-amylase

33. How does pruning help in making the hedge dense? *[2006]*
(a) It frees axillary buds from apical dominance
(b) The apical shoot grows faster after pruning
(c) It releases wound hormones
(d) It induces the differentiation of new shoots from the rootstock

34. Cell elongation in internodal regions of the green plants takes place due to *[2004]*
(a) indole acetic acid (b) cytokinins
(c) gibberellins (d) ethylene

35. Differentiation of shoot is controlled by *[2003]*
(a) high gibberellin : cytokinin ratio
(b) high auxin : cytokinin ratio
(c) high cytokinin : auxin ratio
(d) high gibberellin : auxin ratio

36. Plants deficient of element zinc, show its effect on the biosynthesis of plant growth hormone
(a) abscisic acid (b) auxin *[2003]*
(c) cytokinin (d) ethylene

37. What reason will you assign for coconut milk used in tissue culture? *[2000, 03]*
(a) Gibberellins (b) Cytokinins
(c) Auxins (d) Ethylene

38. Seed dormancy is due to the *[2002]*
(a) ethylene (b) abscisic acid
(c) IAA (d) starch

39. Dwarfness can be controlled by treating the plant with *[1992, 2002]*
(a) cytokinin (b) gibberellic acid
(c) auxin (d) antigibberellin

40. What breaks bud dormancy of potato tuber?
(a) Gibberellin (b) IAA *[2001]*
(c) ABA (d) Zeatin

41. Hormone responsible for senescence *[2001]*
(a) ABA (b) auxin
(c) GA (d) cytokinin

42. Which of the following prevents fall of fruits?
(a) GA_3 (b) NAA *[2001]*
(c) Ethylene (d) Zeatin

43. Removal of apical bud results in *[1993, 2000]*
(a) formation of new apical bud
(b) elongation of main stem
(c) death of plant
(d) formation of lateral branching

44. Which is employed for artificial ripening of banana fruits? *[1992, 2000]*
(a) Auxin (b) Coumarin
(c) Ethylene (d) Cytokinin

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45. ABA is involved in *[1999]*
(a) dormancy of seeds
(b) root elongation
(c) shoot elongation
(d) increased cell division

46. Which combination of gases is suitable for fruit ripening? *[1998]*
(a) 80% CO_2 and 20% CH_2
(b) 80% CH_4 and 20% CO_2
(c) 80% CO_2 and 20% O_2
(d) 80% C_2H_4 and 20% CO_2

47. A plant hormone used for inducing morphogenesis in plant tissue culture is *[1998]*
(a) gibberellins (b) cytokinins
(c) ethylene (d) abscisic acid.

48. Gibberellins promote *[1988, 97]*
(a) seed germination (b) seed dormancy
(c) leaf fall (d) root elongation

49. A chemical believed to be involved in flowering is *[1991, 95]*
(a) gibberellin (b) kinetin
(c) florigen (d) IBA

50. Ethylene gas is used for *[1995]*
(a) growth of plants
(b) delaying fruit's abscission
(c) ripening of fruits
(d) stopping the leaf abscission

51. Movement of auxin is *[1994]*
(a) centripetal (b) basipetal
(c) acropetal (d) both B and C

52. Auxetic growth is *[1994]*
(a) increase in cell volume only
(b) increase in cell number only
(c) increase in fatty tissue
(d) increase in intercellular material

53. What is a stress hormone? or The hormone produced during adverse environmental conditions is *[1993]*
(a) benzyl aminopurine
(b) dichlorophenoxy acetic acid
(c) ethylene
(d) abscisic acid

54. The regulator which retards ageing/senescence of plant parts is : *[1993]*
(a) cytokinin (b) auxin
(c) gibberellin (d) abscisic acid

55. Cytokinins *[1992]*
(a) promote abscission
(b) influence water movement
(c) help retain chlorophyll
(d) inhibit protoplasmic streaming

56. Apical dominance is caused by *[1992]*
(a) abscisic acid in lateral bud
(b) cytokinin in leaf tip
(c) gibberellin in lateral buds
(d) auxin in shoot tip

57. Bananas can be prevented from over-ripening by *[1992]*
(a) maintaining them at room temperature
(b) refrigeration
(c) dipping in ascorbic acid solution
(d) storing in a freezer

58. The hormone responsible for apical dominance is *[1991]*
(a) IAA (b) GA
(c) ABA (d) florigen

59. Abscisic acid causes *[1991]*
(a) stomatal closure (b) stem elongation
(c) leaf expansion (d) root elongation

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60. Hormone primarily connected with cell division is *[1988, 1991]*
(a) IAA (b) NAA
(c) cytokinin/Zeatin (d) gibberellic acid

61. Which of the following movement is not related to auxin level? *[1990]*
(a) Bending of shoot towards light
(b) Movement of root towards soil
(c) Nyctinastic leaf movements
(d) Movement of sunflower head tracking the sun

62. Phototropic and geotropic movements are linked to : *[1990]*
(a) gibberellins (b) enzymes
(c) auxin (d) cytokinins

63. Abscisic acid controls *[1990]*
(a) cell division
(b) leaf fall and dormancy
(c) shoot elongation
(d) cell elongation and wall formation

64. Highest auxin concentration occurs *[1990]*
(a) in growing tips
(b) in leaves
(c) at base of plant organs
(d) in xylem and phloem

65. Mowing grass lawn facilitates better maintenance because *[1989]*
(a) wounding stimulates regeneration
(b) removal of apical dominance and stimulation of intercalary meristem
(c) removal of apical dominance
(d) removal of apical dominance and promotion of lateral meristem

66. Leaf fall can be prevented with the help of
(a) abscisic acid (b) auxins *[1989]*
(c) florigen (d) cytokinins

67. Cut or excised leaves remain green for long if induced to root or dipped in *[1988]*
(a) gibberellins (b) cytokinins
(c) auxins (d) ethylene

Topic 3: Photoperiodism/Vernalisation

68. What is the site of perception of photoperiod necessary for induction of flowering in plants ?
(a) Lateral buds (b) Pulvinus *[2019]*
(c) Shoot apex (d) Leaves

69. Through their effect on plant growth regulators, what do the temperature and light control in the plants? *[2012M]*
(a) Apical dominance (b) Flowering
(c) Closure of stomata (d) Fruit elongation

70. Vernalization stimulates flowering in *[2012M]*
(a) zamikand (b) turmeric
(c) carrot (d) ginger

71. Photoperiodism was first characterised in:
(a) tobacco (b) potato *[2010]*
(c) tomato (d) cotton

72. Importance of day length in flowering of plants was first shown in *[2008]*
(a) lemna (b) tobacco
(c) cotton (d) petunia

73. Treatment of seed at low temperature under moist conditions to break its dormancy is called *[2006]*
(a) vernalization (b) chelation
(c) stratification (d) scarification

74. One set of a plant was grown at 12 hours day and 12 hours night period cycles and it flowered while in the other set night phase was interrupted by flash of light and it did not produce flower. Under which one of the following categories will you place this plant? *[2004]*
(a) Long day (b) Darkness neutral
(c) Day neutral (d) Short day

75. The pigment, that absorbs red and far red light in plants, is *[1995, 97, 2002]*
(a) xanthophyll (b) cytochrome
(c) phytochrome (d) carotene

76. Which one is a long-day plant? *[2001]*
(a) Tobacco (b) *Glycine max*
(c) *Mirabilis jalapa* (d) Spinach

77. Proteinaceous pigment which control activities concerned with light *[2001]*
(a) phytochrome (b) chlorophyll
(c) anthocyanin (d) carotenoids

78. The method that renders the seed coat permeable to water so that embryo expansion is not physically retarded is *[2000]*
(a) vernalization (b) stratification
(c) denudation (d) scarification

79. The response of different organisms to environmental rhythms of light and darkness is called *[1998]*
(a) phototaxis (b) photoperiodism
(c) phototropism (d) vernalization.

80. What will be the effect on phytochrome in a plant subjected to continuous red light? *[1997]*
(a) Level of phytochrome decreases
(b) Phytochrome is destroyed
(c) Phytochrome synthesis increases
(d) Destruction and synthesis of phytochrome remain in equilibrium.

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81. In short day plants, flowering is induced by
(a) photoperiod less than 12 hours *[1992]*
(b) photoperiod below a critical length and uninterrupted long night
(c) long night
(d) short photoperiod and interrupted long night

82. Flowering dependent on cold treatment is *[1992]*
(a) cryotherapy (b) cryogenics
(c) cryoscopy (d) vernalisation

83. Tendrils exhibit/twining of tendrils is due to *[1991]*
(a) thigmotropism (b) seismonasty
(c) heliotropism (d) diageotropism

84. Which one increases in the absence of light?
(a) Uptake of minerals *[1991]*
(b) Uptake of water
(c) Elongation of internodes
(d) Ascent of sap

85. Which of the following hormones can replace vernalisation? *[1989]*
(a) Auxin (b) Cytokinin
(c) Gibberellins (d) Ethylene

86. Phytochrome is involved in *[1988]*
(a) phototropism (b) photorespiration
(c) photoperiodism (d) geotropism

ANSWER KEY

1	(d)	10	(d)	19	(c)	28	(d)	37	(b)	46	(d)	55	(c)	64	(a)	73	(c)	82	(d)
2	(c)	11	(c)	20	(d)	29	(c)	38	(b)	47	(b)	56	(d)	65	(b)	74	(d)	83	(a)
3	(b)	12	(d)	21	(b)	30	(a)	39	(b)	48	(a)	57	(c)	66	(d)	75	(c)	84	(c)
4	(c)	13	(a)	22	(c)	31	(d)	40	(a)	49	(c)	58	(a)	67	(b)	76	(d)	85	(c)
5	(d)	14	(d)	23	(a)	32	(d)	41	(a)	50	(c)	59	(a)	68	(d)	77	(a)	86	(c)
6	(b)	15	(d)	24	(c)	33	(a)	42	(b)	51	(d)	60	(c)	69	(b)	78	(d)		
7	(d)	16	(a)	25	(b)	34	(c)	43	(d)	52	(a)	61	(c)	70	(c)	79	(b)		
8	(a)	17	(b)	26	(c)	35	(c)	44	(c)	53	(d)	62	(c)	71	(a)	80	(a)		
9	(b)	18	(c)	27	(d)	36	(b)	45	(a)	54	(a)	63	(b)	72	(b)	81	(b)		

Hints & Solutions

1. (d) Sigmoid growth curve maintains equilibrium with carrying capacity, it forms asymptote stage in plants.

NOTES The rate of growth of a plant or plant part is not always the same during its life span. If we plot the increase in cell number (growth rate) against time, a typical S-shaped curve is obtained. This is called growth curve or sigmoid growth curve.

2. (c) The coiling of garden pea tendrils around any support is an example of thigmotropism. Thigmotropism is the growth movement in response to touch. The stems and tendrils of the climbers are positively thigmotrophic in their response.
3. (b) Senescence is an active developmental cellular process in the growth and functioning of a flowering plant, indicated in lead abscission. Senescence is the changes that occur in an organism between maturity and death, *i.e.*, ageing.
Characteristically there is a deterioration in functioning as the cells become less efficient in maintaining and replacing vital cells components.
4. (c) Opening of floral buds into flowers, is a type of autonomic movement of growth which is due to epinasty.

NOTES Epinasty is caused by ethylene that is released by the leaves when the roots are flooded. Flooded roots make ACC, the precursor to ethylene, and this is transported up the xylem stream to the leaf where it is converted to the gas hormone.

5. (d) Anthesis is the period during which a flower is fully open and functional. It may also refer to the onset of that period.

NOTES For emasculation the knowledge of flower structure, mechanism of pollination, fertilisation and physiology of flowering is essential for this. In emasculation technique the stamens are removed before anthesis to obtain female parent and pollen from the desired male parent is transferred on to its stigma.

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6. (b) *Mimosa pudica* (touch me not) leaves show seismonastic movement in response to physical contact. The movement is because of turgor changes due to ejection of water by cells of pulvinus (swollen leaf base) on touching it. It causes folding and drooping of leaves.
7. (d) In northern India, during these months maximum variation in light intensity, duration and temperature is observed. Hence, only plants that are photo-and thermoinsensitive can flower during these months.
8. (a) The phenomenon of thigmotropism is a response to contact with a solid object. It is exhibited by tendrils of climbing plants that grow around a pole or the stem of another plant.
9. (b) Klinostat = Clinostat is an apparatus used to nullify the effect of geotropism. It has a clock on the main axis which is attached to a rod. The Top of the rod is attached to a flower pot. The klinostat is kept in horizontal position and allowed to rotate (to nullify the geotropism) and plant growth is observed.
10. (d) Phytohormones are plant hormones which are synthesized by the plants and act as regulators and influence physiological process like growth, movements *etc. auxins*, *gibberellins etc.* are the phytohormones.

11. (c) Monocot leaves have some specialized cells in the epidermal cells of their leaves called bulliform cells (motor cells) which lose or gain turgidity due to which their leaves show coiling and uncoiling.

12. (d) Gibberellic acid breaks seed dormancy. It activate synthesis of alpha-amylase which breakdown starch into simple sugar.

NOTES

The Phytohormones gibberellic acid (GA) has essential signaling functions in multiple processes during plant development. In rice, GA signaling plays an important role in spikelet fertility.

13. (a) Spraying sugarcane crop with gibberellins increases the length of the stem, thus increasing the yield by as much as 20 tonnes per acre.

NOTES

RyzUp® 40SG or **ProGibb®** 40SG can be applied twice during the production cycle.

14. (d) Auxin shows apical dominance. Removal of auxin by removal of shoot tips prevents the apical dominance and promotes the growth of lateral buds which is a very useful in tea leaves production.

NOTES

The plant invests its energy into growing taller in order to maximize the plant's exposure to light. Removing the shoot tip ("cutting back") will remove the source of auxin and will stimulate the growth of axillary buds, and make the plant thicker and bushier. Presence of cytokinin in an area causes preferential movement of nutrients towards it. When applied to lateral buds, they help in their growth despite the presence of apical bud. They thus act antagonistically to auxin which promotes apical dominance. Therefore cytokinin can overcome apical dominance, caused by auxins.

15. (d) Gibberellins (GAs) regulate various developmental processes, including stem elongation, germination, dormancy, flowering, flower development and leaf and fruit senescence. When gibberellin is sprayed on sugarcane crop, the length of the stem increases.

NOTES

Kurosawa, a Japanese botanist, discovered gibberellin while investigating the rice foolish seedling disease in which spindly seedlings are formed due to GA like compounds produced by the fungus (*Gibberella fujikuroi*) infecting the plant. They are produced in the plant cell's plastids, and are eventually transferred to the endoplasmic reticulum of the cell, where they are modified and prepared for use. There are more than 70 gibberellins isolated. They are GA1, GA2, GA3 and so on. GA3 Gibberellic acid is the most widely studied plant growth regulators.

16. (a) A pineapple plant flowers only once, and produces one pineapple. Then it dies. But before it dies it also produces offspring.
Auxin and ethylene can be applied to artificially induce flowering in pineapple to increase yield throughout the year. Applied auxin mimic the action of ethylene by stimulating ethylene formation, and that ethylene, not auxin, causes pineapples to flower. Ethylene initiates flowering and synchronising fruit-set in pineapples.

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17. (b) Auxins helps to prevent premature leaf and fruit fall.

18. (c) Auxin has been clearly demonstrated in the leaf sheath or coleoptile of oat plant (*Avena sativa*). This plant coleoptile has been used for the test of hormone Auxin (IAA) participating in the growth of the plant.

19. (c) Auxin stimulates cell elongation. It accumulates on shaded side which results in more elongation of cells towards shaded side of the plant. This causes bending of the plant towards source of light.

20. (d) *Avena* coleoptile curvature is used for the bioassay of auxin.

21. (b) **Charles Darwin and his son Francis Darwin** observed that the coleoptiles of Oat (*Avena sativa*) and canary grass (*Phalaris canariensis*) responded to unilateral illumination by growing towards the light source **(phototropic curvature or phototropism)**. After a series of experiments, it was concluded that the tip of the coleoptile was the site of production of a substance, that caused the bending of coleoptile.

22. (c) Etiolation is depigmentation of leaf when plant is placed in dark for more than 36 hrs.

23. (a) Abscisic Acid (ABA) is called stress hormone which works in adverse environmental condition when there is low water content in atmosphere or in drought conditions. ABA causes the stomatal closure of leaves due to which the water loss by the plant is minimized.
24. (c) Gibberellins stimulate the synthesis of α-amylase and protease enzyme in germinating grains of cereals. They are involved in the conversion of starch into sugar. The proteases convert an inactive β-amylase to the active form. The active β-amylase and α-amylase together digest starch to glucose which is mobilized to meet the metabolic demands of embryo.
25. (b) Plants which are difficult to flower can be made to do so by spraying them with 2, 4, –D (2, 4 – dichlorophenoxy acetic acid) and NAA (napthalene acetic acid) which are synthetic auxins, *e.g.,* litchi, pineapple.
26. (c) Gibberellins & ABA are antagonistic to each other. ABA counteracts many effects of gibberellins like induction of hydrolases and alpha- amylases in barley seedlings.
27. (d) Phototrophic curvature is the result of uneven distribution of auxin. The experiments conducted by Charles Darwin concluded that the tip of coleoptile of canary grass contain auxin that causes the bending of the entire coleoptile towards the light source.
28. (d) NAA is a synthetic auxin. Some of the most widely used weed killers are synthetic auxins. Synthetic auxin analogs include 1–naphthaleneacetic acid (NAA), 2, 4-dichlorophenoxy acetic acid (2, 4-D) and 2,4,5-trichlorophenoxy acetic acid (2,4,5- T).
29. (c) Abscisic acid (ABA), also known as abscisin II and dormin, is a plant hormone. It functions in many plant developmental processes, including bud dormancy. Abscisic acid is a derivative of carotenoids. It was called "abscisin II" originally because it was thought to play a major role in abscission of fruits. At about the same time another group was calling it "dormin" because they thought it had a major role in bud dormancy. The name abscisic acid (ABA) was coined as a compromise between the two groups.
30. (a) Gibberllic acid stimulates cell growth of leaves and stem causing their expansion, elongation respectively and leaf fall is controlled by ABA.
31. (d) The effect of gibberellins had been known in Japan since early 1800 where certain rice plants were found to suffer from bakane or bakanae (foolish seedling) disease. Such rice plants were thin, pale green, spindle-shaped, longer by 50% than the healthy plants, and were sterile.
32. (d) a-amylase enzyme stimulates the germination of barley seed.
33. (a) When an apical bud is present on a plant, it suppresses the growth of axillary buds, this is called apical dominance. When in pruning apical bud is cut off the axillary buds start growing & hedge become dense.
34. (c) Gibberellins induces elongation of internodes.

NOTES

Some of the major physiological effects of gibberellins are as follows: Gibberellins are weakly acidic growth hormones having gibbane ring structure which cause cell elongation of intact plants in general and increased internodal length of genetically dwarfed plants (e.g., Pea, Corn), in particular.

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35. (c) Differentiation of root is controlled by high auxin concentration. While in tissue culture, auxin concentration is made high to promote rooting.
36. (b) Zinc is one of the components of auxin.

NOTES

Zinc deficiency occurs when plant growth is limited because the plant cannot take up sufficient quantities of this essential micronutrient from its growing medium. It is one of the most widespread macronutrient deficiencies in crops and pastures worldwide and causes large losses in crop production and crop quality.

37. (b) The medium in tissue culture provides all the essential nutrients required for growth and division of callus. Coconut milk contains cytokinins which is useful in tissue culture.
38. (b) Ethylene breaks dormancy of different plants. Abscisic acid induces dormancy in seeds, buds and underground storage organs.

39. (b) One of the most important effects of gibberellins is the reversal of dwarfism (even in genetically dwarf plants). Dwarf pea & dwarf corn attain almost normal size when treated with gibberellins. It has been proven that dwarf plants have lower level of GA which causes the dwarfism. Thus the external supply causes rapid elongation of internodes. GA does not have any effect on elongation of normal (non dwarf or tall) plant.

40. (a) IAA promotes apical dominance. ABA induces dormancy in buds.

NOTES

Presence of cytokinin in an area causes preferential movement of nutrients towards it. When applied to lateral buds, they help in their growth despite the presence of apical bud. They thus act antagonistically to auxin which promotes apical dominance. Therefore cytokinin can overcome apical dominance, caused by auxins.

41. (a) ABA or Abscisic acid is responsible for leaf fall or senescence.

42. (b) NAA or Naphthalene Acetic Acid is synthetic auxin. It is used to check fruit fall specially in tomato.

43. (d) Apical buds inhibit lateral branching due to apical dominance. Removal of apical bud promotes lateral branching.

44. (c) Ethylene is a plant hormone which has the most remarkable effect of stimulation of fruit ripening.

45. (a) Gibberellins are involved in shoot elongation. Auxins are important in root elongation and cell division.

46. (d) Ethylene acts physiologically as a hormone in plants. It stimulates the ripening of fruit, the opening of flowers, and the abscission (or shedding) of leaves. Its biosynthesis starts from methionine with 1-aminocyclopropane-1-carboxylic acid (ACC) as a key intermediate.

47. (b) Cytokinins are used in tissue culture to induce shooting of the cultural callus.

48. (a) Some light sensitive seeds like *Lectuca sativa* (Lettuce) germinate in complete darkness with the help of Gibberellins which otherwise require specific light conditions.

49. (c) Chailakhyan (1936) a Russian investigator who researched on photoperiodism proposed the term 'florigen'. According to him 'Florigen Complex', the true flowering hormone includes two group of substances formed in leaves (i) gibberellins which are necessary for the formation and growth of stem and (ii) anthesins which are necessary for flower formation. Acting together they form the substance named 'florigen'.

50. (c) Ethylene is a gaseous plant hormone which plays an important role in fruit ripening. In the presence of ethylene there is an increase in the rate of respiration.

51. (d) Auxins are synthesized at the tip of shoot & then transported towards the base i.e. basipetal. In all segments of root at all temperatures, the movement of auxin is polarised acropetally.

52. (a) Three types of growth are present in multicellular animals :
(i) Auxetic growth : Increase in cell volume only, not in number.
(ii) Multiplication growth : Increase in number, not in volume.
(iii) Accretionary growth : Growth is due to mitotic division of some special type of cells occurring in specific locations of body.

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53. (d) Abscisic Acid (ABA) is called stress hormone which works in adverse environmental condition when there is low water content in the atmosphere or in drought conditions. ABA causes the stomatal closure of leaves due to which the water loss by the plant is minimized.

54. (a) Cytokinins help in retaining chlorophyll, hence delay senescense.

NOTES

Cytokinin deficiency causes slow growth of the shoot and morphological changes such as dwarfism and smaller leaves. It has been shown previously that SAMs of cytokinin-deficient plants are smaller because of reduced cell numbers.

55. (c) Cytokinins cause delay in senescence (Richmond-Lang effect). Senescence is the phenomenon in which the mature leaves lose chlorophyll, turn yellow and fall off.

NOTES

The Richmond-Lang effect was discovered in 1967 by Richmond & Lang. As per this effect, the lag of senescence of leaves and other parts occurs with the aid of plant growth regulator cytokinin. Retarding senescence leads to delay of chlorophyll degradation rate, the yellowing colour of the leaves and keeping it active longer.

56. (d) Apical dominance is the phenomenon by which presence of apical bud does not allow lateral buds to grow. Apical dominance is due to auxin. When shoot tip is cut; then lateral buds start growing.
57. (c) Ascorbic acid is an organic acid with antioxidant properties. Its appearance is white to light yellow crystals or powder. It is water soluble. The L-enantiomer of ascorbic acid is commonly known as Vitamin C. Ascorbic acid is easily oxidized and so is used as a reductant in photographic developer solutions and as a preservative.
58. (a) Apical dominance is caused by the action of auxins. IAA (Indole-3-acetic acid) is a naturally occurring auxin.
59. (a) Abscisic acid is a stress hormone. During desication abscisic acid is synthesized which reduces transpiration by closure of stomata. It conserves water.
60. (c) The most important function of cytokinins (zeatin is a cytokinin present in *Zea mays* - the corn) is the promotion of cell division. These are now established as true cell division factors.
61. (c) All movements except nyctinastic movement are related to auxin. Nyctinastic (sleeping) movement of leaves is due to diurnal changes. (changes in day and night).
62. (c) Phototropic movements are the plant responses towards light. Generally plant shoot and flower show positive phototropism while geotropism is the plant response to the gravity of earth. Generally roots are positively geotropic. All these movements are linked to Auxin.
63. (b) Abscisic acid as the name suggests cause abscission due to which leaves fall. It also acts as a growth inhibitor & induces bud dormancy in various plants.
64. (a) Highest concentration of auxins occurs at the growing tips. This was proved by Went in 1928 by his experiment on *Avena* coleoptile. It was demonstrated that auxins are synthesized at the tips and then translocated downwards where they cause growth.
65. (b) Apical dominance is a common observation in vascular plants. If apical meristem is intact & growing, the growth of lateral tips is suppressed. According to Thimann & Skoog the auxin, synthesized in apical meristem, is translocated downwards & inhibits the growth of lateral tips. That is why mowing grass lawns facilitate better maintenance.
66. (d) It is due to Richmond-Lang effect. Cytokinins prevent degeneration of chlorophyll, proteins and nucleic acids. They increase of inflow of auxin and amino acids. It reactivates leaf metabolism.
67. (b) Cytokinins help cells in retaining chlorophyll for longer time. Cytokinins delay the senescence (ageing) of leaves and other organs.
68. (d) During flowering, photoperiodic stimulus is perceived by leaves of plants.

NOTES

In 1920, W. W. Garner and H. A. Allard published their discoveries on photoperiodism and felt it was the length of daylight that was critical, but it was later discovered that the length of the night was the controlling factor.

69. (b) Flowering is induced by light and temperature.

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NOTES

Red light promotes flowering. However, it also encourages vertical plant growth. Too much red at the wrong time will cause your plants to stretch, which results in lower yields and lanky, unstable plants. Blue light is your secret weapon for amping up the concentration of oils and resin.

70. (c) Carrot is a biennial plant which flowers in the second season. Vernalization is the subjection of seeds or seedlings to low temperature in order to hasten plant development and flowering. Vernalization is commonly used for crop plants such as winter rye and is possible because the seeds and buds of many plants require cold in order to break dormancy. Winter cereals are therefore sown in the autumn for flowering the following year. However, if germinating seeds are artificially vernalized they can be sown in the spring for flowering the same year. Biennial plants, such as carrot (*Daucus carota*), will remain in their non - flowering rosette form until subjected to cold treatment.
71. (a) Photoperiodism is the response to duration and timings of light and dark period. It was first characterised in tobacco plant.

72. (b) Photoperiodism was first studied by Garner and Allard (1920). They observed that "Maryland Mammoth" variety of tobacco could be made to flower in summer by reducing the light hours with artificial darkening. It could be made to remain vegetative in winter by providing extra light.
73. (c) Treatment of seed at a low temperature under moist conditions to break dormancy is called stratification.
74. (d) Short day plants require long uninterrupted dark period for flowering. They will not produce flower if night was interrupted by flash of light.
75. (c) The pigment phytochrome is involved in flowering and many other light-mediated processes. It absorbs red and far red light in plants for photosynthesis.
76. (d) Long day plants undergo flowering after receiving light above a critical day length. *e.g.* Spinach, sugarbeet. Short day plants flower only when they receive light below a critical day length. *e.g. Glycine max*, Tobacco.
77. (a) Borthwick & Hendricks (1952) gave the concept of phytochrome. Phytochrome is a coloured protein pigment located in plasma membrane to perceive the photoperiodic stimulus in leaves. It may exist in two interconvertable forms Pr and Pfr (red and far red light absorbing forms).
78. (d) Scarification is the breaking of the seed coat barriers which can be done by mechanical or chemical methods.
79. (b) Photoperiodism is the effect of duration of light and darkness on the growth, development and behaviour of an organism.
80 (a) Continuous exposure to red light causes
    - Conversion of Pr to Pfr which is rapidly destroyed.
    - Inhibition of synthesis of Pr.
    - Total amount of phytochrome decreases.
81. (b) A short day plant is one that flowers on photoperiods shorter than the critical day length. It generally flowers when treated by a short day and uninterrupted long night (more than 12 hrs.)
82. (d) Vernalization is the method of inducing early flowering in plants by pretreatment of their seeds at low temperature.
83. (a) Twining of tendrils is due to thigmotropism *i.e.* movement due to the contact with a foreign body (touch).

NOTES

Thigmotropism occurs due to actions of the plant hormone auxin. Touched cells produce auxin which then transfers auxin to non-touched cells. These untouched cells then grow faster causing them to bend around the stimulus. The hormone ethylene helps in changing the shape or turgidity of the cell.

84. (c) In the absence of light stem becomes excessive long due to 'etiolation'. This causes cells of internodes to get enlarged.
85. (c) Vernalization is the low temperature treatment for flowering in plants. Plants are treated (seeds and seedlings) with very low temperature to promote germination. A Lang & co-workers demonstrated that the application of gibberellins can replace the cold treatment or vernalization in many plants.
86. (c) Refer Answer 42.

NOTES

Cytokinins are essential plant hormones. By stimulating cell division, they regulate shoot meristem size, leaf primordia number, and leaf and shoot growth. They can stimulate both the differentiation and the outgrowth of axillary buds. The cytokinins can mediate axillary bud release from apical dominance.

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16 Digestion and Absorption

Trend Analysis with Important Topics & Sub-Topics

		2020		2019		2018		2017		2016	
Topic	Sub-Topics	Qns.	LOD	Qns.	LOD	Qns.	LOD	Qns.	LOD	Qns.	LOD
Digestive System	Alimentary Canal	1	A	2	A	2	A	2	A/D		
	Digestive Glands							1	E	1	A
	Digestion of food	1	A					1	A	1	E
Digestion and Absorption of Digested Products											

LOD - Level of Difficulty | E - Easy | A - Average | D - Difficult | Qns - No. of Questions

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Topic 1: Digestive System

1. Identify the correct statement with reference to human digestive system. *[2020]*
   (a) Serosa is the innermost layer of the alimentary canal
   (b) IIeum is a highly coiled part
   (c) Vermiform appendix arises from duodenum
   (d) IIeum opens into small intestine
2. Which of the following terms describe human dentition? *[2018]*
   (a) Thecodont, Diphyodont, Homodont
   (b) Thecodont, Diphyodont, Heterodont
   (c) Pleurodont, Diphyodont, Heterodont
   (d) Pleurodont, Monophyodont, Homodont
3. Which cells of "Crypts of Lieberkuhn" secrete antibacterial lysozyme ? *[2017]*
   (a) Paneth cells (b) Zymogen cells
   (c) Kupffer cells (d) Argentaffin cells
4. The hepatic portal vein drains blood to liver from : *[2017]*
   (a) Stomach (b) Kidneys
   (c) Intestine (d) Heart
5. A baby boy aged two years is admitted to play school and passes through a dental check - up. The dentist observed that the boy had twenty teeth. Which teeth were absent? *[2017]*
   (a) Canines (b) Pre-molars
   (c) Molars (d) Incisors
6. Which of the following guards the opening of hepatopancreatic duct into the duodenum ? *[2016]*
   (a) Semilunar valve (b) Ileocaecal valve
   (c) Pyloric sphincter (d) Sphincter of Oddi
7. Which of the following statements is not correct? *[2015 RS]*
   (a) Goblet cells are present in the mucosa of intestine and secrete mucus
   (b) Oxyntic cells are present in the mucosa of stomach and secrete HCl.
   (c) Acini are present in the pancreas and secrete carboxypeptidase
   (d) Brunner's glands are present in the submucosa of stomach and secrete pepsinogen
8. The primary dentition in human differs from permanent dentition in not having one of the following type of teeth : *[2015 RS]*

(a) Premolars (b) Molars
(c) Incisors (d) Canine

9. Where do certain symbiotic micro-organisms normally occur in human body? *[2012M]*
(a) Caecum
(b) Oral lining and tongue surface
(c) Vermiform appendix and rectum
(d) Duodenum

10. Two friends are eating together on a dining table. One of them suddenly starts coughing while swallowing some food. This coughing would have been due to improper movement of: *[2011]*
(a) epiglottis (b) diaphragm
(c) neck (d) tongue

11. Which one of the following correctly represents the normal adult human dental formula ? *[2011M]*
(a) $\frac{3}{3}, \frac{1}{1}, \frac{3}{2}, \frac{1}{1}$ (b) $\frac{2}{2}, \frac{1}{1}, \frac{3}{2}, \frac{3}{3}$
(c) $\frac{2}{2}, \frac{1}{1}, \frac{2}{2}, \frac{3}{3}$ (d) $\frac{3}{3}, \frac{1}{1}, \frac{3}{3}, \frac{3}{3}$

12. If for some reason our goblet cells are non functional, this will adversely affect: *[2010]*
(a) production of somatostatin
(b) secretion of sebum from the sebaceous glands
(c) maturation of sperms
(d) smooth movement of food down the intestine

13. Which one of the following is the correct matching of the site of action on the given substrate, the enzyme acting upon it and the end product? *[2008]*
(a) Duodenum: Triglycerides Monoglycerides
(b) Small inestine: Starch Disaccharide (Maltose)
(c) Small intestine: Proteins Amino acids
(d) Stomach: Fats Micelles

14. Angiotensinogen is a protein produced and secreted by *[2006]*
(a) endothelial cells (lining the blood vessels)
(b) liver cells
(c) juxtaglomerular (JG) cells
(d) macula densa cells

15. Stool of a person is whitish grey coloured due to malfunction of which of the following organ? *[2002]*
(a) Pancreas (b) Spleen
(c) Kidney (d) Liver

16. The daily dietary requirement of a moderately active adult individual is approximately *[1999]*
(a) 8,000 k cal (b) 4,000 k cal
(c) 1,000 k cal (d) 2,500 k cal

17. The food having fully undergone mechanical and chemical digestion inside the stomach, is called *[1999]*
(a) Chyle (b) Bolus
(c) Amino acid (d) Chyme

18. An adolescent human below 17 years of age normally has dental formula as *[1999]*
(a) $\frac{3}{3}, \frac{1}{1}, \frac{3}{2}, \frac{1}{1}$ (b) $\frac{2}{2}, \frac{1}{1}, \frac{2}{2}, \frac{3}{3}$
(c) $\frac{2}{2}, \frac{1}{1}, \frac{2}{2}, \frac{3}{3}$ (d) $\frac{2}{2}, \frac{1}{1}, \frac{2}{2}, \frac{2}{2}$

19. The layer of cells that secrete enamel of tooth is *[1998]*
(a) Ameloblast (b) Osteoblast
(c) Odontoblast (d) Dentoblast

20. The contraction of gall bladder is due to *[1998]*
(a) Gastrin (b) Cholecystokinin
(c) Secretin (d) Enterogastrone

21. Kupffer's cells occur in *[1993]*
(a) spleen (b) kidney
(c) brain (d) liver

22. Brunner's glands occur in *[1992]*
(a) submucosa of duodenum
(b) submucosa of stomach
(c) mucosa of oesophagus
(d) mucosa of ileum

23. Pancreas produces *[1991]*
(a) three digestive enzymes and one hormone
(b) three types of digestive enzymes and two hormones
(c) two digestive enzymes and one hormone
(d) three digestive enzymes and no hormone

24. Emulsification of fat is carried out by *[1990]*
(a) Bile pigments (b) Bile salts
(c) HCl (d) Pancreatic juice

25. In man the zymogen or chief cells are mainly found in *[1990]*
(a) Cardiac part of stomach
(b) Pyloric part of stomach
(c) Duodenum
(d) Fundic part of stomach

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26. Duct leading from parotid gland and opening into vestibule is *[1988]*
    (a) Haversian duct
    (b) Stensen's duct
    (c) Wolffian duct
    (d) Infra-orbital duct
27. Wharton's duct is associated with *[1988]*
    (a) Sublingual salivary duct
    (b) Parotid salivary gland
    (c) Submaxillary salivary gland
    (d) Brunner's glands

Topic 2: Digestion and Absorption of Digested Products

28. The enzyme enterokinase helps in conversion of *[2020]*
    (a) trypsinogen into trypsin
    (b) caseinogen into casein
    (c) pepsinogen into pepsin
    (d) protein into polypeptides
29. Match the items given in Column-I with those in Column-II and choose the correct option. *[2019]*

Column-I	Column-II
(A) Rennin	(i) Vitamin B_{12}
(B) Enterokinase	(ii) Facilitated transport
(C) Oxyntic cells	(iii) Milk proteins
(D) Fructose	(iv) Trypsinogen

    (a) (A)-(iii), (B)-(iv), (C)-(i), (D)-(ii)
    (b) (A)-(iii), (B)-(iv), (C)-(ii), (D)-(i)
    (c) (A)-(iv), (B)-(iii), (C)-(i), (D)-(ii)
    (d) (A)-(iv), (B)-(iii), (C)-(ii), (D)-(i)
30. Identify the cells whose secretion protects the lining of gastro-intestinal tract from various enzymes. *[2019]*
    (a) Chief cells (b) Goblet cells
    (c) Oxyntic cells (d) Duodenal cells
31. Match the following structures with their respective location in organs: *[2019]*

(A) Crypts of Lieberkuhn	(i) Pancreas
(B) Glisson's capsule	(ii) Duodenum
(C) Islets of Langerhans	(iii) Small intestine
(D) Brunner's glands	(iv) Liver

    Select the **correct** option from the following:

	(A)	(B)	(C)	(D)
(a)	(iii)	(i)	(ii)	(iv)
(b)	(ii)	(iv)	(i)	(iii)
(c)	(iii)	(iv)	(i)	(ii)
(d)	(iii)	(ii)	(i)	(iv)

32. Which of the following options best represents the enzyme composition of pancreatic juice? *[2017]*
    (a) amylase, pepsin, trypsinogen, maltase
    (b) peptidase, amylase, pepsin, rennin
    (c) lipase, amylase, trypsinogen, procarboxypeptidase
    (d) amylase, peptidase, trypsinogen, rennin
33. In the stomach, gastric acid is secreted by the *[2016]*
    (a) gastrin secreting cells
    (b) parietal cells
    (c) peptic cells
    (d) acidic cells
34. Gastric juice of infants contains : *[2015 RS]*
    (a) nuclease, pepsinogen, lipase
    (b) pepsinogen, lipase, rennin
    (c) amylase, rennin, pepsinogen
    (d) maltase, pepsinogen, rennin
35. The initial step in the digestion of milk in humans is carried out by *[2014]*
    (a) Lipase (b) Trypsin
    (c) Rennin (d) Pepsin
36. Fructose is absorbed into the blood through mucosa cells of intestine by the process called: *[2014]*
    (a) active transport
    (b) facilitated transport
    (c) simple diffusion
    (d) co-transport mechanism
37. Select the correct match of the digested products in humans given in column -I with their absorption site and mechanism in column-II *[NEET 2013]*

	Column I	Column II
(a)	Fructose, Na^+	Small intestine, passive absorption
(b)	Glycerol, fatty acids	Duodenum, move as chylomicrons
(c)	Cholesterol, maltose	Large intestine, active absorption
(d)	Glycine, glucose	Small intestine, active absorption

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38. A healthy person eats the following diet - 5 gm raw sugar, 4 gm albumin, 10 gm pure buffalo ghee adultrated with 2 gm vegetable ghee (hydrogenated vegetable oil) and 5 gm lignin. How many calories he is likely to get? *[NEET Kar. 2013]*
(a) 144 (b) 126
(c) 164 (d) 112

39. Which enzymes are likely to act on the baked potatoes eaten by a man, starting from the mouth and as it moves down the alimentary canal? *[NEET Kar. 2013]*
(a) Salivary maltase → carboxypeptidase → trypsinogen
(b) Pancreatic amylase → salivary amylase → lipases
(c) Disaccharidase like maltase → lipases → nucleases
(d) Salivary amylase → pancreatic amylase → disaccharidases

40. Which one of the following enzymes carries out the initial step in the digestion of milk in humans? *[2011]*
(a) Pepsin (b) Rennin
(c) Lipase (d) Trypsin

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41. One of the constituents of the pancreatic juice while poured into the duodenum in humans, is: *[2011M]*
(a) trypsinogen (b) chymotrypsin
(c) trypsin (d) enterokinase

42. A young infant may be feeding entirely on mothers milk which is white in colour but the stools which the infant passes out is quite yellowish. What is this yellow colour due to ? *[2009]*
(a) bile pigments passed through bile juice
(b) undigested milk protein casein
(c) pancreatic juice poured into duodenum
(d) intestinal juice

43. Which one of the following statements is true regarding digestion and absorption of food in humans? *[2009]*
(a) Fructose and amino acids are absorbed through intestinal mucosa with the help of carrier ions like Na+.
(b) Chylomicrons are small lipoprotein particles that are transported from intestine into blood capillaries.
(c) About 60% of starch is hydrolysed by salivary amylase in our mouth
(d) Oxyntic cells in our stomach secrete the proenzyme pepsinogen.

44. Which one of the following pairs of food components in humans reaches the stomach totally undigested? *[2009]*
(a) Starch and fat (b) Fat and cellulose
(c) Starch and cellulose (d) Protein and starch

45. What will happen if the secretion of parietal cells of gastric glands is blocked with an inhibitor? *[2008]*
(a) Gastric juice will be deficient in chymosin
(b) Gastric juice will be deficient in pepsinogen
(c) In the absence of HCI secretion, inactive pepsinogen is not converted into the active enzyme pepsin
(d) Enterokinase will not be released from the duodenal mucosa and so trypsinogen is not converted to trypsin

46. A person who is one along hunger strike and is surviving only on water, will have *[2007]*
(a) less amino acids in his urine
(b) more glucose in his blood
(c) less urea in his urine
(d) more sodium in his urine.

47. Lysozyme that is present in perspiration, saliva and tears, destroys *[2007]*
(a) certain types of bacteria
(b) all viruses
(c) most virus-infected cells
(d) certain fungi

48. Epithelial cells of the intestine involved in food absorption have on their surface: *[2005]*
(a) pinocytic vesicles
(b) microvilli
(c) zymogen granules
(d) phagocytic vesicles

49. Secretin and cholecystokinin are digestive hormones. They are secreted in : *[2005]*
(a) Pyloric stomach (b) Duodenum
(c) Ileum (d) Oesophagus

50. Duodenum has characteristic Brunner's gland which secrete two hormones called *[2004]*
(a) Kinase, estrogen
(b) Secretin, cholecystokinin
(c) Prolactin, parathormone
(d) Estradiol, progesterone

51. During prolonged fasting, in what sequence are the following organic compounds used up by the body ? *[2003]*
(a) First proteins, next lipids and lastly carbohydrates
(b) First carbohydrates, next fats and lastly proteins
(c) First fats, next carbohydrates and lastly proteins
(d) First carbohydrates, next proteins and lastly lipids

52. Hydrolytic enzymes which act on low pH are called as *[2002]*
(a) proteases (b) a-amylases
(c) hydrolases (d) peroxidases

53. A person is eating boiled potato, which food component is found in it ? *[2000]*
(a) DNA which gets digested by pancreatic DNAase
(b) Lactose which is indigestible
(c) Starch which does not get digested
(d) Cellulose which is digested by intestinal cellulose

54. Secretin and cholecystokinin are two hormones involved in digestion. They are secreted by *[1999]*
(a) Duodenum (b) Ileum
(c) Oesophagus (d) Stomach

55. The hormone that stimulates the stomach to secrete gastric juice is *[1998]*
(a) Enterogastrone (b) Enterokinase
(c) Renin (d) Gastrin

56. A person had to undergo a surgery in which a major portion of his pancreas was removed. Which of the following food constituents will he find especially difficult to digest ? *[1997]*
(a) Starch (b) Proteins
(c) Fats (d) Lactose sugar

57. For persons suffering from high blood cholesterol, the physicians recommend *[1996]*
(a) pure 'deshi ghee' or butter
(b) vegetable oil such as groundnut oil
(c) red meat with layers of fats
(d) vanaspati margarine

58. Which one of the following is a matching pair of a substrate and its particular digestive enzyme? *[1996]*
(a) Starch — maltase
(b) Lactose — rennin
(c) Maltose — steapsin
(d) Casein — chymotrypsin

59. The enzyme enterokinase helps in the conversion of *[1995]*
(a) pepsinogen into pepsin
(b) trypsinogen into trypsin
(c) caesinogen into caesin
(d) proteins into polypeptides

60. Renin acts on *[1994]*
(a) milk changing casein into calcium paracaseinate at 7.2 – 8.2 pH
(b) proteins in stomach
(c) fat in intestine
(d) milk changing casein into calcium paracaseinate at 1 – 3 pH.

61. Inhibition of gastric and stimulation of gastric, pancreatic and bile secretions are controlled by hormones *[1994]*
(a) Gastrin, secretin, enterokinin and cholecystokinin
(b) Enterogastrone, gastrin, pancreozymin and cholecystokinin
(c) Gastrin, enterogastrone, cholecystokinin and pancreozymin
(d) Secretin, enterogastrone, gastrin and enterokinin

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62. Secretion of gastric juice is stopped by *[1993]*
(a) Gastrin (b) Pancreazymin
(c) Cholecystokinin (d) Enterogastrone

63. Most of the fat digestion occurs in *[1993]*
(a) Rectum (b) Stomach
(c) Duodenum (d) Small intestine

64. Where is protein digestion accomplished? *[1991]*
(a) Stomach (b) Ileum
(c) Rectum (d) Duodenum

65. Secretin stimulates production of *[1990]*
(a) Saliva (b) Gastric juice
(c) Bile (d) Pancreatic juice

66. Pancreatic juice and hormones of pancreas are produced by *[1990]*
(a) Same cells
(b) Same cells at different times
(c) Statement is wrong
(d) Different cells

67. Release of pancreatic juice is stimulated by *[1989]*
(a) Enterokinase (b) Cholecystokinin
(c) Trypsinogen (d) Secretin

Topic 3: Disorders of Digestive System

68. Kwashiorkor disease is due to: *[2019, Odisha]*
(a) protein deficiency not accompanied by calorie deficiency.
(b) simultaneous deficiency of proteins and fats.
(c) simultaneous deficiency of proteins and calories.
(d) deficiency of carbohydrates.

69. Anxiety and eating spicy food together in an otherwise normal human, may lead to *[2012]*
(a) Indigestion (b) Jaundice
(c) Diarrhoea (d) Vomiting

70. When breast feeding is replaced by less nutritive food low in proteins and calories; the infants below the age of one year are likely to suffer from: *[2009]*
(a) Rickets (b) Kwashiorkor
(c) Pellagra (d) Marasmus

71. Which one of the following is a fat-soluble vitamin and its related deficiency disease? *[2007]*
(a) Retinol - Xerophthalmia
(b) Cobalamine - Beri-beri
(c) Calciferol - Pellagra
(d) A scorbic acid - Scurvy.

72. Which group of three of the following five statements (a-e) contain is all three correct statements regarding beri-beri? *[2005]*
(a) a crippling disease prevalant among the native population of sub-Saharan Africa;
(b) a deficiency disease caused by lack of thiamine (vitamin B_1)
(c) a nutritional disorder in infants and young children when the diet is persistently deficient in essential protein;
(d) occurs in those countries where the staple diet is polished rice;
(E) the symptoms are pain from neuritis, paralysis, muscle wasting, progressive oedema, mental deterioration and finally heart failure;
(a) B, D and E (b) A, B and D
(c) A, C and E (d) B, C and E

73. A patient is generally advised to specially, consume more meat, lentils, milk and eggs in diet only when he suffers from *[2005]*
(a) Scurvy (b) Kwashiorkor
(c) Rickets (d) Anemia

74. Which one of the following pairs is not correctly matched? *[2004]*
(a) Vitamin B_{12} - Pernicious anaemia
(b) Vitamin B_6 - Loss of appetite
(c) Vitamin B_1 - Beri-beri
(d) Vitamin B_3 - Pellagra

75. Which one of the following is the correct matching of a vitamin, its nature and its deficiency disease? *[2004]*
(a) Vitamin A – Fat-soluble – Night blindness
(b) Vitamin K – Fat-Soluble – Beri-beri
(c) Vitamin A – Fat-soluble – Beri-beri
(d) Vitamin K – Water-soluble – Pellagra

76. The richest sources of vitamin B_{12} are *[2004]*
(a) Goat's liver and *Spirulina*
(b) Chocolate and green gram
(c) Rice and hen's egg
(d) Carrot and chicken's breast

77. Fluoride pollution mainly affects *[2003]*
(a) kidney (b) brain
(c) heart (d) teeth

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78. Which one of the following pairs is not correctly matched? *[2003]*
(a) Vitamin B_6 – Beri Beri
(b) Vitamin C – Scurvy
(c) Vitamin B_3 – Pellagra
(d) Vitamin B_{12} – Pernicious anaemia

79. The haemorrhagic disease of new born is caused due to the deficiency of *[2002]*
(a) vitamin A (b) vitamin B_1
(c) vitamin B_{12} (d) vitamin K

80. Which set is correct? *[2001]*
(a) Corpus callosum — Grafian follicle
(b) Sebum — Sweat
(c) Bundle of His — Pace maker
(d) Vitamin B7 — Niacin

81. Which one is correctly matched? *[2001]*
(a) Vitamin E — Tocopherol
(b) Vitamin D — Riboflavin
(c) Vitamin B — Calciferol
(d) Vitamin A — Thiamine

82. A person deficient in the rhodopsin should be advised to take more of *[2000]*
(a) Guava and ripe banana
(b) Apple and grapes
(c) Carrot and ripe papaya
(d) Radish and potato

83. A patient suffering from cholera is given saline drip because *[1996, 2000]*
(a) Cl^- ions are important component of blood plasma
(b) Na^+ ions help to retain water in the body
(c) Na^+ ions are important in transport of substances across membrane
(d) Cl^- ions help in the formation of HCl in stomach for digestion

84. Which one of the following pairs is mismatched? *[1999]*
(a) Vitamin C - Scurvy
(b) Vitamin D - Rickets
(c) Vitamin K - Beri Beri
(d) Vitamin A - Xerophthalmia

85. Nutrients absorbed by the blood capillaries of intestinal villi first go into *[1999]*
(a) liver through hepatic portal vein
(b) hepatic artery
(c) aorta
(d) posterior vena cava

86. One of the factors required for the maturation of erythrocytes is *[1998]*
(a) Vitamin A (b) Vitamin B_{12}
(c) Vitamin C (d) Vitamin D

87. Which one of the following is a protein deficiency disease? *[1998]*
(a) Night blindness (b) Eczema
(c) Kwashiorkor (d) Cirrhosis

88. Which one of the following vitamins can be synthesized by bacteria inside the gut? *[1997]*
(a) B_1 (b) C
(c) D (d) K

89. Which one of the following is a matching pair of a vitamin and the deficiency disease related with it ? *[1996]*
(a) Riboflavin — beri beri
(b) Thiamine — xerophthalmia
(c) Niacin — pellagra
(d) Calciferol — scurvy

90. The vitamin C or ascorbic acid prevents *[1995]*
(a) rickets (b) pellagra
(c) scurvy (d) antibody synthesis

91. A dental disease characterized by mottling of teeth is due to the presence of a certain chemical element in drinking water. Which of the following is that element ? *[1995]*
(a) mercury (b) chlorine
(c) fluorine (d) boron

92. Prolonged deficiency of nicotinic acid produces *[1994]*
(a) Osteomalacia (b) Xerophthalmia
(c) Pellagra (d) Anaemia

93. Calcium deficiency occurs in the absence of vitamin
(a) D (b) C *[1994]*
(c) E (d) B

94. Vitamin K is required for *[1993]*
(a) change of prothrombin to thrombin
(b) synthesis of prothrombin
(c) change of fibrinogen to fibrin
(d) formation of thromboplastin

95. Which of the following pair is characterised by swollen lips, thick pigmented skin of hands and legs and irritability? *[1993]*
(a) Thiamine – Beri-Beri
(b) Protein – Kwashiorkor
(c) Nicotinamide – Pellagra
(d) Iodine – Goitre

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ANSWER KEY

1	(b)	11	(c)	21	(d)	31	(c)	41	(a)	51	(b)	61	(b)	71	(a)	81	(a)	91	(c)
2	(b)	12	(d)	22	(a)	32	(c)	42	(a)	52	(c)	62	(d)	72	(a)	82	(c)	92	(c)
3	(a)	13	(b)	23	(b)	33	(b)	43	(a)	53	(a)	63	(d)	73	(b)	83	(b)	93	(a)
4	(c)	14	(b)	24	(b)	34	(b)	44	(b)	54	(a)	64	(b)	74	(b)	84	(c)	94	(b)
5	(b)	15	(d)	25	(d)	35	(c)	45	(c)	55	(d)	65	(d)	75	(a)	85	(a)	95	(c)
6	(d)	16	(d)	26	(b)	36	(b)	46	(c)	56	(c)	66	(d)	76	(a)	86	(b)		
7	(d)	17	(d)	27	(c)	37	(d)	47	(a)	57	(b)	67	(b)	77	(d)	87	(c)		
8	(a)	18	(d)	28	(a)	38	(a)	48	(b)	58	(a)	68	(a)	78	(a)	88	(d)		
9	(a)	19	(a)	29	(a)	39	(d)	49	(b)	59	(b)	69	(a)	79	(d)	89	(c)		
10	(a)	20	(b)	30	(b)	40	(b)	50	(b)	60	(d)	70	(d)	80	(c)	90	(c)		

Hints & Solutions

1. (b) Option (b) is correct as ileum is a highly coiled tube. Serosa is the outermost layer of the alimentary canal, thus, option (a) is an incorrect statement.
A narrow finger-like tubular projection, the vermiform appendix arises from caecum part of large intestine thus; option (c) is incorrect statement. Ileum opens into the large intestine, thus option (d) is also an incorrect statement.

NOTES

If the end of the ileum has been removed, the intestines also cannot absorb bile acids secreted by the liver, which aid digestion and cannot absorb vitamin B12. Malabsorption causes diarrhea, typically beginning immediately after the surgery. Later, people develop undernutrition and vitamin deficiencies.

2. (b) In thecodont teeth are present in the sockets of the jaw bone called alveoli. In diphyodont teeth erupts twice, temporary milk or deciduous teeth are replaced by a set of permanent or adult teeth. In heterodont dentition it consists of different types of teeth namely incisors, canine, premolars and molars.
3. (a) – Kupffer-cells are phagocytic cells present in liver.
– Zymogen cells are enzyme producing cells which are secreted by pancreas.
– Paneth cell secrete lysozyme which acts as anti-bacterial agent, into the lumen of intestine.
– Argentaffin cells are hormone producing cells.
4. (c) In hepatic portal system, hepatic portal vein drains blood to liver from intestine.
5. (b) Total number of teeth in a human child is 20. In primary dentition premolars are absent.
6. (d) The sphincter of Oddi (or hepatopancreatic sphincter) is a muscular valve that controls the flow of digestive juices (bile and pancreatic juice) through the ampulla of Vater into the second part of the duodenum.
7. (d) Duodenum contains Brunner's glands which secrete mucus and digestive juices.
8. (a) The dental formula for milk teeth is $\frac{2102}{2102}$, so premolars are absent in the primary dentition.
9. (a) The caecum is a pouch-like portion of the large intestine which hosts some symbiotic micro-organisms. The caecum absorbs water and salts from undigested foods before they continue on to the large intestine.
10. (a) The coughing would have been due to improper movement of epiglottis.
11. (c) The adult dental formula of human is
Incisor $\frac{2}{2}$, Canine $\frac{1}{1}$, Premolar $\frac{2}{2}$,
Molar $\frac{3}{3}$.
12. (d) Goblet cells, found in the intestinal mucosal epithelium, secrete mucus. The mucus lubricates the food for an easy passage. So, if for some reason, goblet cells become non-functional, it will adversely affect the smooth movement of food down the intestine.
13. (b) Small intestine- Starch disaccharide (maltose)
Small intestine is the portion of the alimentary canal between the stomach and large intestine. It is subdivided into the duodenum, jejunum and ileum. It plays an essential role in the final digestion and absorption of food.
14. (b) Angiotensinogen is a protein secreted by the liver cells.
15. (d) Stool colour is due to the bile pigments, biliverdine and bilirubin secreted by liver. whitish grey stool colour indicates secretion of biliveridin and bilirubin is not proper from the liver.
16. (d) The daily dietary requirement of a moderately active adult individual is approximately 2,500 k cal.
17. (d) After mastication, food is converted into a small ball by rolling of the tongue known as bolus. Churning movement of the stomach brings about mechanical breakdown of the

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food into finer particles. The pulpy mass formed in stomach is called chyme. In the intestine food is converted into a liquid emulsion due to completion of digestion of most of the nutrients. The liquefied food emulsion contained in small intestine is called chyle.

18. (d) The permanent teeth appear completely by the age of 12 years, except for the last molars, which, if present, are formed after the age of 18 years. The dental formula before the wisdom teeth appear would be

$$i\frac{2}{2}, c\frac{1}{1}; pm\frac{2}{2}, m\frac{2}{2}$$

after wisdom teeth appear

$$i\frac{2}{2}, c\frac{1}{1}; pm\frac{2}{2}, m\frac{3}{3}$$

19. (a) Osteoblast are the bone degenerating cells. Odontoblast are the special cells secreting dentine.

20. (b) Secretin released by duodenum inhibits movements in the gastrontestinal tract. Enterogasterone inhibits digestive activity of stomach. Gastrin stimulates secretion of HCl.

21. (d) Kupffer's cells or stellate cells are active phagocytic cells present in the liver. They engulf the worn out and dead RBCs & break down haemoglobin. They are hepatic macrophages.

22. (a) These are the tubulo-alveolar glands present in the submucosa of duodenum only. They secrete an alkaline mucus with very little enzymes & pour their secretion into crypts of Lieberkuhn.

23. (b) Pancreas produces enzymes (i) trypsinogen which is then activated by enterokinase into active trypsin (ii) chymotrypsinogen which is again an inactive proenzyme, activated by trypsin (iii) procarboxypeptidases which are activated into carboxypeptidases by trypsin and two hormones (a) Insulin (b) Glucagon which control the glucose level in blood.

24. (b) Bile salts viz sodium glycocholate & sodium taurocholate (both are organic salts present in bile) reduce the surface tension of large fat globules and break them to fine minute fat droplets. This process is known as emulsification of fats.

25. (d) Zymogen or chief cells are mainly found in the fundic part of the stomach. They are the most abundant among the gastric glands & secrete proenzymes, propepsin and prorenin. (They are also present in intestine but their main site is stomach).

26. (b) A pair of parotid glands (the largest salivary glands) present in the cheeks just under the ears open in the vestibule (a narrow, groove like space which separates the gums from lips and cheeks) by the parotid ducts also known as Stensen's duct.

27. (c) A pair of submaxillary glands lie at the angles of lower jaw open by submaxillary ducts also known as Wharton's ducts. They open under the tongue behind the lower incisor of its sides. These glands are present in most mammals but absent in rabbit & horses. They mostly secrete mucus of saliva.

28. (a) The correct option is (a) because trypsinogen is activated by an enzyme, enterokinase, secreted by the intestinal mucosa into active trypsin. Trypsinogen is a zymogen from pancreas.

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NOTES

Enterokinase is a sequence-specific protease that activates trypsinogen (276000) and has a major role in protein digestion. Deficiency of enterokinase is an autosomal recessive disorder characterized by severe protein malabsorption in early infancy, with failure to thrive, chronic diarrhea, and generalized edema.

29. (a) Rennin is a milk digesting proteolytic enzyme releted to pepsin that is synthesised by chief cells in the stomach of some animals.
Enterokinase, produced by cells of duodenum, is involved in digestion. It converts trypsinogen (a zymogen) into its active form trypsin, resulting in the subsequent activation of pancreatic digestive enzymes.
Fructose shows facilitated transport .
Oxyntic cells secrete HCl and intrinsic factors that are essential for absorption of vitamin B_{12}.

30. (b) Goblet cells secretes mucus. It is secreted along entire digestive tract where it lubricates food and lining, coats lining and protects it from mechanical digestion from acid and digestive enzymes.

NOTES

Goblet cells are mostly found scattered in the epithelia of the small intestines and respiratory tract. The morphology of goblet cells reflects their function, with the cell containing all the organelles necessary for the production of glycosylated proteins called **mucins**.

31. (c) Crypts of Lieberkuhn are tubular glands that lie between the finger-like projections of the inner surface of the small intestine. Glisson's capsule is a layer of connective tissue present in liver. Islets of langerhans constitute the endocrine portion of pancreas and are responsible for the production and release of hormones that regulate glucose levels. Brunner's glands are found in submucosa of duodenum and protect the intestinal walls from gastric juices.

NOTES

Argentaffin cells are identified with the production of serotonin (5-hydroxytryptamine), which is secreted into the lamina propria rather than the intestinal lumen. Serotonin is a powerful stimulant of smooth muscle, resulting in contraction, and may play a role in stimulating peristaltic activity of the intestine.

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32. (c) Rennin and Pepsin enzymes are present in the gastric juice whereas Maltase is present in the intestinal juice.
33. (b) The main constituent of gastric acid is hydrochloric acid which is produced by parietal cells (also called oxyntic cells) in the gastric glands in the stomach.
34. (b) Gastric juice of infants contains pepsinogen, lipase and rennin. Gastric juice does not contain amylase, maltase & nuclease.
35. (c) Rennin (also called chymosin) is an enzyme that occurs in gastric juice and is a constituent of rennet. It coagulates milk by converting caseinogen to casein. The initial step in the digestion of milk in humans is carried out by rennin.
36. (b) Facilitated transport is a form of passive transport in which materials are moved across the plasma membrane by a transport protein down their concentration gradient; hence, it does not require energy.
37. (d) Small intestine is major area of absorbtion of nutrients. Approximately 80% of absorbtion take place here. Glucose, fructose, fatty acids, amino acids (Glycine etc.) are absorbed through mucosa into blood and lymph by active absorbtion.
38. (a) Physiological value of carbohydrates is 4.0 kcal/g, proteins 4.0 kcal/g and of fats is 9.0 kcal/g. Hence,
5 g raw sugar will yield $5 \times 4.0 = 20.0$ kcal
4 g albumin (protein) will yield 4×4.0
$= 16.0$ kcal
$10 + 2$ g of fat will yield 12×9.0
$= 108.0$ kcal
Total yield = 144 kcal.
39. (d) Chemical process of digestion starts in the oral cavity by the hydrolytic action of the carbohydrate splitting enzyme, the salivary amylase. Carbohydrates in the chyme are hydrolysed by pancreatic amylase into disaccharides.
40. (b) Rennin is an enzyme that is essential for the protein digestion. It is active in acidic medium and inactive in normal gastric juice of adult.
41. (a) Trypsinegen it is inactive form and we know that all enzymes of pancreas are secreted in this form. Enzyme enterokinase is secreted from the duodenal mucosa, at the chemical stage that changes the inactive pancreatic secretion trypsinogen to trypsin.
42. (a) Young infant may be feeding entirely on mother's milk which is white in colour but the stools which the infant passes out is quite yellowish because of the bile pigments passed through bile juice. Bile pigments are any of several coloured compounds derived from porphyrin that are found in bile; principally bilirubin and biliverdin. Bile pigment is produced regularly when old red blood cells are broken down, mainly by the spleen. In some blood-disorders where the red cells are destroyed, more bile pigment is produced.
43. (a) Fructose and amino acids are absorbed through intestinal mucosa with the help of carrier ions like Na^+. Carbohydrates are absorbed as monosaccharides (simple sugars such as glucose, fructose, and galactose that cannot be further broken down by hydrolysis) or as disaccharides (such as sucrose, lactose, maltose, and dextrin that can be hydrolyzed to two monosaccharides). These simpler molecules, however, must be obtained by

the breaking down of polysaccharides, complex carbohydrates that contain many monosaccharides. Chief among these is amylase, a starch that accounts for 20 percent of dietary carbohydrate.

44. (b) Fat and cellulose is the pair of food components in human that reaches the stomach totally undigested.
45. (c) If the secretion of parietal cells of gastric glands is blocked with an inhibitor, in the absence of HCI secretion, inactive pepsinogen is not converted into the active enzyme pepsin.
46. (c) Due to a long hunger strike and survival on water, a person will have less urea in his urine because urea is delivered to kidney as a waste product from liver which is formed after the breakdown of proteins fats, carbohydrates during hunger.
47. (a) Lysozyme is an antibacterial agent which is secreted by the major salivary glands.
48. (b) Presence of microvilli on the epithelial cells of intestine increases the surface area for absorption of food.
49. (b) Secretin and cholecystokinin are secreted in the duodenum.
They provide stimulus to
(i) Secretin : Acidic chyme entry into duodenum
(ii) CCK-PZ : Presence of fat in duodenum
Their action involves:
(i) Secretin : Releases bicarbonates in the pancreatic juice.
(ii) CCK-PZ : contracts the gall bladder to release bile. Stimulating pancreas to secrete and release digestive enzymes in the pancreatic juice.
50. (b) Secretin released by duodenal cells inhibits movement in gastrointestinal tract. Cholecystokinin stimulates release of pancreatic enzymes. Prolactin is a hormone released by anterior pituitary.

NOTES
Parathormone is released by parathyroid glands. Estradiol is released by ovary and progesterone is released by corpus luteum.

51. (b) Carbohydrates are the basic source of energy, proteins provide material for growth and development.
52. (c) Proteases catalyze breakdown of proteins and amylases act upon carbohydrates. Hydrolases catalyse hydrolysis.
53. (a) Boiled potato does not contain cellulose or lactose. Its starch is also digested. DNA is broken down into purines, pyrimidines and sugars by pancreatic nuclease (such as DNAase).
54. (a) Duodenum.
55. (d) Enterogasterone reduces digestive activity of stomach. Renin is secreted by kidney and regulates blood pressure. Enterokinase activates trypsinogen to trypsin.
56. (c) When a major portion of pancreas is removed, the enzymes that typically digest fat and meat inside the intestine are also removed.
57. (b) Hypercholesterolemia or high blood cholesterol arises due to excess saturated fat in the diet. In this condition cholesterol deposits on the walls of blood vessels causing reduction in their diameter. This results in rise of blood pressure and other cardiac disorders. The disease can be prevented by taking unsaturated oils in the diet i.e. vegetable oils such as groundnut oils. Butter, ghee, animal fats are all rich in saturated fatty acids.
58. (a) Fat is mainly digested by pancreatic lipase while protein is digested by enzymes in pancreatic juice, intestinal juice and stomach.
59. (b) The enzyme enterokinase (enteropeptidase) helps in the conversion of trypsinogen (inactive form of another enzyme) into trypsin (active form of the enzyme) for protein digestion in the intestine.
60. (d) Renin acts on milk protein casein & changes it into paracasein spontaneously precipitating into insoluble calcium paracaseinate, forming solid curd or coagulated milk. Renin is present in the gastric juice and hence works in highly acidic pH (due to HCl) in stomach (about 1-3 pH) and is absent in adult human being.
61. (b) Inhibition of gastric juice secretion is done by a hormone (secreted by the intestinal mucosa) called enterogastrone while stimulation of gastric juice secretion is done by the hormone gastrin secreted by the pyloric stomach mucosa. On the other hand pancreatic

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& bile secretions are controlled by a hormone complex cholecystokinin pancreozymin (CCK-PZ) secreted by the intestinal mucosa.

62. (d) Enterogestrone is a hormone secreted by intestinal mucosa and it has an inhibitory effect on gastric juice from gastric glands in stomach.

63. (d) Although traces of fat digesting enzyme (gastric lipase) have been reported but due to its very little concentration, it is unable to start fat digestion in stomach. Fat digestion starts in duodenum with the help of bile salts & pancreatic juice but completes in small intestine.

64. (b) Protein digestion starts in the stomach with the action of enzyme pepsin. In the duodenum it is performed by the action of trypsin, chymotrypsin & carboxypeptidases (from pancreatic juice). Aminopeptidases & dipeptidases, enterokinase act in jejunum and it ends in the ileum.

65. (d) Pancreatic juice secretion is regulated by the hormone secretin, which is produced by the walls of the duodenum upon detection of acid in food, proteins, and fats.

66. (d) Pancreas consists mainly of large lobules / acini / alveoli and secretes pancreatic juice. In between the acini, randomly spread endocrine cells are present known as Islets of Langerhans which consist of a, b, and F cells & secrete insulin, glucagon, pancreatic polypeptide and somatostatin hormones.

67. (b) Cholecystokinin is a hormone which is secreted by the duodenal wall. It causes the release of bile by the contraction of the gall bladder & increases the enzyme release process of pancreatic cells. The pancreatic juice enterokinase is an 'activator enzyme' which is present in the intestinal juice (success entericus) and converts the inactive proenzyme trypsinogen to active trypsin enzyme. Secretin is also a hormone and causes the release of sodium bicarbonate in the pancreatic juice.

68. (a) Kwashiorkor is a severe protein malnutrition but unaccompanied by calorie deficiency. It results from the replacement of mother's milk by a high calorie-low protein diet in a child more than one year in age. The symptoms are oedema, stunted growth, mental retardation, wrinkled skin, thin legs, bulged eyes, protruded belly.

NOTES

Kwashiorkor is a form of severe protein malnutrition characterized by edema and an enlarged liver with fatty infiltrates. It is caused by sufficient calorie intake, but with insufficient protein consumption, which distinguishes it from marasmus. Kwashiorkor cases occur in areas of famine or poor food supply. Delayed growth in children, a swollen stomach and frequent infections are symptoms.

Treatment for kwashiorkor may include a slow increase in calories followed by an increase in protein.

69. (a) Anxiety and eating spicy food together in normal healthy man can lead to indigestion which causes difficulty in digestion.

70. (d) If breast feeding is replaced by less nutritive food low in proteins and calories; the infants below the age of one year are likely to suffer from Marasmus. It is a form of malnutrition that occurs when there is not enough protein in the diet. This disease is more common in very poor countries. It often occurs during a drought or other natural calamities, or during political unrest. These conditions are responsible for a lack of food, which leads to malnutrition.

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71. (a) Fat soluble vitamins are - A, D, E and K and lack of vitamin A causes xerophthalmia.

72. (a) Deficiency of vitamin B_1 causes Beri Beri disease. Beri Beri disease was discovered by Eijkman in 1897. He observed that the disease occured mainly in people existing on a polished rice diet. This disease is rare in the western world because of food habits and food enrichment. Beri beri disease is characterized by loss of apetite and weight and vigour, retarted growth, degeneration of nerves, muscle atrophy, and even paralysis, weakened heart beat and failure.

73. (b) A child may have a diet containing sufficient carbohydrates and fats but still suffers a serious form of malnutrition. This form of malnutrition is known as Kwashiorkor. It develops in children whose diets are deficient in protein. When the first child is weaned (not accustomed to food other than its mother's

milk) after the second is born, its primary supply of protein (the mother's milk) is lost. If the new diet is very low in protein the needs of the growing individual this disease develops. All the food stuff eg. milks, lentils, meat and eggs are rich in proteins.

74. (b) Deficiency of pyridoxine (Vit B_6) causes dermatitis, anaemia, convulsions, nausea, vomiting and mental disorders.
75. (a) Vitamins, A, D, E and K are fat soluble vitamins.
76. (a) Carrots are a source of vitamin A. Egg is a good source of vitamin E.
77. (d) Main source of flourine include drinking water, tea, sea food. Deficiency causes weak teeth and excess causes mottling of teeth or fluorosis.
78. (a) Deficiency of vitamin B_1 (Thiamine) causes beri beri.
79. (d) Vitamin K is also called anti-haemorrhagic factor or phylloquinone. Its deficiency causes delayed blood clotting. Even minor injuries in the body of those such cause profuse bleeding (haemorrhage).
80. (c) Vitamin B_3 or Niacin is a constituent of NAD. Corpus luteum is temporary endocrine tissue developing from ruptured grafian follicle. Bundle of His is a part of the conducting system of heart conducting cardiac impulse from atria to ventricles. Sebum is the name given to the oil secreted by sebaceous glands in the skin.
81. (a) Vitamin D - Calciferol
    Vitamin B_1 - Thiamine
    Vitamin A - Retinol
    Vitamin B_2 - Riboflavin
82. (c) Vitamin A is essential for the synthesis of retinal pigment, rhodopsin. Carrot and papaya are good sources of vitamin A.
83. (b) In patients affected with cholera, a cholera enterotoxin is produced which results in increased synthesis of intracellular cyclic AMP, which in turn increases the permeability of intestinal mucosa, leading to secretion of fluid throughout the small intestine. Hence the patient is given saline drip whereby Na^+ ions restore the osmotic balance by retaining water in the body.
84. (c) Vitamin K is a fat soluble vitamin. It is essential for synthesis of prothrombin and other clotting factors. Deficiency of vitamin K increases clotting time resulting in prolonged bleeding.
85. (a) Hepatic portal system brings venous blood directly from digestive tract, spleen, pancreas and gall bladder to liver for extraction of nutrients and other metabolites by the hepatic portal vein. Aorta arises from the left ventricle and carries oxygenated blood to all parts of the body. Posterior vena cava opens into the right atrium bringing deoxygenated blood from the lower half of the body.
86. (b) Vitamin A takes parts in synthesis of retinal pigments. Vitamin C functions as antioxidant. Vitamin D is required for the absorption of calcium in the intestine.
87. (c) Nightblindness is caused by deficiency of vitamin A. Cirrhosis is caused by inflammation of liver cells.
88. (d) Vitamin K is a fat soluble vitamin produced in sufficient quantity by intestinal bacteria. Vitamin B_1 is a water soluble vitamin, obtained partly from intestinal bacteria and partly from diet. Vitamin D is a fat soluble sterol synthesized in the skin, Vitamin C is obtained specially from citrus fruits.
89. (c) Beri-beri is a deficiency disease caused by the lack of vitamin B_1 (Thiamine) in the diet. The deficiency of riboflavin (vitamin B_2) causes ariboflavinosis. Scurvy is the result of lack of vitamin C in the diet. Deficiency of calciferol (vitamin D) in the diet causes rickets in children and osteomalacia in adults.
90. (c) Scurvy is a disease with bleeding gums, thin bones etc. It is caused due to the deficiency of vitamin C. It can be cured by taking citrus fruits.
91. (c) The excess of fluorine in water causes a condition called fluorosis, which is identified by mottling of teeth (yellowish streaks) and abnormal bones liable to fracture etc.
92. (c) Pellagra.
93. (a) Vitamin D (ergocalciferol or antirachitic vitamin) which is commonly known as 'sunshine vitamin' regulates the absorption of

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calcium & phosphorus from gastrointestinal tract and hence helping in the normal growth of bones & teeth. Its deficiency disturbs the calcium & phosphorus absorption and hence deficiency of these minerals in the body causes soft bones where bones become curved and fragile (osteomalacia) and teeth decay.

94. (b) Vitamin K is also known as 'antihaemorrhagic factor'. This vitamin is essential for the synthesis of prothrombin in liver cells which is essential for normal blood clotting. It is also synthesized by bacteria present in the colon.

95. (c) Pellagra which is characterized by skin inflammation specially thick pigmented skin of hands and legs, swollen lips, diarrhoea & nervous disorder is caused by the deficiency of vitamin B_3 also known as Nicotinic acid or Vitamin P.P. (Pellagra preventing vitamin).

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17 Breathing and Exchange of Gases

Trend Analysis with Important Topics & Sub-Topics

Topic	Sub-Topics	2020		2019		2018		2017		2016	
		Qns.	LOD	Qns.	LOD	Qns.	LOD	Qns.	LOD	Qns.	LOD
Respiratory Organs/ Mechanism of Breathing	Respiratory Volumes and Capacities	1	D			1	D	1	A		
Exchange and Transport of Gasses	Transport of Oxygen	1	D								
Disorders of Respiratory System	Emphysema					1	A			1	A
	Occupational Respiratory Disorder					1	A				
	Respiratory Disorders			1	A						

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LOD - Level of Difficulty | E - Easy | A - Average | D - Difficult | Qns - No. of Questions

Topic 1: Respiratory Organs/Mechanism of Breathing

1. Select the correct events that occur during inspiration. *[2020]*
   (i) Contraction of diaphragm
   (ii) Contraction of external inter-costal muscles
   (iii) Pulmonary volume decreases
   (iv) Intra pulmonary pressure increases
   (a) (iii) and (iv) (b) (i), (ii) and (iv)
   (c) Only (iv) (d) (i) and (ii)

2. Select the correct statement. *[2019, Odisha]*
   (a) Expiration is initiated due to contraction of diaphragm.
   (b) Expiration occurs due to external intercostal muscles.
   (c) Intrapulmonary pressure is lower than the atmospheric pressure during inspiration.
   (d) Inspiration occurs when atmospheric pressure is less than intrapulmonary pressure.

3. The maximum volume of air a person can breathe in after a forced expiration is known as : *[2019, Odisha]*
   (a) Total lung capacity
   (b) Expiratory capacity
   (c) Vital capacity
   (d) Inspiratory capacity

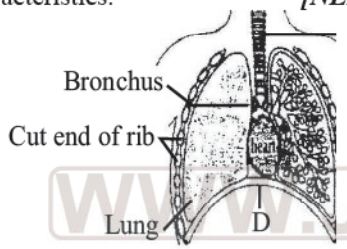
4. Tidal volume and Expiratory reserve volume of an athlete is 500 mL and 1000 mL respectively. What will be his Expiratory capacity if the residual volume is 1200 mL? *[2019]*
   (a) 1500 mL (b) 1700 mL
   (c) 2200 mL (d) 2700 mL

5. Match the items given in Column I with those in Column II and select the correct option given below: *[2018]*

Column I		Column II	
A.	Tidal volume	i.	2500 – 3000 mL
B.	Inspiratory Reserve volume	ii.	1100 – 1200 mL
C.	Expiratory Reserve volume	iii.	500 – 550 mL
D.	Residual volume	iv.	1000 – 1100 mL

	A	B	C	D
(a)	iii	ii	i	iv
(b)	iii	i	iv	ii
(c)	iv	iii	ii	i
(d)	i	iv	ii	iii

6. Lungs are made up of air-filled sacs, the alveoli. They do not collapse even after forceful expiration, because of: *[2017]*
   (a) Inspiratory Reserve Volume
   (b) Tidal Volume
   (c) Expiratory Reserve Volume
   (d) Residual Volume
7. The figure shows a diagrammatic view of human respiratory system with labels A, B, C and D. Select the option which gives correct identification and main function and/or characteristics. *[NEET 2013]*



   (a) B-pleural membrane-surrounds ribs on both sides to provides cushion against rubbing.
   (b) C-Alveoli-thin walled vascular bag like structures for exchange of gases.
   (c) D-Lower end of lungs-diaphragm pulls it down during inspiration
   (d) A-trachea-long tube supported by complete cartilaginous rings for conducting inspired air.
8. Which one of the following is a possibility for most of us in regard to breathing, by making a conscious effort? *[2011M]*
   (a) One can breathe out air totally without oxygen.
   (b) One can breathe out air through eustachian tubes by closing both the nose and the mouth.
   (c) One can consiously breathe in and breathe out by moving the diaphragm alone, without moving the ribs at all.
   (d) The lungs can be made fully empty by forcefully breathing out all air from them
9. Bulk of carbon dioxide (CO_2) released from body tissues into the blood is present as *[2011M]*
   (a) bicarbonate in blood plasma and RBCs
   (b) free CO_2 in blood plasma
   (c) 70% carbamino- haemoglobin and 30% as bicarbonate
   (d) carbamino-haemoglobin in RBCs
10. Listed below are four respiratory capacities (i–iv) and four jumbled respiratory volumes of a normal human adult: *[2010]*

Respiratory capacities	Respiratory volumes
(i) Residual volume	2500mL
(ii) Vital capacity	3500mL
(iii) Inspiratory reserve volume	1200mL
(iv) Inspiratory capacity	4500mL

   Which one of the following is the correct matching of two capacities and volumes?
   (a) (ii) 2500mL, (iii) 4500mL
   (b) (iii) 1200mL, (iv) 2500mL
   (c) (iv) 3500 mL, (i) 1200mL
   (d) (i) 4500 mL, (ii) 3500mL
11. The majority of carbon dioxide produced by our body cells is transported to the lungs *[2006]*
   (a) as bicarbonates
   (b) as carbonates
   (c) attached to hemoglobin
   (d) dissolved in the blood
12. The quantity 1500 ml in the respiratory volumes of a normal human adult refers to *[1996]*
   (a) maximum air that can be breathed in and breathed out
   (b) residual volume
   (c) expiratory reserve volume
   (d) total lung capacity
13. Air is breathed through *[1994]*
   (a) Trachea — lungs — larynx — pharynx — alveoli
   (b) Nose — larynx — pharynx — bronchus — alveoli — bronchioles
   (c) Nostrils — pharynx — larynx — trachea — bronchi — bronchioles — alveoli
   (d) Nose — mouth — lungs
14. Carbonic anhydrase occurs in *[1991]*
   (a) Lymphocytes (b) Blood plasma
   (c) RBC (d) Leucocytes

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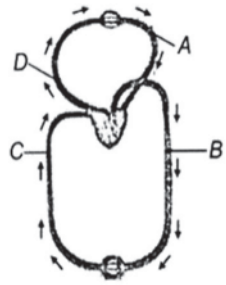
15. Skin is an accessory organ of respiration in *[1990]*
    (a) humans (b) frog
    (c) rabbit (d) lizard
16. The alveolar epithelium in the lungs is *[1990]*
    (a) nonciliated columnar
    (b) nonciliated squamous
    (c) ciliated columnar
    (d) ciliated squamous
17. Intercostal muscles occur in *[1988]*
    (a) abdomen (b) thigh
    (c) ribs (d) diaphragm
18. What is vital capacity of our lungs? *[1988]*
    (a) Inspiratory reserve volume plus tidal volume
    (b) Total lung capacity minus expiratory reserve volume
    (c) Inspiratory reserve volume plus expiratory reserve volume
    (d) Total lung capacity minus residual volume

Topic 2: Exchange and Transport of Gases

19. Identify the wrong statement with reference to transport of oxygen. *[2020]*
    (a) Partial pressure of CO_2 can interfere with O_2 binding with haemoglobin
    (b) Higher H^+ conc. in alveoli favours the formation of oxyhaemoglobin
    (c) Low pCO_2 in alveoli favours the formation of oxyhaemoglobin
    (d) Binding of oxygen with haemoglobin is mainly related to partial pressure of O_2
20. When you hold your breath, which of the following gas changes in blood would first lead to the urge to breathe? *[2015 RS]*
    (a) rising CO_2 concentration
    (b) falling CO_2 concentration
    (c) rising CO_2 and falling O_2 concentration
    (d) falling O_2 concentration
21. Approximately seventy percent of carbon-dioxide absorbed by the blood will be transported to the lungs: *[2014]*
    (a) as bicarbonate ions
    (b) in the form of dissolved gas molecules
    (c) by binding to R.B.C.
    (d) as carbamino - haemoglobin
22. Figure shown schematic plan of blood circulation in humans with labels A to D. Identify the label and give its function's. *[NEET 2013]*



    (a) B-Pulmonary artery-takes blood from heart to lungs, PO_2 = 90 mm Hg
    (b) C-Vena Cava - takes blood from body parts to right auricle, PCO_2 = 45 mm Hg
    (c) D - Dorsal aorta - takes blood from Heart to body Part PO_2 = 95 mm Hg
    (d) A-Pulmonary vein - takes impure blood from body parts, PO_2 = 60 mm Hg
23. The figure given below shows a small part of human lung where exchange of gases takes place. In which one of the options given below, the one part **A, B, C or D** is correctly identified along with its function? *[2011]*

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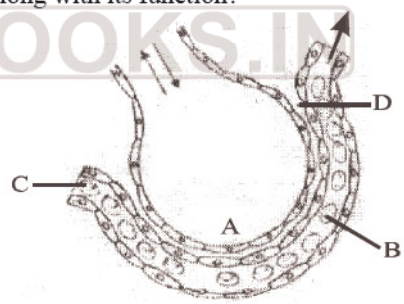

Options :
    (a) C : arterial capillary – passes oxygen to tissues
    (b) A : alveolar cavity – main site of exchange of respiratory gases
    (c) D : capillary wall – exchange of O_2 and CO_2 takes place here.
    (d) B : red blood cell – transport of CO_2 mainly
24. A large proportion of oxygen is left unused in the human blood even after its uptake by the body tissues. This O_2 *[2011]*
    (a) acts as a reserve during muscular exercise
    (b) raise the pCO_2 of blood to 75 mm of Hg.

(c) is enough to keep oxyhaemoglobin saturation at 96%
(d) helps in releasing more O_2 to the epithelial tissues.

25. Which two of the following changes (a–d) usually tend to occur in the plain dwellers when they move to high altitudes (3,500 m or more)? *[2010]*
(i) Increase in red blood cell size
(ii) Increase in red blood cell production
(iii) Increased breathing rate
(iv) Increase in thrombocyte count
Changes occurring are:
(a) (ii) and (iii) (b) (iii) and (iv)
(c) (i) and (iv) (d) (i) and (ii)

26. When CO_2 concentration in blood increases, breathing becomes *[2004]*
(a) shallower and slow
(b) there is no effect on breathing
(c) slow and deep
(d) faster and deeper

27. The process of migration of chloride ions from plasma to RBC and of carbonate ions from RBC to plasma is *[1999]*
(a) chloride shift (b) ionic shift
(c) atomic shift (d) Na+ pump

28. Which one of the following organs in the human body is most affected due to shortage of oxygen? *[1999]*
(a) intestine (b) skin
(c) kidney (d) brain

29. The exchange of gases in the alveoli of the lungs takes place by *[1998]*
(a) simple diffusion (b) osmosis
(c) active transport (d) passive transport

30. In alveoli of the lungs, the air at the site of gas exchange, is separated from the blood by *[1997]*
(a) alveolar epithelium only
(b) alveolar epithelium and capillary endothelium
(c) alveolar epithelium, capillary endothelium and tunica adventitia
(d) alveolar epithelium, capillary endothelium, a thin layer of tunica media and tunica adventitia

31. Although much CO_2 is carried in blood, yet blood does not become acidic, because *[1995]*
(a) it is absorbed by the leucocytes
(b) blood buffers play an important role in CO_2 transport.
(c) it combines with water to form H_2CO_3 which is neutralized by $NaCO_3$
(d) it is continuously diffused through tissues and is not allowed to accumulate

32. The carbon dioxide is transported via blood to lungs as *[1995]*
(a) dissolved in blood plasma
(b) in the form of carbonic acid only
(c) in combination with haemoglobin only
(d) carbaminohaemoglobin and as carbonic acid

33. Oxygen dissociation curve of haemoglobin is *[1994]*
(a) Sigmoid (b) Hyperbolic
(c) Linear (d) Hypobolic

34. Carbon dioxide is transported from tissues to respiratory surface by only *[1993]*
(a) plasma and erythrocytes
(b) plasma
(c) erythrocytes
(d) erythrocytes and leucocytes

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Topic 3: Disordes of Respiratory System

35. Due to increasing air-borne allergens and pollutants, many people in urban areas are suffering from respiratory disorder causing wheezing due to: *[2019]*
(a) benign growth on mucous lining of nasal cavity.
(b) inflammation of bronchi and bronchioles.
(c) proliferation of fibrous tissues and damage of the alveolar walls.
(d) reduction in the secretion of surfactants by pneumocytes.

36. Which part of poppy plant is used to obtain the drug "Smack"? *[2018]*
(a) Flowers (b) Latex
(c) Leaves (d) Roots

37. Which of the following is an occupational respiratory disorder? *[2018]*
(a) Anthracis (b) Silicosis
(c) Emphysema (d) Botulism

38. Name the chronic respiratory disorder caused mainly by cigarette smoking *[2016]*
    (a) emphysema
    (b) asthma
    (c) respiratory acidosis
    (d) respiratory alkalosis
39. Name the pulmonary disease in which alveolar surface area involved in gas exchange is drastically reduced due to damage in the alveolar walls. *[2015 RS]*
    (a) Emphysema
    (b) Pneumonia
    (c) Asthma
    (d) Pleurisy
40. Which of the following are the correct statement for respiration in human? *[2012]*
    (a) Cigarette smoking may lead to inflammation of bronchi
    (b) Neural signals from pneumotaxic centre in pons region of brain can increase the duration of inspiration
    (c) Workers in grinding and stone - breaking industries may suffer from lung fibrosis
    (d) About 90% of carbon dioxide (CO_2) is carried by haemoglobin as carbamino haemoglobin.
41. Blood analysis of a patient reveals an unusually high quantity of carboxyhaemoglobin content. Which of the following conclusions is most likely to be correct? The patient has been inhaling polluted air containing unusually high content of *[2004]*
    (a) carbon disulphide
    (b) chloroform
    (c) carbon dioxide
    (d) carbon monoxide

ANSWER KEY

1	(d)	6	(d)	11	(a)	16	(b)	21	(a)	26	(d)	31	(b)	36	(b)	41	(d)
2	(c)	7	(b)	12	(b)	17	(c)	22	(b)	27	(a)	32	(d)	37	(b)		
3	(c)	8	(b)	13	(c)	18	(d)	23	(b)	28	(d)	33	(a)	38	(a)		
4	(a)	9	(a)	14	(c)	19	(b)	24	(a)	29	(a)	34	(a)	39	(a)		
5	(b)	10	(c)	15	(b)	20	(a)	25	(a)	30	(b)	35	(b)	40	(c)		

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Hints & Solutions

1. (d) Inspiration is initiated by the contraction of diaphragm, which increases the volume of thoracic chamber in the anterio-posterior axis. The contraction of external inter-coastal muscles lifts up the ribs and the sternum causing an increase in the volume of the thoracic chamber in the dorso-ventral axis.

NOTES **Inspiratory Reserve Volume (IRV):** Additional volume of air, a person can inspire by a forcible inspiration. This averages 2500 mL to 3000 mL.

2. (c) During inspiration, diaphragm and external intercostal muscles contract causing increase in volume of thoracic cage. As a result intrapulmonary pressure decreases to a level less than atmospheric pressure, thus causing inspiration.
   Expiration is initiated due to relaxation of diaphragm.
3. (c) Vital capacity is the maximum amount of air expired by a person after forceful inspiration or inspired after forceful expiration. It represents the changes in volume from completely emptied lungs to completely filled lungs. It is about 4800 ml. The value varies according to age and body size.

NOTES Total amount of air in lungs at end of forceful inspiration is total lung capacity 5800 ml

4. (a) Expiratory capacity is the total volume of air that a person can expire after a normal inspiration. this includes tidal volume and expirtory reserve volume (TV + ERV).
Tidal volume of an athelete = 500 ml
Expiratory reserve volume of an athelete = 1000 ml
Expiratory capacity = TV + ERV
= 500 + 1000
= 1500 ml

5. (b) Tidal volume (TV) is volume of air inspired or expired during normal respiration. It is approximately 500 mL. Inspiratory reserve volume (IRV) is additional volume of air a person can inspire by a forceful inspiration. It is around 2500 - 3000 mL. Expiratory reserve volume (ERV) is additional volume of air a person can be expired by a forceful expiration. This averages 1000 - 1100 mL. Residual volume (RV) is volume of air remaining in lungs even after forceful expiration. This averages 1100 - 1200 mL.

6. (d) Volume of air present in lungs after forceful expiration as residual volume prevents the collapsing of alveoli.

NOTES
Atelectasis is a complete or partial collapse of the entire lung or area (lobe) of the lung. It occurs when the tiny air sacs (alveoli) within the lung become deflated or possibly filled with alveolar fluid. Atelectasis is one of the most common breathing (respiratory) complications after surgery.

7. (b) Alveoli are very thin, irregular walled bag like structures for gaseous exchange. Tracheae bronchi and bronchioles are supported by incomplete cartilaginous rings. Double layered pleural membrane surrounds the lungs with pleural fluid between them. It reduces friction on the lung surface.

8. (b) Eustachian tube connects middle ear cavity (tympanic cavity) with nasopharynx. It is approximately 35 mm long in adults, which helps in breathing out by closing both the nose and mouth.

9. (a) 70% to 75% CO_2 is transported as primary buffer of the blood bicarbonate ion (HCO_3) in blood plasma. When CO_2 diffuses from tissues into blood then it is acted upon by the enzyme carbonic anhydrase.

10. (c) The correct matching of respiratory capacities with their respiratory volumes are:

Respiratory Capacities	Respiratory Volumes
Residual volume	1200 mL
Vital capacity	4500 mL
Inspiratory reserve volume	2500 mL
Inspiratory volume	3500 mL

11. (a) Transport of CO_2 is much easier than O_2 because of the higher solubility of CO_2 than O_2. Almost 7% of CO_2 is transported in dissolved state in plasma. About 23% of the CO_2 is transported in the form of carbamino haemoglobin. 70% of CO_2 is transported in the form of bicarbonate ions. CO_2 reacts with water present in plasma.

NOTES
Carbonic acid is unstable & gives H+ and HCO^{3-}. H^+ bind with haemoglobin to maintain the pH of blood while HCO^{3-} remain in the blood and carries the CO_2 to lungs.

12. (b) The total volume of air that can be expelled from the lungs after maximum inspiration and then expiring to the maximum is known as the vital capacity. The volume of air that remains inside lungs at the end of maximum forceful expiration is the residual volume. Expiratory reserve volume is the maximum extra volume of air that can be expired by forceful expiration after a normal tidal expiration. Total lung capacity is the maximum volume of air that can be contained in the lungs after maximum inspiration.

13. (c) The pathway of inhaled air is - Nostrils → pharynx (common passage for food & air) → larynx (voice box) → trachea (the wind pipe) → bronchi (2 for each side lungs) → bronchioles (give rise to alveolar ducts) → alveoli (the exchange site for gases in the form of small sacs or pouches).

14. (c) Carbonic anhydrase is a zinc-containing enzyme present in RBCs. In presence of this enzyme, carbon dioxide reacts with water to form carbonic acid.

NOTES
Carbonic anhydrase is abundantly distributed in renal tissue and functions, as in other epithelia, to catalyze the hydration-dehydration reaction of CO2. The proximal tubule is responsible for at least 80% of whole kidney bicarbonate transport and is mediated by proton secretion.

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15. (b) Frog has lungs as its main respiratory organs but during hibernation & aestivation and when in water it respires through skin.
16. (b) The very thin alveolar wall (about 0.0001 mm) is composed of moist, non–ciliated, squamous epithelial cells.
17. (c) Intercostal muscles (external intercostal and internal intercostal) are attached with the ribs which help in the movement of rib cage during breathing.
18. (d) Vital capacity of lungs is the largest possible expiration after largest possible inspiration that is greatest. Volume of air can be exchanged in single respiration or amount of air breathed in and out with greatest possible efforts.
    VC = TRV +TV + ERV
    = 3000 + 500 + 1100
    = 4600 ml.
19. (b) The correct option is (b) because higher H+ concentration favours the dissociation of oxygen from oxyhaemoglobin in tissues. In the alveoli, high pO2, low pCO2, lesser H+ concentration and lower temperature favour formation of oxyhaemoglobin.
20. (a) Chemoreceptors in the medulla get stimulated by increase in CO_2 concentration in the blood of arteries. Decrease in O_2 concentration has no significant effect on chemoreceptors.
21. (a) CO_2 from the respiratory tissues to the lungs is transported by the blood in 3 ways:
    (i) In dissolved state or as a physical solution: Very small amount is physically dissolved in plasma (7% i.e. ≅ **0.**3 ml of CO_2 by each 100 ml of blood).
    (ii) Bicarbonate ions: ≅ 70% (i.e. ≅ **2.**5 ml per 100 ml of blood) CO_2 diffuses in plasma & then into RBCs where it (in the presence of carbonic anhydrase) combines with H_2O to form carbonic acid which is almost spontaneously dissociated into hydrogen ion and bicarbonate ions.
    (iii) Carbaminohaemoglobin : ≅ 23% (i.e. ≅ 1 ml of CO_2 per 100 ml of blood) combines with haemoglobin forming an unstable compound.
22. (b) A is pulmonary vein which takes pure blood from lungs to heart. B is dorsal aorta which takes pure blood from heart to various body parts. C is vena cava which takes impure blood from various body pars to right auricle of the heart. D is pulmonary artery which takes impure blood from heart to lungs.
23. (b) In the given figure the exchange of respiratory gases occurs in alveolar cavity.

> **NOTES**
> The thickness of the alveolar-capillary barrier varies from 0.2 to 2.5 μm. The wall of the capillary endothelial cell is fused to that of the alveolar cell with only a very thin basement membrane between these two cells. This produces a very narrow gap across which oxygen and carbon dioxide can rapidly diffuse.

24. (a) A large portion of oxygen is left unused in the human blood even after its uptake by the body tissues. This O_2 acts as a reserve during muscular exercise.
25. (a) At high altitude, the body undergoes numerous changes in order to increase oxygen delivery to cells and improve the efficiency of oxygen usage. The early changes include increased breathing rate and increased red blood cell production.
26. (d) The breathing becomes faster and deeper in order to oxygenate the blood at a fast rate. Shallow and slow breathing occurs during rest.
27. (a) During the transport of CO_2 through the blood, bicarbonate ions diffuse out of RBCs while chloride ions from plasma enter the RBCs to maintain ionic equilibrium. This is called chloride shift.
28. (d) Brain is the most vital organ. It stops functioning in the absence of O_2.

> **NOTES**
> Brain death is a legal definition of death. It is the complete stopping of all brain function and cannot be reversed. It means that, because of extreme and serious trauma or injury to the brain, the body's blood supply to the brain is blocked, and the brain dies. Brain death is death. It is permanent.

29. (a) Gaseous exchange between blood (dissolved phase) and alveolar air (gaseous phase) across respiratory membrane occurs by simple diffusion. Obviously, it depends upon the concentration gradient (=partial pressure) of the concerned gases in blood and alveolar air.

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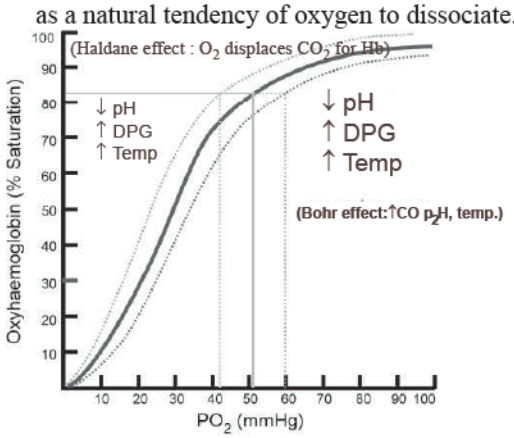
30. (b) Alveoli are the site of respiratory exchange of gases. Oxygen from the alveolar air diffuses through the alveolar epithelium and the capillary endothelium into the capillary blood, and carbon dioxide diffuses in the opposite direction.

31. (b) CO_2 enters RBC and reacts with water to form carbonic acid. Carbonic acid dissociates to form bicarbonate and hydrogen ions. Some bicarbonate ions are transported in erythrocytes while some diffuse into the blood plasma. Exit of bicarbonate ions change the ionic balance between the plasma and erythrocytes. To restore this balance chloride ions diffuse from plasma into erythrocytes. Due to this the pH of blood is maintained.

32. (d) Carbon dioxide is transported via blood to lungs mostly as carbaminohaemoglobin and carbonic acid. It is released in lungs in exchange with oxygen.

33. (a) It is the relationship between the percentage saturation of haemoglobin (by volume) in the blood and the oxygen tension (partial tension) PO_2 of the blood.
It is usually a sigmoid curve. Haemoglobin molecules can bind up to four oxygen molecules in a reversible manner. The shape of the curve results from the interaction of bound oxygen molecules with incoming molecules. The binding of the first molecule is difficult. However, this facilitates the binding of the second and third molecules, and it is only when the fourth molecule is to be bound that the difficulty increases, partly as a result of crowding of the haemoglobin molecule, partly as a natural tendency of oxygen to dissociate.



The O_2-Hb dissociation curve is a sigmoidal curve that represents the relationship between O_2 concentration and the percentage saturation of Hb. As the concentration increases from about 90% there is a significant plateau in the curve, which has several important biological repercussions.

34. (a) CO_2 from the respiratory tissues to the lungs is transported by the blood in 3 ways :
(i) **In dissolved state or as a physical solution :** Very small amount physically dissolved in plasma (7% i.e. ≅ 0.3 ml of CO_2 by each 100 ml of blood)
(ii) **Bicarbonate ions :** ≅ 70% (i.e. ≅ 2.5 ml per 100 ml of blood) CO_2 diffuses in plasma & then into RBCs where it (in the presence of carbonic anhydrase) combines with H_2O to form carbonic acid which is almost spontaneously dissociated into hydrogen ion & bicarbonate ions.
(iii) **Carbaminohaemoglobin :** ≅ 23% (i.e. ≅ 1 ml of CO_2 per 100 ml of blood) combines with haemoglobin forming an unstable compound.

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35. (b) Asthma (an allergic condition) is a difficulty in breathing causing wheezing due to inflammation of bronchi and bronchioles. It can be due to increasing air born allergens and pollutants. Many people in urban areas are suffering from this respiratory disorder.

36. (b) 'Smack' also called as brown sugar/ Heroin is formed by acetylation of morphine. It is obtained from the latex of unripe capsule of Poppy plant (*Papaver somniferum*).

37. (b) Silicosis is an occupational disease caused due to excess inhalation of silica dust in the workers involved grinding or stone breaking industries.

NOTES
Diagnosis is made when someone who has worked with silica has chest computed tomography (CT) that shows distinctive patterns consistent with the disease. A chest x-ray can also be done to help diagnose silicosis. When imaging findings are unclear, samples of lung tissue can help confirm the diagnosis.

38. (a) Emphysema results when the delicate linings of the air sacs in the lungs become damaged beyond repair. Most commonly, the toxins in cigarette smoke create the damage. Emphysema is called smoker's disease.

39. (a) In the disease emphysema, alveolar surface area is reduced due to destruction of alveolar walls.

NOTES

Chronic empyema is characterized by thickened visceral and parietal peels which hamper the ability of the affected lung to re-expand and requires definitive surgical intervention, i.e., decortication with or without lung resection and/or pleural obliteration procedures like thoracoplasty and/or myoplasty. The most common cause of empyema is pneumonia caused by a bacterial infection of the lungs. An empyema can form when pneumonia fails to fully respond to treatment in a straightforward way.

40. (c) (a) and (c). Neural signals from pneumotaxic center in pons region of brain can limit the duration of inspiration. About 25% of carbon dioxide (CO_2) is carried by haemoglobin as carboxyhaemglobin.

NOTES

The pons contains nuclei that relay signals from the forebrain to the cerebellum, along with nuclei that deal primarily with sleep, respiration, swallowing, bladder control, hearing, equilibrium, taste, eye movement, facial expressions, facial sensation, and posture.

41. (d) Carboxyhaemoglobin is the stable product formed by the association of CO and Hb in the blood. The association of carbon dioxide and haemoglobin forms carbaminohaemoglobin.

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18 Body Fluids and Circulation

Trend Analysis with Important Topics & Sub-Topics

Topic	Sub-Topics	2020		2019		2018		2017		2016	
		Qns.	LOD	Qns.	LOD	Qns.	LOD	Qns.	LOD	Qns.	LOD
Blood/ Lymph	Blood					1	D	1	D	1	A
	WBCs	1	D								
Circulatory Pathways/ Double Circulation/ Regulation of Cardiac activity	ECG	1	A	1	D						
	Cardiac Output			1	D						

LOD - Level of Difficulty | E - Easy | A - Average | D - Difficult | Qns - No. of Questions

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Topic 1: Blood / Lymph

1. Match the following columns and select the correct option. *[2020]*

	Column-I		Column-II
(a)	Eosinophils	(i)	Immune response
(b)	Basophils	(ii)	Phagocytosis
(c)	Neutrophils	(iii)	Release histaminase, destructive enzymes
(d)	Lymphocytes	(iv)	Release granules containing histamine

	(A)	(B)	(C)	(D)
(a)	(iv)	(i)	(ii)	(iii)
(b)	(i)	(ii)	(iv)	(iii)
(c)	(ii)	(i)	(iii)	(iv)
(d)	(iii)	(iv)	(ii)	(i)

2. Match the items given in Column I with those in Column II and select the correct option given below : *[2018]*

	Column I		Column II
A.	Fibrinogen	(i)	Osmotic balance
B.	Globulin	(ii)	Blood clotting
C.	Albumin	(iii)	Defence mechanism

	A	B	C
(a)	(iii)	(ii)	(i)
(b)	(i)	(ii)	(iii)
(c)	(ii)	(iii)	(i)
(d)	(i)	(iii)	(ii)

3. Adult human RBCs are enucleated. Which of the following statement(s) is/are **most appropriate** explanation for this feature ? *[2017]*
   (1) They do not need to reproduce
   (2) They are somatic cells
   (3) They do not metabolize
   (4) All their internal space is available for oxygen transport
   (a) only (1).
   (b) (1), (3) and (4).
   (c) (2) and (3).
   (d) only (4).

4. Reduction in pH of blood will *[2016]*
   (a) reduce the rate of heart beat.
   (b) reduce the blood supply to the brain.
   (c) decrease the affinity of haemoglobin with oxygen.
   (d) release bicarbonate ions by the liver.

5. Which one of the following is correct ?
   (a) Serum = Blood + Fibrinogen *[2015 RS]*
   (b) Lymph = Plasma + RBC + WBC
   (c) Blood = Plasma + RBC + WBC
   (d) Plasma = Blood – Lymphocytes
6. Erythropoiesis starts in : *[2015 RS]*
   (a) Liver (b) Spleen
   (c) Red bone marrow (d) Kidney
7. Person with blood group AB is considered as universal recipient because he has: *[2014]*
   (a) both A and B antigens on RBC but no antibodies in the plasma.
   (b) both A and B antibodies in the plasma.
   (c) no antigen on RBC and no antibody in the plasma.
   (d) both A and B antigens in the plasma but no antibodies.
8. The figure shows a human blood cell. Identify it and give its characteristics. *[NEET Kar. 2013]*

	Blood Cell	Characteristics
(a)	Monocyte	Life span 3 days, produce antibodies
(b)	Basophil	Secrete serotonin, inflammatory response
(c)	B-lymphocyte	Form about 20% of blood cells involved in immune response
(d)	Neutrophil	Most abundant blood cell, phagocytic

9. Which one of the following plasma proteins is involved in the coagulation of blood ? *[2011]*
   (a) an albumin (b) serum amylase
   (c) a globulin (d) fibrinogen
10. Which one of the following human organs is often called the graveyard of RBCs? *[2011M]*
   (a) Gall bladder (b) Kidney
   (c) Spleen (d) Liver
11. ABO blood groups in humans are controlled by the gene I. It has three alleles – I^A I^B and i. Since there are three different alleles, six different genotypes are possible. How many phenotypes can occur? *[2010]*
   (a) Three (b) One
   (c) Four (d) Two
12. What is true about RBCs in humans? *[2010]*
   (a) They carry about 20–25 per cent of CO_2.
   (b) They transport 99.5 per cent of O_2.
   (c) They transport about 80 per cent oxygen only and the rest 20 per cent of it is transported in dissolved state in blood plasma.
   (d) They do not carry CO_2 at all.
13. The most popularly known blood grouping is the ABO grouping. It is named ABO and not ABC, because "O" in it refers to having: *[2009]*
   (a) overdominance of this type on the genes for A and B types.
   (b) one antibody only - either anti - A or anti-B on the RBC.
   (c) no antigens A and B on RBCs.
   (d) other antigens besides A and B on RBCs.
14. Compared to blood our lymph has: *[2009]*
   (a) plasma without proteins
   (b) more WBCs and no RBCs
   (c) more RBCs and less WBCs
   (d) no plasma
15. There is no DNA in: *[2009]*
   (a) mature RBCs
   (b) a mature spermatozoan
   (c) hair root
   (d) an enucleated ovum
16. Globulins contained in human blood plasma are primarily involved in : *[2009]*
   (a) osmotic balance of body fluids.
   (b) oxygen transport in the blood.
   (c) clotting of blood.
   (d) defence mechanisms of body.
17. Which type of white blood cells are concerned with the release of histamine and the natural anti- coagulant heparin? *[2008]*
   (a) Neutrophils (b) Basophils
   (c) Eosinophils (d) Monocytes
18. The most active phagocytic white blood cells are: *[2008]*
   (a) neutrophils and eosinophils
   (b) lymphocytes and macrophages
   (c) eosinophils and lymphocytes
   (d) neutrophils and monocytes
19. The haemoglobin of a human foetus *[2008]*
   (a) has a lower affinity for oxygen than that of the adult.
   (b) has affinity for oxygen is the same as that of an adult.
   (c) has only 2 protein subunits instead of 4.
   (d) has a higher affinity for oxygen than that of an adult.

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20. A drop of each of the following, is placed separately on four slides. Which of them will not coagulate? *[2007]*
(a) Blood serum
(b) Sample from the thoracic duct of lymphatic system
(c) Whole blood from pulmonary vein
(d) Blood plasma.

21. Which one of the following statements is **incorrect** ? *[2006]*
(a) The presence of non-respiratory air sacs, increases the efficiency of respiration in birds.
(b) In insects, circulating body fluids serve to distribute oxygen to tissues.
(c) The principle of countercurrent flow facilitates efficient respiration in gills of fishes.
(d) The residual area in lungs slightly decreases the efficiency of respiration in mammals.

22. In the ABO system of blood groups, if both antigens are present but no antibody, the blood group of the individual would be *[2004]*
(a) B (b) O
(c) AB (d) A

23. You are required to draw blood from a patient and to keep it in a test tube for analysis of blood corpuscles and plasma. You are also provided with the following four types of test tubes. Which of them will you not use for the purpose? *[2004]*
(a) Test tube containing calcium bicarbonate
(b) Chilled test tube
(c) Test tube containing heparin
(d) Test tube containing sodium oxalate

24. Which of the following statements is true for lymph? *[2002]*
(a) WBC and serum
(b) all components of blood except RBCs and some proteins
(c) RBCs, WBCs and plasma
(d) RBCs proteins and platelets

25. What is correct for blood group 'O'?*[2001]*
(a) No antigens but both a and b antibodies are present
(b) A antigen and b antibody
(c) Antigen and antibody both absent
(d) A and B antigens and a, b antibodies

26. What is true about leucocytes ? *[2000]*
(a) Their sudden fall in number is indication of blood cancer.
(b) These are produced in thymus.
(c) These are enucleated.
(d) These can squeeze out through the capillary walls.

27. In mammals, histamine is secreted by *[1998]*
(a) histiocytes (b) lymphocytes
(c) mast cells (d) fibroblasts

28. With respect to the ABO group, there are four major blood types because this blood group is determined by *[1998]*
(a) three alleles, all of which are recessive.
(b) three alleles, of which, two are recessive and the third is dominant.
(c) three alleles, of which two are co-dominant and the third is recessive.
(d) three alleles, all of which are co-dominant.

29. Which of the following is not a granulocyte? *[1997]*
(a) Lymphocyte (b) Eosinophil
(c) Basophil (d) Neutrophil

30. The life span of human W.B.C. is approximately
(a) less than 10 days. *[1997]*
(b) between 20 to 30 days.
(c) between 2 to 3 months.
(d) more than 4 months.

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31. Which one of the following vertebrate organs receives the oxygenated blood only ?
(a) Gill (b) Lung *[1996]*
(c) Liver (d) Spleen

32. Which one of the following statements about blood constituents and transport of respiratory gases is most accurate ? *[1996]*
(a) RBCs transport oxygen whereas WBCs transport CO_2.
(b) RBCs transport oxygen whereas plasma transports only CO_2.
(c) RBCs as well as WBCs transport both oxygen and CO_2.
(d) RBCs as well as plasma transport both oxygen and CO_2.

33. The lymph serves to *[1995]*
(a) transport oxygen to the brain.
(b) transport carbon dioxide to the lungs.
(c) return the interstitial fluid to the blood.
(d) return the WBCs and RBCs to the lymph nodes.

34. Antigens are present *[1995]*
(a) inside the nucleus
(b) on cell surface
(c) inside the cytoplasm
(d) on nuclear membrane

35. A child of blood group O cannot have parents of blood groups *[1994]*
(a) AB and AB/O (b) A and B
(c) B and B (d) O and O

36. Cells formed in bone marrow include *[1993]*
(a) RBC
(b) RBC and leucocytes
(c) Leucocytes
(d) Lymphocytes

37. A man with blood group A marries AB blood group woman. Which type of progeny indicate that the man is not homozygous? *[1993]*
(a) AB (b) B
(c) A (d) O

38. Blood capillaries are made of *[1993]*
(a) endothelium, connective tissue and muscle fibres
(b) endothelium and muscle fibres
(c) endothelium and connective tissue
(d) endothelium only

39. The genotype of B-group father of an O-group child is *[1992]*
(a) I^OI^O (b) I^BI^B
(c) I^AI^B (d) I^OI^B

40. Component of blood responsible for producing antibodies is *[1992]*
(a) Thrombocytes (b) Monocytes
(c) Erythrocytes (d) Lymphocytes

41. Wall of blood capillary is formed of *[1991]*
(a) haemocytes (b) parietal cells
(c) endothelial cells (d) oxyntic cells

42. Blood group AB has *[1991]*
(a) no antigen
(b) no antibody
(c) neither antigen nor antibody
(d) both antigen and antibody

43. Which one engulfs pathogens rapidly? *[1989]*
(a) Acidophils (b) Monocytes
(c) Basophils (d) Neutrophils

44. A person with blood group A requires blood. The blood group which can be given is *[1989]*
(a) A and B (b) A and AB
(c) A and O (d) A, B, AB and O

45. Removal of calcium from freshly collected blood would *[1989]*
(a) cause delayed clotting
(b) prevent clotting
(c) cause immediate clotting
(d) prevent destruction of haemoglobin

46. Lymph differs from blood in possessing *[1989]*
(a) only WBC
(b) more RBC and WBC
(c) more RBC and few WBC
(d) more WBC and few RBC

47. Mineral found in red pigment of vertebrate blood is *[1989]*
(a) magnesium (b) iron
(c) calcium (d) copper

48. RBCs do not occur in *[1988]*
(a) frog (b) cow
(c) camel (d) cockroach

Topic 2: Circulatory Pathways/Double Circulation/Regulation of Cardiac activity

49. The QRS complex in a standard ECG represents
(a) Depolarisation of auricles
(b) Depolarisation of ventricles
(c) Repolarisation of ventricles
(d) Repolarisation of auricles

50. All the components of the nodal tissue are autoexcitable. Why does the SA node act as the normal pacemaker? *[2019]*
(a) SA node has the highest rate of depolarisation.
(b) SA node has the lowest rate of depolarisation.
(c) SA node is the only component to generate the threshold potential.
(d) Only SA node can convey the action potential to the other components.

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51. A specialised nodal tissue embedded in the lower corner of the right atrium, close to Atrio-ventricular septum, delays the spreading of impulses to heart apex for about 0.1 sec. This delay allows *[2019]*
(a) the atria to empty completely.
(b) blood to enter aorta.
(c) the ventricles to empty completely.
(d) blood to enter pulmonary arteries.

52. Match the Column-I with Column-II. *[2019]*

	Column-I		Column-II
(a)	P-wave	(i)	Depolarisation of ventricles
(b)	QRS complex	(ii)	Repolarisation of ventricles
(c)	T - wave	(iii)	Coronary ischemia
(d)	Reduction in the size of T-wave	(iv)	Depolarisation of atria
		(v)	Repolarisation of atria

Select the **correct** option.

	(A)	(B)	(C)	(D)
(a)	(iv)	(i)	(ii)	(iii)
(b)	(iv)	(i)	(ii)	(v)
(c)	(ii)	(i)	(v)	(iii)
(d)	(ii)	(iii)	(v)	(iv)

53. What would be the heart rate of a person if the cardiac output is 5 L, blood volume in the ventricles at the end of diastole is 100 mL and at the end of ventricular systole is 50 mL? *[2019]*
(a) 50 beats per minute
(b) 75 beats per minute
(c) 100 beats per minute
(d) 125 beats per minute

54. Match the items given in Column I with those in Column II and select the correct option given below : *[2018]*

	Column I		Column II
A.	Tricuspid valve	i.	Between left atrium and left ventricle
B.	Bicuspid valve	ii.	Between right ventricle and pulmonary artery
C.	Semilunar valve	iii.	Between right atrium and right ventricle

	A	B	C
(a)	iii	i	ii
(b)	i	iii	ii
(c)	ii	i	iii
(d)	i	ii	iii

55. Blood pressure in the pulmonary artery is
(a) same as that in the aorta. *[2016]*
(b) more than that in the carotid.
(c) more than that in the pulmonary vein.
(d) less than that in the venae cavae.

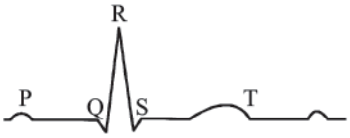
56. Blood pressure in the mammalian aorta is maximum during : *[2015 RS]*
(a) Diastole of the right ventricle.
(b) Systole of the left ventricle.
(c) Diastole of the right atrium.
(d) Systole of the left atrium.

57. Doctors use stethoscope to hear the sounds produced during each cardiac cycle. The second sound is heard when: *[2015 RS]*
(a) Ventricular wall vibrate due to gushing in of blood from atria.
(b) Semilunar valves close down after the blood flows into vessels from ventricles.
(c) AV node receives signal from SA node.
(d) AV valves open up.

58. Which one of the following animals has two separate circulatory pathways? *[2015 RS]*
(a) Lizard (b) Whale
(c) Shark (d) Frog

59. How do parasympathetic neural signals affect the working of the heart? *[2014]*
(a) Reduce both heart rate and cardiac output.
(b) Heart rate is increased without affecting the cardiac output.
(c) Both heart rate and cardiac output increase.
(d) Heart rate decreases but cardiac output increases.

60. The diagram given here is the standard ECG of a normal person the P-wave represents the : *[NEET 2013]*



(a) Initiation of the ventricular contraction
(b) Beginning of the systole
(c) End of systole
(d) Contraction of both the atria

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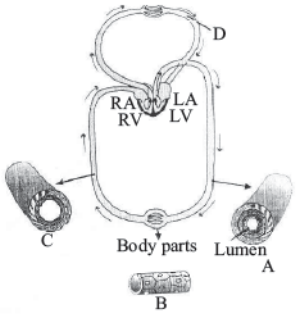
61. Figure shows blood circulation in humans with labels A to D. Select the option which gives correct identification of label and functions of the part: *[NEET Kar. 2013]*



(a) A – Artery - thick walled and blood flows evenly
(b) B – Capillary - thin without muscle layers and wall two cell thick
(c) C – Vein - thin walled and blood flows in jerks/spurts
(d) D – Pulmonary vein - takes oxygenated blood to heart PO_2 = 95 mmHg

62. 'Bundle of His' is a part of which one of the following organs in humans? *[2011]*
(a) Brain (b) Heart
(c) Kidney (d) Pancreas

63. Arteries are best defined as the vessels which : ***[2011]***
(a) supply oxygenated blood to the different organs.
(b) break up into capillaries which reunite to form one visceral organ.
(c) break up into capillaries which reunite to form a vein.
(d) carry blood from one visceral organ to another visceral organ.

64. Which one of the following statements is **correct** regarding blood pressure ? ***[2011]***
(a) 130/90 mmHg is considered high and requires treatment.
(b) 100/55 mmHg is considered an ideal blood pressure.
(c) 105/50 mm Hg makes one very active.
(d) 190/110 mmHg may harm vital organs like brain and kidney.

65. Given below is the ECG of a normal human. Which one of its components in human is correctly interpreted below. ***[2011M]***
(a) Complex QRS-One complete Pulse
(b) Peak T - Initiation of total cardiac contraction
(c) Peak P and Peak R together-Systolic and diastolic blood pressures
(d) Peak P- Initiation of left atrial contraction only

66. If due to some injury the chordae tendinae of the tricuspid valve of the human heart is partially non - functional, what will be the immediate effect? ***[2010]***
(a) The flow of blood into the aorta will be slowed down.
(b) The 'pacemaker' will stop working.
(c) The blood will tend to flow back into the left atrium.
(d) The flow of blood into the pulmonary artery will be reduced.

67. In a standard ECG which one of the following alphabets is the correct representation of the respective activity of the human heart?
(a) S - start of systole ***[2009]***
(b) T - end of diastole
(c) P - depolarisation of the atria
(d) R - repolarisation of ventricles

68. In humans, blood passes from the post caval to the diastolic right atrium of heart due to.
(a) pushing open of the venous valves ***[2008]***
(b) suction pull
(c) stimulation of the sino auricular node
(d) pressure difference between the post caval and atrium

69. Which one of the following mammalian cells is not capable of metabolising glucose to carbon-dioxide aerobically? ***[2007]***
(a) Unstriated muscle cells
(b) Liver cells
(c) Red blood cells
(d) White blood

70. Which one of the following has an open circulatory system ? ***[2006]***
(a) *Periplaneta* (b) *Hirudinaria*
(c) *Octopus* (d) *Pheretima*

71. Which of the following substances, if introduced into the blood stream, would cause coagulation of blood at the site of its introduction? ***[2005]***
(a) Prothrombin (b) Fibrinogen
(c) Thromboplastin (d) Heparin

72. The cardiac pacemaker in a patient fails to function normally. The doctors find that an artificial pacemaker is to be grafted in him. It is likely that it will be grafted at the site of
(a) Atrioventricular bundle ***[2004]***
(b) Purkinje system
(c) Sinuatrial node
(d) Atrioventricular node

73. Systemic heart refers to: ***[2003]***
(a) the two ventricles together in humans.
(b) the heart that contracts under stimulation from nervous system.
(c) left auricle and left ventricle in higher vertebrates.
(d) entire heart in lower vertebrates.

74. Bundle of His is a network of ***[2003]***
(a) nerve fibres found throughout the heart
(b) muscle fibres distributed throughout the heart walls
(c) muscle fibres found only in the ventricle wall
(d) nerve fibres distributed in ventricles

75. Impulse of heart beat originates from ***[2002]***
(a) S. A. node (b) A. V. node
(c) Vagus nerve (d) Cardiac nerve

76. Pulmonary artery differs from pulmonary vein in having ***[2000]***
(a) no endothelium
(b) valves
(c) large lumen
(d) thick muscular walls

77. The active molecule that helps initiate the inflammatory response when mast cells degranulate is ***[1999]***
(a) perforin (b) histamine
(c) heparin (d) insulin

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78. Contraction of the ventricle in the heart begins by the command from *[1999]*
(a) Chordae tendinae (b) S.A. node
(c) Purkinje fibres (d) A. V. node

79. An adult human with average health has systolic and diastolic pressures as *[1998]*
(a) 70 mm Hg and 120 mm Hg
(b) 120 mm Hg and 80 mm Hg
(c) 50 mm Hg and 80 mm Hg
(d) 80 mm Hg and 80 mm Hg

80. The correct route through which pulse-making impulse travels in the heart is *[1995]*
(a) AV node →bundle of His →SA node Purkinje fibres →heart muscles
(b) AV node →SA node →Purkinje fibres → bundle of His→heart muscles
(c) SA node→Purkinje fibre→bundle of His→AV node →heart muscles
(d) SA node →AV node →bundle of His →Purkinje fibre →heart muscles

81. 'Dup' sound is produced during closure of *[1994]*
(a) Semilunar valves (b) Bicuspid valve
(c) Tricuspid valve (d) Both b and c

82. Closed circulatory system occurs in *[1994]*
(a) cockroach (b) tadpole/fish
(c) mosquito (d) housefly

83. Pacemaker of heart is *[1994]*
(a) AV node (b) Bundle of His
(c) SA node (d) Purkinje fibres

84. Vitamin K is required for *[1993]*
(a) formation of thromboplastin
(b) conversion of fibrinogen to fibrin
(c) conversion of prothrombin to thrombin
(d) synthesis of prothrombin

85. A vein possesses a large lumen because *[1990]*
(a) tunica media and tunica externa form a single coat.
(b) tunica interna and tunica media form a single coat.
(c) tunica interna, tunica media and tunica externa are thin.
(d) tunica media is a thin coat.

86. Splenic artery arises from *[1990]*
(a) anterior mesenteric artery
(b) coeliac artery
(c) posterior mesenteric artery
(d) intestinal artery

87. Tricuspid valve is found in between *[1989]*
(a) sinus venosus and right auricle
(b) right auricle and right ventricle
(c) left ventricle and left auricle
(d) ventricle and aorta

88. Arteries carry oxygenated blood except
(a) Pulmonary (b) Cardiac *[1989]*
(c) Hepatic (d) Systemic

89. Breakdown product of haemoglobin is
(a) Bilirubin (b) Iron *[1988]*
(c) Biliverdin (d) Calcium

90. Child death may occur in the marriage between
(a) Rh^+ man and Rh^+ woman *[1988]*
(b) Rh^+ man and Rh^- woman
(c) Rh^- man and Rh^- woman
(d) Rh^- man and Rh^+ woman

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Topic 3: Disorders of Circulatory System

91. Examination of blood of a person suspected of having anaemia, shows large, immature, nucleated erythrocytes without haemoglobin. Supplementing his diet with which of the following, is likely to alleviate his symptoms?
(a) Folic acid and cobalamine *[2006]*
(b) Riboflavin
(c) Iron compounds
(d) Thiamine

92. The blood cancer is known as *[1995]*
(a) leukaemia (b) thrombosis
(c) haemolysis (d) haemophilia

93. Haemophilia is *[1989]*
(a) royal disease
(b) faulty blood clotting
(c) both (a) and (b)
(d) mosquito having haemocoel

94. Presence of RBC in urine is: *[1988]*
(a) Alkaptonuria (b) Ureathiasis
(c) Haematuria (d) Proteinuria

95. Sickle cell anaemia is characterised by
(a) Leukemia *[1988]*
(b) Polycythemia
(c) Mental retardation
(d) Haemolytic anaemia

ANSWER KEY

1	(d)	11	(c)	21	(b)	31	(d)	41	(c)	51	(a)	61	(d)	71	(c)	81	(a)	91	(a)
2	(c)	12	(a)	22	(c)	32	(d)	42	(b)	52	(a)	62	(b)	72	(c)	82	(b)	92	(a)
3	(d)	13	(c)	23	(a)	33	(c)	43	(d)	53	(c)	63	(b)	73	(c)	83	(c)	93	(c)
4	(c)	14	(b)	24	(b)	34	(b)	44	(c)	54	(a)	64	(d)	74	(c)	84	(d)	94	(c)
5	(c)	15	(a)	25	(a)	35	(a)	45	(b)	55	(c)	65	(c)	75	(a)	85	(d)	95	(d)
6	(c)	16	(d)	26	(d)	36	(b)	46	(a)	56	(b)	66	(d)	76	(d)	86	(b)		
7	(a)	17	(b)	27	(c)	37	(b)	47	(b)	57	(b)	67	(c)	77	(b)	87	(b)		
8	(b)	18	(d)	28	(c)	38	(d)	48	(d)	58	(b)	68	(b)	78	(b)	88	(a)		
9	(d)	19	(d)	29	(a)	39	(d)	49	(b)	59	(a)	69	(c)	79	(b)	89	(b)		
10	(c)	20	(a)	30	(a)	40	(d)	50	(a)	60	(d)	70	(a)	80	(d)	90	(b)		

Hints & Solutions

1. (d) Option (d) is the correct answer because Eosinophils are associated with allergic reactions and release histaminase, Basophils secrete histamine, serotonin, heparin etc. and are involved in inflammatory reactions, Neutrophils are phagocytic cells; Both B and T lymphocytes are responsible for immune responses of the body.

2. (c) Fibrinogen forms fibrin strands during coagulation. These strands forms a network and the meshes of which are occupied by blood cells, this structure finally forms a clot.

NOTES Antibodies are derived from Gamma-Globulin fraction of plasma proteins which means globulins are involved in defence mechanisms. Albumin is a plasma protein mainly responsible for Blood Colloidal Osmotic Pressure (BCOP).

3. (d) In human RBCs, nucleus get degenerates during maturation and it provide more space for oxygen carrying pigment (haemoglobin). It lacks many cell organelles including mitochondria so respires anaerobically.

4. (c) Reduction of pH of blood will decrease the affinity of haemoglobin with oxygen which in turn causes acidosis.

5. (c) Blood is a body fluid that delivers necessary substances such as nutrients and oxygen to the cells and transports metabolic waste products from those same cells. It is composed of blood cells (RBC, WBC platelets) suspended in plasma.

6. (c) Erythropoiesis is the process of formation of RBC. In the first month of pregnancy, yolk sac is the haemopoietic tissue. After 5 weeks, it is followed by the liver. Red bone marrow from 6 months onwards becomes the principal site of erythropoiesis.

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7. (a) Karl Landsteiner first reported ABO blood groups in human beings. A, B and O blood groups were discovered by Landsteiner in 1900 while AB blood group was found out by de Castello and Steini (1902). ABO blood groups are determined by the gene I (isoagglutinin). There are three alleles– I^A, I^B and I^O of this gene. Proteins produced by the I^A and I^B alleles are called A antigen and B antigen. Individuals with AB blood group have both antigen A and antigen B on their RBCs, and no antibodies for either of the antigens in their plasma, so they can receive blood from any blood type.

NOTES The concepts of universal donor and universal recipient are more for simplicity sake as ideally only blood group matched unit is transfused. As red blood cells of blood group O-negative carry 'no antigen', it can be given to any other group and is thus called universal donor.

8. (b) Basophils secrete histamine, serotonin, heparin, etc., and are involved in inflammatory reactions.

9. (d) Fibrinogen, the protein of blood plasma is converted to insoluble protein fibrin during the clotting process. The fibrinogen free fluid, obtained after removal of the clot, called blood serum, is plasma minus fibrinogen.

10. (c) Spleen, an organ of the lymphatic system is located in the left side of the abdominal cavity under the diaphragm, the muscular partition between the abdomen and the chest.

NOTES Spleen is called graveyard of RBC because fragment of red blood cells, old and dead cells are constantly being removed from the blood streams by it.

11. (c) The three alleles in ABO blood groups in humans can produce six different genotypes and four different phenotypes.

Genotypes	Phenotypes
I^A, I^A, $I^A i$	Blood group A
$I^B I^B$, $I^B i$	Blood group B
$I^A I^B$	Blood group AB
$i\ i$	Blood group O

12. (a) Blood transports oxygen from respiratory organs to the tissue cells and also transports carbon dioxide from the tissue cells to the respiratory membrane. About 97% of oxygen is transported by RBCs in the blood while the remaining three percent of oxygen is carried in a dissolved state through plasma. Nearly 20-25% of carbon dioxide is transported by RBCs whereas 70% is carried as bicarbonate. About 7% of CO_2 is carried in dissolved state through plasma.

13. (c) The ABO blood group system is the most important blood type system (or blood group system) in human blood transfusion. It is named ABO and not ABC, because blood group O (or blood group zero in some countries) individuals do not have either A or B antigens on the surface of their RBCs, but their blood serum contains IgM anti-A antibodies and anti-B antibodies against the A and B blood group antigens. Therefore, a group O individual can receive blood only from a group O individual, but can donate blood to individuals of any ABO blood group (ie A, B, O or AB).

14. (b) Lymph is a mobile connective tissue comprising lymph plasma and lymph corpuscles. Its composition is just like blood plasma except that it lacks RBCs and large plasma proteins.

15. (a) Red blood cells are the most common type of blood cell and delivering oxygen to the body tissues *via* the blood. There is no DNA in mature RBC. The reticulocyte which is the immediate precursor of the mature RBC evolves into mature RBC within 24 hours of release into the peripheral circulation.

16. (d) Globulins contained in human blood plasma are primarily involved in defence mechanism of body. Globulin is one of the two types of serum proteins, the other being albumin. Globulins can be divided into three fractions based on their electrophoretic mobility.

NOTES Most of the alpha and beta globulins are synthesised by the liver, whereas gamma globulins are produced by lymphocytes and plasma cells in lymphoid tissue.

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17. (b) Basophil is a type of white blood cell (leucocyte) that has a lobed nucleus surrounded by granular cytoplasm. Basophils are produced continually by stem cells in the red bone marrow & move about in an amoeboid fashion. Like, mast cells, they produce histamine and heparin as part of the body's defences at the site of an infection or injury.

NOTES Heparin is a naturally occurring glycosaminoglycan produced in the body by liver, lungs, and other tissues from basophils and mast cells. It is injected into muscle or blood to prevent or dissolve blood clots.0

18. (d) The most active phagocytic white blood cells are neutrophils and monocytes which modulate the innate immune response and phagocytose infections agents.
Neutrophil has a lobed nucleus and granular cytoplasm. Neutrophils engulf bacteria and release various substance such as lysozyme and oxidising agents.
Monocyte is the largest form of WBC in vertebrates. It has a kidney shaped nucleus and is actively phagocytic, ingesting bacteria and cell's debris.

19. (d) The haemoglobin of a human foetus has a higher affinity for oxygen than that of an adult. Foetal haemoglobin binds to oxygen more strongly than adult haemoglobin, enabling the transfer of oxygen from mother to foetus prenatally.
20. (a) Blood serum is of pale yellow colour and is liquid minus clotting elements. It does not have fibrinogen and other clotting materials therefore it does not takes part in blood clotting.
21. (b) In insects circulating body fluid called haemolymph does not help in the circulation of respiratory gases for the body. It only circulates the food and nutrients to the different body parts. Distribution of oxygen (respiration) takes place through small air chambers called spiracles.
22. (c) Blood group AB is also known as the universal recipient.
23. (a) Presence of calcium will remove heparin (blood anti-coagulant) and will promote blood clotting. Sodium oxalate and heparin containing test tubes will not allow the blood to clot.

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NOTES

The test is used to monitor heparin therapy to ensure that a person is receiving sufficient heparin for anticoagulation without causing excess bleeding. Since the test involves a chemical reaction color change (colorimetric), it is also known as chromogenic anti-Xa assay or anti-Xa assay.

24. (b) Lymph is a colourless vascular connective tissue derived from tissue fluid. RBCs and platelets are absent. Only leucocytes and floating amoeboid lymphocytes are present.
25. (a) Blood group 'O' is known as the universal donor since it does not contain antigens.
26. (d) Leucocytes are colourless, nucleated amoeboid cells found in blood which are devoid of haemoglobin and are capable of coming out of blood capillaries through the process of diapedesis. Fall of WBC count is called leucopenia, and occurs due to folic acid deficiency and AIDS etc.
27. (c) Histamine is a potent vasodilator formed by decarboxylation of the amino acid histidine and released by mast cells in response to appropriate antigens. Mast cells are especially prevalent in the connective tissue of the skin and respiratory tract and in surrounding blood vessels.
28. (c) Blood group is determined by three alleles - I^A, I^B, and I^o. Alleles I^A and I^B are codominant. Blood group A is determined by $I^A I^A$ or $I^A I^o$. Blood group B is $I^B I^B$ or $I^B I^o$. Blood group O is $I^o I^o$. Blood group AB is $I^A I^B$.
29. (a) White blood cells are of two types :
(i) Granulocytes (with granular cytoplasm) - neutrophils, basophils and eosinophils.
(ii) Agranulocytes (with clear cytoplasm) - Lymphocytes and monocytes
30. (a) The white blood cells have a life span of 10 days. Most of the WBCs have a life span which is even less than 1 day.
White blood cells or leucocytes are produced in the bone marrow at a rate of about 1000 million per day and help to defend the body against infectious disease and foreign materials as a part of the immune system.
In conditions such as leukemia this may rise to as many as 50,000 white blood cells in a single drop of blood (only 1% of blood on average is a white blood cell). As well as in the blood, white cells are also found in large numbers in the lymphatic system, the spleen, and in other body tissues.

NOTES

There are normally between 4×109 and 1.1×1010 white blood cells in a litre of healthy adult blood.

31. (d) Spleen and brain are the organs which receive only oxygenated blood.
32. (d) RBCs as well as plasma both carry oxygen and CO_2 in dissolved and chemically combined form.
33. (c) An important function of lymph is to return interstitial fluid back to the blood. This interstitial fluid is also called extracellular fluid, which is formed from blood due to various factors, *i.e.* hydrostatic pressure, osmotic gradient etc.
34. (b) Antigens are foreign proteins, which stimulate specific immune response (antibody) against itself when introduced into the body. They are present on the surface of cell wall.

35. (a) The inheritance of blood group is determined by some allelic genes which are I^A, I^B & I°. In one individual two allelic genes are present. I^A & I^B are dominant while I^o is recessive in heterozygous condition. So if a child has a blood group O he/she must have I^oI^o & he/she cannot have the parents of blood group AB & AB/O.

36. (b) In foetus ; liver, spleen, bone marrow, lymph nodes & thymus are the haemopoietic organs (blood forming). In adults most of the blood corpuscles form in the peripheral region of red bone marrow in long bones.

37. (b)

$$\left.\begin{array}{l} \text{Man (A)}: I^AI^o \rightarrow I^AI^A \rightarrow A \\ \qquad\qquad\quad \rightarrow I^AI^B \rightarrow AB \\ \text{Woman (AB)}: I^AI^B \rightarrow I^AI^o \rightarrow AB \\ \qquad\qquad\quad \rightarrow I^BI^o \rightarrow B \end{array}\right] \text{all show heterozygous}$$

OR

$$\left.\begin{array}{l} I^AI^A \rightarrow I^AI^A \rightarrow A \\ \qquad \rightarrow I^AI^B \rightarrow AB \\ I^AI^B \rightarrow I^AI^A \rightarrow A \\ \qquad \rightarrow I^AI^B \rightarrow AB \end{array}\right] \text{all show homozygous}$$

38. (d) Blood capillaries are made up of endothelial cells. These are where the important functions of circulation takes place.

39. (d) The genotype child of having O blood group is $I^\circ I^\circ$
If father has B blood group it is either – $I^B I^B$ or $I^B I^o$ But if father has $I^B I^B$ then child cannot have $I^\circ I^\circ$, so father must have $I^B I^o$.

40. (d) Lymphocyte is a type of white blood cells in the vertebrate immune system. Lymphocytes are responsible for making antibodies.

41. (c) The walls of blood capillaries do not possess tunica externa (connective tissue layer containing lymph vessels), tunica media (a thick network of smooth muscle fibres) but only tunica interna (a single layer endothelium of squamous cells).

42. (b) Blood group A has Antigen-A & antibody 'b' or anti A or a,
Blood group B has antigen-B & antibody a or anti B or b.
Blood group AB has antigen-A & B and no antibody.
Blood group O has no antigen & antibodies a & b both.

43. (d) Neutrophils are a type of leucocyte (WBCs) that can take all types of stain (Acidic-Basic-Neutral). It is most abundant (60-70% of total WBCs) and most active type of WBCs. Neutrophil helps heal damaged tissues and resolve infections. Its levels increases naturally in response to infections, injuries and other types of stress.

44. (c) A has antigen A & antibody b so it can have the same blood group. O has no antigen & antibodies a & b so it is called universal donor.

45. (b) Removal of calcium from freshly collected blood would prevent clotting because the process of blood clotting starts when prothrombinase (an enzyme formed by thromboplastin) catalyses the conversion of prothrombin (an inactive protein in the blood plasma) into thrombin (active protein) and this reaction takes place in the presence of Ca^{2+}. Now this thrombin converts fibrinogen into fibrin which makes fibrin threads on polymerisation & with blood corpuscles, it clots blood. So if Ca^{2+} are removed from blood it'll prevent clotting. It may also be done by adding some anti coagulants, eg. sodium & potassium oxalates in blood as they precipitate Ca^{2+} present in the blood.

46. (a) Lymph differs from blood in that it contains less protein and no red blood cells. Lymph contains white blood cells.

47. (b) Mineral found in red pigment of vertebrate blood is iron.

48. (d) The blood of cockroach does not contain RBCs as it is not infact the blood, but haemolymph which has some unpigmented free cells in plasma known as haemotocytes which have nothing to do with the transport of gases or respiration.

49. (b) The QRS complex represents the depolarisation of the ventricles, which initiates the ventricular contraction. The contraction starts shortly after Q and marks the beginning of the systole.

NOTES

The term electrocardiogram used to describe these wave forms was first coined by Einthoven at the Dutch Medical Meeting of 1893. In 1901, he successfully developed a new string galvanometer with very high sensitivity, which he used in his electrocardiograph.

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50. (a) SA node acts as pace-maker of heart because its autoexcitable tissue have the ability to generates heart impulses at highest rate (frequency).

NOTES

This electrical impulse is then transmitted by perinodal cells, or transitional (T) cells, to the right atrium and then through the rest of the heart's electrical conduction system, eventually resulting in myocardial contraction and blood distributed to the rest of the body. The sinus node continuously generates electrical impulses, thereby setting the normal rhythm and rate in a healthy heart. Hence, the SA node is referred to as the natural or normal pacemaker of the heart.

51. (a) The delay in transmission of impulse from SAN to the ventricles provided by AVN prevents simultaneous contraction of ventricles and auricles. This allows atria to empty completely before ventricles start contraction.

52. (a) Electrocardiogram is a diagnostic tool, used to assess the electrical and muscular functions of the heart. It consists of waveform components which indicate electrical events during one heart beat. These waveforms are labelled P, Q, R, S, T and U.

- P wave indicates atrial depolarisation *i.e.* that the atria are contracting, pumping blood into the ventricles.
- The QRS complex represents ventricular depolarisation and contraction.
- T wave is upwards waveform representing ventricular repolarisation. The normal T wave is slightly asymmetric with a steeper downward slope. Reduction in the size of T wave represents insufficient supply of oxygen *i.e.* coronary ischemia. Coronary ischemia is an intermediate condition in coronary artery disease during which the heart tissue is slowly or suddenly starved of oxygen and other nutrients.

53. (c) Cardiac output is the product of the heart rate (HR), or the number of heart beats per minute (bpm),and the stroke volume (SV), which is the volume of blood pumped from the ventricle per beat; thus,

Cardiac output = stroke volume × Heart rate

As per the given information,

Cardiac output = 5L or 5000 ml

Blood volume in ventricles at the end of diastole = 100 ml

Blood volume in ventricles at the end of systole = 50 ml

∴ Stroke volume = 100 – 50
= 50 ml.

So,

5000 ml = 50 ml × Heart rate

So,

Heart rate = 100 beats per minute.

54. (a) Tricuspid valves are AV valve present between right atrium and right ventricle in heart. Bicuspid valves (mitral valves) are AV valve present between left atrium and left ventricle. Semilunar valves are present at the openings of aortic and pulmonary aorta.

55. (c) Arteries have higher blood pressure than vein because blood is forced inside them from heart and also their lumen is narrow.

56. (b) The wall of left ventricle is the thickest of all the chambers. It supplies oxygenated blood throughout the body. Aorta arises from left ventricle and the musculature is best developed.

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57. (b) The second sound heard by doctors using stethoscope occurs when semilunar valves close down after the blood flows into vessels from ventricles.

58. (b) Whale is a mammal. It has four chambered heart having two atria and two ventricles. Oxygenated and deoxygenated blood flow in separate circulatory pathways.

59. (a) Control of heart beat by nervous system can be done by medulla oblongata. Medulla oblongata has two regulatory centre:

(*i*) *Accelerator centre* - It functions through sympathetic nervous system (SNS) and increases heart beat by the secretion of epinephrine or adrenaline.

(*ii*) *Depressor centre* - It functions through parasympathetic nervous system (PSNS) by the secretion of acetylcholine. It decreases heart beat, speed of conduction of action potential and thereby the cardiac output.

60. (d) In the given ECG of a normal person, P-wave represents the electrical excitation (or depolarisation) of the atria, which leads to the

contraction of both the atria. The QRS complex represents the depolarisation of the ventricles, which initiates the ventricular contraction. The contraction starts shortly after Q and marks the beginning of the systole.

61. (d) Artery is a blood vessel which receives blood from heart, has elastic thick wall showing jerky movements due to pumping activity of heart. Vein is a blood vessel which carries blood towards the heart, has wider lumen with internal valves where blood flows smoothly and slowly.

NOTES

Blood capillary is a very fine blood vessel which has a single layered wall. Pulmonary veins are the only veins which carry oxygenated blood. (PO2 = 95 mmHg, PCO2 = 40 mmHg)

62. (b) 'Bundle of His' are a typical cardiac muscle fibres, connecting the atria with ventricle.

63. (b) Arteries are the vessels which break up into capillaries which reunite to form one visceral organ.

64. (d) 190/110 mmHg may harm vital organs like brain and kidney. This is called hypertension which can give rise to increased heart rate and palpitation.

65. (c) Peak P-causes diastolic phase in ventricle while R-Peak causes systole in ventricle. Diastolic and systolic phases represented by P & R.

66. (d) Chordae tendinae are thread like bands of fibrous tissue which attach on one end to the edges of the tricuspid and mitral valves of the heart and on the other end to the papillary muscles, that serve to anchor the valves. Tricuspid valve is the valve in the heart between the right atrium and right ventricle. The valve opens to allow blood to flow from atrium into the ventricle. Thus if tricuspid valve is partially non-functional, then the flow of blood into the pulmonary artery will be reduced.

67. (c) In a standard ECG, the P-wave is a small upward wave that indicates the depolarisation of the atria. This is caused by the activation of SA node.

68. (b) In human, blood passes from the post caval to the diastolic right atrium of heart due to suction pull.

69. (c) Since RBCS do not have mitochondria so they can respire only anaerobically.

70. (a) *Periplaneta* (*P. americana,* the Indian Cockroach) is an insect & insects do not have closed blood circulation. Their blood (called haemolymph) even does not serve for respiration. They do not possess blood vessels in this circulatory system and hence it is an open system.

71. (c) Fibrinogen, prothrombin, thromboplastin are respectively clotting factors I, II and III. Thromboplastin is released from injured platelets or injured tissue. This converts prothrombin into thrombin in the presence of calcium ions. The thrombin converts fibrinogen into fibrin and the latter froms the clot.

72. (c) SA node is the natural pacemaker located in the right atrium. SA node initiates the cardiac impulse. So, artificial pacemaker will be grafted at the site of SA node.

NOTES

SA is located at the junction of the crista terminalis in the upper wall of the right atrium and the opening of the superior vena cava. These cells have the ability to spontaneous generate an electrical impulse. It is the integrated activity of these so-called pacemaker (P) cells that form the SA node..

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73. (c) Systemic heart refers to the part of the heart propelling blood through the systemic circulation specifically the left auricle and left ventricle in higher vertebrates. Systemic circulation carries oxygenated blood away from the heart to the body and return deoxygenated blood back to the heart. In this circulation, the blood leaves the heart, services the body's cells and then reenters the heat. Blood leaves through the left ventricle to the aorta, the body's largest artery.

74. (c) Bundle of his are specialised heart muscle cells (fibres) that transmit electrical impulses from the AV node in the heart to the muscle cells of the heart wall which contract in response produced the heart beat. These fibres distribute the impulses to the ventricle muscle.

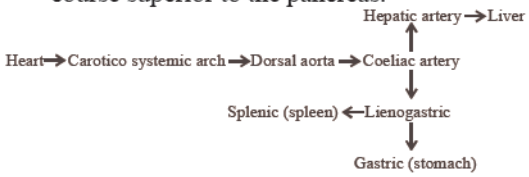
75. (a) SA node is called the pacemaker because it initiates the cardiac impulse. AV node receives the impulse from the SA node and transmits it to the ventricles.

76. (d) Arteries have thick wall and narrow lumen while veins have thin walls and large lumen. Arteries do not have valves.
77. (b) Mast cells contain granules of heparin and histamine. Heparin prevents blood clotting. Histamine produces inflammation.
78. (b) SA is the site of generation of the rhythmic cardiac impulse. AV node is a compact mass of myogenic fibres which receives impulse from SA node and transmits it to ventricles. Purkinje fibres are in contact with the contractile muscles of the ventricular walls. Chordae tendinae are the muscles which keep the AV valves in position.

NOTES

Purkinje fibers are part of the specialized conduction network of the heart that ensures that the wave of excitation spreads rapidly and almost synchronously to the ventricular muscle mass.

79. (b) An adult human with average health has systolic and diastolic pressures as 120 mm Hg and 80 mm Hg respectively.
80. (d) The pulse making impulse travels in the heart in the order of SA node→AV node→bundle of His→Purkinje fibres→heart muscles.
81. (a) Heart produces two types of sounds. 1st sound is 'Lubb' which produced by closure of bicuspid and tricuspid valves and 2nd sound is 'Dup' which is produced by closure of semilunar valves present at the base of aorta to avoid back flow of blood into the ventricle.
82. (b) Closed circulatory system means blood flows in some definite vessels in a specific direction in more organised manner than that of open system in which blood does not flow in vessels.
83. (c) Sino-Auricular node (S.A node) present in the walls of right auricle has a myogenic initiation of heartbeat in a regular fashion and controls the pace of heartbeat.
84. (d) Synthesis of prothrombin helps in coagulation of blood. Vitamin K is required for the synthesis of prothrombin and blood clotting factors I, VII, IX and X.
85. (d) Veins have larger lumen because the wall of blood vessels is made up of tunica externa, tunica media & tunica interna is thin in veins.
86. (b) Splenic artery is the blood vessels that supplies oxygenated blood to the spleen. It branches from the celiac artery and follows a course superior to the pancreas.



87. (b) Tricuspid valve is present between right auricle and right ventricle. It has 3 membranous flaps to check the flow of blood in reverse direction. Sinus venosus and right auricle are guarded by sinu-atrial valve. The opening of left auricle and left ventricle is guarded by bicuspid valve. The opening of ventricle and aorta is guarded by semilunar valves.
88. (a) Pulmonary artery carries the blood from the right ventricle of the heart to the lungs for oxygenation so it carries deoxygenated blood.
89. (b) The breakdown products of haemoglobin are haem *i.e.* iron & globin protein which is then converted into yellowish substance bilirubin, extracted by the liver cells from the blood & stored in the form of bile in gall bladder. The more appropriate answer is iron.
90. (b) Rh factor was discovered by Karl Landsteiner. A child of Rh^+ man will be Rh^+ whether the mother is Rh^+ or Rh^-. If the mother is Rh^+ then there will be no problem but if mother is Rh^- so when the blood of Rh^+ child (in womb) mixes with the blood of Rh^- mother then some antibodies in mother's blood are formed against Rh+ factor which coagulate the womb blood causing death. If birth takes place then there is a possibility of child death in early years. This in known as erythroblastosis foetalis. In most cases the Ist pregnancy may succeed but after that it fails.
91. (a) Folic acid (Cyanocobalamine-Vit. B_{12}) works in the formation and maturation of RBCs. In its deficiency RBC formation decreases and the formed RBCs will not mature *i.e.* they will not loose the nucleus and hence remain nucleated and lack haemoglobin. Such RBCs cannot carry oxygen & person suffers from anaemia. Supplementing his diet with folic acid and cobalamine will lead to the

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increased formation and proper maturation of enucleated RBCs with haemoglobin and eliminate anaemia.

92. (a) Leukaemia is a type of blood cancer, which is characterised by an uncontrolled increase in the number (through mitosis) of leucocytes in the blood.

93. (c) Haemophilia is a sex linked disease (linked with X chromosomes). In this disease, blood lacks the thromboplastin protein which causes blood clotting during injury. In normal human, blood clots in 2-6 min. While in haemophilic human, it may take from 3 hrs to 24 hrs due to which death may occur.

NOTES

Hemophilia disease was Ist discovered by Jon Catto in 1803. The most famous families in which the inheritance of this disease was found were the Royal families of Britain & Russia, so it is also called Royal disease.

94. (c) Alkaptonuria (also known as blackurine disease) is excretion of large amount of alkapton in urine which when comes in the contact with light turn black and it is caused by gene mutation. Haematuria is presence of blood or RBCs in urine, proteinuria is presence of protein in the urine.

95. (d) In sickle cell anaemia, normal haemoglobin (HbA) gets changed in denatured form of haemoglobin (HbS) in which the haemoglobin molecule's configuration changes and it changes its shape, in low O_2 concentration unable to transport O_2 and RBCs become sickle shaped. It is a genetic disease caused by the denaturation of haemoglobin, that is why it is known as hemolytic anaemia.

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19 Excretory Products and Their Elimination

Trend Analysis with Important Topics & Sub-Topics

Topic	Sub-Topics	2020		2019		2018		2017		2016	
		Qns.	LOD	Qns.	LOD	Qns.	LOD	Qns.	LOD	Qns.	LOD
Excretory Products of Different Animals											
Human Excretory system	Parts of Human Excretory System					1	D	1	A	1	A
	Parts of Human Excretory System										
	Disorders of the Excretory System	1	A	1	A	1	D				
	Regulation of Kidney Function	1	A								

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LOD - Level of Difficulty	E - Easy	A - Average	D - Difficult	Qns - No. of Questions

Topic 1: Excretory Products of Different Animals

1. Select the option which shows correct matching of animal with excretory organs and excretory product *[NEET Kar. 2013]*

Animal	Excretory organs	Excretory product
(a) Housefly	Renal tubules	Uric acid
(b) *Labeo* (Rohu)	Nephridial tubes	Ammonia
(c) Salamander	Kidney	Urea
(d) Peacock	Kidney	Urea

2. Which one of the following options gives the correct categorization of six animals according to the type of nitrogenous wastes (A, B, C), they give out? *[2012M]*

	A-Ammo-notelic	B-Ureotelic	C-Urico-telic
(a)	Pigeon, Humans	Aquatic Amphibia, Lizards	Cockroach, Frog
(b)	Frog, Lizards	Aquatic Amphibia, Humans	Cockroach, Pigeon
(c)	Aquatic Amphibia	Frog, Humans	Pigeon, Lizards, Cockroach
(d)	Aquatic Amphibia	Cockroach, Humans	Frog, Pigeon, Lizards

3. Uricotelic mode of passing out nitrogenous wastes is found in *[2011]*
   (a) Reptiles and Bird
   (b) Birds and Annelids
   (c) Amphibians and Reptiles
   (d) Insects and Amphibians
4. Uric acid is the chief nitrogenous component of the excretory products of *[2009]*
   (a) earthworm (b) cockroach
   (c) frog (d) man
5. Earthworms are *[2006]*
   (a) uricotelic when plenty of water is available
   (b) uricotelic under conditons of water scarcity
   (c) ammonotelic when plenty of water is available
   (d) ureotelic when plenty of water is available

6. Uricotelism is found in *[2004]*
   (a) Mammals and birds
   (b) Fishes and fresh water protozoans
   (c) Birds, reptiles and insects
   (d) Frogs and toads
7. A terrestrial animal must be able to *[2004]*
   (a) excrete large amounts of water in urine
   (b) conserve water
   (c) actively pump salts out through the skin
   (d) excrete large amounts of salts in urine
8. In *Hydra* waste material of food digestion and nitrogenous waste material removed from
   (a) mouth and body wall *[2001]*
   (b) mouth and tentacles
   (c) mouth and nematocyst
   (d) body wall and tentacles
9. Which one of the following is a matching pair? *[2000]*
   (a) Tears-excretion of salts
   (b) Sweat-thermoregulation
   (c) Saliva-tasting food
   (d) Sebum-sex attraction
10. In ureotelic animals, urea is formed by the *[1997, 2000]*
   (a) Arginine cycle
   (b) Cori's cycle
   (c) Ornithine cycle
   (d) EM pathway
11. Solenocytes are the main excretory structures in *[1998]*
   (a) Platyhelminthes
   (b) Annelids
   (c) Molluscs
   (d) Echinodermates
12. In Ornithine cycle, which one pair of the following wastes are removed from the blood? *[1996]*
   (a) CO_2 and urea
   (b) CO_2 and ammonia
   (c) Ammonia and urea
   (d) Urea and sodium salts
13. Uric acid is nitrogenous waste in *[1994]*
   (a) Mammals and molluscs
   (b) Birds and lizards
   (c) Frog and cartilaginous fishes
   (d) Insects and bony fishes
14. Nitrogenous waste products are eliminated mainly as *[1991]*
   (a) urea in tadpole and ammonia in adult frog
   (b) ammonia in tadpole and urea in adult frog
   (c) urea in both tadpole and adult frog
   (d) urea in tadpole and uric acid in adult frog

Topic 2: Human Excretory System

15. Presence of which of the following conditions in urine are indicative of Diabetes Mellitus? *[2020]*
   (a) Uremia and Renal Calculi
   (b) Ketonuria and Glycosuria
   (c) Renal calculi and Hyperglycaemia
   (d) Uremia and Ketonuria
16. Which of the following would help in prevention of diuresis? *[2020]*
   (a) Reabsorption of Na^+ and water from renal tubules due to aldosterone
   (b) Atrial natriuretic factor causes vasoconstriction
   (c) Decrease in secretion of renin by JG cells
   (d) More water reabsorption due to undersecretion of ADH
17. Match the following parts of a nephron with their function : *[2019, Odisha]*

	Column-I		Column-II
(A)	Descending limb of Henle's loop	(i)	Reabsorption of salts only
(B)	Proximal convoluted tubule	(ii)	Reabsorption of water only
(C)	Ascending limb of Henle's loop	(iii)	Conditional reabsorption of sodium ions and water
(D)	Distal convoluted tubule	(iv)	Reabsorption of ions, water and organic nutrients

Select the correct option from the following :
   (a) (A)-(iv), (B)-(i), (C)-(iii), (D)-(ii)
   (b) (A)-(i), (B)-(iii), (C)-(ii), (D)-(iv)
   (c) (A)-(ii), (B)-(iv), (C)-(i), (D)-(iii)
   (d) (A)-(i), (B)-(iv), (C)-(ii), (D)-(iii)

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18. Which of the following factors is responsible for the formation of concentrated urine ? ***[2019]***
    (a) Low levels of antidiuretic hormone.
    (b) Maintaining hyperosmolarity towards inner medullary interstitium in the kidneys.
    (c) Secretion of erythropoietin by juxtaglomerular complex.
    (d) Hydrostatic pressure during glomerular filtration.
19. Use of an artificial kidney during hemodialysis may result in: ***[2019]***
    (a) Nitrogenous waste build-up in the body.
    (b) Non-elimination of excess potassium ions .
    (c) Reduced absorption of calcium ions from gastro-intestinal tract.
    (d) Reduced RBC production.

    Which of the following options is the most **appropriate**?
    (a) (a) and (b) are correct
    (b) (b) and (c) are correct
    (c) (c) and (d) are correct
    (d) (a) and (d) are correct
20. Match the items given in Column I with those in Column II and select the correct option given below : ***[2018]***

	Column I		Column II
A.	Glycosuria	i.	Accumulation of uric acid in joints
B.	Gout	ii.	Mass of crystallised salts within the kidney
C.	Renal calculi	iii.	Inflammation in glomeruli
D.	Glomerular	iv.	Presence of in nephritis glucose urine

	A	B	C	D
(a)	iii	ii	iv	i
(b)	i	ii	iii	iv
(c)	iv	i	ii	iii
(d)	ii	iii	i	iv

21. Which of the following statements is correct? ***[2017]***
    (a) The descending limb of loop of Henle is impermeable to water.
    (b) The ascending limb of loop of Henle is permeable to water.
    (c) The descending limb of loop of Henle is permeable to electrolytes.
    (d) The ascending limb of loop of Henle is impermeable to water.
22. In mammals, which blood vessel would normally carry largest amount of urea? ***[2016]***
    (a) Renal Vein
    (b) Dorsal Aorta
    (c) Hepatic Vein
    (d) Hepatic Portal Vein
23. Which of the following does not favour the formation of large quantities of dilute urine?
    (a) Caffeine ***[2015 RS]***
    (b) Renin
    (c) Atrial-natriuretic factor
    (d) Alcohol
24. Removal of proximal convoluted tubule from the nephron will result in: ***[2015 RS]***
    (a) More concentrated urine
    (b) No change in quality and quantity of urine
    (c) No urine formation
    (d) More diluted urine
25. Human urine is usually acidic because : ***[2015 RS]***
    (a) excreted plasma proteins are acidic
    (b) potassium and sodium exchange generates acidity
    (c) hydrogen ions are actively secreted into the filtrate.
    (d) the sodium transporter exchanges one hydrogen ion for each sodium ion, in peritubular capillaries.
26. Which of the following causes an increase in sodium reabsorption in the distal convoluted tubule? ***[2014]***
    (a) Increase in aldosterone levels
    (b) Increase in antidiuretic hormone levels
    (c) Decrease in aldosterone levels
    (d) Decrease in antidiuretic hormone levels

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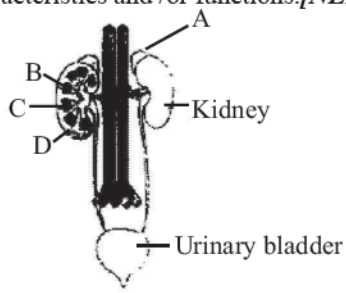
27. Figure shown human urinary system with structures labelled A to D. Select option which correctly identifies them and gives their characteristics and /or functions.*[NEET 2013]*



(a) B-pelvis-broad funnel shaped space inner to hilum, directly connected to loops of Henle.
(b) C-Medulla-inner zone of kidney and contains complex nephrons.
(c) D - Cortex - outer part of kidney and do not contain any part of nephrons
(d) A-Adrenal gland - located at the anterior part of kidney. Secrete Catecholamines which stimulate glycogen breakdown.

28. The maximum amount of electrolytes and water (70 - 80 percent) from the glomerular filtrate is reabsorbed in which part of the nephron ? *[2012]*
(a) Ascending limb of loop of Henle
(b) Distal convoluted tubule
(c) Proximal convoluted tubule
(d) Descending limb of loop of Henle

29. A fall in glomerular filtration rate (GFR) activates *[2012M]*
(a) adrenal cortex to release aldosterone.
(b) adrenal medulla to release adrenaline.
(c) juxta - glomerular cells to release renin.
(d) posterior pituitary to release vasopressin.

30. Which one of the following characteristics is common to both in humans and adult frogs?
(a) Four - chambered heart *[2012M]*
(b) Internal fertilization
(c) Nucleated RBCs
(d) Ureotelic mode of excretion

31. Which one of the following is not a part of a renal pelvis? *[2011]*
(a) Peritubular capillaries
(b) Convoluted tubules
(c) Collecting ducts
(d) Loops of Henle

32. Which one of the following correctly explains the function of a specific part of a human nephron ? *[2011]*
(a) Podocytes : create minute spaces (slite pores) for the filtration of blood into the Bowman's capsule
(b) Henle's loop : most reabsorption of the major substances from the glomerular filtrate
(c) Distal convoluted tubule : reabsorption of K^+ ions into the surrounding blood capillaries
(d) Afferent arteriole : carries the blood away from the glomerular towards renal vein.

33. Which one of the following statements is correct with respect to kidney function regulation ? *[2011]*
(a) When someone drinks lot of water,ADH release is suppressed.
(b) Exposure to cold temperature blood flow stimulates formation of Angiotensin II.
(c) An increase in glomerular blood flow stimulates formation of Angiotensin II.
(d) During summer when body loses lot of water by evaporation, the release of ADH is suppressed.

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34. Ureters act as urogenital ducts in *[2011M]*
(a) human males
(b) human females
(c) frog's both males and females
(d) frog's males

35. Which one of the following statements in regard to the excretion by the human kidneys is correct? *[2010]*
(a) Descending limb of Loop of Henle is impermeable to water
(b) Distal convoluted tubule is incapable of reabsorbing HCO_3
(c) Nearly 99 per cent of the glomerular filtrate is reabsorbed by the renal tubules
(d) Ascending limb of Loop of Henle is impermeable to electrolytes

36. The principal nitrogenous excretory compound in humans is synthesised *[2010]*
    (a) in kidneys but eliminated mostly through liver
    (b) in kidneys as well as eliminated by kidneys
    (c) in liver and also eliminated by the same through bile
    (d) in the liver, but eliminated mostly through kidneys
37. Consider the following four statements (i-iv) regarding kidney transplant and select the two correct ones out of these. *[2010]*
    (i) Even if a kidney transplant is proper the recipient may need to take immune suppresants for a long time
    (ii) The cell mediated immune response is responsible for the graft rejection
    (iii) The B lymphocytes are responsible for rejection of the graft
    (iv) The acceptance or rejection of a kidney transplant depends on specific interferons
    The two correct statements are:
    (a) (ii) and (iii) (b) (iii) and (iv)
    (c) (i) and (iii) (d) (i) and (ii)
38. What will happen if the stretch receptors of the urinary bladder wall are totally removed?
    (a) Micturition will continue *[2009]*
    (b) Urine will continue to collect normally in the bladder
    (c) There will be no micturition
    (d) Urine will not collect in the bladder
39. Bowman's glands are found in *[2006]*
    (a) external auditory canal
    (b) cortical nephrons only
    (c) juxtamedullary nephrons
    (d) olfactory epithelium
40. A person is undergoing prolonged fasting. His urine will be found to contain abnormal quantities of: *[2005]*
    (a) fats (b) amino acids
    (c) glucose (d) ketones
41. The net pressure gradient that causes the fluid to filter out of the glomeruli into the capsule is: *[2005]*
    (a) 50 mm Hg (b) 75 mm Hg
    (c) 20 mm Hg (d) 30 mm Hg
42. In Ornithine cycle, which of the following wastes are removed from the blood? *[2005]*
    (a) CO_2 and urea
    (b) Ammonia and urea
    (c) CO_2 and ammonia
    (d) Urea and urine
43. If Henle's loop were absent from mammalian nephron, which of the following is to be expected? *[2003]*
    (a) The urine will be more dilute
    (b) There will be no urine formation
    (c) There will be hardly any change in the quality and quantity of urine formed
    (d) The urine will be more concentrated
44. Formation of concentrated (hyperosmotic) urine in vertebrates generally depends on *[2000]*
    (a) length of the proximal convoluted tubule
    (b) length of Henle's loop
    (c) area of Bowman's capsule epithelium
    (d) capillary network forming glomerulus
45. In the renal tubules the permeability of the distal convoluted tubule and collecting duct to water is controlled by *[1999]*
    (a) Vasopressin (b) Aldosterone
    (c) Growth hormone (d) Renin
46. The basic functional unit of the human kidney is *[1997]*
    (a) nephron (b) nephridia
    (c) pyramid (d) Henle's loop
47. Part not belonging to uriniferous tubule is *[1994]*
    (a) Glomerulus
    (b) Henle's loop
    (c) Distal convoluted tubule
    (d) Connecting tubule
48. If kidney fail to reabsorb water, the effect on tissue would *[1994]*
    (a) remain unaffected
    (b) shrink and shrivel
    (c) absorb water from blood plasma
    (d) take more O_2 from blood
49. Glucose is taken back from glomerular filtrate through *[1993]*
    (a) Active transport (b) Passive transport
    (c) Osmosis (d) Diffusion
50. Under normal conditions which one is completely reabsorbed in the renal tubule? *[1991]*
    (a) Urea (b) Uric acid
    (c) Salts (d) Glucose

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51. Brush border is characteristic of *[1990]*
    (a) neck of nephron
    (b) collecting tube
    (c) proximal convoluted tubule
    (d) all the above
52. Proximal and distal convoluted tubules are parts of *[1990]*
    (a) Seminiferous tubules
    (b) Nephron
    (c) Oviduct
    (d) Vas deferens
53. Reabsorption of useful substances from glomerular filtrate occurs in *[1989]*
    (a) Collecting tube
    (b) Loop of Henle
    (c) Proximal convoluted tubule
    (d) Distal convoluted tubule

ANSWER KEY

1	(c)	7	(b)	13	(b)	19	(c)	25	(c)	31	(c)	37	(d)	43	(a)	49	(a)
2	(c)	8	(a)	14	(b)	20	(c)	26	(a)	32	(a)	38	(a)	44	(b)	50	(d)
3	(a)	9	(b)	15	(b)	21	(d)	27	(d)	33	(a)	39	(d)	45	(a)	51	(c)
4	(b)	10	(c)	16	(a)	22	(c)	28	(c)	34	(d)	40	(d)	46	(a)	52	(b)
5	(c)	11	(a)	17	(c)	23	(b)	29	(c)	35	(c)	41	(c)	47	(a)	53	(c)
6	(c)	12	(b)	18	(b)	24	(d)	30	(d)	36	(d)	42	(c)	48	(b)		

Hints & Solutions

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1. (c) Salamander (Amphibia; Caudata) excrete urea through kidneys (mesonephric).

NOTES Like many organisms, the Rich Mountain Salamander's two kidneys are extremely important in excreting nitrogenous waste, and the urinary bladder stores waste in the form of urea and ammonia before it is released into the environment. The salamander can close its cloaca orifice and divert urea into the bladder.

2. (c) Those animals that excrete ammonia are called as ammonotelic, eg. aquatic amphibia. Those animals that excrete urea are called as ureotelic, eg. frog, humans.
   Those animals that excrete uric acid are called as uricotelic, eg. pigeon, lizards, and cockroach.
3. (a) Organisms which excrete nitrogenous wastes in the form of urea are called ureotelic organisms whereas the organisms which excrete nitrogenous wastes in the form of uric acid are called uricotelic organisms. Uric acid is the least poisonous and the least soluble in water, relative to Ammonia and Urea.
4. (b) Uric acid is the chief nitrogenous component of the excretory product of cockroach. Animals which live in dry conditions have to conserve water in their bodies. Therefore, they synthesise crystals of uric acid from ammonia. Uric acid crystals are non-toxic and can be retained in the body for a considerable time. Uricotelic animals include insects, reptiles and birds.
5. (c) Some animals have dual behaviour of excretion eg. earthworm. It excretes ammonia (hence called ammonotelic) when enough water is available but excretes urea (ureotelic) in dry conditions.
6. (c) In uricotelic animals nitrogenous waste is eliminated in the form of uric acid. Ammonotelism is seen in aquatic animals wherein nitrogenous wastes is eliminated in the form of ammonia eg. Fishes, tadpole. Ureotelism is observed in human beings in which nitogenous waste is eliminated as urea.

7. (b) Terrestial animals have limited access to water. Hence they have to secrete hypertonic urine and conserve water. Choices (c) and (d) are characteristics of marine animals who need to overcome the problem of preventing entry of salts and loss of water. Choice (a) is characteristic of fresh water animals.

8. (a) *Hydra* being a coelenterate, has blind sac body plan. It has only one mouth which serves as the opening for ingestion and waste elimination besides diffusion across body wall.

NOTES

The fluid is excreted through a break in the body wall created as a result of a strong contraction when the gut is distended with fluid. A normal hydra, therefore, must remove excess fluid by contracting and expelling it through its mouth.

9. (b) Sweat regulates body temperature. Sweating also called perspiration or sometimes *transpiration* is the production and evaporation of a fluid, consisting primarily of *water* as well as a smaller amount of *sodium chloride* the main constituent of "*table salt*", that is excreted by the sweat *glands* in the *skin* of *mammals*.

10. (c) In ureotelic animals urea is formed by Ornithine cycle. Urea is formed in the liver where two molecules of ammonia combine with one molecule of CO_2 in presence of Ornithine, citrulline, arginine and enzyme arginase. This is called Ornithine cycle.

11. (a) Solenocytes or flame cells or protonephridia are excretory organs in Platyhelminthes (Flatworms). They excrete ammonia. In Annelids excretory organ are nephridia. In Molluscs sac like kidneys are excretory organ. In a Echinodermata nitrogenous wastes are excreted through gills.

12. (b) In ureotelic animals urea is formed from ammonia by Ornithine cycle.

$$CO_2 + 2NH_3 \rightarrow CO(NH_2)_2 + H_2O$$

ammonia Urea

13. (b) The excretion of uric acid as nitrogenous waste is called uricotelism. The excretion of uric acid is advantageous for those animals which have to conserve water for their survival like birds and lizards.

14. (b) Ammonia molecules are small and highly soluble in water. In ammonotelic animals large amount of H_2O is required to eliminate ammonia from the body, so it is found in aquatic animals like tadpole of frog. When tadpole becomes a mature frog it acquires mainly ureotelism.

15. (b) Presence of Ketone bodies in urine (Ketonuria) and presence of glucose in urine (Glycosuria) are indicative of Diabetes mellitus.

NOTES

High ketone levels in urine may indicate diabetic ketoacidosis (DKA), a complication of diabetes that can lead to a coma or even death. Renal glycosuria, also known as renal **glucosuria**, is a rare condition in which the simple sugar glucose is eliminated (excreted) **in the** urine despite normal or low blood glucose levels.

16. (a) Adrenal cortex secretes mineralocorticoids like aldosterone which increase the reabsorption of Na^+ and water from renal tubule that prevent diuresis. Diuresis is a condition in which the kidneys filter too much bodily fluid.

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NOTES

Atrial natriuretic factor (ANF) is a 28 amino acid polypeptide hormone secreted mainly by the heart atria in response to atrial stretch. ANF acts on the kidney to increase sodium excretion and GFR, to antagonize renal vasoconstriction, and to inhibit renin secretion.

17. (c)

Descending limb of Henle's loop -	Reabsorption of water only
PCT -	Reabsorption of ions, water organic nutrients
Ascending limb of Henle's loop -	Reabsorption of salts only.
DCT -	Conditional reabsorption of sodium ions and water

18. (b) Loop of Henle along with vasa rectae plays an important role in the concentration of urine. The proximity between loop of Henle and vasa recta as well as counter current in them help in maintaining an increasing osmolarity towards the inner medullary interstitium. This mechanism helps to maintain a concentration gradient in medullary interstitium so human urine is nearly four times concentrated than initial filtrate formed. The urine concentrating

mechanism plays a fundamental role in regulating water and sodium excretion.

19. (c) Statements (iii) and (iv) are correct.
Dialysis is a procedure that is a substitute for many of the normal functions of the kidney.
(a) It remove waste, salt and extra water to prevent them from building up in the body.
(b) It keep a safe level of certain chemicals in your blood, such as potassium, sodium and bicarbonate helping to control blood pressure.
(c) There will be reduced absorption of calcium ions from gastrointestinal tract.
(d) RBC production will be reduced, due to reduced erythropoietin hormone.

20. (c) Glycosuria denotes presence of glucose in the urine. Gout is due to deposition of uric acid crystals in the joint. Renal calculi are precipitates of calcium phosphate produced in the pelvis of the kidney. Glomerular nephritis is the inflammatory condition of glomerulus characterised by proteinuria and haematuria.

21. (d) Descending limb of loop of Henle is permeable to water but impermeable to electrolytes whereas ascending limb is impermeable to water but permeable to electrolytes.

NOTES
The descending loop of Henle receives isotonic (300 mOsm/L) fluid from the proximal convoluted tubule (PCT). Substances reabsorbed in the PCT include urea, water, potassium, sodium, chloride, glucose, amino acids, lactate, phosphate, and bicarbonate.

22. (c) Hepatic Vein, because the liver produces urea and other waste materials and then it pours it all in the right ventricle of the heart for oxygenation. The heart distributes the blood to various parts of the body from here. So the impure blood brought by the Hepatic Vein and other blood vessels get distributed through the aorta. This will automatically imply that the Renal Artery will contain lesser impure blood than the Hepatic Vein.

23. (b) The secretion of Renin is induced by decrease in blood pressure and blood volume. It maintains the proper BP and BV. It has no role in the formation of large quantities of urine.

NOTES
Renin's primary function is therefore to eventually cause an increase in blood pressure, leading to restoration of perfusion pressure in the kidneys. Renin is secreted from juxtaglomerular kidney cells, which sense changes in renal perfusion pressure, via stretch receptors in the vascular walls.

24. (d) Gnerally all of the essential nutrients and 70% to 80% of electrolytes and water are reabsorbed by this segment. Removal of proximal convolnted tubule from the nephron will result in dilution of urine.

25. (c) Urine has acidic nature because hydrogen ions(H^+) are components of an acid which are secreted into the filtrate.

26. (a) Aldosterone hormone, released by the adrenal glands, helps the body regulate blood pressure. Aldosterone causes the tubules of the kidneys to increase the reabsorption of sodium and water into the blood. This increases the volume of fluid in the body, which also increases blood pressure.

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27. (d) A – Adrenal gland – located at the anterior part of kidney, secrete Catecholamines which stimulate glycogen breakdown.

28. (c) Nearly all the essential nutrients, and 70-80 percent of electrolytes and H_2O are reabsorbed by proximal convoluted tubules.

29. (c) The amount of the filtrate formed by the kidneys per minute is called glomerular filtration rate (GFR). GFR in a healthy individual is approximately 125 ml/minute, i.e., 180 litres per day. A fall in GFR can activate the JG cells to release renin which can stimulate the glomerular blood flow and thereby the GFR back to normal. Renin converts angiotensinogen in blood to angiotensin I and further angiotensin II. Angiotensin II being powerful vasoconstrictor increases the glomerular blood pressure and thereby GFR.

30. (d) Adult frog and human exhibit ureotelism because there excretory waste product is urea.

31. (c) Renal pelvis is the innermost portion of kidney. So, collecting ducts are not a part of renal pelvis.

32. (a) Podocytes are highly specialized cells with a complex cytoarchitecture plays a major role in establishing the selective permeability of glomerular filtration barrier.

33. (a) When some one drinks lots of water, kidney release of ADH is suppressed.

> **NOTES**
> Anti-diuretic hormone helps to control blood pressure by acting on the kidneys and the blood vessels. Its most important role is to conserve the fluid volume of your body by reducing the amount of water passed out in the urine.

34. (d) In male frogs the sperms are carried through the ureters, hence in male, ureters are called urinogenital ducts.

35. (c) Urine formation involves three main process called, glomerular filtration, reabsorption and secretion. A comparison of the volume of the filtrate formed per day (which is 180 litres per day) with that of urine released (about 1.5 litres) suggest that nearly 99 percent of the glomerular filtrate is resorbed by the renal tubules. The descending limb of loop of Henle is permeable to water but impermeable to electrolytes.
The ascending limb is impermeable to water but allows transport of electrolytes.
Reabsorption of sodium ions and water takes place in distal convoluted tubule.
Also, it is capable of reabsorption of HCO_3.

36. (d) The principal nitrogenous excretory compound in humans is urea. It is synthesized in the mitrochondrial matrix and cytosol of liver cells and eliminated through kidneys.

37. (d) Tissue and blood group matching are essential before undertaking kidney transplant. Even if kidney transplant is proper, the recipient may need to take immuno suppresant all his/her life. The ability of body to differentiate self and nonself and the cell-mediated immune response is responsible for graft rejection.

38. (a) Sensory stretch receptors are responsible for the stretch reflex. If these are removed then autonomic nervous system control will not be there and micturition will continue. Micturition is the expulsion of urine from the urinary bladder.

39. (d) Bowman's glands are found in olfactory epithelium which secrete mucus to keep the olfactory epithelium moist and free from germs.

> **NOTES**
> Smell detects volatile chemicals in the inhaled air, and taste detects dissolved chemicals in food and drink. Olfactory receptor cells have long cilia that protrude into a mucus layer that is secreted by Bowman's glands in the olfactory epithelium.

40. (d) Under fasting conditions and in uncontrolled diabetes, the liver produces large amount of ketone bodies like Acetoacetate, dihydroxy butyrate. The presence of excess ketone bodies in blood or urine is termed ketonemic and ketonuria respectively.

41. (c) (i) Glomerular capillary pressure (45 mm Hg) favours filteration.
(ii) The colloidal osmotic pressure (due to plasma proteins, particularly albumin) acts against filteration. Its value is ~20 mmHg.
(iii) The filterate pressure due to the glomerular filterate filled in the Bowman's capsule also acts against filteration. Its value is ~10 mmHg.
Net filteration pressure
= 45 – (20 + 10) mm Hg
= 15 mm of Hg (10 – 20 mm of Hg)

42. (c) Urea $NH_2 - CO - NH_2$ is formed from two molecules of ammonia and one molecule of carbon dioxide. A molecule of ammonia combines with carbondioxide to form carbonyl phosphate. It reacts with ornithine to form citrulline. Citrulline accepts another molecule of NH_4^+ giving rise to arginine. Arginine is hydrolysed into urea and ornithine with the help of enzyme arginase.

43. (a) Henle's loop is associated with the concentration of urine and production of hypertonic urine.

44. (b) Henle's loop is involved in osmoregulation and concentrating urine. Thus producing a hypertonic urine.

45. (a) Growth hormone, released by the anterior lobe of pituitary which brings about body growth by synthesis and deposition of proteins in tissues. Renin secreted by special cells in kidneys regulates blood pressure. Aldosterone reduces Na^+ elimination by helping active reabsorption from the nephric filtrate.

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46. (a) Nephridia are the excretory structures of annelids. Henle's loop is a part of the nephron or uriniferous tubule of the vertebrate kidney.
47. (a) Glomerulus is a group of about 50 capillaries which have numerous pores and are separated by the lumen of Bowman's Capsule through a basement layer.
48. (b) If kidneys fail to reabsorb water the urine will be diluted causing polyuria (frequent urination). Then the body tissues get dehydrated & the cell will loose water content & shrink.
49. (a) Active transport.

NOTES

Under normal circumstances, up to 180 g/day of glucose is filtered by the renal glomerulus and virtually all of it is subsequently reabsorbed in the proximal convoluted tubule. This reabsorption is effected by two sodium-dependent glucose cotransporter (SGLT) proteins.

50. (d) The cells of Proximal Convoluted Tubule (PCT) reabsorb entire glucose, amino acids, most of the inorganic ions (Na^+, K^+, Cl^-), most of the water as well as some urea. Glucose is reabsorbed actively and most effectively.
51. (c) Brush border cells are found mainly in the following organs: The small intestine tract: This is where absorption takes place. The microvilli that constitute the brush border have enzymes for this final part of digestion anchored into their apical plasma membrane as integral membrane proteins.

NOTES

They are known to secrete large amounts of protein-rich material and are thought to secrete the enzyme peptidase, which breaks peptide molecules into amino acids suitable for assimilation by the body. In humans the granules are found to contain carbohydrates, proteins, and radioactive zinc.

52. (b) Nephron is the excretory unit of human excretory system. Each nephron has a Bowman's Capsule, a Proximal Convoluted Tubule (PCT), Loop of Henle (Descending & Ascending limbs) and Distal Convoluted Tubule (DCT) which then enter into collecting duct.
53. (c) From Bowman's capsule, glomerular filtrate enters the proximal convoluted tubule. Most of the useful substances like Glucose, Amino Acids, inorganic ions (Na^+, K^+, Cl^- etc), and most of the important buffer bicarbonates are reabsorbed in Proximal Convoluted Tubule. Cells are specially adaptive for absorption having numerous microvilli & mitochondria (to provide energy for active absorption).

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20 Locomotion and Movement

Trend Analysis with Important Topics & Sub-Topics

		2020		2019		2018		2017		2016	
Topic	Sub-Topics	Qns.	LOD	Qns.	LOD	Qns.	LOD	Qns.	LOD	Qns.	LOD
Types of Movement/ Muscle	Muscle contraction					1	A			1	A
Skeletal System/ Joints	Pivot Joints							1	E		
	Ribs	1	D	1	D			1	D		
Disorders of Muscular and Skeletal system	Muscular Disorder			1	A						

LOD - Level of Difficulty | E - Easy | A - Average | D - Difficult | Qns - No. of Questions

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Topic 1: Types of Movement / Muscle

1. Calcium is important in skeletal muscle contraction because it *[2018]*
   (a) Binds to troponin to remove the masking of active sites on actin for myosin.
   (b) Activates the myosin ATPase by binding to it.
   (c) Prevents the formation of bonds between the myosin cross bridges and the actin filament.
   (d) Detaches the myosin head from the actin filament.
2. Lack of relaxation between successive stimuli in sustained muscle contraction is known as
   (a) Spasm (b) Fatigue *[2016]*
   (c) Tetanus (d) Tonus
3. Sliding filament theory can be best explained as: *[2015 RS]*
   (a) Actin and Myosin filaments shorten and slide pass each other
   (b) Actin and Myosin filaments do not shorten but rather slide pass each other
   (c) When myofilaments slide pass each other, Myosin filaments shorten while Actin filaments do not shorten
   (d) When myofilaments slide pass each other Actin filaments shorten while Myosin filament do not shorten
4. The H-zone in the skeletal muscle fibre is due to : *[NEET 2013]*
   (a) The central gap between myosin filaments in the A-band.
   (b) The central gap between actin filaments extending through myosin filaments in the A-band
   (c) Extension of myosin filaments in the central portion of the A-band.
   (d) The absence of myofibrils in the central portion of A-band.
5. During muscle contraction in humans the *[NEET Kar. 2013]*
   (a) Actin filaments shorten
   (b) Sarcomere *does not* shorten
   (c) A band remain same
   (d) A, H and I bands shorten

6. Which one of the following pairs of chemical substances is correctly categorized? *[2012M]*
   (a) Calcitonin and thymosin - Thyroid hormones
   (b) Pepsin and prolactin - Two digestive enzymes secreted in stomach
   (c) Troponin and myosin - Complex proteins in striated muscles
   (d) Secretin and rhodopsin - Polypeptide hormones
7. Which of the following is the contractile protein of a muscle? *[1998, 2006]*
   (a) Myosin (b) Tropomyosin
   (c) Actin (d) Tubulin
8. What is sarcomere? *[2001]*
   (a) Part between two H-lines
   (b) Part between two A-lines
   (c) Part between two I-bands
   (d) Part between two Z-lines
9. Which statement is correct for muscle contraction? *[2001]*
   (a) Length of H-line decreases
   (b) Length of A-band remains constant
   (c) Length of I-band increases
   (d) Length of two Z-lines increase
10. Which ion is essential for muscle contraction? *[1994]*
   (a) Na (b) K
   (c) Ca (d) Cl
11. Characteristics of smooth muscle fibres are *[1990]*
   (a) spindle-shaped, unbranched, unstriated, uninucleate and involuntary
   (b) spindle shaped, unbranched, unstriped, multinucleate and involuntary
   (c) cylindrical, unbranched, unstriped, multinucleate and involuntary
   (d) cylindrical, unbranched, striated, multinucleate and voluntary

Topic 2: Skeletal System / Joints

12. Match the following columns and select the correct option. *[2020]*

	Column-I		Column-II
(a)	Floating Ribs	(i)	Located between second and seventh ribs
(b)	Acromion	(ii)	Head of the Humerus
(c)	Scapula	(iii)	Clavicle
(d)	Glenoid cavity	(iv)	Do not connect with the sternum

	(a)	(B)	(C)	(D)
(a)	(i)	(iii)	(ii)	(iv)
(b)	(iii)	(ii)	(iv)	(i)
(c)	(iv)	(iii)	(i)	(ii)
(d)	(ii)	(iv)	(i)	(iii)

13. Match the following joints with the bones involved: *[2019, Odisa]*

	Column-I		Column-II
(a)	Gliding joint	(i)	Between carpal and metacarpal of thumb
(b)	Hinge joint	(ii)	Between atlas and axis
(c)	Pivot joint	(iii)	Between the carpals
(d)	Saddle joint	(iv)	Between humerus and ulna

Select the correct option from the following :
   (a) (a)-(i), (B)-(iii), (C)-(ii), (D)-(iv)
   (b) (a)-(iii), (B)-(iv), (C)-(ii), (D)-(i)
   (c) (a)-(iv), (B)-(i), (C)-(ii), (D)-(iii)
   (d) (a)-(iv), (B)-(ii), (C)-(iii), (D)-(i)
14. Select the correct option: *[2019]*
   (a) 8th, 9th and 10th pairs of ribs articulate directly with the sternum.
   (b) 11th and 12th pairs of ribs are connected to the sternum with the help of hyaline cartilage.
   (c) Each rib is a flat thin bone and all the ribs are connected dorsally to the thoracic vertebrae and ventrally to the sternum.
   (d) There are seven pairs of vertebrosternal, three pairs of vertebrochondral and two pairs of vertebral ribs.
15. The pivot joint between atlas and axis is a type of : *[2017]*
   (a) Cartilaginous joint (b) Synovial joint
   (c) Saddle joint (d) Fibrous joint
16. Out of 'X' pairs of ribs in humans only 'Y' pairs are true ribs. Select the option that correctly represents values of X and Y and provides their explanation: *[2017]*
   (a) X = 12, Y = 5 True ribs are attached dorsally to vertebral column and sternum on the two ends.
   (b) X = 24, Y = 7 True ribs are dorsally attached to vertebral column but are free on ventral side.
   (c) X = 24, Y = 12 True ribs are dorsally attached to vertebral column but are free on ventral side.
   (d) X = 12, Y = 7 True ribs are attached dorsally to vertebral column and ventrally to the sternum.

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17. Glenoid cavity articulates : ***[2015 RS]***
    (a) Scapula with acromion
    (b) Clavicle with scapula
    (c) Humerus with scapula
    (d) Clavicle with acromion
18. Which of the following joints would allow no movement? ***[2015 RS]***
    (a) Cartilaginoius joint
    (b) Synovial joint
    (c) Ball and Socket joint
    (d) Fibrous joint
19. Which of the following is not a function of the skeletal system? ***[2015 RS]***
    (a) Storage of minerals
    (b) Production of body heat
    (c) Locomotion
    (d) Production of erythrocytes
20. Select the correct matching of the type of the joint with the example in human skeletal system: ***[2014]***

	Type of joint	Example
(a)	Cartilaginous joint	between frontal and pariental
(b)	Pivot joint	between third and fourth cervical vertebrae
(c)	Hinge joint	between humerus and pectoral girdle
(d)	Gliding joint	between carpals

21. The characteristics and an example of a synovial joint in humans is : ***[NEET 2013]***

	Characteristics	Examples
(a)	Fluid filled between two joints, provides cushion	Skull bones
(b)	Fluid filled synovial cavity between two bones	Joint between atlas and axis
(c)	Lymph filled between two bones, limited movement	gliding joint between carpals
(d)	Fluid cartilage between two bones, limited movements	Knee joint

22. Select the correct statement with respect to locomotion in humans : ***[NEET 2013]***
    (a) Accumulation of uric acid crystals in joints causes their inflammation
    (b) The vertebral column has 10 thoracic vertebrae.
    (c) The joint between adjacent vertebrae is a fibrous joint
    (d) The decreased level of progesterone causes osteoporosis in old people
23. Three of the following pairs of the human skeletal parts are correctly matched with their respective inclusive skeletal category and one pair is not matched. Identify the non-matching pair. ***[2011M]***

	Pairs of skeletal parts	Category
(a)	Sternum and Ribs	Axial skeleton
(b)	Clavicle and Glenoid cavity	Pelvic girdle
(c)	Humerus and Ulna skeleton	Appendicular
(d)	Malleus and Stapes	Ear ossicles

24. Which one of the following is the correct matching of three items and their grouping category? ***[2009]***

	Items		Group
(a)	ilium, ischium, pubis	-	coxal bones of pelvic girdle
(b)	actin, myosin, rhodopsin.	-	muscle proteins
(c)	cytosine, uracil, thiamine	-	pyrimidines
(d)	malleus, incus, cochlea	-	ear ossicles

25. Elbow joint is an example of: ***[2009]***
    (a) hinge joint (b) gliding joint
    (c) ball and socket joint (d) pivot joint
26. Which one of the following items gives its correct total number? ***[2008]***
    (a) Floating ribs in humans - 4
    (b) Amino acids found in proteins - 16
    (c) Types of diabetes - 3
    (d) Cervical vertebrae in humans - 8
27. In human body, which one of the following is anatomically correct? ***[2007]***
    (a) Collar bones - 3 pairs
    (b) Salivary glands - 1 pairs
    (c) Cranial nerves - 10 pairs
    (d) Floating ribs - 2 pairs
28. Which of the following pairs, is correctly matched? ***[2005]***
    (a) Hinge joint - between vertebrae
    (b) Gliding joint - between zygapophyses of the successive vertebrae
    (c) Cartilaginous joint - skull bones
    (d) Fibrous joint - between phalanges

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29. An acromian process is characteristically found in the: *[2005]*
(a) pelvic girdle of mammals
(b) pectoral girdle of mammals
(c) skull of frog
(d) sperm of mammals

30. ATPase enzyme needed for muscle contraction is located in *[2004]*
(a) actinin (b) troponin
(c) myosin (d) actin

31. What will happen if ligaments are cut or broken? *[2002]*
(a) Bones will move freely at joints
(b) No movement at joints
(c) Bones will become unfix
(d) Bones will become fixed

32. The joint found between sternum and the ribs in humans is *[2000]*
(a) angular joint (b) fibrous joint
(c) cartilaginous joint (d) gliding joint

33. Which one of the following is a skull bone ?
(a) Atlas (b) Coracoid *[2000]*
(c) Arytaenoid (d) Pterygoid

34. Total number of bones in the hind limb of man is *[1998]*
(a) 14 (b) 30
(c) 24 (d) 21

35. The lower jaw in mammals is made up of
(a) Mandible (b) Dentary *[1998]*
(c) Maxilla (d) Angulars

36. The functional unit of contractile system in striated muscle is *[1998]*
(a) myofibril (b) sarcomere
(c) Z-band (d) cross bridges

37. The number of floating ribs in the human body, is *[1995]*
(a) 6 pairs (b) 5 pairs
(c) 3 pairs (d) 2 pairs

38. Which is part of pectoral girdle? *[1994]*
(a) Glenoid cavity (b) Sternum
(c) Ilium (d) Acetabulum

39. Long bones function in *[1993]*
(a) support
(b) support, erythrocyte and leucocyte synthesis
(c) support and erythrocyte synthesis
(d) erythrocyte formation

40. A deltoid ridge occurs in *[1990]*
(a) Radius (b) Ulna
(c) Femur (d) Humerus

41. Number of cervical vertebrae in camel is *[1990]*
(a) more than that of rabbit
(b) less than that of rabbit
(c) same as that of whale
(d) more than that of horse

42. Extremities of long bones possess cartilage
(a) calcified (b) fibrous *[1989]*
(c) elastic (d) hyaline

43. Haversian canals occur in *[1989]*
(a) Humerus (b) Pubis
(c) Scapula (d) Clavicle

Topic 3: Disorders of Muscular and Skeletal System

44. Which of the following diseases is an autoimmune disorder ? *[2019, Odisa]*
(a) Gout (b) Myasthenia gravis
(c) Arthritis (d) Osteoporosis

45. Which of the following muscular disorders is inherited? *[2019]*
(a) Tetany
(b) Muscular dystrophy
(c) Myasthenia gravis
(d) Botulism

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46. Which of the following is not an autoimmune disease? *[2018]*
(a) Psoriasis
(b) Rheumatoid arthritis
(c) Vitiligo
(d) Alzheimer's disease

47. Which of the following hormones can play a significant role in osteoporosis? *[2018]*
(a) Aldosterone and Prolactin
(b) Progesterone and Aldosterone
(c) Parathyroid hormone and Prolactin
(d) Estrogen and Parathyroid hormone

48. Select the correct statement with respect to disorders of muscles in humans *[NEET Kar. 2013]*
(a) Rapid contractions of skeletal muscles causes muscle dystrophy
(b) Failure of neuromuscular transmission in myasthenia gravis can prevent normal swallowing
(c) Accumulation of urea and creatine in the joints cause their inflammation
(d) An overdose of vitamin D causes osteoporosis

49. Select the correct statement regarding the specific disorder of muscular or skeletal system: *[2012]*
    (a) Muscular dystrophy - age related shortening or muscles.
    (b) Osteoporosis - decrease in bone mass and higher chance of fractures with advancing age.
    (c) Myasthenia gravis - Auto immune disorder which inhibits sliding of myosin filaments
    (d) Gout - inflammation of joints due to extra deposition of calcium.

50. Low Ca^{++} in the body fluid may be the cause of: *[2010]*
    (a) tetany
    (b) anaemia
    (c) angina pectoris
    (d) gout

51. Parathormone deficiency produces muscle ramps or tetany as a result of *[1999]*
    (a) lowered blood Ca^{2+}
    (b) enhanced blood Na^{+}
    (c) enhanced blood glucose
    (d) enhanced blood $Ca2^{+}$

ANSWER KEY

1	(a)	7	(a)	13	(b)	19	(b)	25	(a)	31	(c)	37	(d)	43	(a)	49	(b)
2	(c)	8	(d)	14	(d)	20	(d)	26	(a)	32	(c)	38	(a)	44	(b)	50	(a)
3	(b)	9	(ab)	15	(b)	21	(b)	27	(d)	33	(d)	39	(b)	45	(b)	51	(a)
4	(b)	10	(c)	16	(d)	22	(a)	28	(b)	34	(b)	40	(d)	46	(d)		
5	(c)	11	(a)	17	(c)	23	(b)	29	(b)	35	(a)	41	(c)	47	(d)		
6	(c)	12	(c)	18	(d)	24	(a)	30	(c)	36	(b)	42	(d)	48	(b)		

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Hints & Solutions

1. (a) The sarcoplasmic reticulum to release calcium ions into the muscle interior where they bind to troponin, thus causing tropomyosin to shift from the face of the actin filament to which myosin heads need to bind to produce contraction.

2. (c) Sustained contraction with no relaxation phase is called muscle tetanus.

> **NOTES**
> A tetanic contraction (also called tetanised state, tetanus, or physiologic tetanus, the latter to differentiate from the disease called tetanus) is a sustained muscle contraction evoked when the motor nerve that innervates a skeletal muscle emits action potentials at a very high rate.

3. (b) Sliding filament theory was given by Huxley and Huxley (1954). It states that Actin and Myosin filaments do not become short but rather slide pass each other. Because of sliding of actin filaments over myosin the length of I-band will change.

4. (b) Central part of thick filament, not overlapped by thin filaments is called the 'H' zone. 'H' zone is also called Hensen's Line.

5. (c) Increase in Ca^{++} level into the sarcoplasm leads to the binding of calcium with a subunit of troponin on actin filaments and there by remove the masking of active sites for myosin. Utilising the energy from ATP hydrolysis, the myosin head now binds to the exposed active sites on actin to form a cross bridge. This pulls the attached actin filaments towards the centre of 'A' band. The 'Z' line attached to these actins are also pulled inwards thereby causing a shortening of the sarcomere, *i.e.*, contraction. It is clear from the above steps, that during shortening of the muscle, *i.e.*, contraction, the 'I' bands get reduced, whereas the 'A' bands retain the length.

6. (c) Troponin is a protein which is found on actin filament and myosin protein is found in myosin filament. Both actin and myosin are complex proteins in striated muscles.
Thymosin is a hormone secreted by the thymus that stimulates development of T cells.

Prolactin is a hormone released by the pituitary gland that stimulates breast development and milk production in women. Rhodopsin, also known as visual purple, is not a hormone. It is a biological pigment in photoreceptor cells of the retina that is responsible for the first events in the perception of light.

7. (a) Actin and tropomyosin are part of thin filaments of skeletal muscle. Tubulin is presents in microtubules. Myosin is muscle protein.
8. (d) Darks bands on the myofibril form A-band. Middle part of A-band contains light zones-Hensen line (H-lines). Light band on myofibril is called I-band. Middle part of I-band contains Z-lines. Sarcomere is part between two Z-lines.
9. (a,b) When Ca^+ ions combine with troponin contraction of muscles initiates. During contraction the Z lines come closer together and the sarcomere becomes shorter. The length of A band remains constant. I bands shortens and H-band narrows.
10. (c) Movement of Ca^{2+} out in sarcoplasmic reticulum controls the making and breaking of actin and myosin complex actomyosin due to which muscle contraction and relaxation takes place. Albert Szent Gyorgyi worked out biochemical events of muscle contraction.
11. (a) Characteristics of smooth muscle fibres.
    - cells range from 5 to 10 μm in diameter and 30 to 200 μm in length
    - spindle-shaped
    - single, centrally located nucleus
    - smooth muscle tissue occuring within almost every organ, forming sheets, bundles or sheaths around other tissues.

    Smooth muscle differs from both skeletal and cardiac muscle tissues in structure and function. Sarcomeres or myofibrils are not present - therefore not striated, ie. smooth.
12. (c) 11*th* and 12*th* pairs of ribs are not connected ventrally and are therefore, called floating ribs. Acromion is a flat expanded process of spine of scapula. The lateral end of clavicle articulates with acromion process. Scapula is a flat triangular bone in the dorsal part of the thorax between 2*nd* and the 7*th* rib. Glenoid cavity of scapula articulates with head of the humerus to form the shoulder joint.

NOTES

The acromion of the scapula is a large bony projection on the superior end of the scapula. It is an important landmark of the skeletal system and a muscle attachment point essential to the function of the shoulder joint. The acromion also forms the acromian clavicular (AC) joint with the clavicle.

13. (b) Gliding joint is present between the carpals. Hinge joint is present between humerus and ulna. Pivot joint is present between atlas and axis. Saddle joint is present between carpal and metacarpal of thumb.
14. (d) There are 12 pairs of ribs in human body. First seven pairs are attached to the sternum ventrally with the help of hyaline carlilage, also called as true ribs. These are called vertebrosternal ribs. The next three pairs (8th, 9th and 10th) do not articulate directly with the sternum, also called vertebrochondral (false) ribs . The last two pairs (11th and 12th) are the free floating ribs because they are not connected ventrally.
15. (b) Pivot joint is a type of synovial joint which provide freely movement between atlas and axis vertebrae of vertebral column.

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NOTES

The pivot joints (and the other joints) can be affected by such conditions as the following: Ankylosis: The fusion of bones across a joint. It is often a complication of arthritis. Ankylosing spondylitis: A type of inflammatory arthritis that progresses to ankylosis.

16. (d) In human, 12 pairs of ribs are present out of which 7 pairs of ribs (1st to 7th pair) are dorsally attached to vertebral column and ventrally to the sternum.
17. (c) Glenoid cavity articulates humerus with scapula.

NOTES

The end of the scapula, called the glenoid, meets the head of the humerus to form a glenohumeral cavity that acts as a flexible ball-and-socket joint. The joint is stabilized by a ring of fibrous cartilage surrounding the glenoid, called the labrum.

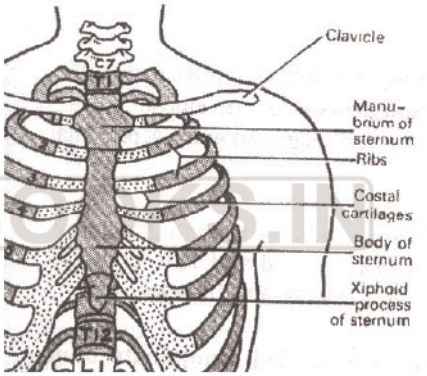
18. (d) Fibrous joint is an attachment between bones, being held together by fibrous connective tissue. For example- suture between skull bones.

19. (b) Production of body heat is caused by the process of metabolism (respiration).
20. (d) A gliding joint is a common type of synovial joint formed between bones that meet at flat or nearly flat articular surfaces. Gliding joints allow the bones to glide past one another in any direction along the plane of the joint - up and down, left and right, and diagonally. Many gliding joints are formed in the appendicular skeleton between the carpal bones of the wrist; between the carpals and the metacarpals of the palm; between the tarsal bones of the ankle; and between the tarsals and the metatarsals of the foot.
21. (b) **Synovial joints** are characterised by the presence of a fluid filled synovial cavity between the articulating surfaces of the two bones. Such an arrangement allows considerable movement. These joints help in locomotion and many other movements. Ball and socket joint (between humerus and pectoral girdle), Hinge joint (knee joint), Pivot joint (between atlas and axis), Gliding joint (between the carpals) and Saddle joint (between carpal and metacarpal of thumb) are some examples.
22. (a) Vertebral column has 12 thoracic vertebrate. The joints between adjacent vertebrae is cartilaginous joint which permits limited movements. Progesterone is secreted by corpus luteum which supports in pregnancy in females. Deposition of uric acid in form of urate crystal in the joints are responsible for the inflammation and painful symptoms of gout.
23. (b) Glenoid cavity is found in pectoral girdle.

NOTES

A tear of the rim below the middle of the glenoid socket that also involves the inferior glenohumeral ligament is called a Bankart lesion. Tears of the glenoid rim often occur with other shoulder injuries, such as a dislocated shoulder (full or partial dislocation). Trauma may cause a fracture of the humerus (ball) or the glenoid (socket) of the shoulder joint. The majority of these injuries can be treated without surgery with a good, long-term result. Some fractures are better treated with surgery because they may carry a high risk of arthritis if left alone.

24. (a) The pelvic girdle is formed by two innominate bones consists of three separate bones ilium, ischium and the pubis.
25. (a) Elbow joint is an example of hinge joint. The elbow is a hinge joint; it can open and close like a door. Hinge joint is a form of diarthrosis (freely movable joint) that allows angular movement in one plane only, increasing or decreasing the angle between the bones e.g. elbow joint, knee joint etc.
26. (a) In a humans total number of ribs are Fourteen (14). These are of three types
    (1) True ribs-These are 7 in number.
    (2) False ribs- These are two (2) in number.
    (3) Floating ribs-These are 4 in number.
27. (d) Floating ribs are 2- pairs (11th and 12th pair) which are not attached to sternum.



28. (b) Hinge joint : elbow joint, knee joint, ankle joint, inter phalangeal joint.
    Gliding joint : Intercarpal joint, intertarsal joint, sternoclavicular joint and joint between pre and post zygapophysis of adjacent vertebra.
    Fibrous joint (Synarthroses) : Joints of cranium - bones. Joints between teeth and Jaw bones.
    Cartilaginous joint (Amphiarthroses): Joints between mammalian vertebrae and two innominate bones (pubic symphysis).
29. (b) Each half of pectoral girdle has two bones *i.e.* clavicle and scapula. A spine like, acromian process is attached to scapula for articulation with clavicle bone.
30. (c) ATPase enzyme is located in the myosin cross bridge heads. Actin forms the light or I- Band. Actin slides over myosin during contraction. Troponin protein is involved in establishing connection with myosin cross

bridges. Actin is not involved in muscle contraction. It is also an ATPase (an enzyme) which is activated by Ca^{2+} and Mg^{2+} ions. Hence, ATPase enzyme is located in myosin.

31. (c) Ligments are specialised connective tissues which connect bones together, hence if they are cut or broken the bone will be come unfixed.

32. (c) In angular joint articulating surface of one bone is oval and convex whereas that of the other is elliptical and concave, it allows movement only in two directions *e.g.* Wrist. Fibrous joints are unmovable joints *e.g.* Sutures of skull.

NOTES

Cartilaginous joints have little motility due to disc of fibrocartilage between the articular ends. In gliding joints articulate end of both the bones are either flat or curved to allow gliding movements. e.g. between carpels and wrist.

33. (d) Atlas is the first cervical vertebra. Coracoid is part of the pectoral girdle. Pterygoid is a small bone articulated with palatine. Arytenoids are cartilage present at the back of larynx.

34. (b) Each hind limb contain 30 bones namely 1 femur in the thigh, 1 petala in the knee, 1 tibia and 1 fibula in the lower leg, 7 tarsals in the ankle, 5 metatarsals in the sole and 14 phalanges in toes.

35. (a) Lower jaw is made of mandible or jaw bone.

NOTES

The mandible is the largest bone in the human skull. It holds the lower teeth in place; it assists in mastication and forms the lower jawline. The mandible is composed of the body and the ramus and is located inferior to the maxilla. The body is a horizontally curved portion that creates the lower jawline.

36. (b) A skeletal muscle consists of a bundle of long fibres running the length of the muscle. Each fibre is a single cell with many nuclei. Skeletal muscle is also called striated muscle because the regular arrangement of the myofilaments creates repeating pattern of light and dark bands. Each repeating unit is a sarcomere, the basic functional unit of the muscle. The borders of the sarcomere are the Z lines, which line up in adjacent myofibrils and contribute to striations visible with a light microscope.

37. (d) In a human body, there are two pairs of floating ribs. i.e., 11th and 12th pairs. These ribs are not attached to either to sternum or the cartilage of another rib. They protect the kidneys.

38. (a) Glenoid cavity is a shallow concavity on the lateral side of pectoral girdle in which the head of humerus fits making the shoulder joint.

39. (b) Long bones gives us support as well as their bone marrow (the peripheral part) synthesizes (in adults) the blood cells.

40. (d) A deltoid ridge is present along the ventral side of humerus (bone of upper arm - Brachium) which provides the attachement points to muscles.

41. (c) All mammals have 7 cervical vertebrae in their neck (it is one of the unique mammalian characters). Though they become long in camel & giraffe but the number is 7 only. As whale is also a mammal it also possess the same number of cervical vertebrae.

42. (d) Hyaline Cartilage forms the 'cushions' or 'pads' upon the articular surfaces at the joints of long bones and called 'articular cartilage'. Its role in adult body is to withstand forces of compression and torsion at the joints.

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43. (a) Haversian canals are a characteristic feature of the mammalian bones present in the matrix of bones. They are present in the humerus bone.

NOTES

Haversian canals are microscopic tubes or tunnels in cortical bone that house nerve fibers and a few capillaries. This allows bone to get oxygen and nutrition without being highly vascular. These canals also communicate with bone cells using special connections, or canaliculi.

44. (b) Myasthenia gravis is autoimmune disorder that affects neuromuscular junction leading to fatigue, weakening and paralysis of skeletal muscles.

Arthritis is inflammation of one or more joints. It is characterised by pain, stiffness and limited function of joints.

Gout, a type of metabolic arthritis (diet related) is inflammation of joints due to accumulation of uric acid crystals. It can cause painful swelling in joints and typically affects the big toe.

Osteoporosis is age related disorder characterised by decreased bone mass and increased chances of fractures. It starts with the roughening of cartilage.

NOTES

An autoimmune disease is a condition arising from an abnormal immune response to a functioning body part. There are at least 80 types of autoimmune diseases. Nearly any body part can be involved. Common symptoms include low grade fever and feeling tired. Often symptoms come and go. Autoimmune disorders in general cannot be cured, but the condition can be controlled in many cases. Historically, treatments include: anti-inflammatory drugs – to reduce inflammation and pain.

45. (b) Muscular dystrophy is a inheritable disease that gradually cause the muscles to weaken, leading to an increasing level of disability.
Tetany, Myasthenia gravis and Botulism are not inheritable diseases.

46. (d) Alzheimer's disease is a neurodegenerative disorder due to deficiency of neurotransmitter acetylcholine. Rheumatoid arthritis is an autoimmune disorder in which antibodies are produced against the synovial membrane and cartilage. Vitiligo causes white patches on skin also characterized as autoimmune disorder. Psoriasis is a skin disease that causes itchy or sore patches of thick red skin and is also autoimmune.

47. (d) Osteoporosis has 3 causes: excess parathyroid hormone, advanced age, and lack of estrogen in older females. Estrogen promotes the activity of osteoblast and inhibits osteoclast. Parathormone promotes mobilisation of calcium from bone into blood. Excessive activity of parathormone causes demineralisation leading to osteoporosis.

48. (b) Myasthenia gravis is a chronic autoimmune muscular disease. It causes breakdown of neuromuscular junction due to which the brain loses control over muscles. The symptoms may include drooping eyelids, difficulty in swallowing muscle fatigue, difficult breathing and inability to control facial expressions.

NOTES

Myasthenia gravis is a chronic (long-lasting) disease that usually worsens slowly over time. Although symptoms may fluctuate in severity over the years, the disease rarely goes away on its own. The patients should avoid dairy foods, except for yogurt which can sooth digestive problems. Good choices include mild foods like bananas, white rice, eggs and chicken. Diarrhoea can lower potassium levels. Foods rich in potassium include orange juice, bananas, potatoes, avocados and apricots.

49. (b) Major causative factors of osteoporosis are imbalances of hormones like calcitonin of thyroid, parathormone of parathyroids, sex hormones, and deficiencies of calcium and vitamin D.

50. (a) Tetany is caused by reduction in the calcium level due to underactive parathyroid hormone.

51. (a) Parathormone released by the parathyroid gland elevates the level of Ca^{2+} in blood. The deficiency of this hormone lowers blood Ca^{2+}. As a result, the excitability of muscles and nerves increases causing tetany -sustained contraction.

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21 Neural Control and Coordination

Trend Analysis with Important Topics & Sub-Topics

		2020		2019		2018		2017		2016	
Topic	Sub-Topics	Qns.	LOD	Qns.	LOD	Qns.	LOD	Qns.	LOD	Qns.	LOD
Neural System	Neuron							2	E		
	Brain			1	A	1	A				
Reflex Action & Reflex Arc											
Sensory Reception & Processing	Eye			1	A	1	A	1	D	1	A
	Ear	1	D								

LOD - Level of Difficulty | E - Easy | A - Average | D - Difficult | Qns - No. of Questions

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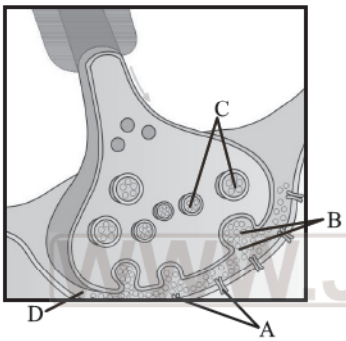
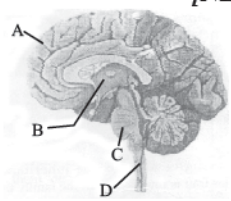
Topic 1: Neural System

1. Which of the following structures or regions is incorrectly paired with its functions? *[2018]*
   (a) Medulla oblongata : controls respiration and cardiovascular reflexes.
   (b) Limbic system : consists of fibre tracts that interconnect different regions of brain; controls movement.
   (c) Corpus callosum : band of fibers connecting left and right cerebral hemispheres.
   (d) Hypothalamus : production of releasing hormones and regulation of temperature, hunger and thirst.
2. Nissl bodies are mainly composed of *[2018]*
   (a) Proteins and lipids
   (b) DNA and RNA
   (c) Free ribosomes and RER
   (d) Nucleic acids and SER
3. Myelin sheath is produced by : *[2017]*
   (a) Astrocytes and Schwann cells
   (b) Oligodendrocytes and Osteoclasts
   (c) Osteoclasts and Astrocytes
   (d) Schwann cells and Oligodendrocytes
4. Receptor sites for neurotransmitters are present on : *[2017]*
   (a) Pre-synaptic membrane
   (b) Tips of axons
   (c) Post-synaptic membrane
   (d) Membrane of synaptic vesicles
5. Which of the following regions of the brain is incorrectly paired with its function? *[2015 RS]*
   (a) Cerebellum – language comprehension
   (b) Corpus callosum – communication between the left and right cerebral cortices
   (c) Cerebrum – calculation and contemplation
   (d) Medulla oblongata – homeostatic control
6. Destruction of the anterior horn cell of the spinal cord would result in loss of : *[2015 RS]*
   (a) voluntary motor impulses
   (b) commissural impulses
   (c) integrating impulses
   (d) sensory impulses
7. Stimulation of a muscle fiber by a motor neuron occurs at: *[2014]*
   (a) the neuromuscular junction
   (b) the transverse tubules
   (c) the myofibril
   (d) the sacroplasmic reticulum

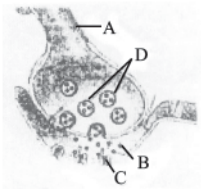
8. Injury localized to the hypothalamus would most likely disrupt: ***[2014]***
   (a) short - term memory.
   (b) co-ordination during locomotion.
   (c) executive functions, such as decision making.
   (d) regulation of body temperature.
9. The most abundant intracellular cation is : ***[NEET 2013]***
   (a) Ca^{++} (b) H^{+}
   (c) K^{+} (d) Na^{+}
10. A diagram showing axon terminal and synapse is given. Identify correctly at least two of A-D. ***[NEET 2013]***



   (a) B-Synaptic connection, D-K^{+}
   (b) A-Neurotransmitter, B-Synaptic cleft
   (c) C- Neurotransmitter, D-Ca^{++}
   (d) A-Receptor, C-Synaptic vesicles
11. A sagittal section of human-brain is shown here. Identify at least two labels from A-D. ***[NEET Kar. 2013]***



   (a) A – Cerebral hemispheres; B – Cerebellum
   (b) C – Mid brain; D – Cerebellum
   (c) A – Cerebrum; C – Pons
   (d) B – Corpus callosum; D – Medulla
12. The figure shows an axon terminal and synapse. Select the option giving correct identifications of tables A-D ***[NEET Kar. 2013]***



   (a) A – Axon terminal; B–Serotonin complex
   (b) A – Action potential; C – Neurotransmitter
   (c) B – Neurotransmitter; D – Receptor capsules
   (d) C – Receptor; D – Synaptic vesicles
13. The human hind brain comprises three parts, one of which is : ***[2012]***
   (a) Spinal cord (b) Corpus callosum
   (c) Cerebellum (d) Hypothalamus
14. A person entering an empty room suddenly finds a snake right in front on opening the door. Which one of the following is likely to happen in his neuro-hormonal control system ? ***[2012]***
   (a) Sympathetic nervous system is activated releasing epinephrin and norepinephrin from adrenal medulla.
   (b) Neurotransmitters diffuse rapidly across the cleft and transmit a nerve impulse.
   (c) Hypothalamus activates the parasympathetic division of brain.
   (d) Sympathetic nervous system is activated releasing epinephrin and norepinephrin from adrenal cortex.
15. When a neuron is in resting state i.e., not conducting any impulse, the axonal membrane is: ***[2011]***
   (a) comparatively more permeable to Na^{+} ions and nearly impermeable to K^{+} ions
   (b) equally permeable to both Na^{+} and K^{+} ions
   (c) impermeable to both Na^{+} and K^{+} ions
   (d) comparatively more permeable to K^{+} ions and nearly impermeable to Na^{+} ions
16. The nerve centres which control the body temperature and the urge for eating are contained in: ***[2010]***
   (a) hypothalamus (b) pons
   (c) cerebellum (d) thalamus

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17. Which part of human brain is concerned with the regulation of body temperature? *[2009]*
(a) Cerebellum
(b) Cerebrum
(c) Hypothalamus
(d) Medulla Oblongata

18. During the propagation of a nerve impulse, the action potential results from the movement of : *[2008]*
(a) K^+ ions from extracellular fluid to intracellular fluid
(b) Na^+ ions from intracellular fluid to extracellular fluid
(c) K^+ ions from intracellular fluid to extracellular fluid
(d) Na^+ ions from extracellular fluid to intracellular fluid

19. During the transmission of nerve impulse through a nerve fibre, the potential on the inner side of the plasma membrane has which type of electric change? *[2007]*
(a) First positive, then negative and continue to be positive
(b) First negative, then positive and continue to be positive.
(c) First positive, then negative and again back to positive
(d) First negative, then positive and again back to negative.

20. Which one of the following pairs of structures distinguishes a nerve cell from other types of cells? *[2007]*
(a) Vacuoles and fibres
(b) Flagellum and medullary sheath
(c) Nucleus and mitochondria
(d) Perikaryon and dendrites.

21. Four healthy people in their twenties got involved in injuries resulting in damage and death of a few cells of the following. Which of the cells are least likely to be replaced by new cells? *[2005]*
(a) Liver cells
(b) Neurons
(c) Malpighian layer of the skin
(d) Osteocytes

22. In a man, abducens nerve is injured. Which one of the following functions will be affected? *[2005]*
(a) Movement of the eye ball
(b) Movement of the tongue
(c) Swallowing
(d) Movement of the neck

23. One of the examples of the action of the autonomous nervous system is *[2005]*
(a) swallowing of food
(b) pupillary reflex
(c) peristalsis of the intestine
(d) knee-jerk response

24. Injury to vagus nerve in humans is not likely to affect *[2004]*
(a) tongue movements
(b) gastrointestinal movements
(c) pancreatic secretion
(d) cardiac movements

25. In the resting state of the neural membrane, diffusion due to concentration gradients, if allowed, would drive *[2004]*
(a) K^+ into the cell
(b) K^+ and Na^+ out of the cell
(c) Na^+ into the cell
(d) Na^+ out of the cell

26. The Nissl's granules of nerve cells are made up of *[1997, 03]*
(a) ribosomes (b) proteins
(c) DNA (d) mitochondria

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27. Which of the following statements is correct for 'nodes of Ranvier' of nerve? *[2002]*
(a) Neurilemma is discontinuous
(b) Myelin sheath is discontinuous
(c) Both neurilemma and myelin sheath are discontinuous
(d) Covered by myelin sheath

28. In which animal nerve cell is present but brain is absent? *[2002]*
(a) Sponge (b) Earthworm
(c) Cockroach (d) *Hydra*

29. Neuroglia consist of cells found in the *[1999]*
(a) liver
(b) kidney
(c) central nervous system and ganglia
(d) testes

30. Anesthetics reduce pain by blocking the transmission of nerve impulses. The kind of chemicals working as anesthetics are those that block *[1998]*
(a) only the voltage-gated sodium channels in membranes
(b) only the voltage-gated potassium channels in membranes
(c) only the neuro-transmitter receptors
(d) voltage-gated sodium and potassium channels and neuro-transmitter receptors

31. In humans, visceral organs are innervated by *[1996]*
    (a) sympathetic nerves and are under conscious control
    (b) parasympathetic nerves and are under conscious control
    (c) both sympathetic and parasympathetic nerves and are under conscious control
    (d) both sympathetic and parasympathetic nerves but are not under conscious control
32. The sympathetic nerves in mammals arise from *[1995]*
    (a) sacral nerves
    (b) cervical nerves
    (c) thoraco-lumbar nerves
    (d) 3rd, 7th, 9th and 10th cranial nerves
33. Respiratory centre is situated in *[1994]*
    (a) cerebellum
    (b) medulla oblongata
    (c) hypothalamus
    (d) cerebrum
34. CNS is mostly made of *[1993]*
    (a) motor neurons and sensory neurons
    (b) sensory neurons and association neurons
    (c) association neurons
    (d) motor neurons and association neurons
35. Vagus nerve is *[1992]*
    (a) X (b) IX
    (c) VII (d) V
36. Afferent nerve fibres carry impulses from
    (a) effector organs to CNS *[1992]*
    (b) receptors to CNS
    (c) CNS to receptors
    (d) CNS to muscles
37. One function of parasympathetic nervous system is *[1990]*
    (a) contraction of hair muscles
    (b) stimulation of sweat glands
    (c) acceleration of heart beat
    (d) constriction of pupil
38. Third ventricle of brain is also known as *[1990]*
    (a) metacoel (b) rhincoel
    (c) paracoel (d) diacoel
39. Which of the following cranial nerves can regulate heart beat? *[1989]*
    (a) X (b) IX
    (c) VIII (d) VII

Topic 2 : Reflex Action & Reflex Arc

40. Which of the following receptors are specifically responsible for maintenance of balance of body and posture? *[2019, Odisha]*
    (a) Crista ampullaris and macula
    (b) Basilar membrane and otoliths
    (c) Hair cells and organ of corti
    (d) Tectorial membrane and macula
41. Which of the following is an example of negative feedback loop in humans? *[2007]*
    (a) Secretion of tears after falling of sand particles into the eye.
    (b) Salivation of mouth at the sight of delicious food
    (c) Secretion of sweat glands and constriction of skin blood vessels when it is too hot
    (d) Constriction of skin blood vessels and contraction of skeletal muscles when it is too cold
42. In vertebrates, simple reflex action is *[1999]*
    (a) polysynaptic (b) bisynaptic
    (c) trisynaptic (d) monosynaptic
43. Ivan Pavlov performed experiments on *[1993]*
    (a) simple reflexes
    (b) conditioned reflexes
    (c) cardiac reflexes
    (d) origin of life

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Topic 3: Sensory Reception & Processing

44. Match the following columns and select the correct option.

	Column-I		Column-II
(a)	Organ of Corti	(i)	Connects middle ear and pharynx
(b)	Cochlea	(ii)	Coiled part of the labyrinth
(c)	Eustachian tube	(iii)	Attached to the oval window
(d)	Stapes	(iv)	Located on the basilar membrane

	(A)	(B)	(C)	(D)
(a)	(iii)	(i)	(iv)	(ii)
(b)	(iv)	(ii)	(i)	(iii)
(c)	(i)	(ii)	(iv)	(iii)
(d)	(ii)	(iii)	(i)	(iv)

45. Which of the following statements is not correct ? *[2019]*
(a) In the knee-jerk reflex, stimulus is the stretching of muscle and response is its contraction.
(b) An action potential in an axon does not move backward because the segment behind is in a refractory phase.
(c) Depolarisation of hair cells of cochlea results in the opening of the mechanically gated potassium-ion channels.
(d) Rods are very sensitive and contribute to daylight vision.

46. The transparent lens in the human eye is held in its place by *[2018]*
(a) ligaments attached to the ciliary body
(b) ligaments attached to the iris
(c) smooth muscles attached to the ciliary body
(d) smooth muscles attached to the iris

47. Good vision depends on adequate intake of carotene rich food.
Select the best option from the following statements : *[2017]*
(i) Vitamin A derivatives are formed from carotene
(ii) The photopigments are embedded in the membrane discs of the inner segment
(iii) Retinal is a derivative of Vitamin A
(iv) Retinal is a light absorbing part of all the visual photopigments
Options :
(a) (i), (iii) and (iv) (b) (i) and (iii)
(c) (ii), (iii) and (iv) (d) (i) and (iv)

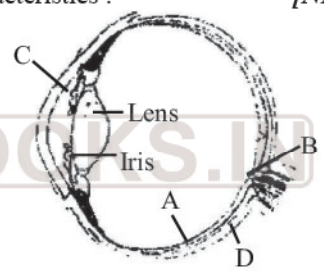
48. Photosensitive compound in human eye is made up of *[2016]*
(a) Guanosine and Retinol
(b) Opsin and Retinal
(c) Opsin and Retinol
(d) Transducin and Retinene

49. A gymnast is able to balance his body upside down even in the total darkness because of :
(a) Vestibular apparatus *[2015 RS]*
(b) Tectorial membrane
(c) Organ of corti
(d) Cochlea

50. In mammalian eye, the 'fovea' is the center of the visual field, where: *[2015 RS]*
(a) the optic nerve leaves the eye
(b) only rods are present
(c) more rods than cones are found
(d) high density of cones occur, but has no rods.

51. Which one of the following statements is not correct? *[2014]*
(a) Retinal is the light absorbing portion of visual photo pigments.
(b) In retina the rods have the photopigment rhodopsin while cones have three different photopigments.
(c) Retinal is a derivative of Vitamin C.
(d) Rhodopsin is the purplish red protein present in rods only.

52. Parts A, B, C and D of the human eye are shown in the diagram. Select the option which gives correct identification along with its functions/ characteristics : *[NEET 2013]*



(a) B-Blind spot-has only a few rods and cones
(b) C-Aqueous chamber-reflects the light which does not pass through the lens.
(c) D-Choroid-is anterior part forms ciliary body
(d) A-Retina-contains photoreceptors-rods and cones.

53. Which part of the human ear plays no role in hearing as such but is otherwise very much required? *[2012]*
(a) Eustachian tube
(b) Organ of corti
(c) Vestibular apparatus
(d) Ear ossicles

54. The purplish red pigment rhodopsin contained in the rods type of photoreceptor cells of the human eye, is a derivative of: *[2011]*
(a) vitamin B_1 (b) vitamin C
(c) vitamin D (d) vitamin A

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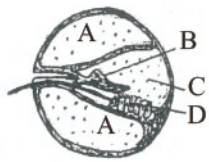
55. Alzheimer disease in humans is associated with the deficiency of: ***[2009]***
(a) glutamic acid
(b) acetylcholine
(c) gamma aminobutyric acid (GABA)
(d) dopamine

56. Given below is a diagrammatic cross section of a single loop of human cochlea: ***[2008]***



Which one of the following options correctly represents the names of three different parts?
(a) B: Tectorial membrane, C: Perilymph, D: Secretory cells
(b) C: Endolymph, D: Sensory hair cells, A: Serum
(c) D: Sensory hair cells, A: Endolymph, B: Tectorial membrane
(d) A: Perilymph, B: Tectorial membrane, C: Endolymph

57. Which one of the following is the correct difference between Rod Cells and Cone Cells of our retina? ***[2008]***

		Rod Cells	Cone Cells
(a)	Visual: acuity	High	Low
(b)	Visual : pigment contained	Iodops	in Rhodpsin
(c)	Overall : function	Vision in poor light	Colour vision and detailed vision in bright light
(d)	Distribution :	More concentrated in retina	Evenly distributed all over

58. Cornea transplant in humans is almost never rejected. This is because ***[2008]***
(a) its cells are least penetrable by bacteria
(b) it has no blood supply
(c) it is composed of enucleated cells
(d) it is a non-living layer

59. What is intensity of sound in normal conversation? ***[2001]***
(a) 10—20 decibel
(b) 30—60 decibel
(c) 70—90 decibel
(d) 120—150 decibel

60. When we migrate from dark to light, we fail to see for sometime but after a time visibility becomes normal. It is an example of ***[2001]***
(a) accommodation (b) adaptation
(c) mutation (d) photoperiodism

61. Characteristic feature of human cornea ***[2001]***
(a) Secreted by conjunctiva and glandular
(b) It is lacrimal gland which secretes tears
(c) Blood circulation is absent in cornea
(d) In old age it becomes harden and white layer deposits on it which causes cataract

62. Suspensory ligament is part of ***[1999]***
(a) heart (b) eye
(c) tongue (d) brain

63. In the chemistry of vision in mammals, the photosensitive substance is called ***[1997]***
(a) sclerotin (b) retinol
(c) rhodopsin (d) melanin

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64. Cornea transplantation is outstandingly successful because ***[1996]***
(a) cornea is easy to preserve
(b) cornea is not linked up with blood vascular and immune systems
(c) the technique involved is very simple
(d) cornea is easily available

65. Function of iris is to ***[1993]***
(a) move lens forward and backward
(b) refract light rays
(c) bring about movements of eye lids
(d) alter the size of pupil.

66. Retina is most sensitive at ***[1993]***
(a) optic disc (b) periphery
(c) macula lutea (d) fovea centralis

67. Light rays entering the eye is controlled by ***[1993]***
(a) pupil (b) iris
(c) cornea (d) lens

68. Iris is part of ***[1992]***
(a) sclerotic
(b) choroid/Uvea
(c) choroid and retina
(d) sclerotic and choroid

69. Eye lens is formed from *[1992]*
(a) ectoderm
(b) mesoderm
(c) endoderm
(d) ectoderm and mesoderm

70. Afferent nerve fibre carries impulses from *[1992]*
(a) effector to central nervous system
(b) receptor to central nervous system
(c) central nervous system to muscles
(d) central nervous system to receptors

71. Sensitive pigmented layer of eye is *[1989]*
(a) cornea (b) retina
(c) sclerotic (d) iris

72. Acute vision is present in *[1988]*
(a) vulture (b) shark
(c) bat (d) frog

ANSWER KEY

1	(b)	9	(c)	17	(c)	25	(c)	33	(b)	41	(d)	49	(a)	57	(c)	65	(d)
2	(c)	10	(d)	18	(d)	26	(a)	34	(c)	42	(d)	50	(d)	58	(b)	66	(d)
3	(d)	11	(c)	19	(d)	27	(b)	35	(a)	43	(b)	51	(c)	59	(b)	67	(a)
4	(c)	12	(d)	20	(d)	28	(d)	36	(b)	44	(b)	52	(d)	60	(b)	68	(d)
5	(a)	13	(c)	21	(b)	29	(c)	37	(d)	45	(d)	53	(c)	61	(c)	69	(a)
6	(a)	14	(a)	22	(a)	30	(d)	38	(d)	46	(a)	54	(d)	62	(b)	70	(b)
7	(a)	15	(d)	23	(c)	31	(d)	39	(a)	47	(a)	55	(b)	63	(c)	71	(b)
8	(d)	16	(a)	24	(a)	32	(c)	40	(a)	48	(b)	56	(d)	64	(b)	72	(a)

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Hints & Solutions

1. (b) The limbic system (emotional motor system) is responsible for the experience and expression of emotion but not movement. It is located in the core of the brain and includes the amygdala, hippocampus and hypothalamus.
2. (c) Nissl bodies are present in the soma or cell body of a neuron. When observed under electron microscope, they appear to be composed of rough endoplasmic reticulum (RER) and free ribosomes hence help in protein synthesis.
3. (d) Myelin sheath wrapped around the nerve axon. Oligodendrocytes are neuroglial cells which produce myelin sheath in central nervous system while Schwann cell produces myelin sheath in peripheral nervous system.

NOTES
The demyelinating form of Guillain-Barre syndrome destroys the protective covering of the peripheral nerves (myelin sheath), preventing the nerves from transmitting signals to the brain.

4. (c) Pre-synaptic membrane is involved in the release of neurotransmitter in the chemical synapse. The receptors sites for neurotransmitters are present on post-synaptic membrane of neuron.
5. (a) Cerebellum maintains the balance and body posture. It is not concerned with logical part.
6. (a) In poliomyelitis, anterior horn cells of spinal cord are destructed which causes loss of motor activities of limbs.
7. (a) The neuromuscular junction connects the nervous system to the muscular system via synapses between efferent nerve fibres and muscle fibres.
8. (d) The hypothalamus is a highly complex structure in the brain that regulates many important brain chemicals. The hypothalamus is responsible for hormone production. The hormones produced by this area govern body

temperature, thirst, hunger, sleep, circadian rhythm, moods, sex drive, and the release of other hormones in the body. This area of the brain controls the pituitary gland and other glands in the body.

9. (c) The most abundant intracellular cation is K^+.

NOTES

Potassium plays an important role in regulation of cellular electrolyte metabolism, electric signaling in cells, transport of essential nutrients, and enzymatic analysis. In alliance with other (i.e., sodium and chloride ions), it contributes to overall electrolyte balance of virtually all living organisms.

10. (d) A-Receptor, C-Synaptic vesicles B is synaptic cleft. A synapse is formed by the membranes of a synaptic neuron and post synaptic neuron, which may or may not separated by a gap called synaptic cleft. It is filled by fluid called neurotransmitter which are involved in transmission of impulse at these synapses.

11. (c) Cerebrum is the first and most developed part of fore brain. It makes 2/3 part of total brain. Pons is a small spherical projection, which is situated below the midbrain and upper side of the medulla oblongata. It acts as a relay centre among different parts of brain. B and D are thalamus and spinal cord respectively.

12. (d) In the given figure, A, B, C and D are axon, neurotransmitters, receptors and synaptic vesicles respectively.

13. (c) The human hind brain comprises of pons, cerebellum and medulla oblongata.

14. (a) Epinephrine and norepinephrine are secreted by adrenalmedulla in response to stress of any kind and during emergency situations and are called emergency hormones or hormones of flight, or fight.

15. (d) When a neuron is in resting state i.e., not conducting any impulse, the axonal membrane is comparatively more permeable to K+ ion and nearly impermeable to Na+ ions.

16. (a) Hypothalamus contains important nerve centres that controls the body temperature, thirst, hunger and eating, water balance and sexual function.

17. (c) Hypothalamus part of human brain is concerned with the regulation of body temperature. The hypothalamus is a portion of the brain that contains a number of small nuclei with a variety of functions. The hypothalamus is small cone-shaped structure, projects downward, ending in the pituitary.

18. (d) Total sum of physio-electrochemical changes that takes place along the length of nerve fibre is known as nerve impulse.
Change in potential due to stimulation of nerve fibre is called action potential. During propagation of nerve impulse, Na^+ enters inside so (+ve) charge is formed inside the membrane. K^+ ions come out.

19. (d) Once the events of depolarization have occurred, a nerve impulse or spike is initiated. Action potential is another name of nerve impulse. It lasts for about 1 msec (millisecond). The stimulalted, negatively charged point on the outside of the membrane sends out an electrical current to the positive point (still polarized adjacent to it).

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NOTES

This local current causes the adjacent inner part of the membrane to reverse its potential from –70 mV to +30 mV. The reversal repeats itself over and over until the nerve impulse is conducted through the length of the neuron.

20. (d) The cytoplasm immediately surrounding the nucleus is loaded with protein synthetic machinery and is called perikaryon, dendrites are usually shorter, tapering and much branched processes which may be one to several. These two are only present in nerve cells.

21. (b) The neurons are cells specialised to conduct an electrochemical current. Neuron cells do not have the capability of division.

22. (a) Abducens nerve is the sixth cranial nerve. It innervates the extraocular muscle (superior oblique) of eyeball, therefore controls movement of the eyeball.

23. (c) Autonomic nerveous system regulates and coordinates involuntry activities like heart beat, homeostasis, body temperature, breathing, gut peristalsis and secretion of glands. Human intestine shows movements during food digestion called peristalsis.

24. (a) Muscles of the tongue are invested by the 12th cranial nerve, Hypoglossal. The 10th cranial nerve, vagus supplies the viscera of the thorax, abdominal region and thus controls gastrointestinal, cardiac movements and pancreatic secretion.

25. (c) In a resting state of the neural membrane, Na^+ concentration is higher on the outer side and K^+ concentration is more within the cell. This concentration gradient is maintained by voltage gated channels. Hence if diffusion is allowed Na^+ would enter the cell and K^+ would leave.

26. (a) Prominent granules (Nissl's granules) observed in the cytoplasm of the cyton are believed to be made of ribosomes.
A Nissl body (or Nissl granule or tigroid body) is a large granular body found in nerve cells. It was named after Franz Nissl, German neurologist (1860-1919).

NOTES

Nissl bodies can be demonstrated by selective staining, which was developed by Nissl and the stain used was an aniline stain to label extranuclear RNA granules. These granules are rough endoplasmic reticulum (with ribosomes) and are the site of protein synthesis. Nissl bodies show changes under various physiological conditions and in pathological conditions they may dissolve and disappear (karyolysis).

27. (b) Neurons are the chief functional units of the nervous system. An ordinary neuron has a soma or cyton and a long thread called axon which is enclosed in a multilayered myelin sheath, made by Schwann cells. The myelin sheath is interrupted at the spaces between schwann cells to form gaps. These gaps are called Nodes of Ranvier.
These nodes and the myelin sheath create condition that speed up the nerve impulses.

28. (d) A primitive type of nervous system, without brain is found in the form of intra epidermal nerve net. However, there is no brain in Hydra to coordinate the response.

29. (c) Neuroglia are non-nervous cells present-along with and in between the neurons in central nervous system, ganglia and retina. They have roles like myelin formation, transport of materials to neurons, maintenance of ionic balance and phagocytosis.

30. (d) Anesthetic chemicals block the voltage gate sodium and potassium channel.

NOTES

Today, the most common modern general anesthetics are mixtures of inhalable gases, which include nitrous oxide (laughing gas) and various derivatives of ether, such as Isoflurane, Sevoflurane, and desflurane.

31. (d) The activities of all visceral organs are coordinated through the regulation of their smooth muscles and glands by the nerve fibres of the sympathetic and parasympathetic nervous system. These constitute the autonomic nervous system which carry out functions that are not under the control of our will.

32. (c) In mammals, the sympathetic nerves arise from thoraco-lumbar nerves (autonomic nervous system).

33. (b) Respiratory centre is situated bilaterally in medulla oblongata, while breathing is controlled by pneumotaxic and apneustic centres in pons varolii. Impulse for voluntary forced breathing starts in cerebral hemisphere.

34. (c) Association neurons or interneuron.

NOTES

Disruption of the development or function of GABA ergic interneurons in the cerebral cortex leads to epilepsy and may contribute to the emergence of specific symptoms of certain neuropsychiatric disorders, in particular those associated with cognitive impairment.

35. (a) Vagus nerve is 10th pair of nerves arising from medulla oblongata of brain. These are mixed nerves i.e. having both sensory as well as motor nerve fibres.

36. (b) Afferent nerve fibres – sensory nerve fibres which carry senses from receptors to brain or spinal cord (CNS).
Efferent nerve fibres – motor nerve fibres carry orders or responses from CNS to effectors (muscles and glands).

37. (d) Sympathetic system prepares the body for stress or emergency conditions while parasympathetic system is associated with the period of rest. So when one faces the stress or emergency conditions sympathetic system enlarges the pupil to allow more light in the eye while during rest, parasympathetic nervous system constricts the pupil to its normal condition.

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38. (d) It is the cavity of diancephalon which is connected ahead with the lateral ventricles or paracoel of cerebral hemisphere by foramen of Monro & behind with the iter (the duct of midbrain). The ventral wall of diocoel in known as hypothalamus.

39. (a) Xth pair of cranial nerves (vagus nerves) has a motor branch called cardiac nerve which innervate cardiac muscles.

> **NOTES** Motor paralysis due to dysfunction of the tenth cranial nerve has the following clinical features: loss of reflex contraction of the palate seen in the gag reflex. Hoarseness of voice - this may occur in a unilateral recurrent laryngeal nerve lesion. A bovine cough may occur with a bilateral recurrent nerve lesion.

40. (a) Crista ampullaris is a sensory organ of rotation. It maintains the dynamic balance of the body. It is found in the ampulla of each of the semicircular canals of inner ear.

> **NOTES** Otolith organ consists of two structures i.e. saccule and utricle. The projecting ridge of the saccule and utricle is called macula. The otolith organ maintains the static balance of the body.

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41. (d) When the set point of hypothalamus is disturbed by high temperature, it stimulates vasodilation and sweating while in low temperature there is vasoconstriction and shivering.

42. (d) A reflex action is a nerve mediated spontaneous, automatic and involuntary response to a stimulus acting through specific receptors without consulting the will of the animal. When a reflex arc consists of only two neurons in an animal (one sensory neuron, and one motor neuron), is defined as monosynaptic.

43. (b) Conditioned reflexes (reflexes developed by training and learning) were first demonstrated by Russian Scientist Ivan Pavlov in dogs. He used to ring the bell while giving the food to his dog, after some time when only bell is rung watering of mouth started in dog i.e. dog learnt a close association of food and bell and it gets into dog's reflexes.

44. (b) Option (b) is correct because organ of Corti is located on the basilar membrane, thus (a) in column-I matches with (iv) in column-II. Cochlea, so (b) matches with (ii) in. The coiled portion of the labyrinth is called column II.

> **NOTES** These three bones, often referred to as the ossicles, serve a crucial role in moving sound waves from your outer ear to your inner ear. Without your ossicles, you wouldn't be able to hear as you do now. All sound starts as sound waves. When a sound wave reaches your ear, it pushes up against the eardrum as vibrations.

45. (d) Rods and cones are two types of photoreceptor in human retina. Cones are very sensitive to operate in day light. They are capable of colour vision and responsible for high spatial acuity. Rods are very sensitive in dim light and do not mediate colour vision and have a low spatial acuity.

46. (a) The muscles that move the eyeball are attached to the sclera. Suspensory ligament of lens - a series of fibers that connect the ciliary body of the eye with the lens, holding it in place.

47. (a) Carotene is the source of retinal which is involved in formation of rhodopsin of rod cells. Retinal, a derivative of vitamin A, is the light-absorbing part of all visual photopigments. Photopigments are occur entirely on the surface of membrane disc.

48. (b) Retinal is also known as retinaldehyde. It was originally called retinene, and renamed afterwards it was discovered to be vitamin A aldehyde. Retinal is one of the many forms of vitamin A (the number of which varies from species to species). Retinal is a polyene chromophore, bound to proteins called opsins, and is the chemical basis of animal vision.

49. (a) Vestibular apparatus has specific receptors called crista and macula to maintain the balance and posture of body.

50. (d) Fovea centralis is the most sensitive part of retina. It has high density of cones, but rods are not found.

> **NOTES** The syndrome of acquired foveal cone dysfunction presents as a bilateral, painless, progressive central visual loss with minimal or absent fundus changes. It eludes diagnosis until focal, foveal cone ERG is performed.

51. (c) Retinal is a derivative of vitamin A. Retinal is a polyene chromophore, and bound to proteins called opsins, is the chemical basis of animal vision. Bound to proteins called type 1 rhodopsins, retinal allows certain microorganisms to convert light into metabolic energy.

52. (d) Retina is the innermost layer of eyeball and it contains three layers of cells - ganglion cells, bipolar cells and photoreceptor cells. Photoreceptor cells are not present in blind spot. The space between the cornea and the lens is called the aqueous chamber and contains a thin watery fluid called aqueous humor.
Choroid is anterior part of external sclera layer of eyeball while ciliary body is anterior part of middle choroid layer.

53. (c) Vestibular apparatus is a part of inner ear which has no role in hearing but responsible for the maintenance of balance of the body and posture.

54. (d) Rhodopsin contained in the rod type of photoreceptor cells of human eye is a derivative of vitamin A.

NOTES

Rhodopsin is a biological pigment found in the rods of the retina and is a G-protein-coupled receptor (GPCR). It belongs to opsins. Rhodopsin is extremely sensitive to light, and thus enables vision in low-light conditions. When rhodopsin is exposed to light, it immediately photobleaches.

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55. (b) Alzheimer disease in humans is associated with the deficiency of acetylcholine. Acetylcholine is the neurotransmitter produced by neurons referred to as cholinergic neurons. Acetylcholine plays a role in skeletal muscle movement, as well as in the regulation of smooth muscle and cardiac muscle. Acetylcholine is synthesised from choline and acetyl coenzyme-A through the action of the enzyme choline acetyltransferase and becomes packaged into membrane-bound vesicles.

56. (d) The diagrammatic cross section of a single loop of human cochlea represents three different parts-
A- Perilymph
B- Tectorial membrane
C-Endolymph
Cochlea arises from sacculus. It is spirally coiled duct. It is also known as Lagena.
It is connected with sacculus by duct of reuniens.

57. (c) Rod cells is a type of light sensitive receptor cell present in the retinas of vertebrates. Rod contains the pigment rhodopsin and are essential for vision in dim light.
Cone cells is a type of light sensitive receptor cell, found in retinas of all diurnal vertebrates. Cones are specialized to transmit information about colour and are responsible for the visual acuity of the eye. They function best in bright light.

58. (b) Cornea transplant in humans is almost never rejected. This is because it has no blood supply. Cornea is a transparent layer of tissue, continuous with the sclerotic, that forms the front part of the vertebrate eye, over the iris and lens.

NOTES

Complications of a corneal transplant can be significant and can include cornea graft rejection, eye infection and problems associated with the use of stitches. Rejection of the donor tissue is the most serious complication after a corneal transplant and occurs in 5 to 30 percent of patients.

59. (b) The word noise is taken from the latin word nausea and is defined as unwanted or unpleasant sound that causes discomfort.

Source	Intensity (dB)
Breathing	10
Broadcasting studio	20
Trickling clock	30
Library	30 – 35
Normal conversation	35 – 60
Telephone office Noise	60 – 80
Alarm clock	70 – 80
Traffic	50 – 90
Motorcycle	105
Jet fly over	100 – 110
Train whistle	110
Air craft	110 – 120

60. (b) It takes some time for rhodopsin to split into scotopsin and retinal (bleading) and release of transmitter passing nerve inpulse via bipolar and ganglion cells to the optic nerves.
This is a case of adaptation. It differs from accomodations which is a reflex mechanism by which the focus of the eye change to make the images of distant and near objects sharp on the retina.

61. (c) The outermost layer of the eye ball is fibrous in nature. Two-third part of this layer is opaque and lies inside the eyeorbit and is known

as sclera. The remaining one-third of the outer layer is transparent and bulges out to form the cornea. There is no supply of blood in cornea.

62. (b) Stretching and relaxation of suspensory ligament changes the focal length of lens for accommodation.
63. (c) Melanin is the pigment which gives colour to the skin. Retinol is the other name for vitamin A. Sclerotin is the component of the carapace in crustaceans.
64. (b) Cornea transplants are easy, since there are no blood vessels involved.
65. (d) Iris controls the size of pupil by contracting or relaxing of its circular muscles. It controls the amount of light entering in eye.
66. (d) Fovea centralis is the most sensitive part of retina (in fact most sensitive part of the eye). This is the area of most acute vision. Actually it is a small depression present in mammals (not in frog) at macula lutea or yellow spot.
67. (a) Pupil is the opening which controls the amount of light entering in eye. When light intensity is high, it decreases in size and when light intensity is low it dilates to allow more light in the eye to make eye enable to see the object.
68. (d) At the junction of the sclera and the cornea, the vascular coat sharply blends into the cavity of the eyeball to form a thin, coloured partition. This partition is called iris.
69. (a) Ectoderm forms : Eye (conjunctiva, cornea, lens, retina, iris, ciliary muscles) Mesoderm forms : Sclera & choroid of eye.
70. (b) In nervous systems, afferent nerve fibres carry nerve impulse from receptors or sense organs towards the central nervous system.
71. (b) Retina has 2 layers, an outer heavily pigmented (melanin containing) layer and an inner neurosensory layer. The inner layer consists of rods and cones, bipolar nerve cells and large ganglionic nerve cells.
72. (a) Vulture, some other birds and man have acute vision.

NOTES

Acute bird vision derives from the retina's fovea - the center of sharpest vision - that's densely packed with about 400,000 photoreceptor cones per square millimeter compared to about 200,000 in humans.

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22 Chemical Coordination and Regulation

Trend Analysis with Important Topics & Sub-Topics

Topic	Sub-Topics	2020		2019		2018		2017		2016	
		Qns.	LOD	Qns.	LOD	Qns.	LOD	Qns.	LOD	Qns.	LOD
Human Endocrine system	Ovary							1	E		
	Hypothalamus Gland							1	E		
	Adrenal Gland					1	A				
	Parathyroid Gland					1	A				
	Growth Hormone							1	A		
	Pancrease	1	A								
	Hormonal Disorders			1	D						
	Pituitary Hormone	1	D							2	A
Hormones of Heart, Kidney & Gastrointestinal Tract/ Mechanism of Hormone Action	Hormones of Gastro-intestinal Tract									1	A
	Mechanism of steroid hormone			1	D						

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LOD - Level of Difficulty	E - Easy	A - Average	D - Difficult	Qns - No. of Questions

Topic 1: Human Endocrine System

1. Match the following columns and select the correct option. *[2020]*

	Column-I		Column-II
(a)	Pituitary gland	(i)	Grave's disease
(b)	Thyroid gland	(ii)	Diabetes mellitus
(c)	Adrenal gland	(iii)	Diabetes insipidus
(d)	Pancreas	(iv)	Addison's disease

	(A)	(B)	(C)	(D)
(a)	(iii)	(ii)	(i)	(iv)
(b)	(iii)	(i)	(iv)	(ii)
(c)	(ii)	(i)	(iv)	(iii)
(d)	(iv)	(iii)	(i)	(ii)

2. Select the correct statement. *[2020]*
   (a) Glucagon is associated with hypoglycemia.
   (b) Insulin acts on pancreatic cells and adipocytes.
   (c) Insulin is associated with hyperglycemia.
   (d) Glucocorticoids stimulate gluconeogenesis.

3. Artificial light, extended work-time and reduced sleep-time disrupt the activity of – *[2019, Odisha]*
   (a) Posterior pituitary gland
   (b) Thymus gland
   (c) Pineal gland
   (d) Adrenal gland

4. Match the following hormones with the respective disease: ***[2019]***

(a) Insulin	(i) Addison's disease
(b) Thyroxine	(ii) Diabetes insipidus
(c) Corticoids	(iii) Acromegaly
(d) Growth hormone	(iv) Goitre
	(v) Diabetes mellitus

Select the correct option.

	(a)	(b)	(c)	(d)
(a)	(v)	(i)	(ii)	(iii)
(b)	(ii)	(iv)	(iii)	(i)
(c)	(v)	(iv)	(i)	(iii)
(d)	(ii)	(iv)	(i)	(iii)

5. Which of the following is an amino acid derived hormone? ***[2018]***
   (a) Epinephrine (b) Ecdysone
   (c) Estriol (d) Estradiol
6. A temporary endocrine gland in the human body is: ***[2017]***
   (a) Corpus cardiacum
   (b) Corpus luteum
   (c) Corpus allatum
   (d) Pineal gland
7. GnRH, a hypothalamic hormone, needed in reproduction, acts on: ***[2017]***
   (a) anterior pituitary gland and stimulates secretion of LH and FSH.
   (b) posterior pituitary gland and stimulates secretion of oxytocin and FSH.
   (c) posterior pituitary gland and stimulates secretion of LH and relaxin.
   (d) anterior pituitary gland and stimulates secretion of LH and oxytocin.
8. Hypersecretion of Growth Hormone in adults does not cause further increase in height, because: ***[2017]***
   (a) Epiphyseal plates close after adolescence.
   (b) Bones loose their sensitivity to Growth Hormone in adults.
   (c) Muscle fibres do not grow in size after birth.
   (d) Growth Hormone becomes inactive in adults.
9. Which of the following pairs of hormones are not antagonistic (having opposite effects) to each other? ***[2016]***
   (a) Parathormone – Calcitonin
   (b) Insulin – Glucagon
   (c) Aldosterone – Atrial Natriuretic Factor
   (d) Relaxin – Inhibin
10. Changes in GnRH pulse frequency in females is controlled by circulating levels of ***[2016]***
   (a) estrogen and progesterone
   (b) estrogen and inhibin
   (c) progesterone only
   (d) progesterone and inhibin
11. Which one of the following hormones is not involved in sugar metabolism ? ***[2015 RS]***
   (a) Aldosterone (b) Insulin
   (c) Glucagon (d) Cortisone
12. Which one of the following hormones though synthesised elsewhere is stored and released by the master gland ? ***[2015 RS]***
   (a) Luteinizing hormone
   (b) Prolactin
   (c) Melanocyte stimulating hormone
   (d) Antidiuretic hormone
13. Identify the hormone with its **correct** matching of source and function: ***[2014]***
   (a) Oxytocin - posterior pituitary, growth and maintenance of mammary glands.
   (b) Melatonin - pineal gland, regulates the normal rhythm of sleepwake cycle.
   (c) Progesterone - corpus-luteum, stimulatiuon of growth and activities of female secondary sex organs.
   (d) Atrial natriuretic factor - ventricular wall increases the blood pressure.
14. Fight-or-flight reactions cause activation of: ***[2014]***
   (a) the parathyroid glands, leading to increased metabolic rate.
   (b) the kidney, leading to suppression of reninangiotensin-aldosterone pathway.
   (c) the adrenal medulla, leading to increased secretion of epinephrine and norepinephrene.
   (d) the pancreas leading to a reduction in the blood sugar levels.

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15. Which of the following statements is correct in relation to the endocrine system? *[NEET 2013]*
    (a) Organs in the body like gastrointestinal tract, heart, kidney and liver do not produce any hormones.
    (b) Non-nutrient chemicals produced by the body in trace amount that act as intercellular messenger are known as hormones.
    (c) Releasing and inhibitory hormones are produced by the pituitary gland .
    (d) Adenohypophysis is under direct neural regulation of the hypothalamus.

16. A pregnant female deliver a baby who suffers from stunted growth, mental retardation/low intelligence quotient and abnormal skin. This is the result of : *[NEET 2013]*
    (a) Low secretion of growth hormone
    (b) Cancer of the thyroid gland
    (c) Over secretion of pars distalis
    (d) Deficiency of iodine in diet

17. Select the answer which correctly matches the endocrine gland with the hormone it secrets and its function/deficiency symptom: *[NEET 2013]*

	Endocrine gland	Hormone	Function/ deficiency symptom
(a)	Posterior pituitary	Growth Hormone (GH)	oversecretion Stimulates abnormal growth
(b)	Thyroid gland	Thyroxine	Lack of iodine in diet results in goitre
(c)	Corpus luteum	Testosterone	Stimulates spermato-genesis
(d)	Anterior pituitary uterus	Oxytocin	Stimulates contraction during child birth

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18. Which of the following represents the action of insulin? *[NEET Kar. 2013]*
    (a) Increases blood glucose levels by hydrolysis of glycogen
    (b) Increases blood glucose levels by stimulating glucagon production
    (c) Decreases blood glucose levels of forming glycogen
    (d) Increases blood glucose level by promoting cellular uptake of glucose

19. Norepinephrine : *[NEET Kar. 2013]*
    (1) Is released by sympathetic fibres
    (2) Is released by parasympathetic fibres
    (3) Increases the heart rate
    (4) Decreases blood pressure

    Which of the above said statements are correct?
    (a) (1) and (4) (b) (1) and (3)
    (c) (2) and (3) (d) (2) and (4)

20. Select the option which correctly matches the endocrine gland with its hormone and its function *[NEET Kar. 2013]*

	Endocrine gland	Hormone	Function
(a)	Ovary	FSH	stimulates follicular development and the secretion of estrogens.
(b)	Placenta	estrogen	initiates secretion of the milk.
(c)	Corpus luteum	estrogen	essential for maintenance of endometerium
(d)	Leydig cells	androgen	initiates the production of sperms.

21. Which one of the following pairs of hormones are the examples of those that can easily pass through the cell membrane of the target cell and bind to a receptor inside it (Mostly in the nucleus) *[2012]*
    (a) Insulin, glucagon
    (b) Thyroxin, insulin
    (c) Somatostain, oxytocin
    (d) Cortisol, testosterone

22. Match the source gland with respective hormone as well as the function correctly. *[2011]*

	Source gland	Hormone	Function
(a)	Anterior pituitary	Oxytocin	Contraction of uterus muscles during child birth
(b)	Posterior pituitary	Vasopressin	Stimulates reabsorption of water in the distal tubules in the nephron
(c)	Corpus luteum	Estrogen	Supports pregnancy
(d)	Thyroid	Thyroxine	Regulates blood calcium level

23. Given below is an incomplete table about certain hormones, their source glands and one major effect of each on the body in humans. Identify the correct option for the three blanks A, B and C. *[2011]*

Source gland	Hormone	Function
A	Oestrogen	Maintenance of secondary sexual characters
Alpha cells of islets of Langerhans	B	Raises blood sugar level
Anterior pituitary	C	Over secretion leads to gigantism

Options:
(a) A-Ovary; B-Glucagon; C-Growth hormone
(b) A-Placenta; B-Insulin; C-Vasopressin
(c) A-Ovary; B-Insulin; C-Calcitonin
(d) A-Placenta; B-Glucagon; C-Calcitonin

24. The 24 hour (diurnal) rhythm of our body such as the sleep-wake cycle is regulated by the hormone : *[2011M]*
(a) calcitonin (b) prolactin
(c) adrenaline (d) melatonin

25. Injury to adrenal cortex is not likely to affect the secretion of which one of the following? *[2010]*
(a) Aldosterone
(b) Both Androstenedione and Dehydroepiandrosterone
(c) Adrenaline
(d) Cortisol

26. Which one of the following pairs is incorrectly matched? *[2010]*
(a) Glucagon - Beta cells (source)
(b) Somatostatin - Delta cells (source)
(c) Corpus luteum - Relaxin (secretion)
(d) Insulin - Diabetes mellitus (disease)

27. Toxic agents present in food which interfere with thyroxine synthesis lead to the development of: *[2010]*
(a) toxic goitre (b) cretinism
(c) simple goitre (d) thyrotoxicosis

28. A health disorder that results from the deficiency of thyroxine in adults and characterised by (i) a low metabolic rate, (ii) increase in body weight and (iii) tendency to retain water in tissues is: *[2009]*
(a) simple goitre (b) myxoedema
(c) cretinism (d) hypothyroidism

29. The blood calcium level is lowered by the deficiency of *[2008]*
(a) parathormone
(b) thyroxine
(c) both calcitonin and parathormone
(d) calcitonin

30. Which one of the following pairs of organs includes only the endocrine glands? *[2008]*
(a) Parathyroid and Adrenal
(b) Pancreas and Parathyroid
(c) Thymus and Testes
(d) Adrenal and Ovary

31. Which part of ovary in mammals acts as an endocrine gland after ovulation ? *[2007]*
(a) Stroma
(b) Germinal epithelium
(c) Vetelline membrane
(d) Graafian follicle.

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32. A person is having problems with calcium and phosphorus metabolism in his body. Which one of following glands may not be functioning properly ? *[2007]*
(a) Parotid (b) Pancreas
(c) Thyroid (d) Parathyroid

33. Feeling the tremors of an earthquake a scared resident of seventh floor of a multistored building starts climbing down the stairs rapidly. Which hormone initiated this action ? *[2007]*
(a) adrenaline (b) glucagon
(b) gastrin (d) thyroxine

34. Sertoli cells are regulated by the pituitary hormone known as *[2006]*
(a) GH (b) Prolactin
(c) LH (d) FSH

35. Which of the following is an accumulation and release centre of neurohormones ? *[2006]*
(a) Intermediate lobe of the pituitary
(b) Hypothalamus
(c) Anterior pituitary lobe
(d) Posterior pituitary lobe

36. Which one of the following pairs correctly matches a hormone with a disease resulting from its deficiency? *[2004]*
(a) Luteinizing - Failure of ovulation
(b) Insulin - Diabetes insipidus
(c) Thyroxine - Tetany
(d) Parathyroid - Diabetes mellitus

37. Which of the following hormones is not a secretion product of human placenta ? *[2004]*
(a) Human chorionic gonadotropin
(b) Prolactin
(c) Estrogen
(d) Progesterone

38. Which one of the following pairs correctly matches a hormone with a disease resulting from its deficiency ? *[2003]*
(a) Insulin – Diabetes insipidus
(b) Relaxin – Gigantism
(c) Prolactin – Cretinism
(d) Parathyroid hormone – Tetany

39. Melanin protects us from *[2002]*
(a) U. V. rays (b) visible rays
(c) infrared rays (d) X-rays

40. Mainly which type of hormones control the menstrual cycle in human beings? *[2002]*
(a) FSH
(b) LH
(c) FSH, LH, estrogen
(d) Progesteron

41. When both ovaries are removed from rat then which hormone is decreased in blood?
(a) Oxytocin *[2002]*
(b) Prolactin
(c) Estrogen
(d) Gonadotropin releasing factor

42. Adrenaline directly affects on *[2002]*
(a) S. A. node
(b) b-cells of Langerhans
(c) dorsal root of spinal cord
(d) epithelial cells of stomach

43. Acromegaly is caused by *[2002]*
(a) excess of G.H.
(b) excess of thyroxin
(c) deficiency of thyroxin
(d) excess of adrenalin

44. Which of the following radioactive isotope is used in the detection of thyroid cancer? *[1995, 02]*
(a) Iodine-131 (b) Carbon-14
(c) Uranium-238 (d) Phosphorus-32

45. Melatonin is produced by *[2000]*
(a) thymus (b) skin
(c) pituitary (d) pineal gland

46. Melanocyte stimulating hormone (MSH) is produced by *[2000]*
(a) parathyroid
(b) pars intermedia of pituitary
(c) anterior pituitary
(d) posterior pituitary

47. Progesterone, the component of the oral contraceptive pills, prevents pregnancy by *[2000]*
(a) preventing the cleavage of the fertilized egg
(b) preventing the formation of ova
(c) blocking ovulation
(d) creating unfavourable chemical environment for the sperms to survive in the female reproductive tract

48. Oxytocin helps in *[1999]*
(a) lactation
(b) child birth
(c) ovulation
(d) implantation of the embryo

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49. A candidate vaccine for male contraception is based on *[1999]*
(a) follicle stimulating hormone
(b) progesterone
(c) testosterone
(d) luteinizing hormone

50. Insulin differs from growth hormone in that it *[1999]*
(a) stimulates lipoprotein lipase in vicinity of fat cells
(b) increases the transport of amino acids across the cell membranes of muscles
(c) increases mRNA/ribosome acitivity
(d) stimulates hormone sensitive lipase in fat cells

51. The gland that regresses with age is *[1999]*
(a) adrenal (b) gonad
(c) thymus (d) thyroid

52. Calcitonin is a thyroid hormone which *[1998]*
(a) lowers calcium level in blood
(b) elevates calcium level in blood
(c) has no effect on calcium
(d) elevates potassium level in blood

53. The most important component of the oral contraceptive pill is *[1998]*
(a) growth hormone
(b) thyroxine
(c) luteinizing hormone
(d) progesterone

54. Hormones, thyroxine, adrenaline and the pigment melanin are formed from *[1997]*
(a) tryptophan (b) glycine
(c) tyrosine (d) proline

55. Which one of the following hormone stimulates the "let-down" (release) of milk from the mother's breasts when the baby is sucking ? *[1996]*
(a) Progesterone (b) Oxytocin
(c) Prolactin (d) Relaxin

56. According to the "immunity theory" of ageing, the process starts with the gradual atrophy and disappearance of *[1996]*
(a) thyroid (b) parthyroid
(c) thymus (d) islets of Langerhans

57. In human adult females oxytocin *[1996]*
(a) is secreted by anterior pituitary
(b) stimulates growth of mammary glands
(c) stimulates pituitary to secrete vasopressin
(d) causes strong uterine contractions during parturition

58. The mammalian corpus luteum produces *[1995]*
(a) estrogen
(b) progesterone
(c) luteotropic hormone
(d) luteinizing hormone

59. Nicotine acts as a stimulant, because it mimics the effect of *[1995]*
(a) thyroxine (b) acetylcholine
(c) testosterone (d) dopamine

60. Which of the following endocrine gland stores its secretion in the extracellular space before discharging it into the blood? *[1995]*
(a) Pancreas (b) Adrenal
(c) Testis (d) Thyroid

61. Ovulation is stimulated by *[1994]*
(a) LH (b) FSH
(c) estrogen (d) progesterone

62. Function of enterogastrone is*[1994]*
(a) regulation of bile flow
(b) stimulation of pancreatic flow
(c) inhibition of gastric secretion
(d) stimulation of gastric secretion

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63. Ovulation occurs under the influence o *[1994]*
(a) LH (b) FSH
(c) estrogen (d) progesterone

64. Testosterone is produced by *[1993]*
(a) sertoli cells (b) leydig's cells
(c) oxyntic cells (d) pituitary gland

65. Male hormone is produced in the testis by cells of *[1993]*
(a) sertoli (b) epithelial
(c) spermatocytes (d) leydig

66. Occurrence of Leydig's cells and their secretion is *[1991]*
(a) ovary and estrogen
(b) liver and cholesterol
(c) pancreas and glucagon
(d) testes and testosterone

67. ADH or vasopressin is *[1991]*
(a) enzyme that hydrolyses peptides
(b) hormone secreted by pituitary that promotes reabsorption of water from glomerular filtrate
(c) hormone that promotes glycogenolysis
(d) energy rich compound connected with muscle contraction.

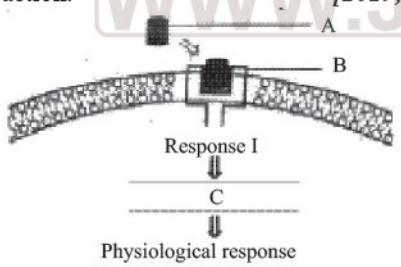
68. Addition of a trace of thyroxine or iodine in water containing tadpoles will *[1990]*
(a) keep them in larval stage
(b) hasten their metamorphosis
(c) slow down their metamorphosis
(d) kill the tadpoles

69. MSH of pars intermedia of middle pituitary is responsible for *[1988]*
(a) darkening of skin in lower vertebrates
(b) light colouration of skin in lower vertebrates
(c) noth A and B
(d) darkening of skin in human beings

70. Which hormone possesses anti-insulin effect? *[1988]*
(a) Cortisol (b) Calcitonin
(c) Oxytocin (d) Aldosterone

Topic 2: Hormones of Heart, Kidney & Gastrointestinal Tract/mechanism of Hormone Action

71. Identify A, B and C in the diagrammatic representation of the mechanism of hormone action. *[2019, Odisha]*



Select the correct option from the following :
(a) A = Protein hormone; B = Cyclic AMP; C = Hormone-receptor complex
(b) A = Steroid hormone; B = Hormone-receptor complex; C = Protein
(c) A = Protein hormone; B = Receptor C = Cyclic AMP
(d) A = Steroid hormone; B = Receptor; C = Second messenger

72. How does steroid hormone influence the cellular activities?
(a) Changing the permeability of the cell membrane.
(b) Binding to DNA and forming a gene-hormone complex.
(c) Activating cyclic AMP located on the cell membrane.
(d) Using aquaporin channels as second messenger.

73. A decrease in blood pressure / volume will not cause the release of : *[2017]*
(a) Atrial natriuretic factor
(b) Aldosterone
(c) ADH
(d) Renin

74. Identify the correct statement on 'inhibin' *[2016]*
(a) Inhibits the secretion of LH, FSH and Prolactin.
(b) Is produced by granulose cells in ovary and inhibits the secretion of FSH.
(c) Is produced by granulose cells in ovary and inhibits the secretion of LH.
(d) Is produced by nurse cells in testes and inhibits the secretion of LH.

75. A chemical signal that has both endocrine and neural roles is ? *[2015 RS]*
(a) Calcitonin (b) Epinephrine
(c) Cortisol (d) Melatonin

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76. What is correct to say about the hormone action in humans? *[2012]*
(a) Glucagon is secreted by β-cells of islets of Langerhans and stimulates glycogenolysis
(b) Secretion of thymosins is stimulated with ageing
(c) In females FSH first binds with specific receptors on ovarian cell membrane
(d) FSH stimulates the secretion of estrogen and progesterone

77. A steroid hormone which regulates glucose metabolism is *[2006]*
(a) corticosterone
(b) 11- deoxycorticosterone
(c) cortisone
(d) cortisol

78. Which one of the following is not a second messenger in hormone action ? *[2006]*
(a) Calcium (b) Sodium
(c) cAMP (d) cGMP

79. Which one of the following does not act as a neurotransmitter ? *[2006]*
(a) Epinephrine (b) Norepinephrine
(c) Cortisone (d) Acetylcholine

80. Which hormone causes dilation of blood vessels, increased oxygen consumption and glucogenesis? *[2006]*
(a) Insulin (b) Adrenaline
(c) Glucagon (d) ACTH

81. Which one of the following statement is correct? *[2006]*
(a) Endrocrine glands regulate neural activity, and nervous system regulates endocrine glands
(b) Neither hormones control neural activity nor the neurons control endocrine activity
(c) Endocrine glands regulate neural activity, but not vice versa
(d) Neurons regulate endocrine activity, but not vice versa

82. Parkinson's disease (characterized by tremors and progressive rigidity of limbs) is caused by degeneration of brain neurons that are involved in movement control and make use of neurotransmitter *[2005]*
(a) acetylcholine (b) norepinephrine
(c) dopamine (d) GABA

83. Mast cells of connective tissue contain *[2004]*
(a) vasopressin and relaxin
(b) heparin and histamine
(c) heparin and calcitonin
(d) serotonin and melanin

84. Chemically hormones are *[2004]*
(a) biogenic amines only
(b) proteins, steroids and biogenic amines
(c) proteins only
(d) steroids only

85. Which one of the following hormones is a modified amino acid? *[2004]*
(a) Epinephrine (b) Progesterone
(c) Prostaglandin (d) Estrogen

86. Which steroid is used for microbial transformation? *[2002]*
(a) Cortisol (b) Cholesterol
(c) Testosterone (d) Progesterone

87. The technique used for estimation of minute amounts of hormones and drugs is called *[1999]*
(a) electrophoresis
(b) electroencephalogram
(c) fractionation
(d) radioimmunoassay

88. According to the accepted concept of hormone action, if receptor molecules are removed from target organs, then the target organ will *[1995]*
(a) not respond to the hormone
(b) continue to respond to hormone without any difference
(c) continue to respond to the hormone but in the opposite way
(d) continue to respond to the hormone but will require higher concentration

89. Gastric secretion is stopped by hormone *[1993]*
(a) enterogastrone (b) gastrin
(c) pancreozymin (d) cholecystokinin

90. Insulin is *[1990]*
(a) vitamin (b) lipid
(c) hormone (d) enzyme

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ANSWER KEY

1	(b)	10	(a)	19	(b)	28	(b)	37	(b)	46	(b)	55	(b)	64	(b)	73	(a)	82	(c)
2	(d)	11	(a)	20	(d)	29	(a)	38	(d)	47	(c)	56	(c)	65	(d)	74	(b)	83	(b)
3	(c)	12	(d)	21	(d)	30	(a)	39	(a)	48	(b)	57	(d)	66	(d)	75	(b)	84	(b)
4	(c)	13	(b)	22	(b)	31	(d)	40	(c)	49	(c)	58	(b)	67	(b)	76	(c)	85	(a)
5	(a)	14	(c)	23	(a)	32	(d)	41	(c)	50	(d)	59	(b)	68	(b)	77	(d)	86	(b)
6	(b)	15	(b)	24	(d)	33	(a)	42	(a)	51	(c)	60	(d)	69	(a)	78	(b)	87	(d)
7	(a)	16	(d)	25	(c)	34	(d)	43	(a)	52	(a)	61	(a)	70	(a)	79	(c)	88	(a)
8	(a)	17	(b)	26	(a)	35	(d)	44	(a)	53	(d)	62	(c)	71	(c)	80	(b)	89	(a)
9	(d)	18	(c)	27	(c)	36	(a)	45	(d)	54	(c)	63	(a)	72	(b)	81	(a)	90	(c)

Hints & Solutions

1. (b) Grave's disease is due to excess secretion of thyroid hormones (T_3 & T_4). Diabetes mellitus is due to hyposecretion of insulin from beta-cells of pancreas. Diabetes insipidus is due to hyposecretion of ADH from posterior pituitary. Addison's disease is due to hyposecretion of hormone from adrenal cortex.

NOTES
Diabetes insipidus is a disorder of salt and water metabolism. Its symptoms are:
- Intense thirst
- Heavy urination
- Excessive weight loss

2. (d) Glucagon is associated with hyperglycemia. Insulin acts on hepatocytes and adipocytes and is associated with hypoglycemia. Glucocorticoid stimulates gluconeogenesis, so increase blood sugar level.

NOTES
Glycogenolysis occurs when the body, which prefers glucose as an energy source, needs energy. When glycogen stores are depleted and glucose is required by the body, the liver initiates the production of glucose from amino acids, lactate, and glycerol in a process called gluconeogenesis.

3. (c) Artificial light, extended work time and reduced sleep-time disrupt the activity of pineal gland.
Melatonin hormone of pineal gland plays a very important role in the regulation of a 24-hours (diurnal) rhythm of our body.
Melatonin helps in maintaining the normal rhythms of sleep-wake cycle and body temperature.

NOTES
The pineal gland is a small, pea-shaped gland in the brain. Its function isn't fully understood. Researchers do know that it produces and regulates some hormones, including melatonin. Melatonin is best known for the role it plays in regulating sleep patterns. Sleep patterns are also called circadian rhythms. It's considered a somewhat mysterious organ, as its function was discovered last of the endocrine glands. The pineal gland was once dubbed the "third eye," which originated for many reasons, ranging from its location deep in the center of the brain to its connection to light.

4. (c) Insulin is a pancreatic hormone, secreted from alpha cells of islets of Langerhans. Its deficiency leads to diabetes mellitus (characterised by high blood sugar levels over a prolonged period).
Thyroxine is an iodine containing hormone, secreted by the thyroid gland. It plays an important role in regulating the body's metabolic rate, heart and digestive function, muscle control, brain development and bone maintenance. Hyper secretion or hyposecretion of thyroxine can be associated with enlargement of thyroid gland called goitre.
Deficiency of corticoids (cortisol and aldosterone) secreted from adrenal gland (cortex region) leads to Addison's disease. Cortisol regulates the body's reaction to stressful situations. Aldosterone helps with sodium and potassium regulation. The adrenal cortex also produces sex hormones (androgens).
Acromegaly is an abnormal growth of the hands, feet, and face, caused by overproduction of growth hormone by the pituitary gland.

NOTES
Glucocorticoids are steroid hormones that regulate multiple aspects of glucose homeostasis. Glucocorticoids promote gluconeogenesis in liver, whereas in skeletal muscle and white adipose tissue they decrease glucose uptake and utilization by antagonizing insulin response.

5. **(a)** Epinephrine is derived from tyrosine by the removal of carboxyl group. It is a catecholamine.

NOTES
Epinephrine and norepinephrine are very similar neurotransmitters and hormones. While epinephrine has slightly more of an effect on your heart, norepinephrine has more of an effect on your blood vessels. Both play a role in your body's natural fight-or-flight response to stress and have important medical uses as well.

6. (b) Corpus luteum is the temporary endocrine gland formed in the ovary after ovulation. It release hormones like progesterone, oestrogen etc.

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7. (a) GnRH is secreted by hypothalamus which stimulates anterior pituitary gland for the secretion of gonadotropins (FSH and LH).
8. (a) Epiphyseal plate which is responsible for bone growth close after adolescence so hypersecretion of growth hormone in adults does not cause further increase in height. The epiphyseal plate is a hyaline cartilage plate in the metaphysis at each end of a long bone.
9. (d) Calcitonin exerts its effects by interacting with target cells, primarily in bone and kidney. The actions of PTH and calcitonin are antagonistic on bone resorption but synergistic on decreasing the renal tubular reabsorption of phosphorus. Insulin and glucagon work synergistically to keep blood glucose concentrations normal. An elevated blood glucose concentration results in the secretion of insulin and glucose is transported into body cells. Aldosterone secretion may be inhibited by potassium depletion, inhibitors of the renin-angiotensin system, dopamine and atrial natriuretic factor. The latter appears to be an important physiological regulator of aldosterone secretion. ANF inhibits basal, ACTH, Angiotensin II and potassium-stimulated aldosterone production in vitro by a direct action on the adrenal gland. Inhibin is a hormone secreted by granulosa cells of the ovary which inhibit the secretion of FSH (Follicle Stimulating Hormone) whereas relaxin produced by ovary and placenta at the time of childbirth to softens the ligament in the pelvis and widens the cervix.
10. (a) At the pituitary, GnRH stimulates the synthesis and secretion of the gonadotropins, follicle-stimulating hormone (FSH), and luteinizing hormone (LH). These processes are controlled by the size and frequency of GnRH pulses, as well as by feedback from progesterone and estrogens. Low-frequency GnRH pulses are required for FSH release, whereas high-frequency GnRH pulses stimulate LH pulses in a one to one manner.
11. (a) Aldosterne is produced by adrenal cortex and plays an important role in the regulation of Na^+ and K^+ levels in body.
12. (d) ADH (Antidiuretic hormone) and oxytocin are produced by hypothalamus and stored in posterior pituitary.
13. (b) Oxytocin, a neurohypophysial hormone, is produced by the hypothalamus and stored and secreted by the posterior pituitary gland. It stimulates contractions of the smooth muscle tissue in the wall of the uterus during childbirth. Progesterone is a female hormone produced by the ovaries during release of a mature egg from an ovary (ovulation). Progesterone helps prepare the lining of the uterus (endometrium) to receive the egg if it becomes fertilized by a sperm. If the egg is not fertilized, progesterone levels drop and menstrual bleeding begins. Atrial natriuretic factor is a hormonal substance produced by the right atrium of the heart that stimulates the excretion of sodium and water by the kidneys and helps regulate blood pressure.
14. (c) **Adrenal Medulla** is called *emergency gland* and secretes **adrenaline** (Epinephrine) and **nor-adrenaline** (nor-epinephrine) hormones.

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Adrenaline (epinephrine) is commonly called as 'emergency hormone' or 3F – hormone (For fear, fight & flight). It stimulates sweating, heart beat and breathing rate. It causes the dilation of coronary artery (supplying blood to the heart muscles), bronchioles (for increasing inspiratory volume) and pupil (for better vision).
15. (b) Hormones are non-nutrient chemicals which act as intercellular messengers and are produced in trace amounts.
Gastrointestinal tracts secretes four major peptide hormones – gastrin, secretin, cholecystokinin (CCK) and gastric inhibitory peptide (GIP) while juxtaglomerular cells of kidney secretes erythropoietin, a peptide hormone. Releasing and inhibitory hormones are produced by hypothalamus. Neurohypophysis or posterior pituitary is under direct neural regulation of the hypothalamus.
16. (d) Iodine is essential for the normal rate of hormone synthesis in the thyroid. Deficiency of iodine in our diet results in **hypothyroidism** and enlargement of the thyroid gland, commonly called **goitre.**

NOTES

Hypothyroidism during pregnancy causes defective development and maturation of the growing baby leading to stunted growth (cretinism), mental retardation, low intelligence quotient, abnormal skin, deaf-mutism, etc.

17. (b) • Growth hormone secreted by Anterior pituitary
    - Corpus leutum secreted Progesterone
    - Oxytocin is secreted by Posterior pituitary
18. (c) Insulin is a peptide hormone, which plays a major role in the regulation of glucose homeostasis. Insulin acts mainly on hepatocytes and adipocytes (cells of adipose tissue), and enhances cellular glucose uptake and utilization. Insulin also stimulates conversion of glucose to glycogen (glycogenesis) in the target cells.
19. (b) Norepinephrine is released by sympathetic fibres *i.e*, rapidly secreted in response to stress of any kind and during emergency situations. It increases the heart beat, the strength of heart contraction and the rate of respiration.
20. (d) Leydig cells or interstitial cells, which are present in the intertubular spaces produce a group of hormones called androgens mainly testosterone. Androgens play a major stimulatory role in the process of spermatogenesis (formation of spermatozoa).
21. (d) Cortisol and testosterone are steroid hormones which are lipid soluble and easily pass through the cell membrane of a target cell and bind to specific intracellular receptor.
22. (b) Posterior pituitary releases vasopressin which stimulates reabsorption of water in the distal tubules in nephron.
23. (a) Anterior pituitary secrets growth hormone. Ovary secrets oestrogen hormone. Alpha cells of islets of langerhans secrets glucagon.

NOTES

Myxoedema refers to deposition of mucopolysaccharides in the dermis, which results in swelling of the affected area.

24. (d) Melatonin is a hormone that regulates the 24 hour rhythm of our body such as the sleep-wake cycle *etc*. Melatonin is produced by pineal gland in the brain, which is responsible for operation and regulation of the biological clock in mammals.
25. (c) Adrenal gland has two parts-cortex and medulla. The medulla is stimulated by sympathetic nervous tissue to produce adrenaline and non-adrenaline while the cortex is stimulated by pituitary hormone to release cortisol, aldosterone and estrogens. Thus injury to adrenal cortex is not likely to affect the secretion of adrenaline.
26. (a) Glucagon is secreted by a-cells of the islets of Langerhans in the pancreas. It increases the concentration of glucose in the blood by stimulating the breakdown of glycogen.
27. (c) Goitre is caused by deficiency of iodine in diet. Iodine is needed for the synthesis of thyroxine. Toxic agents present in food interfere with thyroxine synthesis and lead to goitre.
28. (b) Myxoedema is caused by deficiency of thyroid hormone or thyroxine in adults. It is characterised by increase in body weight, puffy appearance, low metabolic rate, and tendency to retain water in tissues.
29. (a) A peptide hormone secreted by the parathyroid gland in response to low levels of calcium in the blood. It acts to maintain normal blood levels of calcium by increasing the number of osteoclasts, which break down the bone matrix and release calcium into the blood. It also increases the reabsorption of calcium and magnesium ions in the kidney tubules, so that their concentration is maintained in the blood.
30. (a) Parathyroid and adrenal are the endocrine glands. Adrenal glands are the pairs of endocrine glands situated immediately above the kidneys. Hence they are also known as suprarenal glands.

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Parathyroid glands are the two pairs of endocrine glands situated behind or embedded within the thyroid gland in higher vertebrates. They produce parathyroid hormone, which controls the amount of calcium in the blood.

31. (d) Graafian follicle – the ovarian medulla contains many rounded or oval bodies, called ovarian, or graafian follicles, at various stages of development. Each follicle contains a large ovum surrounded by many layers of follicle cells.
32. (d) Parathyroid disorders : It causes the lowering of blood calcium level. This increases the excitability of nerves and muscles causing cramps and convulsions.
33. (a) It is commonly called as 'emergency hormone' or 3F – hormone (For fear, fight & flight). Its secretion is regulated by SNS, and not by pituitary as in case of adrenal cortex. It stimulates sweating, heart beat and breathing rate. It causes the dilation of coronary artery (supplying blood to the heart muscles), bronchioles (for increasing inspiratory volume) and pupil (for better vision).
34. (d) During spermatogenetic developments spermatids get nourished by nurse or sertoli cells. The function of sertoli cells and hence the spermatogenesis is under the direct influence of follicle-stimulating hormone (FSH) secreted by adenohypophysis of pituitary gland.
35. (d) Neurohormones are actually secreted by the neurosecretory cells of the hypothalamus. They are circulated to the posterior part of the pituitary gland through the blood & stored there and released when required.
36. (a) Luteinizing hormone (LH) stimulates ovulation. Deficiency of insulin causes diabetes mellitus. Deficiency of ADH or vasopressin causes diabetes insipidus. Deficiency of parathormone causes tetany. Deficiency of thyroxine causes cretinism in infants and myxoedema in adults.
37. (b) Human chorionic gonadotropin is released by Anophoblast cells of the placenta. Estrogen and progesterone are also released by placental cells to maintain pregnancy. Prolactin is secreted from anterior lobe of pituitary. Placenta secretes Human Placental Lactogenic Factor which prepare mammary glands to secrete milk.
38. (d) Deficiency of parathyroid hormone causes tetany. The disease causes sustained contraction of muscles of larynx, face, hands and feet.
39. (a) Melanin is secreted from the intermediate lobe of pituitary. Melanin mainly protects the skin from harmful effects of UV-rays. People living in tropics tend to disperse more melanin in their skin – an adaptive feature.
40. (c) Estrogens are steroid hormones secreted by growing ovarian follicles. During menstrual cycle a negative feedback prevents the secretion of estrogen. FSH stimulates maturation of Graafian follicles. LH stimulates ovulation and development of corpus luteum.

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NOTES

In response to various types of injury, melanocyte stem cells (McSCs) located in the bulge of hair follicles can regenerate mature melanocytes for hair and skin pigmentation.

41. (c) Estrogen is released from the ovarian follicles. Oxytocin is secreted by posterior pituitary and prolactin is released by anterior pituitary. Gonadotropin releasing factor is produced by hypothalamus.
42. (a) Adrenaline is a neurotransmitter that directly acts on the S A node.
The hormone adrenaline (epinephrine) is secreted by adrenal medulla. This hormone is primarily responsible for the alarming reactions. It increases the heart rate, breathing blood glucose level.

NOTES

Adrenaline was first hormone to be isolated in crystalline form.

43. (a) Deficiency of thyroxine causes cretinism in infants and myxoedema in adults. Excess of adrenaline does not cause any disorder. Acromegaly is caused by over secretion of STH or somatotrophic hormone (Growth hormone).

44. (a) Iodine is an element used by thyroid gland for the synthesis of thyroid hormones. Thus radioactive isotope Iodine -131 is used as radioactive material for detection of thyroid cancer.

45. (d) Melatonin is secreted by pineal gland present between the cerebral hemispheres. Melatonin concentration in blood follows a diurnal cycle, it rises in the evening and drops at noon. Melatonin lightens skin colour in certain animals and regulates working of gonads.

46. (b) Parathyroid gland secretes parathormone which regulates Ca^{2+} level in blood. Anterior lobe of pituitary secretes the following hormones growth hormone, ACTH, TSH, FSH, LH. Posterior pituitary secretes vasopressin and oxytocin.
The intermediate lobe (pars intermedia) of the pitutary gland secretes MSH which causes dispersal of pigment granules in the pigment cells which give colour to the skin.

47. (c) Contraceptive pills have estrogen and progesterone. Progesterone suppresses ovulation and production of LH while estrogen suppresses the production of FSH.

48. (b) Oxytocin is also called the 'child birth hormone'. Prolactin helps in lactation. Luteinizing hormone levels trigger ovulation.

49. (c) Progesterone is a steroid hormone secreted by corpus luteum and causes routine temporary changes in the endometrial lining of uterus. Follicle stimulating hormone secreted by anterior pituitary lobe stimulates spermatogenesis in testes of males. Luteinizing hormone activates Leydig's cells of testes to secrete testosterones.

NOTES

The TYR gene provides instructions for making an enzyme called tyrosinase. This enzyme is located in melanocytes, which are specialized cells that produce a pigment called melanin. Melanin is the substance that gives skin, hair, and eyes their color. Tyrosinase is responsible for the first step in melanin production.

50. (d) Insulin is released from the pancreas it helps in conversion of glucose to fatty acids. It increases fat synthesis in adipose tissues.

51. (c) Thymus gland is present in children with maximum development at puberty and thereafter it begins to shrink and atrophies with the development of sex glands.

52. (a) Calcitonin is a polypeptide hormone which lowers calcium and phosphate level of plasma by inhibiting bone degradation and stimulating their uptake by bone. Parathyroid hormone elevates calcium level in blood.

53. (d) Use of contraceptive pills is a wide spread form of birth control. Contraceptive pills contain estrogen and progesterone. The production of the pituitary hormones FSH & LH in the normal sexual cycle of a female is shut down by these hormones. In the absence of FSH, the ovarian follicles do not ripe and ovulation does not occur in the absence of LH.

54. (c) Hormones thyroxine, adrenaline and the pigment melanin are formed from tyrosine. Tyrosine is transformed into dopa through the enzyme tyrosinase. Then through different metabolic pathways it produces thyroxine, adrenaline, melanin etc.

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55. (b) Prolactin is a proteinaceous hormone released by anterior lobe of pituitary. Prolactin supplements the action of gonadal hormones in stimulating the growth and activity of female mammary gland during pregnancy and lactation. Oxytocin released by the posterior lobe of pituitary gland, is important for the mechanism of ejection of milk from the mammary glands due to sucking of breasts by infant. Progesterone, released by corpus luteum brings about pregnancy changes such as uterine growth, implantation of embryo *etc*. Relaxin is a proteinaceous hormone secreted by corpus luteum towards the end of gestation period for loosening and softening of pelvic ligaments, relaxing of uterus for easing parturition.

56. (c) According to the immunity theory ageing occurs due to the loss of power of defence against the invasion of germs and pathogens. The process starts with the gradual atrophy and disappearance of the thymus gland during middle age.

57. (d) Oxytocin also known as pitocin. It is an important hormone which is released in neurohypophysis of pituitary. It stimulate the contraction of smooth muscles. It stimulate labour pain and also increase labour pain. It is a hormone for quick birth. Its more secretion results in parturition.
58. (b) Mammalian corpus luteum produces progesterone. It is essential for the continuation of pregnancy and it also stimulates acini glands.
59. (b) Nicotine and acetylcholine have the same receptors-Nicotinic cholinergic receptors and hence have the same action.
60. (d) The thyroid gland stores its hormone, thyroglobulin in its follicles called extracellular space before discharing it into the blood.
61. (a) Luteinizing Hormone (LH) induces the Leideyg's cells in males to produce testesterone and in female it causes ovulation and secretion of female sex hormone estrogen from mature ovarian follicle & progesterone by corpus luteum.
62. (c) Enterogastrone is a hormone released by the upper intestinal mucosa that inhibits gastric motility and secretion.
63. (a) Ovulation occurs under the influence of luteinizing hormone-LH secreted by the anterior lobe of pituitary.
64. (b) Leydig's cells.
65. (d) Male hormones are secreted by the Interstitial or Leydig's cells present in the stroma of connective tissue in between the seminiferous tubules in testis. They produce androgens (mainly testosterone) Sertoli cells are elongated epithelial cells present inside the seminal vesicle to nourish the growing spermatozoa.
66. (d) Leydig's cells are present in testes and they secrete male hormone testesterone.
Small groups of polygonal, large cells present in the connective tissue in between the seminiferous tubules are known as Leydig's cells are interstitial cells. They secrete male sex hormone, testosterone.
67. (b) ADH : Antidiuretic hormone – vasopressin is secreted by neurohypophysis (posterior lobe) of pituitary gland. This hormone increases the reabsorption of water from the urine and hence urine gets concentrated and ECF gets diluted. Diabetes insipidus caused by the hyposecretion of ADH.
68. (b) In 1912, Gudernatsch discovered that metamorphosis in frog's tadpole is controlled by the thyroxine hormone which has the iodine as the main constituent. If thyroxine or iodine is added in water having tadpoles in it, then it increases the rate of metamorphosis in tadpole.
69. (a) Melanocyte-stimulating hormone (MSH) or Melanotropin is secreted by the intermediate lobe of adenohypophysis (pars intermedia) of pituitary gland in mammals (other than man) so named 'intermedin'. In lower vertebrates, it targets chromatophores & does wider distribution of the melanin grannules in chromatophores, so that the skin colour darkens. In birds & human beings and other mammals its role is uncertain but in man it is probably responsible for bronzing of skin, moles *etc*.

NOTES

Growth and sexual maturation are mainly controlled by the growth hormone (GH)–insulin-like growth factor-1 (IGF-1) and hypothalamic–pituitary–gonadal (HPG) axes.

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70. (a) Cortisol is secreted by the middle region of adrenal cortex. It increases the blood glucose level (which is anti-insulin effect) by converting proteins & fats into glucose.
71. (c) The given diagrammatic representation shows the mechanism of protein hormone action.
'A' is a hormone such as FSH that cannot cross lipid bilayer therefore it interacts with the membrane-bound receptors and does not enter the target cell, but generates second messengers. Peptide, polypeptide, protein hormones and catecholamines act through this mechanism.
'B' represents the extracellular receptors present on cell surface that forms a hormonereceptor complex which brings about conformational changes in the cytoplasmic part of the receptor. This cytoplasmic part can produces second messengers such as Ca^{+2}, cAMP, IP_3 etc. which activates the existing enzyme system of the cell and accelerates the biochemical reactions in the cell.
Hence, 'C' represents the generation of second messenger.

72. (b) Steroid hormones pass through the plasma membrane of a target cell and adhere to intracellular receptors residing in the cytoplasm or in the nucleus. In the nucleus, the hormone-receptor complex binds to a DNA sequence, called a hormone response element , which triggers gene transcription and translation.

NOTES

Intracellular receptors are located in the cytoplasm of the cell and are activated by hydrophobic ligand molecules that can pass through the plasma membrane. Cell-surface receptors bind to an external ligand molecule and convert an extracellular signal into an intracellular signal.

73. (a) A decrease in blood pressure / volume stimulates the release of renin, aldosterone, and ADH while increase in blood pressure / volume stimulates the release of Atrial Natriuretic Factor (ANF) secreted by atria of heart, which causes vasodilation and also inhibits RAAS (Renin Angiotensin Aldosterone System) mechanism that decreases the blood volume/ pressure.

74. (b) In both females and males, inhibin inhibits FSH production. In females, FSH stimulates the secretion of inhibin from the granulosa cells of the ovarian follicles in the ovaries. In turn, inhibin suppresses FSH. In males, androgens stimulate inhibin production. It is secreted from the Sertoli cells, located in the seminiferous tubules inside the testes.

75. (b) Epinephrine has two role as a hormone and as a neurotransmitter.

76. (c) Glucagon is secreted by α cells of islets of langerhans and stimulate glycogenolysis *i.e.* breakdown of glycogen into glucose Thymosin hormone secreted from thymus gland stimulates the development of certain kinds of white blood cells involved in producing immunity. It also hastens attainment of sexual maturity.

77. (d) Cortisol is the steroid hormone secreted by adrenal cortex and plays an important role in carbohydrate metabolism. It retards the glucose consumption & hence level of glucose in blood increases & blood pressure increases.

78. (b) In heart cells cAMP acts as secondary messenger which is made in the response of adrenaline and it stimulates Ca^{2+} ions to come out from the sarcoplasmic reticulum of muscle fibres which causes muscle contraction.
cGMP (Cyclic Guanosine Monophosphate) which acts as secondary messenger works on the action of acetylcholine, increase in flow of Ca^{2+} into muscle fibres & hence causes muscle relaxation. There is no role of sodium in hormonal action.

79. (c) Epinephrine or adrenaline, norepinephrine or noradrenaline and acetylchloline are the neurotransmitters. These are released by the nerve fibres to transmit the impulse to the next neuron. Cortisone is not the neurotransmitter.

80. (b) Adrenaline (called Frieght-Flight-Fight hormone) is responsible for the dilation of blood vessels, increased oxygen consumption by tissues & glucogenesis to prepare the body for emergency reactions under the threatening conditions.

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81. (a) Endocrine glands regulate neural activity as endocrine glands secrete epinephrine & norepinephrine which have their effects on neuron activity. On the other hand neuron also controls the activity of endocrine glands by secreting neurohormones which regulate the activity of many endocrine glands.

82. (c) Parkinson's disease (Paralysis agitans)
(i) It develops due to deficiency of neuro transmitter, dopamine. The dopamine is not produced due to gradual destruction of neurons in the substantia nigra.
(ii) It produces muscle tremors so called shaking palsy.
(iii) There is lack of control and coordination of movements resulting in expression less face and stooping posture which gradually produces physical disability.

83. (b) Mast cells are granulated leucocyte cells. Their granules contain histamine which is a vasodilator and heparin (an anticoagulant). These take part in body defence and allergic reaction. Vasopressin is released by posterior lobe of pituitary. Relaxin is released by placenta. Calcitonin is released by thyroid. Serotonin and melanin are released by intermediate lobe of pituitary gland.

84. (b) Hormones are chemical messengers formed by endocrine cells. Chemically hormones are of the following types: Amines– composed of amino group e.g., Melatonin.

Amino acids	–	eg. thyroxine
Peptides	–	eg. insulin
Steroids	–	eg. aldosterone

85. (a) Epinephrine is synthesized from amino acid tyrosine. While estrogen and progesterone are modified steroids and prostaglandins are basically fat.

86. (b) Microbial transformation is a biological process in which organic compounds are modified into reversible products. These biotransformation reactions are catalysed by purified enzymes present in microbial cells or pure cullures of micro-organisms. Cholesterol forms a major component of animal cell membranes liposomes (artificially created spheres surrounded by a phospholipid bilayer like a membrane). Cholesterol is used for microbial transformation (transgenics).

87. (d) Electroencephalogram is the recording of electric potentials originating from different parts of the brain in the form of waves. Fractionation is the technique of rupturing cells and separating their components especially cell organelles for studying their chemistry and functions. Electrophoresis is the technique of separation of charged solutes on the basis of their differential migration in an applied electric field.

88. (a) The hormones in blood act on specific sites or receptors of target organ. So if we remove the receptor molecule from the target organs, there will be no response.

89. (a) Enterogastrone secreted by the mucosa of duodenum, it slows gastric contractions and stops the secretion of gastric juice.

90. (c) Insulin is a hormone secreted by the b-cells of pancreas and it controls the sugar level in blood.

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23 Reproduction in Organisms

Trend Analysis with Important Topics & Sub-Topics

		2020		2019		2018		2017		2016	
Topic	Sub-Topics	Qns.	LOD	Qns.	LOD	Qns.	LOD	Qns.	LOD	Qns.	LOD
Asexual Reproduction	Vegetative Propagation					1	E				
Sexual Reproduction	Post-Fertilization			2	D					1	A
	Flowering					1	A				

LOD - Level of Difficulty | E - Easy | A - Average | D - Difficult | Qns - No. of Questions

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Topic 1: Asexual Reproduction

1. Offsets are produced by *[2018]*
   (a) Meiotic divisions (b) Mitotic divisions
   (c) Parthenogenesis (d) Parthenocarpy
2. In ginger vegetative propagation occurs through: *[2015 RS]*
   (a) Offsets (b) Bulbils
   (c) Runners (d) Rhizome
3. Which of the following pairs is not correctly matched? *[2015 RS]*

Mode of reproduction	Example
(a) Rhizome	Banana
(b) Binary fission	*Sargassum*
(c) Conidia	*Penicillium*
(d) Offset	Water hyacinth

4. Which one of the following is **correctly** matched? *[2012]*
   (a) Onion - Bulb
   (b) Ginger - Sucker
   (c) *Chlamydomonas* - Conidia
   (d) Yeast - Zoospores
5. The "Eyes" of the potato tuber are *[2011]*
   (a) root buds
   (b) flower buds
   (c) shoot buds
   (d) axillary buds
6. What is common between vegetative reproduction and apomixis? *[2011M]*
   (a) Both are applicable to only dicot plants
   (b) Both bypass the flowering phase
   (c) Both occur round the year
   (d) Both produces progeny identical to the parent
7. Which one of the following pairs is wrongly matched while the remaining three are correct? *[2011M]*
   (a) *Penicillium* - Conidia
   (b) Water hyacinth - Runner
   (c) *Bryophyllum* - Leaf buds
   (d) *Agave* - Bulbils
8. Vegetative propagation in mint occurs by: *[2009]*
   (a) offset (b) rhizome
   (c) sucker (d) runner

9. In which one pair both the plants can be vegetatively propagated by leaf pieces?
   (a) *Agave* and *Kalanchoe* ***[2005]***
   (b) *Bryophyllum* and *Kalanchoe*
   (c) *Asparagus* and *Bryophyllum*
   (d) *Chrysanthemum* and *Agave*
10. What is true for cleavage? ***[2002]***
   (a) Size of embryo increases
   (b) Size of cells decrease
   (c) Size of cells increase
   (d) Size of embryo decreases
11. During regeneration, modification of an organ to other organ is known as ***[2001]***
   (a) Morphogenesis
   (b) Epimorphosis
   (c) Morphallaxis
   (d) Accretionary growth
12. A population of genetically identical individuals, obtained from asexual reproduction is ***[1993]***
   (a) Callus (b) Clone
   (c) Deme (d) Aggregate
13. Vegetative reproduction of Agave occurs through
   (a) rhizome (b) stolon ***[1991]***
   (c) bulbils (d) sucker

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Topic 2: Sexual Reproduction

14. In some plants, the female gamete develops into embryo without fertilisation. This phenomenon is known as : ***[2019]***
   (a) Autogamy (b) Parthenocarpy
   (c) Syngamy (d) Parthenogenesis
15. Which of the following flowers only once in its life-time? ***[2018]***
   (a) Bamboo species (b) Jackfruit
   (c) Papaya (d) Mango
16. Seed formation without fertilization in flowering plants involves the process of:
   (a) Sporulation ***[2016]***
   (b) Budding
   (c) Somatic hybridisation
   (d) Apomixis
17. Select the wrong statement: ***[NEET 2013]***
   (a) Anisogametes differ either in structure, function or behaviour.
   (b) In oomycetes female gamete is smaller and motile, while male gamete is larger and non-motile.
   (c) *Chalmydomonas* exhibits both isogamy and anisogamy and *Fucus* shows oogamy.
   (d) Isogametes are similar in structure, function and behaviour.
18. Monoecious plant of *Chara* shows occurrence of : ***[NEET 2013]***
   (a) stamen and carpel of the same plant
   (b) upper antheridium and lower oogonium on the same plant
   (c) upper oogonium and lower antheridium on the same plant
   (d) antheridiophore and archegoniophore on the same plant
19. Meiosis takes place in : ***[NEET 2013]***
   (a) Conidia (b) Gemmule
   (c) Megaspore (d) Meiocyte
20. Syngamy can occur outside the body of the organism in ***[NEET Kar. 2013]***
   (a) Fungi (b) Mosses
   (c) Algae (d) Ferns
21. Geocarpic fruits are produced by ***[2000, 02]***
   (a) onion (b) watermelon
   (c) ground nut (d) carrot
22. Which of the following processes is associated with a change in the cellular DNA amount? ***[1999]***
   (a) Spore germination
   (b) Cytokinesis
   (c) Fertilisation
   (d) Blastulation
23. In an egg, the type of cleavage is determined by ***[1995]***
   (a) shape and size of the sperm
   (b) size and location of the nucleus
   (c) amount and distribution of yolk
   (d) number of egg membranes
24. A perennial plant differs from biennial in ***[1994]***
   (a) having underground perennating structure
   (b) having asexual reproductive structures
   (c) being tree species
   (d) not dying after seasonal production of flowers
25. Cells become variable in morphology and function in different regions of the embryo. The process is ***[1989]***
   (a) differentiation (b) metamorphosis
   (c) organisation (d) rearrangement

ANSWER KEY																	
1	(b)	4	(a)	7	(b)	10	(b)	13	(c)	16	(d)	19	(d)	22	(c)	25	(a)
2	(d)	5	(d)	8	(c)	11	(b)	14	(d)	17	(b)	20	(c)	23	(c)		
3	(b)	6	(d)	9	(b)	12	(b)	15	(a)	18	(c)	21	(c)	24	(d)		

Hints & Solutions

1. (b) An offset is a small, virtually complete daughter plant that has been naturally and asexually produced on the mother plant. They are clones, meaning that they are genetically identical to the mother plant. Offset is a vegetative part of a plant, formed by mitosis.
2. (d) Vegetative propagation takes place through rhizome in ginger.
3. (b) Binary fission usually takes place in *Amoeba*, *Paramoecium* and *Euglena*.
4. (a) Onion - Bulb - Underground stem
   Ginger - Rhizome
   Chlamydomonas - Zoospore
   Yeast - Ascospores
5. (d) The axillary buds of the potato tuber are called "eyes" in common language. They are found at the nodes of the stem tuber.
6. (d) Vegetative reproduction and apomixis both are asexual methods of reproduction, which gives the progeny genetically similar to parent.
7. (b) Water hyacinth is a free floating perennial plant, which can grow to a height of 3 feet.
8. (c) Vegetative propagation in mint occurs through sucker. Vegetative reproduction is a type of asexual reproduction for plants, and is also called vegetative propagation, vegetative multiplication, or vegetative cloning. It is a process by which new plant "individuals" arise and are obtained without production of seeds or spores.
9. (b) Leaves of a number of plants develop or possess adventitious buds for vegetative propagation, e.g., *Bryophyllum, Kalanchoe, Adiantum caudatum.*
10. (b) Cleavage involves repeated cell division without increase in size. But cell size decreases.

NOTES

In placental mammals (including humans) where nourishment is provided by the mother's body, the eggs have a very small amount of yolk and undergo **holoblastic** cleavage. Other species, such as birds, with a lot of yolk in the egg to nourish the embryo during development, undergo **meroblastic** cleavage.

11. (b) Morphallaxis is a mechanism of regeneration involving reorganization of body cells. In epimorphosis new cells proliferate from the surface of the wound to form the missing structure. In accretionary growth some specialized cells retain the ability to divide and produce new cells to replace the worn-out.
12. (b) Cloning is a technique by which genetically same individuals can be produced without including any sexual reproduction eg. Dolly sheep.
    The term *clone* is derived from *Klon*, the *Greek* word for "twig", refering to the process, whereby a new plant can be created from a twig.

NOTES

Callus is as an unorganized mass of tissue growing on solid substrate and is used in a Plant tissue Culture technique for the development of new plant.

13. (c) Vegetative reproduction occurs in *Agave* through bulbils. Bulbils are the specialised bud vegetative or floral that modify into a swollen structure. It separates from the parent plant and on approach of favourable condition gives rise to new plant.
14. (d) The phenomenon in which female gamete develops into embryo without getting fused with male gamete (fertilisation) is called parthenogenesis.

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Autogamy is a form of self-fertilisation in which fission of the cell nucleus occurs without division of the cell, the two pronuclei so formed reuniting to form the synkaryon. Parthenocarpy is the production of fruit without fertilisation of an egg in the ovary. Synkaryon is a nucleus formed by the fusion of two pre-existing nuclei.

15. (a) A monocarpic plant flowers and produces seeds only once before dying, e.g. bamboo. A polycarpic plant reproduces sexually more than once in its lifetime, e.g. jackfruit, papaya, mango, etc.
16. (d) Apomixis is defined as the asexual formation of seed from the maternal tissues of the ovule, avoiding the process of meiosis and fertilisation, leading to the development to embryo.
17. (b) In oomycetes female gamete is large and non-motile while male gamete is small and motile.
18. (c) Male sex organ is called antheridium or globule while female sex organ is called oogonium. They develop on the same branchlet in the same plant in *Chara*.
19. (d) Meiosis takes place in meiocyte while conidia and gemmule are asexual structures and megaspore is female gametophyte *i.e.,* embryosac.
20. (c) In most aquatic organisms, such as a majority of algae and fishes as well as amphibians, syngamy occurs in the external medium (water), *i.e.*, outside the body of the organism. This type of gametic fusion is called external fertilisation.
21. (c) Geocarpic fruits are those which develop underground. Groundnut is the fruit which develops underground, onion and carrot also occur within the soil but onion is a modified stem while carrot is a modified root.
22. (c) Fertilisation involves the fusion of two haploid gametes. Cytokinesis involves division of the cytoplasm of the parent cell into its daughter cells. Blastulation refers to the process of cleavage in the zygote to form a blastula.
23. (c) The amount of yolk and its distribution determines the type and depth of cleavage. Cleavage is effected due to yolk resulting in different types of segmentation or cleavage.
24. (d) Perennials survive for more than two years and produce flowers and fruits during specific seasons. They are usually herbs, shrubs or trees whereas biennials are those plants which complete their life cycle in two years. These plants are usually herbs.
25. (a) Cells become variable in shape, size & getting their specialisation for the formation of particular tissue or organ in future foetus. They place themselves at some specific regions in embryo for further organogeny.

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24 Sexual Reproduction in Flowering Plants

Trend Analysis with Important Topics & Sub-Topics

Topic	Sub-Topics	2020		2019		2018		2017		2016	
		Qns.	LOD	Qns.	LOD	Qns.	LOD	Qns.	LOD	Qns.	LOD
Flower/ Pre-fertilisation	Pollination	1	A					3	E/A	2	D
	Female Reproductive Parts	1	A	2	E/A						
	Male Reproductive Parts					2	A				
Double Fertilisation	Double Fertilisation					1	E				
Post-Fertilisation	Embryo							1	E		

LOD - Level of Difficulty | E - Easy | A - Average | D - Difficult | Qns - No. of Questions

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Topic 1: Flower / Pre-fertilisation

1. The body of the ovule is fused within the funicle at *[2020]*
   (a) Micropyle (b) Nucellus
   (c) Chalaza (d) Hilum
2. The plant parts which consist of two generations - one within the other *[2020]*
   (i) Pollen grains inside the anther
   (ii) Germinated pollen grain with two male gametes
   (iii) Seed inside the fruit
   (iv) Embryo sac inside the ovule
   (a) (i), (ii) and (iii) (b) (iii) and (iv)
   (c) (i) and (iv) (d) (i) only
3. What type of pollination takes place in *Vallisneria*? *[2019, Odisa]*
   (a) Male flowers are carried by water currents to female flowers at surface of water.
   (b) Pollination occurs in submerged condition by water.
   (c) Flowers emerge above surface of water and pollination occurs by insects.
   (d) Flowers emerge above water surface and pollen is carried by wind.
4. In which one of the following, both autogamy and geitonogamy are prevented? *[2019, Odisa]*
   (a) Maize (b) Wheat
   (c) Papaya (d) Castor
5. What is the fate of the male gametes discharged in the synergid? *[2019]*
   (a) One fuses with the egg, other(s) degenerate(s) in the synergid.
   (b) All fuse with the egg.
   (c) One fuses with the egg, other(s) fuse(s) with synergid nucleus.
   (d) One fuses with the egg and other fuses with central cell nuclei.
6. Pollen grains can be stored for several years in liquid nitrogen having a temperature of *[2018]*
   (a) – 120°C (b) – 80°C
   (c) – 160°C (d) – 196°C
7. Attractants and rewards are required for: *[2017]*
   (a) Entomophily (b) Hydrophily
   (c) Cleistogamy (d) Anemophily
8. Flowers which have single ovule in the ovary and are packed into inflorescence are usually pollinated by: *[2017]*
   (a) Bee (b) Wind
   (c) Bat (d) Water

9. A dioecious flowering plant prevents both :
   (a) Autogamy and geitonogamy ***[2017]***
   (b) Geitonogamy and xenogamy
   (c) Cleistogamy and xenogamy
   (d) Autogamy and xenogamy
10. Which one of the following statements is not true? ***[2016]***
   (a) Tapetum helps in the dehiscence of anther
   (b) Exine of pollen grains is made up of sporopollenin
   (c) Pollen grains of many species cause severe allergies
   (d) Stored pollen in liquid nitrogen can be used in the crop breeding programmes
11. Which of the following statements is not correct? ***[2016]***
   (a) Pollen grains of many species can germinate on the stigma of a flower, but only one pollen tube of the same species grows into the style.
   (b) Insects that consume pollen or nectar without bringing about pollination are called pollen/nectar robbers.
   (c) Pollen germination and pollen tube growth are regulated by chemical components of pollen interacting with those of the pistil.
   (d) Some reptiles have also been reported as pollinators in some plant species.
12. Which one of the following may require pollinators, but is genetically similar to autogamy? ***[2015 RS]***
   (a) Xenogamy (b) Apogamy
   (c) Cleistogamy (d) Geitonogamy
13. Which one of the following statements is not true? ***[2015 RS]***
   (a) Pollen grains of some plants cause severe allergies and bronchial afflictions in some people
   (b) The flowers pollinated by flies and bats secrete foul odour to attract them
   (c) Honey is made by bees by digesting pollen collected from flowers
   (d) Pollen grains are rich in nutrients, and they are used in the form of tablets and syrups
14. The hilum is a scar on the : ***[2015 RS]***
   (a) Fruit, where it was attached to pedicel
   (b) Fruit, where style was present
   (c) Seed, where micropyle was present
   (d) Seed, where funicle was attached
15. Which of the following are the important floral rewards to the animal pollinators? ***[2015 RS]***
   (a) Nectar and pollen grains
   (b) Floral fragrance and calcium crystals
   (c) Protein pellicle and stigmatic exudates
   (d) Colour and large size flower
16. Filiform apparatus is characteristic feature of: ***[2015 RS]***
   (a) Nucellar embryo (b) Aleurone cell
   (c) Synergids (d) Generative cell
17. Geitonogamy involves: ***[2014]***
   (a) fertilization of a flower by the pollen from another flower of the same plant.
   (b) fertilization of a flower by the pollen from the same flower.
   (c) fertilization of a flower by the pollen from a flower of another plant in the same population.
   (d) fertilization of a flower by the pollen from a flower of another plant belonging to a distant population.
18. Male gametopyte with least number of cell is present in: ***[2014]***
   (a) *Pteris* (b) *Funaria*
   (c) *Lilium* (d) *Pinus*
19. Function of filiform apparatus is to: ***[2014]***
   (a) Recognize the suitable pollen at stigma
   (b) Stimulate division of generative cell
   (c) Produce nectar
   (d) Guide the entry of pollen tube
20. Megasporangium is equivalent to: ***[NEET 2013]***
   (a) Fruit (b) Nucellus
   (c) Ovule (d) Embryo sac
21. Advantage of cleistogamy is : ***[NEET 2013]***
   (a) More vigorous offspring
   (b) No dependence of pollinators
   (c) Vivipary
   (d) Higher genetic variability
22. Product of sexual reproduction generally generates: ***[NEET 2013]***
   (a) Prolonged dormancy
   (b) New genetic combination leading to variation
   (c) Large biomass
   (d) Longer viability of seeds
23. Which one of the following statements is correct? ***[NEET 2013]***
   (a) Sporogenous tissue is haploid
   (b) Endothecium produces the microspores
   (c) Tapetum nourishes the developing pollen
   (d) Hard outer layer of pollen is called intine

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24. Which one of the following statements is **correct**? *[NEET Kar. 2013]*
(a) Geitonogamy involves the pollen and stigma of flowers of different plants
(b) Cleistogamous flowers are always autogamous
(c) Xenogamy occurs only by wind pollination
(d) Chasmogamous flowers do not open at all

25. Megaspores are produced from the megaspore mother cells after *[NEET Kar. 2013]*
(a) Meiotic division
(b) Mitotic division
(c) Formation of a thick wall
(d) Differentiation

26. Animal vectors are required for pollination in *[NEET Kar. 2013]*
(a) Maize (b) *Vallisneria*
(c) Mulberry (d) Cucumber

27. Which of the following statements is **correct?** *[NEET Kar. 2013]*
(a) Sporopollenin can withstand high temperatures but not strong acids
(b) Sporopollenin can be degraded by enzymes
(c) Sporopollenin is made up of inorganic materials
(d) Sporopollenin can withstand high temperatures as well as strong acids and alkalis

28. Both, autogamy and geitonogamy are prevented in - *[2012]*
(a) Papaya (b) Cucumber
(c) Castor (d) Maize

29. An organic substance that can withstand environmental extremes and cannot be degraded by any enzyme is : *[2012]*
(a) Cuticle (b) Sporopollenin
(c) Lignin (d) Cellulose

30. Even in absence of pollinating agents seed setting is assured in *[2012]*
(a) *Commelina* (b) *Zostera*
(c) *Salvia* (d) Fig

31. What is the function of germ pore? *[2012M]*
(a) Emergence of radicle
(b) Absorption of water for seed germination
(c) Initiation of pollen tube
(d) Release of male gametes

32. Which one of the following statements is wrong? *[2012M]*
(a) When pollen is shed at two-celled stage, double fertilization does not take place.
(b) Vegetative cell is larger than generative cell.
(c) Pollen grains in some plants remain viable for months.
(d) Intine is made up of cellulose and - pectin.

33. Plants with ovaries having only one or a few ovules, are generally pollinated by *[2012M]*
(a) bees (b) butterflies
(c) birds (d) wind

34. Filiform apparatus is a characteristic feature of
(a) suspensor (b) egg *[2011]*
(c) synergid (d) zygote

35. In which one of the following pollination is autogamous? *[2011]*
(a) Geitonogamy (b) Xenogamy
(c) Chasmogamy (d) Cleistogamy

36. Wind pollination is common in *[2011]*
(a) legumes (b) lilies
(c) grasses (d) orchids

37. Transfer of pollen grains from the anther to the stigma of another flower of the same plant is called *[2010]*
(a) Xenogamy (b) Geitonogamy
(c) Karyogamy (d) Autogamy

38. Wind pollinated flowers are *[2010]*
(a) small, brightly coloured, producing large number of pollen grains
(b) small, producing large number of dry pollen grains
(c) large producing abundant nectar and pollen
(d) small, producing nectar and dry pollen

39. Unisexuality of flowers prevents *[2008]*
(a) autogamy, but not geitonogamy
(b) both geitonogamy and xenogamy
(c) geitonogamy, but not xenogamy
(d) autogamy and geitonogamy

40. What does the filiform apparatus do at the entrance into ovule? *[2008]*
(a) It helps in the entry of pollen tube into a synergid
(b) It prevents entry of more than one pollen tube into the embryo sac
(c) It brings about opening of the pollen tube
(d) It guides pollen tube from a synergid to egg

41. Which one of the following is surrounded by a callose wall? *[2007]*
(a) male gamete
(b) egg
(c) pollen grain
(d) microspore mother cell

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42. Male gametes in angiosperms are formed by the division of *[2007]*
(a) generative cell
(b) vegetative cell
(c) microspore mother cell
(d) microspore.

43. Which one of the following pairs of plant structures has haploid number of chromosomes? *[2007]*
(a) Megaspore mother cell and antipodal cells
(b) Egg cell and antipodal cells
(c) Nucelus and antipodal cells
(d) Egg nucleus and secondary nucleus

44. The arrangement of the nuclei in a normal embryo sac in the dicot plants is *[2006]*
(a) 3 + 2 + 3 (b) 2 + 3 + 3
(c) 3 + 3 + 2 (d) 2 + 4 + 2

45. What would be the number of chromosomes in the cells of the aleuron layer in a plant species with 8 chromosomes in its synergids *[2006]*
(a) 24 (b) 32
(c) 8 (d) 16

46. Through which cell of the embryo sac, does the pollen tube enter the embryo sac? *[2005]*
(a) Egg cell
(b) Persistent synergid
(c) Degenerated synergid
(d) Central cell

47. Which one of the following represents an ovule, where the embryo sac becomes horse-shoe shaped and the funiculus and micropyle are close to each other? *[2005]*
(a) Amphitropous (b) Circinotropous
(c) Atropous (d) Antropous

48. An ovule which becomes curved so that the nucellus and embryo sac lie at right angles to the funicle is *[2004]*
(a) Hemitropous (b) Campylotropous
(c) Anatropous (d) Orthotropous

49. In oogamy, fertilization involves *[2004]*
(a) a small non-motile female gamete and a large motile male gamete
(b) a large non-motile female gamete and a small motile male gamete
(c) a large non-motile female gamete and a small non motile male gamete
(d) a large motile female gamete and a small nonmotile male gamete

50. An ovule which becomes curved so that the nucellus and embryo sac lie at right angles to the funicle is *[2004]*
(a) Hemitropous (b) Campylotropous
(c) Anatropous (d) Orthotropous

51. In a flowering plant, archesporium gives rise to *[2003]*
(a) only tapetum and sporogenous cells
(b) only the wall of the sporangium
(c) both wall and the sporogenous cells
(d) wall and the tapetum

52. In angiosperms pollen tubes liberate their male gametes into the *[2002]*
(a) central cell (b) antipodal cell
(c) egg cell (d) synergids

53. What is the direction of micropyle in anatropous ovule ? *[2002]*
(a) upward (b) downward
(c) right (d) left

54. In angiosperms all the four microspores of tetrad are covered by a layer which is formed by *[2002]*
(a) pectocellulose (b) callose
(c) cellulose (d) sporopollenin

55. Anemophily type of pollination is found in *[2001]*
(a) *Salvia* (b) Bottle brush
(c) *Vallisneria* (d) Coconut

56. Eight nucleate embryo sacs are *[2000]*
(a) always tetrasporic
(b) always monosporic
(c) always bisporic
(d) sometime monosporic, sometimes bisporic and sometimes tetrasporic

57. The endosperm of gymnosperm is *[1999]*
(a) triploid (b) haploid
(c) diploid (d) polyploid

58. Flowers showing ornithophily show few characteristic like *[1999]*
(a) blue flower with nectaries at base of corolla
(b) red sweet scented flower with nectaries
(c) bright red flower into thick inflorescence
(d) white flowers with fragrance

59. How many pollen grains will be formed after meiotic division in ten microspore mother cells? *[1996]*
(a) 10 (b) 20
(c) 40 (d) 80

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60. In an angiosperm, how many microspore mother cells are required to produce 100 pollen grains *[1995]*
(a) 25 (b) 50
(c) 75 (d) 100

61. Chief pollinators of agricultural crops are *[1994]*
(a) butterflies (b) bees
(c) moths (d) beetles

62. Transfer of pollen to the stigma of another flower of the same plant is *[1994]*
(a) Autogamy (b) Allogamy
(c) Xenogamy (d) Geitonogamy

63. Fertilization involving carrying of male gametes by pollen tube is *[1994]*
(a) Porogamy (b) Siphonogamy
(c) Chalazogamy (d) Syngonogamy

64. One of the most resistant biological material is *[1994]*
(a) lignin (b) hemicellulose
(c) lignocellulose (d) sporopollenin

65. Ovule is straight with funiculus, embryo sac, chalaza and micropyle lying on one straight line. It is *[1993]*
(a) Orthotropous (b) Anatropous
(c) Campylotropous (d) Amphitropous

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66. Number of meiotic divisions required to produce 200/400 seeds of Pea would be *[1993]*
(a) 200/400 (b) 400/800
(c) 300/600 (d) 250/500

67. Meiosis is best observed in dividing *[1992]*
(a) cells of apical meristem
(b) cells of lateral meristem
(c) microspores and anther wall
(d) microsporocytes

68. Pollination occurs in *[1991]*
(a) Bryophytes and angiosperms
(b) Pteridophytes and angiosperms
(c) Angiosperms and gymnosperms
(d) Angiosperms and fungi

69. Embryo sac occurs in *[1991]*
(a) Embryo (b) Axis part of embryo
(c) Ovule (d) Endosperm

70. Which of the following pair has haploid structures? *[1991]*
(a) Nucellus and antipodal cells
(b) Antipodal cells and egg cell
(c) Antipodal cells and megaspore mother cell
(d) Nucellus and primary endosperm nucleus

71. Point out the odd one? *[1991]*
(a) Nucellus (b) Embryo sac
(c) Micropyle (d) Pollen grain

72. Syngamy means *[1991]*
(a) fusion of gametes
(b) fusion of cytoplasms
(c) fusion of two similar spores
(d) fusion of two dissimilar spores

73. Which ones produces androgenic haploids in anther cultures? *[1990]*
(a) Anther wall
(b) Tapetal layer of anther wall
(c) Connective tissue
(d) Young pollen grains

74. Male gametophyte of angiosperms/monocots is *[1990]*
(a) Microsporangium (b) Nucellus
(c) Microspore (d) Stamen

75. Female gametophyte of angiosperms is represented by *[1990]*
(a) Ovule
(b) Megaspore mother cell
(c) Embryo sac
(d) Nucellus

76. Entry of pollen tube through micropyle is *[1990]*
(a) Chalazogamy (b) Mesogamy
(c) Porogamy (d) Pseudogamy

77. Generative cell was destroyed by laser but a normal pollen tube was still formed because
(a) vegetative cell is not damaged *[1989]*
(b) contents of killed generative cell stimulate pollen growth
(c) laser beam stimulates growth of pollen tube
(d) the region of emergence of pollen tube is not harmed

78. Which is correct? *[1989]*
(a) Gametes are invariably haploid
(b) Spores are invariably haploid
(c) Gametes are generally haploid
(d) Both spores and gametes are invariably haploid

79. Male gametophyte of angiosperms is shed as
(a) four celled pollen grain *[1988]*
(b) three celled pollen grain
(c) microspore mother cell
(d) anther

80. Total number of meiotic division required for forming 100 zygotes/100 grains of wheat is
(a) 100 (b) 75 *[1988]*
(c) 125 (d) 50

Topic 2: Double Fertilisation

81. Double fertilization is *[2018]*
(a) Fusion of two male gametes of a pollen tube with two different eggs
(b) Fusion of one male gamete with two polar nuclei
(c) Syngamy and triple fusion
(d) Fusion of two male gametes with one egg

82. A diploid female plant and a tetraploid male plant are crossed. The ploidy of endosperm shall be *[1989, 2004]*
(a) tetraploid (b) triploid
(c) diploid (d) pentaploid

83. Double fertilisation leading to initiation of endosperm in Angiosperms require *[2000]*
(a) fusion of one polar nucleus and the second male gamete only
(b) fusion of two polar nuclei and the second male gamete
(c) fusion of four or more polar nuclei and the second male gamete only
(d) all the above kinds of fusion in different angiosperms

84. If an angiospermic male plant is diploid and female plant tetraploid, the ploidy level of endosperm will be *[1997]*
(a) haploid (b) triploid
(c) tetraploid (d) pentaploid

85. In angiosperms, triple fusion is required for the formation of *[1996]*
(a) embryo (b) endosperm
(c) seed coat (d) fruit wall

86. Double fertilization is characteristic of *[1993]*
(a) Angiosperms (b) Pteridophytes
(c) Gymnosperms (d) Bryophytes

87. Double fertilization and triple fusion were discovered by *[1988, 93]*
(a) Hofmeister
(b) Nawaschin and Guignard
(c) Leeuwenhoek
(d) Strasburger

88. Double fertilization is fusion of *[1991]*
(a) two eggs
(b) two eggs and polar nuclei with pollen nuclei
(c) one male gamete with egg and other with synergid
(d) one male gamete with egg and other with secondary nucleus

89. Micropyle of seed is involved in the passage of *[1988]*
(a) male gamete (b) pollen tube
(c) water (d) gases

Topic 3: Post-fertilisation

90. Which one of the following statements regarding post-fertilisation development in flowering plants is incorrect? *[2019]*
(a) Ovary develops into fruit.
(b) Zygote develops into embryo.
(c) Central cell develops into endosperm.
(d) Ovules develop into embryo sac.

91. Persistent nucellus in the seed is known as:
(a) Chalaza (b) Perisperm *[2019]*
(c) Hilum (d) Tegmen

92. Functional megaspore in an angiosperm develops into ? *[2017]*
(a) Endosperm (b) Embryo sac
(c) Embryo (d) Ovule

93. Non-albuminous seed is produced in: *[2014]*
(a) Maize (b) Castor
(c) Wheat (d) Pea

94. Perisperm differs from endosperm in;
(a) having no reserve food *[NEET 2013]*
(b) being a diploid tissue
(c) its formatting by fusion of secondary nucleus with several sperms
(d) being a haploid tissue

95. Seed coat is not thin, membranous in : *[NEET 2013]*
(a) Coconut (b) Groundnut
(c) Gram (d) Maize

96. The viability of seeds is tested by
(a) Safranine *[NEET Kar. 2013]*
(b) 2, 6 dichlorophenol indophenols
(c) 2, 3, 5 triphenyl tetrazolium chloride
(d) DMSO

97. Albuminous seeds store their reserve food mainly in *[NEET Kar. 2013]*
(a) Perisperm (b) Endosperm
(c) Cotyledons (d) Hypocotyl

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98. Which of the following statements is not true about somatic embryogenesis? *[NEET Kar. 2013]*
(a) A somatic embryo develops from a somatic cell
(b) The pattern of development of a somatic embryo is comparable to that of a zygotic embryo
(c) Somatic embryos can develop from microspores
(d) Somatic embryo is induced usually by an auxin such as 2, 4-D

99. A drupe develops in *[2011]*
(a) mango (b) wheat
(c) pea (d) tomato

100. Apomictic embryos in citrus arise from *[2010]*
(a) Synergids
(b) Maternal sporophytic tissue in ovule
(c) Antipodal cells
(d) Diploid egg

101. The scutellum observed in a grain of wheat or maize is comparable to which part of the seed in other monocotyledons? *[2010]*
(a) Cotyledon (b) Endosperm
(c) Aleurone layer (d) Plumule

102. A fruit developed from hypanthodium inflorescence is called *[2009]*
(a) Sorosis (b) Syconus
(c) Caryopsis (d) Hasperidium

103. Cotyledons and testa respectively are edible parts in *[2009]*
(a) walnut and tamarind
(b) french bean and coconut
(c) cashew nut and litchi
(d) groundnut and pomegranate

104. An example of a seed with endosperm, perisperm, and caruncle is *[2009]*
(a) coffee (b) lily
(c) castor (d) cotton

105. Endosperm is consumed by developing embryo in the seed of *[2008]*
(a) coconut (b) castor
(c) pea (d) maize

106. Dry indehiscent single-seeded fruit formed from bicarpellary syncarpous inferior ovary is
(a) Caryopsis (b) Cypsela *[2008]*
(c) Berry (d) Cremocarp

107. The fleshy receptacle of syconus of fig encloses a number of: *[2008]*
(a) Achenes (b) Samaras
(c) Berries (d) Mericarps

108. The fruit is chambered, developed from inferior ovary and has seeds with succulent testa in
(a) pomegranate (b) orange *[2008]*
(c) guava (d) cucumber

109. Top-shaped multiciliate male gametes, and the mature seed which bears only one embryo with two cotyledons, are characteristic features of
(a) Cycads *[2005]*
(b) Conifers
(c) Polypetalous angiosperms
(d) Gamopetalous angiosperms

110. Why is vivipary an undesirable character for annual crop plants? *[2005]*
(a) It reduces the vigour of the plant.
(b) It adversely affects the fertility of the plant.
(c) The seeds exhibit long dormancy.
(d) The seeds cannot be stored under normal conditions for the next season.

111. Adventive polyembryony in citrus is due to *[2001, 05]*
(a) nucellus (b) integuments
(c) zygotic embryo (d) fertilised egg

112. Study of formation, growth and development of new individual from an egg is *[1993]*
(a) Apomixis (b) Embryology
(c) Embryogeny (d) Cytology

113. Tegmen develops from *[1990]*
(a) funiculus (b) chalaza
(c) inner integument (d) outer integument

114. Parthenogenesis is *[1988]*
(a) development of embryo without fertilization
(b) development of fruit without fertilization
(c) development of fruit without hormones
(d) development of embryo from egg without fertilization

Topic 4: Apomixis & Polyembryony

115. Which is the most common type of embryo sac in angiosperms? *[2019, Odisa]*
(a) Bisporic with two sequential mitotic divisions.
(b) Tetrasporic with one mitotic stage of divisions.
(c) Monosporic with three sequential mitotic divisions.
(d) Monosporic with two sequential mitotic divisions.

116. Nucellar polyembryony is reported in species of *[2011]*
(a) *Citrus* (b) *Gossypium*
(c) *Triticum* (d) *Brassica*

117. Which plant will lose its economic value if its fruits are produced by induced parthenocarpy? *[1997]*
(a) brape (b) pomegranate
(c) banana (d) orange

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118. The polyembryony commonly occurs in *[1995]*
(a) citrus (b) turmeric
(c) tomato (d) potato

119. Development of an organism from female gamete/ egg without involving fertilization is *[1989]*
(a) Adventitive embryony
(b) Polyembryony
(c) Parthenocarpy
(d) Parthenogenesis

120. Nucellar embryo is *[1989]*
(a) Amphimictic haploid
(b) Amphimictic diploid
(c) Apomictic haploid
(d) Apomictic diploid

121. Formation of gametophyte directly from sporophyte without meiosis is *[1988]*
(a) Apospory (b) Apogamy
(c) Parthenogenesis (d) Amphimixis

ANSWER KEY

1	(d)	14	(d)	27	(d)	40	(a)	53	(b)	66	(d)	79	(b)	92	(b)	105	(c)	118	(a)
2	(c)	15	(a)	28	(a)	41	(d)	54	(d)	67	(d)	80	(c)	93	(d)	106	(b)	119	(d)
3	(a)	16	(c)	29	(b)	42	(a)	55	(d)	68	(c)	81	(c)	94	(b)	107	(a)	120	(d)
4	(c)	17	(a)	30	(a)	43	(b)	56	(d)	69	(c)	82	(a)	95	(a)	108	(a)	121	(a)
5	(d)	18	(c)	31	(c)	44	(a)	57	(b)	70	(b)	83	(b)	96	(c)	109	(a)		
6	(d)	19	(d)	32	(a)	45	(a)	58	(b)	71	(d)	84	(d)	97	(b)	110	(d)		
7	(a)	20	(c)	33	(d)	46	(c)	59	(c)	72	(a)	85	(b)	98	(c)	111	(a)		
8	(b)	21	(b)	34	(c)	47	(a)	60	(a)	73	(d)	86	(a)	99	(a)	112	(b)		
9	(a)	22	(b)	35	(d)	48	(a)	61	(b)	74	(c)	87	(b)	100	(b)	113	(c)		
10	(a)	23	(c)	36	(c)	49	(b)	62	(d)	75	(c)	88	(d)	101	(a)	114	(d)		
11	(a)	24	(b)	37	(b)	50	(a)	63	(b)	76	(c)	89	(c)	102	(b)	115	(c)		
12	(d)	25	(a)	38	(b)	51	(c)	64	(d)	77	(a)	90	(d)	103	(d)	116	(a)		
13	(c)	26	(d)	39	(a)	52	(d)	65	(a)	78	(a)	91	(b)	104	(c)	117	(b)		

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Hints & Solutions

1. (d) The attachment point of funicle and body of ovule is known as hilum. A hilum is a scar or mark left on a seed coat by the former attachment to the ovary wall or to the funiculus (which in turn attaches to the ovary wall). A hilum can also be a nucleus of a starch grain; the point around which layers of starch are deposited.

NOTES Hilum permits water to enter the embryo before active germination.

2. (c) The plant parts which consist of two generations one within the other are pollen grains inside the anther and embryo sac inside the ovule. Pollen grain is haploid inside the diploid anther. Embryo sac is haploid inside the diploid ovule.

3. (a) *Vallisneria* shows epihydrophily. Epihydrophily involves transfer of pollen at the water surface. In *Vallisneria* male flowers after breakage float on the surface of water and reach the female flowers.

NOTES Characteristics of hydrophilous flowers: Flowers are small and inconspicuous, Perianth and other floral parts are unwettable, Nectar and odour are absent, Pollen grains are light and unwettable due to presence of mucilage cover, and Stigma is long, sticky but unwettable. Epihydrophily can be seen in plants that are grown above the surface of water whereas the hypohydrophily can be seen in submerged plants.

4. (c) Papaya is a dioecious plant in which male and female flowers are produced on two separate plants. Hence it prevents both autogamy as well as geitonogamy.
Castor and Maize are monoecious and unisexual. Wheat is monoecious and bisexual.

NOTES
Papayas can be dioecious (male and female flowers on different plants), monoecious (separate male and female flowers on the same plant) or exhibit both male and female flower parts on the same flower.

5. (d) In flowering plants, out of the two male gametes discharged in synergids, one fuses with the egg and other fuses with the secondary or definitive nucleus present in central cell.
Egg (n) + 1st male gamete (n) → Zygote (2n)
Secondary nucleus (2n) + 2nd male gamete (n) → Endosperm Nucleus(3n)
(central cell nuclei)

NOTES
The synergid cells produce an attractant that guides the pollen tube to the female gametophyte and likely contain factors that control arrest of pollen tube growth, pollen tube discharge, and gamete fusion.

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6. (d) Pollen grains can be stored for several years in liquid nitrogen at -196°C (cryopreservation). Cryopreservation is the process of cooling and storing cells, tissues, or organs at very low temperatures; most common -196°C/-321°F in liquid nitrogen (N2) to maintain their viability.
7. (a) Insect pollinated plants provide rewards as edible pollen grain and nectar as usual rewards. In order to materialize and maximize pollination flowers have developed a set of attributes which are aimed at attracting the pollinators called attractants.
8. (b) Wind pollination or anemophily occurs in flowers which are having a single ovule in each ovary, and numerous flowers packed in an inflorescence. It is a non-directional pollination.
9. (a) Autogamy occurs in bisexual flowers. Geitonogamous flowers are unisexual but present in the same plant. Dioecious condition is observed when unisexual male and female flowers are present on different plants and it prevents both autogamy and geitonogamy.
10. (a) Tapetum is important for the nutrition and development of pollen grains, as well as a source of precursors for the pollen coat.
11. (a) Pollen grains of different species are incompatible, so they fail to germinate. If the pollen-stigma interaction is compatible, the pollen grain hydrates and germinates shortly following landing on the stigma.
12. (d) Geitonogamy, genetically, shows similarity with autogamy because the pollen grains are borne on the same plant.
13. (c) Honey is produced by worker bees using nectar (fructose) of flowering plants.
14. (d) The hilum is a scar found on the seed coat through which the developing seeds are attached to the fruit.
15. (a) Nectar and pollen grains are the usual floral rewards which the animal pollinators get.
16. (c) Synergids have filiform apparatus.
17. (a) Geitonogamy is the transfer of pollen grains in different flowers of same plant.
18. (c) Male gametophyte is highly reduced in angiosperm and is known as pollen grain. It is 2 or 3-celled.
19. (d) Filiform apparatus helps in the entry of pollen tube into a synergid in ovule. Filiform apparatus is in form of finger like projection comprising a core of micro fibrils enclosed in a sheath. It resembles transfer cells meant for short distance movement of metabolites. It is responsible for the absorption of food from the nucleus.
20. (c) Ovule is also called integumented megasporangium. It develops into seed after fertilisation in spermatophytes. It occurs singly or in a cluster inside ovary with parenchymatous cushions called placenta.
21. (b) Cleistogamy favours no dependence on pollinator because flowers never open. In such flowers, the anthers and stigma lie close to each other. When anthers dehisce in flower buds pollen grains come in contact with the stigma to effect pollination.
22. (b) Sexual reproduction leads to formation of new progeny with appearance of variations by Genetic recombination, of two different organisms interaction etc. During sexual

reproduction provides vigour and vitality to the offsprings. They better adapt themselves to changing environmental conditions and also plays an important role in evolution.

23. (c) Sporogenous tissue is always diploid, endothecium is second layer of anther wall and perform the function of protection and help in dehiscence of anther to release the pollen. Hard outer layer of pollen is called exine but tapetum always nourishes the developing pollen.
Cells of the tapetum possess dense cytoplasm and generally have more than one nucleus (polypoid).

24. (b) Cleistogamous flowers do not expose their reproductive parts. Anthers and stigma lie close to each other. Pure autogamy occurs since there is no chance of cross-pollination. Cleistogamy is the most efficient floral adaptation for promoting self-pollination. E.g., *Viola mirabilis* and *Oxalis autosella*.

25. (a) Single Megaspore Mother Cell (MMC) with dense cytoplasm and a prominent nucleus gets differentiated from nucellus near the micropylar region. This Megaspore Mother Cell (MMC) undergoes meiosis to form '4' haploid cells called megaspores and the process of formation is known as megasporogenesis.

26. (d) There are different types of vectors involved in pollination.
For example, maize, mulberry → pollination by wind. *Vallisneria* → pollination through water (hydrophily). Cucumber → Bees are brought for the commercial plantings of cucumber.

27. (d) Pollen grains are generally spherical and a prominent two-layered wall. The hard outer layer called the exine is made up of sporopollenin which is one of the most resistant organic material known. It can withstand high temperatures and strong acids and alkali.

28. (a) Papaya is dioecious *i.e.* male and female flowers occurs in separate plants so that it prevents both autogamy & geitonogamy (method of self pollination).

29. (b) Sporopollenin is fatty substance present in pollen wall and provides resistance against extremes conditions like high temperature, acid, bases.

30. (a) Cleistogamous flower produce assured seed set even in the absence of pollinations. Plants such as *Viola*, *Oxalis* and *Commelina*.

31. (c) The germ pores are apertures in the exine layer of the pollen grain where the sporopollenin is absent. The germ pore helps in the formation of the germ tube or pollen tube and which makes its exit on germination.

32. (a) In over 60 per cent of angiosperms, pollen grains are shed at cell 2-celled stage. In the remaining species the generative cell divides mitotically to give rise to the two male gametes before pollen grains are shed (3-celled stage.)

33. (d) Wind pollinated flowers have generally single ovule in each ovary.

34. (c) A synergid cell wall forms a highly thickened structure called the filiform apparatus at the micropylar end consisting of numerous finger like projections into synergid cytoplasm. These synergid cells are necessary for pollen tube guidance in ovule.

35. (d) Cleistogamy is autogamous pollination. When pollination and fertilization occur in unopened flower bud, it is known as cleistogamy. It ensures self-pollination and prevents cross-pollination.

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NOTES

The German physician and botanist Rudolf Jakob Camerarius (1665-1721) is credited with the first empirical demonstration that plants reproduce sexually. Camerarius discovered the roles of the different parts of a flower in seed production.

36. (c) Wind pollination is common in grasses. Grasses produce large amount of pollen which by the help of wind reach to opposite sex for reproduction.

37. (b) Geitonogamy is the process of transfer of pollen grains from the anther to the stigma of another flower of the same plant. Example, maize.

38. (b) Pollination by wind is called anemophily. Wind pollinated flowers are small in size, producing large number of dry pollen grains. Pollens are small, dry and light in weight. Grasses are anemophilous plants.

39. (a) Unisexuality of flowers prevents autogamy, but not geitonogamy. In self fertilisation , the male and female gametes are derived from the same individual. Among

plants, self fertilization also called autogamy is common in many cultivated species, *eg*., wheat and oats. However, self fertilization is a form of inbreeding and does not allow for the mixing of genetic material; if it occurs over a number of generations it will result in offspring being less vigorous and productive than those resulting from cross fertilization.

40. (a) Filiform apparatus helps in the entry of pollen tube into a synergid in ovule.
Filiform apparatus is in form of finger like projection comprising a core of micro fibrils enclosed in a sheath. The filiform apparatus resembles transfer cells" meant for short distance movement of metabolites. The filiform apparatus responsible for the absorption of food from the nucleus.
41. (d) MMC microspore mother cell is surrounded by a callose wall inner to the cell wall.
42. (a) Generative cell which is a cell of the male gametophyte or pollen grain in seed plants that divides to give rise directly or indirectly two sperms.
43. (b)
44. (a) In a dicot plant general arrangement of nuclei in the embryosac is that 3 nuclei in 3 cells of egg apparatus (one egg cell & 2 synergids) at micropylar end and 2 polar nuclei in almost middle region and 3 nuclei in the form of antipodals at the distal end from micropyle, towards nucellus. So total nuclei 3 + 2 + 3.
45. (a) Aleurone layer is the layer formed by the endospermic tissue in the members of family graminae e.g. wheat, rice, maize etc. Obviously it will be a triploid tissue. So if synergids have 8 no. of chromosomes which are haploid than aleurone- layer must have 24 chromosomes.
46. (c) After entering the ovule, the pollen tube is attracted towards the micropylar end of the embryosac. The attractants are secreted by synergids. The pollen tube pierces one of the two synergids and bursts it. The synergid is simultaneously destroyed.
47. (a) Circinotropous : The funicle is large and coiled around the ovule eg. *Opuntia*.
Amphitropous : Both body of ovule and embryo sac are curved. The embryo sac assumes horse-shoe shape. *e.g. Papaveraceae*.
48. (a) In campylotropous ovule, the body is curved but the embryosac is straight eg. *Capsella*. In Anatropous, the body of ovule is inverted and gets fused with funiculus along its whole length on one side (most of the angiosperms). In orthotropous condition the body of ovule lies straight and upright over the funicle. e.g. Piperaceae, Polygonaceae.
49. (b) In oogamy, male and female gametes are morphologically as well as physiologically different. Female gametes are large and non-motile. Male gametes are small but motile.
50. (a) In campylotropous ovule, the body is curved but the embryo sac is straight eg. *Capsella*. In anatropous ovule, the body of ovule is inverted and gets fused with funiculus along its whole length on one side (most of the angiosperms). In orthotropous condition, the body of ovule lies straight and upright over the funicle. e.g. Piperaceae, Polygonaceae.
51. (c) In flowering plants, archesporium cells undergo periclinal (transverse) division to form outer primary parietal layer and inner sporogenous cells. Primary parietal wall after few more periclinal divisions form anther wall and sporogenous cells give rise to sporogenous tissue.
52. (d) Antipodal cells occur at the chalazal end of the ovule. Synergids are the helping cells.
53. (b) In anatropous, ovule gets inverted and micropyle is on the lower side. It is the most common type of ovule. In orthotropous ovule micropyle is upward. This is the presentive type of ovule.
54. (d) The outermost covering of the pollen grain is made of sporopollenin.

NOTES

Sporopollenin is highly cross-linked polymer composed of carbon, hydrogen, and oxygen that is extraordinarily stable and has been found chemically intact in sedimentary rocks some 500 million years old.

55. (d) *Vallisneria* exhibits hydrophily and *Salvia* is pollinated by honey bee. In bottle brush pollination is carried out by birds.
56. (d) Monosporic type - eight nucleated *Polygonum* type. In this types only one

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megapore situated at chalazal end takes part in the development of embryosac.
Bisporic type - eight nucleated *Allium* type.
Tetrasporic type - eight nucleated *Adoxa* type.

57. (b) In gymnosperms, the female gametophyte forming archegonia provides nourishment to the developing embryo. It later gets transformed into food-laden endosperm inside the seed. Endosperm provides nourishment for growth of seed at the time of seed germination. Triploid endosperm occurs in angiosperms.
58. (b) Transfer of pollen grains by birds is known as ornithophily. They usually have bright coloured flowers, tubular or cup shaped and having a large quantity of nectar.
59. (c) Each microspore mother cell gives rise to 4 microspores which develop into pollen grains.
60. (a) Each microspore mother cells undergoes meiosis to produce four pollen grains. Thus, 25 microspore mother cells are required to produce 100 pollen grains.
61. (b) Pollination by insect is known as Entomophily. Among insects bees are the most common pollinators which pollinate about 80% of the total insect pollinated flowers.
62. (d) Autogamy = Self Pollination
Geitonogamy - (*geiton* = neighbour, *gamos* = marriage.) *i.e.* when pollen grains are transferred to the stigma of other flower of the same plant (i.e. neighbouring flower).
Allogamy = Xenogamy – Cross pollination.
63. (b) In angiosperms the male gametes are carried by the pollen tube was discovered by Strasburger in 1884. The process is called Siphonogamy.
64. (d) Each pollen has two layered wall. The outer layer is thick, tough, cuticularised called exine which is composed of a material called "sporopollenin". It is highly resistant to biological and physical decomposition, due to which pollens are preserved for a long time in fossils.
65. (a) It is a *Polygonum* type ovule in which the body of ovule is straight *i.e.* funiculus, chalaza, embryo sac and micropyle lie in the same vertical axis.
66. (d) 200 seeds of pea would be produced from 200 pollen grains and 200 embryo sac. 200 pollen grains will be formed by 50 microspore mother cell while 200 embryo sac will be formed by 200 megaspore mother cell (because 3 will degenerate) so 250/500.
67. (d) Microsporocytes or microspore mother cell after meiosis give rise to microspore. No any other cell (in given options) divide by meiosis.
68. (c) Pollen grains are found only in Gymnosperms and Angiosperms.
69. (c) Embryo sac is a female gametophyte which contains the egg apparatus.
70. (b) (a) Nucellus - 2n, antipodal cells - n
(b) Antipodal cells - n, egg cell - n
(c) Antipodal cells - n, megaspore mother cell - 2n
(d) Nucellus - 2n primary endosperm nucleus - 3n
Antipodal and egg cell are the product of meiotic division and rest are not.
71. (d) They are all found in ovule (nucellus, embryo sac and micropyle) while pollen grain is male gametophyte.
72. (a) Fusion of male gamete with the egg is called syngamy.
73. (d) Androgenic haploids are produced by young pollen grains because rest all are the diploid tissue.
74. (c) Microspore is haploid, uninucleate, minute spore produced in large number as a result of meiosis in microspore mother cell inside the microsporangia. These are the first cell of gametophytic generation in angiosperms.
75. (c) Embryo sac is 7-celled structure. There is a large central cell with two polar nuclei, egg apparatus with egg cell and 2 synergids present at micropylar end and its chalazal end, 3 antipodal cells are present.
76. (c) In porogamy the tip of pollen tube enters the micropyle, pushes through the nucellar tissue & finally pierces the egg-apparatus end of the embryo sac. If pollen tube enters through chalazal side it is called chalazogamy & if it enters laterally it is called mesogamy.
77. (a) Each microspore divide by mitotic division making a smaller generative cell and a

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larger vegetative cell or tube cell. If generative cell is damaged then the normal pollen tube will be formed because pollen tube is formed by vegetative cell, not by generative cell of microspore.

78. (a) Spores are formed in lower plants by mitotic division and they may be diploid but gametes are always made by meiosis & they are always haploid.

79. (b) In majority of angiosperms the pollen grains are shed from the anther at bi-celled stage (one generative cell and one vegetative cell) but in some angiosperms the generative cell divides forming 2 sperms prior to the dehiscence of anther & pollen grains are shed at 3 celled stage.

80. (c) 100 zygotes requires 100 pollen grains and 100 embryo sacs. 100 pollen grains are formed from 25 microspore mother cells while 100 embryo sacs are formed from 100 functional megaspores which in turn are produced by 100 megaspore mother cells since three out of four megaspores degenerate in each case.

81. (c) Double fertilization is a unique phenomenon that occurs in angiosperms only.
Double fertilization = Syngamy + Triple fusion

82. (a) Diploid female plant will have 2 polar nuclei (each haploid) with which one male gamete form tetraploid male plant (male gamete of tetraploid plant will be diploid) fuses, making endosperm. So endosperm will be tetraploid.

$$\underset{(2n)}{\text{Male gamete}} + \underset{(n)\ (n)}{\text{2 polar nuclei}} \longrightarrow \underset{(4n)}{\text{Endosperm}}$$

83. (b) The second male gamete entering the ovary fuses with two haploid polar nuclei to form triploid primary endosperm nucleus which develops into endosperm. This fusion of two male gametes with two different structures (egg and secondary nucleus) in the same female gametophyte is called double fertilization.

84. (d) The male gamete will be haploid (n). 2 polar nuclei will be diploid (2n). Endosperm formed by fusion of male gamete with two polar nuclei will be pentaploid.

$$\underset{(n)}{\text{Male gamete}} + \underset{(2n)+(2n)}{\text{2 polar nuclei}} \longrightarrow \underset{(5n)}{\text{Endosperm}}$$

85. (b) In angiosperms, one male gamete fuses with the egg resulting in the formation of a diploid zygote. The other male gamete fuses with the two polar nuclei forming the primary endosperm nucleus . Thus type of fertilization is called double fertilization.

86. (a) Double fertilization in a characteristic feature of angiosperms in which one male gamete fuses with egg (called syngamy) and other male gamete fuses with 2 polar nuclei (called triple fusion) to form endosperm.

87. (b) In angiosperms one male gamete fuses with the egg to form diploid zygote. The process is called syngamy. The other male gamete fuses with the two polar nuclei to form triploid primary endosperm nucleus. The process is called triple fusion. These two acts together known as double fertilization. The process was Ist demonstrated by Nawaschin & Guignard in *Fritillaria* & *Lilium*.

88. (d) In angiosperms one male gamete fuses with the egg to form diploid zygote. The process is called syngamy. The other male gamete fuses with the two polar nuclei to form triploid primary endosperm nucleus. The process is called triple fusion. These two acts together known as double fertilization. The process was Ist demonstrated by Nawaschin & Guignard in *Fritillaria* & *Lilium*.

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89. (c) Micropyle of seed performs the function of absorbing water during germination.

90. (d) Post-fertilisation is a series of events that takes place after fertilisation. Following are the post-fertilisation changes in flowering plants:
- Ovule → Seed
- Ovary → Fruit
- Zygote → Embryo
- Central cell → Endosperm

91. (b) In some seeds like black pepper and beet, the ramnents of nucellus are persistant, this persistant nucellus is called perisperm. It is present in the seeds in the form of a layer of nutritive tissue

92. (b) The first cell of female gametophytic generation in angiosperm is megaspore. It undergoes three successive mitotic division to form 8-nucleated and 7-celled embryo sac.

93. (d) Exalbuminous (non-endospermic) seeds usually store reserve food material in cotyledons. in these seeds, the endosperm is used up and not present in mature seeds, *e.g.*, bean, gram and pea.
94. (b) Perisperm is remnants of nucellus which is diploid (2n) but endosperm is triploid (3n). Perisperm occurs in the seeds of Black pepper, coffee, castor, cardamum, *Nymphaea.* Endosperm is the food laden tissue which is meant for nourishing the embryo in seed plants. In angiosperms the endosperm is formed as a result of vegetative fertilization, triple fusion or fusion of a male gamete with diploid secondary nucleus of the central cell.
95. (a) The seed coat develops from integuments originally surrounding the ovule. It is thick and hard in coconut which protect the embryo from mechanical injury and from drying out.
96. (c) Dehydrogenase enzymes present in living tissue reduce the tetrazolium chloride to formazan, a reddish, water insoluble compound. This reaction occurs in or near living cells which are releasing hydrogen in respiration processes. Viable tissues produce a normal red-colour, weak living tissue produce an abnormal colour. Dead tissues do not stain, remaining usually white.
97. (b) Endosperm is the nutritive tissue which provides nourishment to the embryo in seed plant. Albuminous seeds retain a part of endosperm as it is not completely used up during embryo development (*e.g.*, wheat, maize, barley, castor, sunflower).
98. (c) Somatic embryogenesis is a process where a plant or embryo is derived from a single somatic cell or group of somatic cells. Somatic embryos are formed from plant cells that are not normally involved in the development of embryos, *i.e.*, ordinary plant tissue. No endosperm or seed coat is formed around a somatic embryo.
99. (a) Some fleshy fruits such as mango, plum etc. usually have a single hard stone that encloses a seed, called drupe.
100. (b) Apomixis is an asexual type of reproduction in which the plant embryos grow from egg cells without being fertilized by pollen-the male part of the plant. In citrus, apomictic embryos arise from maternal sporophytic tissue like nucellus and integuments in ovule. This type of embryony is called adventive embryony.
101. (a) Scutellum is the modified cotyledon observed in a grain of wheat or maize. It lies between embryo and the endosperm.
102. (b) The fig *(Syconus)* is an aggregate fruit, consisting of numerous seed-like pericarps inclosed within a hollow, fleshy receptacle where the flowers were attached. This fruit developed from hypanthodium inflorescence.
103. (d) Cotyledons and testa respectively are edible parts in groundnut and pomegranate. A cotyledon is a significant part of the embryo within the seed of a plant. Upon germination, the cotyledon may become the embryonic first leaves of a seedling. Testa is often thick or hard outer coat of a seed.
104. (c) An example of a seed with endosperm, perisperm, and caruncle is castor. Castor seed is the source of castor oil, which has a wide variety of uses. The seeds contain between 40% and 60% oil that is rich in triglycerides.
105. (c) In pea, endosperm is consumed by developing embryo in the seed. The endosperm is completely absorbed by the growing embryo and the food reserve gets stored in the cotyledons. Such seeds are called non endospermic or exalbuminous.
106. (b) Dry indehiscent single-seeded fruit formed from bicarpellary syncarpous inferior ovary is cypsela. Cypsela is also called inferior, false or pseudocarpic achene, the thin fruit wall (developed from pericarp and thalamus) is attached to the seed at one point but the fruits develops from an inferior, unilocular and uniovuled ovary, *e.g.*, sunflower, marigold. Some cypsela develop pappus for dispersal e.g. Soncus, *Taraxacum.*
107. (a) The fleshy receptacle of syconus of *fig* encloses a number of Achenes. Achene is the thin dry pericarp is free from seed except at one point. The fruit develops from a monocarpellary pistil having superior unilocular and ovuled ovary.

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108. (a) The fruit of pomegranate is chambered, developed from inferior ovary and has seeds with succulent testa. The fruit is Balausta. It is a special type of false or pseudocarpic berry in which the syncarpous pistil consists of two rows of fused carpels, one above the other.
109. (a) Cycads is a group of gymnosperms which have top shaped multiciliated male gametes and each mature seed of these plants contain one embryo and two cotyledons e.g., *Cycas*.
110. (d) Vivipary is the condition when seeds germinate on the plant. It is an undesirable character for annual crop plants because germinated seeds cannot be stored under normal conditions for the next season.
111. (a) The embryos arising from the maternal sporophyte tissues are called adventive embryos. In polyembryonate species the adventive embryo arises by the proliferation of the nucellus cells.
112. (b) Embryology is the study of an individual's life cycle after the fertilization takes place and till it develops into a new organism.
113. (c) In seeds developing from bitegmic ovules the seed coat has two layers outer testa and inner tegmen. Testa develops from outer integument whereas tegmen develops from inner integument.
114. (d) It is involved in apomixis (asexual reproduction).
115. (c) Monosporic embryo sac (also known as polygonum type embryo sac) is the most common type of embryo sac in flowering plants which develops after one meiosis and three sequential mitosis in megaspore mother cell.

    In most angiosperms, the megaspore mother cell divides by meiosis to form four haploid megaspores arranged in a linear fashion. The three haploid megaspores situated towards the micropyle degenerate, while one remains functional which develops into the female gametophyte.
116. (a) Nucellar polyembryony is reported in a *Citrus* species.
117. (b) The development of fruit without fertilization is called parthenocarpy. Parthenocarpy is induced to produce seedless variety of fruits. And since in pomegranate seeds form edible part, it will loose its importance if parthenocarpy is induced.
118. (a) Polyembryony refers to the formation of more than one embryo within a seed of a flowering plant. e.g. Citrus.
119. (d) Development of an organism from unfertilized egg is known as parthenogenesis and when a fruit is developed by this technique it is called parthenocarpy.

NOTES

The phenomenon of parthenogenesis was discovered in the 18th cent. by Charles Bonnet.

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120. (d) Substitution of usual sexual reproduction by a form of reproduction which does not include meiosis and syngamy is called apomixis. In this phenomenon embryo is developed by some other tissue without fertilization eg. nucellus or integuments or unfertilized egg. Nucellus is a diploid tissue so nucellar embryo is apomictic diploid.
121. (a) A somatic cell in the nucellus directly forms an unreduced embryo sac and the diploid egg parthenogenetically develops into embryo i.e. formation of gametophyte from sporophyte without meiosis. It is known as Apospory and it is a type of Apomixis.

25 Human Reproduction

Trend Analysis with Important Topics & Sub-Topics

		2020		2019		2018		2017		2016	
Topic	**Sub-Topics**	**Qns.**	**LOD**	**Qns.**	**LOD**	**Qns.**	**LOD**	**Qns.**	**LOD**	**Qns.**	**LOD**
The Male Reproductive System	Capacitation							1	E		
Gametogenesis/ Menstrual cycle/ Fertilisation and Implantation	Fertilisation	1	D			1	E			1	A
	Menstrual Cycle	1	A			1	D			1	A
	Oogenesis			1	A						
	Spermatogenesis			1	D	1	D				
Pregnancy and Embryonic Development/ Parturition and Lactation	Preganancy hormone					1	D				

LOD - Level of Difficulty | E - Easy | A - Average | D - Difficult | Qns - No. of Questions

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Topic 1: The Male Reproductive System

1. Capacitation occurs in: *[2017]*
   (a) Epididymis
   (b) Vas deferens
   (c) Female reproductive tract
   (d) Rete testic
2. Capacitation refers to changes in the: *[2015 RS]*
   (a) Ovum before fertilization
   (b) Ovum after fertilization
   (c) Sperm after fertilization
   (d) Sperm before fertilization
3. The shared terminal duct of the reproductive and urinary system in the human male is: *[2014]*
   (a) Urethra (b) Ureter
   (c) Vas deferens (d) Vasa efferentia
4. The Leydig cells found in the human body are the secretory source of *[2012]*
   (a) Progesterone (b) intestinal mucus
   (c) glucagon (d) androgens
5. If for some reason, the vasa efferentia in the human reproductive system gets blocked, the gametes will not be transported from *[2011]*
   (a) testes to epididymis
   (b) epididymis to vas deferens
   (c) ovary to uterus
   (d) vagina to uterus
6. The testes in humans are situated outside the abdominal cavity insides pouch called scrotum. The purpose served is for *[2011]*
   (a) maintaining the scrotal temperature lower than the internal body temperature
   (b) escaping any possible compression by the visceral organs
   (c) providing more space for the growth of epididymis
   (d) providing a secondary sexual feature for exhibiting the male sex
7. Sertoli cells are found in *[2010]*
   (a) ovaries and secrete progesterone
   (b) adrenal cortex and secrete adrenaline
   (c) seminiferous tubules and provide nutrition to germ cells
   (d) pancreas and secrete cholecystokinin

8. Vasa efferentia are the ductules leading from
   (a) testicular lobules to rete testis *[2010]*
   (b) rete testis to vas deferens
   (c) vas deferens to epididymis
   (d) epididymis to urethra
9. Seminal plasma in human males is rich in :
   (a) fructose and calcium *[2010]*
   (b) glucose and calcium
   (c) DNA and testosterone
   (d) ribose and potassium
10. Seminal plasma in humans is rich in *[2009]*
   (a) fructose and calcium but has no enzymes
   (b) glucose and certain enzymes but has no calcium
   (c) fructose and certain enzymes but poor in calcium
   (d) fructose, calcium and certain enzymes
11. Given below is a diagrammatic sketch of a portion of human male reproductive system. Select the correct set of the names of the parts labelled A, B, C, D. *[2009]*

   (a) vas deferens (a); seminal vesicle (B) prostate (C); bulbourethral gland (D).
   (b) vas deferens (a); seminal vesicle (B) bulbourethral gland (C); prostate (D).
   (c) ureter (a); seminal vesicle (B); prostate (C); bulbourethral gland (D)
   (d) ureter (a); prostate(B); seminal vesicle (C); bulbourethral gland (D).
12. Grey crescent is the area *[2005]*
   (a) at the point of entry of sperm into ovum
   (b) just opposite to the site of entry of sperm into ovum
   (c) at the animal pole
   (d) at the vegetal pole
13. Location and secretion of Leydig's cells are
   (a) Liver – cholesterol *[1991]*
   (b) Ovary – estrogen
   (c) Testes – testosterone
   (d) Pancreas – glucagon
14. What is the correct sequence of sperm formation? *[NEET 2013]*
   (a) Spermatogonia, spermatocyte, spermatozoa, spermatid
   (b) Spermatogonia; spermatozoa, spermatocyte, spermatid
   (c) Spermatogonia, spermatocyte, spermatid, spermatozoa
   (d) Spermatid, spermatocyte, spermatogonia, spermatozoa
15. Which one of the following statements is false in respect of viability of mammalian sperm? *[2012]*
   (a) Sperm is viable for only up to 24 hours.
   (b) Survival of sperm depends on the pH of the medium and is more active in alkaline medium.
   (c) Viability of sperm is determined by its motility.
   (d) Sperms must be concentrated in a thick suspension.
16. Which one of the following statements about human sperm is correct? *[2010]*
   (a) Acrosome has a conical pointed structure used for piercing and penetrating the egg, resulting in fertilisation
   (b) The sperm lysins in the acrosome dissolve the egg envelope facilitating fertilisation
   (c) Acrosome serves as a sensory structure leading the sperm towards the ovum
   (d) Acrosome serves no particular function
17. The correct sequence of spermatogenetic stages leading to the formation of sperms in a mature human testes is: *[2009]*
   (a) spermatogonia - spermatocyte - spermatid-sperms
   (b) spermatid - spermatocyte - spermatogonia - sperms
   (c) spermatogonia - spermatid - spermatocyte - sperms
   (d) spermatocyte - spermatogonia - spermatid - sperms
18. In humans, at the end of the first meiotic division, the male germ cells differentiate into the *[2008]*
   (a) primary spermatocytes
   (b) secondary spermatocytes
   (c) spermatids
   (d) spermatozonia
19. At the end of first meiotic division, male sperm differentiates into *[1994]*
   (a) secondary spermatocyte
   (b) primary spermatocyte
   (c) spermatogonium
   (d) spermatid

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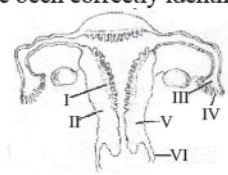
20. Acrosome reaction in sperm is triggered by *[1993]*
    (a) capacitation (b) release of lysin
    (c) influx of Na^+ (d) release of fertilizin
21. Middle piece of mammalian sperm possesses *[1991]*
    (a) mitochondria and centriole
    (b) mitochondria only
    (c) centriole only
    (d) nucleus and mitochondria
22. How many sperms are formed from a secondary spermatocyte? *[1990]*
    (a) 4 (b) 8
    (c) 2 (d) 1

Topic 2: The Female Reproductive System

23. Meiotic division of the secondary oocyte is completed *[2020]*
    (a) At the time of copulation
    (b) After zygote formation
    (c) At the time of fusion of a sperm with an ovum
    (d) Prior to ovulation
24. Extrusion of second polar body from egg nucleus occurs: *[2019]*
    (a) after entry of sperm but before fertilisation
    (b) after fertilisation
    (c) before entry of sperm into ovum
    (d) simultaneously with first cleavage
25. Select the **correct** sequence for transport of sperm cells in male reproductive system *[2019]*
    (a) Testis → Epididymis → Vasa efferentia → Rete testis → Inguinal canal → Urethra
    (b) Seminiferous tubules → Rete testis → Vasa efferentia → Epididymis → Vas deferens → Ejaculatory duct → Urethra → Urethral meatus
    (c) Seminiferous tubules → Vasa efferentia → Epididymis → Inguinal canal → Urethra
    (d) Testis → Epididymis → Vasa efferentia → Vas deferens → Ejaculatory duct → Inguinal canal → Urethra → Urethral meatus
26. Which of the following layers in an antral follicle is acellular ? *[2015 RS]*
    (a) Theca interna (b) Stroma
    (c) Zona pellucida (d) Granulosa
27. The main function of mammalian corpus luteum is to produce: *[2014]*
    (a) estrogen only
    (b) progesterone
    (c) human chorionic gonadotropin
    (d) relaxin only
28. The figure given below depicts a diagrammatic sectional view of the female reproductive system of humans. Which one set of three parts out of I-VI have been correctly identified ? *[2011]*



    (a) (II) Endometrium(III) Infundibulum, (IV) Fimbriae
    (b) (III) Infundibulum, (IV) Fimbriae, (V) Cervix,
    (c) (IV) Oviducal funnel, (V) Uterus, (VI) Cervix
    (d) (I) Perimetrium, (II)Myometrium, (Ill) Fallopian tube
29. The part of fallopian tube closest to the ovary is *[2010]*
    (a) isthmus (b) infundibulum
    (c) cervix (d) ampulla

Topic 3: Gametogenesis/Menstrual cycle Fertilisation and Implantation

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30. Which of the following hormone levels will cause release of ovum (ovulation) from the graffian follicle? *[2020]*
    (a) High concentration of Progesterone
    (b) Low concentration of LH
    (c) Low concentration of FSH
    (d) High concentration of Estrogen
31. Match the following columns and select the correct option. *[2020]*

	Column-I		Column-II
(A)	Placenta	(i)	Androgens
(B)	Zona pellucida	(ii)	Human Chorionic Gonadotropin (hCG)
(C)	Bulbo-urethral glands	(iii)	Layer of the ovum
(D)	Leydig cells	(iv)	Lubrication of the Penis

	(A)	(B)	(C)	(D)
(a)	(i)	(iv)	(ii)	(iii)
(b)	(iii)	(ii)	(iv)	(i)
(c)	(ii)	(iii)	(iv)	(i)
(d)	(iv)	(iii)	(i)	(ii)

32. Select the correct sequence of events. *[2019, Odisa]*
(a) Gametogenesis → Gamete transfer → Syngamy → Zygote → Cell differentiation → Cell division (Cleavage) → Organogenesis.
(b) Gametogenesis → Gamete transfer → Syngamy → Zygote → Cell division (Cleavage) → Cell differentiation → Organogenesis.
(c) Gametogenesis → Gamete transfer → Syngamy → Zygote → Cell division → (Cleavage) → Organogenesis → Cell differentiation.
(d) Gametogenesis → Syngamy → Gamete transfer → Zygote → Cell division (Cleavage) → Cell differentiation → Organogenesis.

33. No new follicles develop in the luteal phase of the menstrual cycle because: *[2019, Odisa]*
(a) Both FSH and LH levels are low in the luteal phase.
(b) Follicles do not remain in the ovary after ovulation.
(c) FSH levels are high in the luteal phase.
(d) LH levels are high in the luteal phase.

34. The difference between spermiogenesis and spermiation is *[208]*
(a) In spermiogenesis spermatids are formed, while in spermiation spermatozoa are formed.
(b) In spermiogenesis spermatozoa are formed, while in spermiation spermatids are formed.
(c) In spermiogenesis spermatozoa are formed, while in spermiation spermatozoa are released from sertoli cells into the cavity of seminiferous tubules.
(d) In spermiogenesis spermatozoa from sertoli cells are released into the cavity of seminiferous tubules, while in spermiation spermatozoa are formed.

35. Match the items given in Column I with those in Column II and select the correct option given below : *[2018]*

	Column I		Column II
A.	Proliferative Phase	i.	Breakdown of endometrial lining
B.	Secretory Phase	ii.	Follicular Phase
C.	Menstruation	iii.	Luteal Phase

	A	B	C
(a)	iii	ii	i
(b)	i	iii	ii
(c)	iii	i	ii
(d)	ii	iii	i

36. Fertilization in humans is practically feasible only if *[2016]*
(a) the sperms are transported into vagina just after the release of ovum in fallopian tube
(b) the ovum and sperms are transported simultaneously to ampullary isthmic junction of the fallopian tube
(c) the ovum and sperms are transported simultaneously to ampullary - isthmic junction of the cervix
(d) the sperms are transported into cervix within 48 hrs of release of ovum in uterus

37. Select the incorrect statement : *[2016]*
(a) FSH stimulates the sertoli cells which help in spermiogenesis
(b) LH triggers ovulation in ovary
(c) LH and FSH decrease gradually during the follicular phase
(d) LH triggers secretion of androgens from the Leydig cells

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38. Which of the following cells during gametogenesis is normally diploid? *[2015 RS]*
(a) Spermatid
(b) Spermatogonia
(c) Secondary polar body
(d) Primary polar body

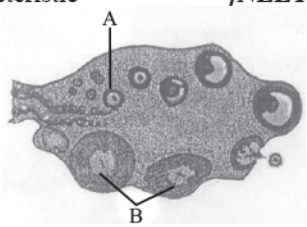
39. Which of the following events is not associated with ovulation in human female? *[2015 RS]*
(a) Full development of Graffin follicle
(b) Release of secondary oocyte
(c) LH surge
(d) Decrease in estradiol

40. In human females, meiosis-II is not complete until? *[2015 RS]*
(a) fertilization (b) uterine implantation
(c) birth (d) puberty

41. Select the correct option describing gonadotropin activity in a normal pregnant female: *[2014]*
(a) High level of FSH and LH stimulates the thickening of endometrium.
(b) High level of FSH and LH facilitate implantation of the embryo.
(c) High level of hCG stimulates the synthesis of estrogen and progesterone.
(d) High level of hCG stimulates the thickening of endometrium.

42. Menstrual flow occurs due to lack of : ***[NEET 2013]***
(a) FSH (b) Oxytocin
(c) Vasopressin (d) Progesterone

43. The figure shows a section of human ovary. Select the option which gives the correct identification of A and B with function/ characteristic ***[NEET Kar. 2013]***



(a) A – Primary oocyte – it is the prophase – I of the meiotic division
(b) B – Corpus luteum – secretes progesterone
(c) A – Tertiary follicle – forms Graafian follicle
(d) B – Corpus luteum – secretes estrogen

44. In a normal pregnant woman, the amount of total gonadotropin activity was assessed. The result expected was ***[2012]***
(a) High level of circulating FSH and LH in the uterus to stimulate implantation of the embyro
(b) High level of circulating HCG to stimulate endometrial thickening
(c) High level of FSH and LH in uterus to stimulate endometrical thickening
(d) High level of circulating HCG to stimulate estrogen and progesterone synthesis

45. The secretory phase in the human menstrual cycle is also called ***[2012M]***
(a) luteal phase and lasts for about 6 days
(b) follicular phase lasting for about 6 days
(c) luteal phase and lasts for about 13 days
(d) follicular phase and lasts for about 13 days.

46. What happens during fertilisation in humans after many sperms reach close to the ovum? ***[2011M]***
(a) Secretions of acrosome helps one sperm enter cytoplasm of ovum through zona pellucida
(b) All sperms except the one nearest to the ovum lose their tails
(c) Cells of corona radiata trap all the sperms except one
(d) Only two sperms nearest the ovum penetrate zona pellucida

47. About which day in a normal human menstrual cycle does rapid secretion of LH (Popularly called LH-surge) normally occurs? ***[2011M]***
(a) 14th day (b) 20th day
(c) 5th day (d) 11th day

48. The second maturation division of the mammalian ovum occurs ***[2010]***
(a) shortly after ovulation before the ovum makes entry into the fallopian tube
(b) until after the ovum has been penetrated by a sperm
(c) until the nucleus of the sperm has fused with that of the ovum
(d) in the graafian follicle following the first maturation division

49. Which one of the following is the correct matching of the events occurring during menstrual cycle? ***[2009]***
(a) Proliferative phase: Rapid regeneration of myometrium and maturation of Graffian follicle.
(b) Development of corpus luteum : Secretory phase and increased secretion of progesterone.
(c) Menstruation: Breakdown of myometrium and ovum not fertilised.
(d) Ovulation: LH and FSH attain peak level and sharp fall in the secretion of progesterone.

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50. Which one of the following is the most likely root cause why menstruation is not taking place in regularly cycling human female? ***[2009]***
(a) maintenance of the hypertrophical endometrial lining
(b) maintenance of high concentration of sex hormones in the blood stream
(c) retention of well -developed corpus luteum
(d) fertilisation of the ovum

51. Which one of the following statements is incorrect about menstruation? ***[2008]***
(a) During normal menstruation about 40 ml blood is lost
(b) The menstrual fluid can easily clot
(c) At menopause in the female, there is especially abrupt increase in gonadotropic hormones
(d) The beginning of the cycle of menstruation is called menarche

52. In the human female, menstruation can be deferred by the administration of ***[2007]***
(a) combination of FSH and LH
(b) combination of estrogen and progesterone
(c) FSH only
(d) LH only

53. Withdrawal of which of the following hormones is the immediate cause of menstruation? *[2006]*
(a) FSH (b) FSH-RH
(c) Progesterone (d) Estrogen

54. If mammalian ovum fails to get fertilized, which one of the following is unlikely? *[2005]*
(a) Corpus luteum will disintegrate
(b) Progesterone secretion rapidly declines
(c) Estrogen secretion further decreases
(d) Primary follicle starts developing

55. After ovulation the collapsed ovarian follicle shrinks and becomes filled with cell to form *[1999]*
(a) corpus luteum (b) corpus albicans
(c) corpus atresia (d) corpus adiposum

56. The growth of corpus luteum is initiated by
(a) Human chorionic gonadotropin *[1999]*
(b) Follicle stimulating hormone
(c) Luteinizing hormone
(d) Prolactin

57. In 28 day human ovarian cycle, ovulation occurs on *[1994, 1997]*
(a) Day 1 (b) Day 5
(c) Day 14 (d) Day 28

58. Fertilizins are emitted by *[1991, 1997]*
(a) immature eggs (b) mature eggs
(c) sperms (d) polar bodies

59. The estrous cycle is a characteristic of *[1995]*
(a) human males only
(b) human females only
(c) mammalian males other than primates
(d) mammalian females other than primates

60. Extrusion of second polar body from egg nucleus occurs *[1993]*
(a) after entry of sperm before completion of fertilization
(b) after completion of fertilization
(c) before entry of sperm
(d) without any relation of sperm entry

61. Freshly released human egg has *[1991]*
(a) one Y-chromosome
(b) one X-chromosome
(c) two X-chromosomes
(d) one X-chromosome & one Y-chromosome

62. Sperm and egg nuclei fuse due to *[1990]*
(a) base pairing of their DNA and RNA
(b) formation of hydrogen bonds
(c) mutual attraction
(d) attraction of their protoplasts

63. Human eggs are *[1989]*
(a) Alecithal (b) Microlecithal
(c) Mesolecithal (d) Macrolecithal

64. Egg is liberated from ovary in *[1989]*
(a) secondary oocyte stage
(b) primary oocyte stage
(c) oogonial stage
(d) mature ovum stage

Topic 4: Pregnancy and Embryonic Development/Parturition and Lactation

65. Which of the following hormones is responsible for both the milk ejection reflex and the foetal ejection reflex? *[2019, Odisa]*
(a) Relaxin (b) Oestrogen
(c) Prolactin (d) Oxytocin

66. The amnion of mammalian embryo is derived from *[2018]*
(a) ectoderm and mesoderm
(b) endoderm and mesoderm
(c) ectoderm and endoderm
(d) mesoderm and trophoblast

67. Hormones secreted by the placenta to maintain pregnancy are *[2018]*
(a) hCG, hPL, progestogens, prolactin
(b) hCG, hPL, estrogens, relaxin, oxytocin
(c) hCG, progestogens, estrogens, glucocorticoids
(d) hCG, hPL, progestogens, estrogens

68. Which of these is not an important component of initiation of parturition in humans? *[2015 RS]*
(a) Synthesis of prostaglandins
(b) Release of oxytocin
(c) Release of prolactin
(d) Increase in estrogen and progesterone ratio

69. Which one of the following is not the function of placenta? It : *[NEET 2013]*
(a) secretes estrogen
(b) facilitates removal of carbon dioxide and waste material from embryo.
(c) secretes oxytocin during parturition
(d) facilitates supply of oxygen and nutrients to embyo

70. The foetal ejection reflex in humans triggers release of *[NEET Kar. 2013]*
(a) Oxytocin from maternal pituitary
(b) Oxytocin from foetal pituitary
(c) Human Chorionic Gonadotropin (hCG) from placenta
(d) Human Placental Lactogen (hPL) from placenta

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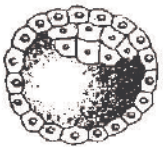
71. Signals for parturition originate from : ***[2012]***
(a) Both placenta as well as fully developed foetus
(b) Oxytocin released from maternal pituitary
(c) Placenta only
(d) Fully developed foetus only

72. Identify the human developmental stage shown below as well as the related right place of its occurrence in a normal pregnant woman, and select the right option for the two together. ***[2012M]***



	Developmental stage	Site of occurrence
(a)	Late morula	Middle part of fallopian tube
(b)	Blastula	End part of fallopian tube
(c)	Blastocyst	Uterine wall
(d)	8 celled morula	Starting point of fallopian tube

73. In vitro fertilisation is a technique that involves transfer of which one of the following into the fallopian tube? ***[2010]***
(a) Embryo only, upto 8 cell stage
(b) Either zygote or early embryo upto 8 cell stage
(c) Embryo of 32 cell stage
(d) Zygote only

74. The signals for parturition originate from ***[2010]***
(a) placenta only
(b) placenta as well as fully developed foetus
(c) oxytocin released from maternal pituitary
(d) fully developed foetus only

75. The first movements of the foetus and appearance of hair on its head are usually observed during which month of pregnancy? ***[2010]***
(a) Fourth month (b) Fifth month
(c) Sixth month (d) Third month

76. Which one of the following statements about morula in humans is correct? ***[2010]***
(a) It has almost equal quantity of cytoplasm as an uncleaved zygote but much more DNA
(b) It has far less cytoplasm as well as less DNA than in an uncleaved zygote
(c) It has more or less equal quantity of cytoplasm and DNA as in uncleaved zygote
(d) It has more cytoplasm and more DNA than an uncleaved zygote

77. Foetal ejection reflex in human female is induced by ***[2009]***
(a) release oxytocin from pituitary
(b) fully developed foetus and placenta
(c) differentiation of mammary glands
(d) pressure exerted by amniotic fluid

78. A change in the amount of yolk and its distribution in the egg will affect ***[2009]***
(a) pattern of cleavage
(b) number of blastomeres produced
(c) fertilization
(d) formation of zygote

79. Which extra-embryonic membrane in humans prevents desiccation of the embryo inside the uterus? ***[2008]***
(a) Chorion (b) Allantois
(c) Yolk sac (d) Amnion

80. During embryonic development, the establishment of polarity along anterior/posterior, dorsal/ventral or medial/lateral axis is called ***[2003]***
(a) pattern formation
(b) organizer phenomena
(c) axis formation
(d) anamorphosis

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81. Cleavage in mammalian egg is ***[2000]***
(a) superficial meroblastic
(b) discoidal meroblastic
(c) unequal holoblastic
(d) equal holoblastic

82. Extra-embryonic membranes of the mammalian embryo are derived from ***[1994]***
(a) inner cell mass (b) trophoblast
(c) formative cells (d) follicle cells

83. Gonads develop from embryonic ***[1990]***
(a) ectoderm
(b) endoderm
(c) mesoderm
(d) both mesoderm and endoderm

84. The correct sequence in the process of development of human embryo is ***[1998]***
(a) fertilisation—zygote—cleavage—morula—blastula—gastrula
(b) fertilisation—cleavage—morula—zygote—blastula—gastrula
(c) fertilisation—zygote—blastula—morula—cleavage—gastrula
(d) cleavage—zygote—fertilisation—morula—blastula—gastrula

85. What is true about cleavage in fertilized egg of humans? *[1994]*
(a) Meroblastic
(b) Starts when egg reaches uterus
(c) Starts in fallopian tube
(d) It is identical to normal mitosis

86. Termination of gastrulation is indicated by *[1993]*
(a) obliteration of blastocoel
(b) obliteration of archenteron
(c) closure of blastopore
(d) closure of neural tube

87. In telolecithal egg the yolk is found *[1993]*
(a) all over the egg (b) on one side
(c) both the sides (d) centre

88. Amount of yolk and its distribution are changed in the egg. Which one is affected? *[1993]*
(a) Pattern of cleavage
(b) Formation of zygote
(c) Number of blastomeres
(d) Fertilisation

89. Meroblastic cleavage is division *[1992]*
(a) horizontal (b) partial/parietal
(c) total (d) spiral

90. Blastopore is *[1992]*
(a) opening of neural tube
(b) opening of gastrocoel
(c) future anterior end of embryo
(d) found in blastula

91. During cleavage, what is true about cells? *[1991]*
(a) Nucleocytoplasmic ratio remains unchanged
(b) Size does not increase
(c) There is less consumption of oxygen
(d) The division is like meiosis

ANSWER KEY

1	(c)	11	(a)	21	(a)	31	(c)	41	(c)	51	(b)	61	(b)	71	(a)	81	(c)	91	(b)
2	(d)	12	(b)	22	(c)	32	(b)	42	(d)	52	(b)	62	(d)	72	(c)	82	(b)		
3	(a)	13	(c)	23	(c)	33	(a)	43	(b)	53	(c)	63	(a)	73	(a)	83	(c)		
4	(d)	14	(c)	24	(a)	34	(c)	44	(d)	54	(c)	64	(a)	74	(b)	84	(a)		
5	(a)	15	(a)	25	(b)	35	(d)	45	(c)	55	(a)	65	(d)	75	(b)	85	(c)		
6	(a)	16	(b)	26	(c)	36	(b)	46	(a)	56	(c)	66	(a)	76	(a)	86	(a)		
7	(c)	17	(a)	27	(a)	37	(c)	47	(a)	57	(c)	67	(d)	77	(b)	87	(b)		
8	(b)	18	(b)	28	(b)	38	(d)	48	(b)	58	(b)	68	(c)	78	(a)	88	(a)		
9	(a)	19	(a)	29	(b)	39	(d)	49	(b)	59	(d)	69	(c)	79	(d)	89	(b)		
10	(d)	20	(d)	30	(d)	40	(a)	50	(d)	60	(a)	70	(a)	80	(b)	90	(b)		

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Hints & Solutions

1. (c) Capacitation is increase in fertilising capacity of sperms which occurs in female reproductive tract. It is required to render sperm to fertilize an oocyte.

2. (d) Capacitation and acrosomal reaction occur before fertilization. The process of capacitation happens when sperms enter vagina. During this period, cholesterol vesicles are removed from the acrosome.

3. (a) Urethra is a tube that connects the urinary bladder to the genitals for the removal of fluids from the body. The urethra travels through the penis, and carries semen as well as urine.

4. (d) Leydig cells found in testis is the endocrine portion of the testis which are present in between seminiferous tubules secretes androgens or male sex hormone *e.g.* testosterone.

NOTES Sperm capacitation refers to the physiological changes spermatozoa must undergo in order to have the ability to penetrate and fertilize an egg.

5. (a) If the vasa efferentia in the human reproductive system get blocked the gametes will not be transformed from testes to epididymis.

NOTES

The seminal vesicles produce a viscous, fructose-rich fluid forming around 65-70% of the semen base. The white color of the semen is due to secretion from the prostate glands containing enzymes, citric acid, lipids, and acid phosphatase. This forms around 25-30% of the semen base. At each ejaculation around 200-500 million sperms are released by the testes. This forms about 2-5% of the semen composition.

6. (a) The testes are present in the scrotum which maintains the scrotal temperature below 2°C of the internal body temperature.
7. (c) Sertoli cells are found in the walls of seminiferous tubules of the testes. They anchor and provide nutrition to the developing germ cells especially the spermatids.

NOTES

Vasa efferentia helps in the transportation of sperms from rete testis to the epididymis (a tube that connects a testicle to a vas deferens) by contraction of smooth muscle. It also plays an essential role in the reabsorption of luminal fluid, which leads to the increase of the concentration of sperm as they enter the epididymis.

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8. (b) Vasa efferentia are ductuless leading from rete testis to vas deferens. The rete testis is an anastomosing network of tubules located in the hilum of the testicles that carries sperm from the seminiferous tubules to the vasa efferentia.

NOTES

The temperature of the testes is regulated by the scrotum (which expands and contracts to facilitate heat transfer) and heat exchange between blood flowing into the testes via the arteries in the spermatic cord, and that flowing out of the testes via the veins in the spermatic cord. This results in the pre-cooling of blood entering the testes, although the pre-cooling mechanism can only regulate testicular temperature to an extent. In situations of extreme heat, the scrotum's natural cooling mechanism is insufficient to prevent a rise in testicular temperature. The increased testicular temperature may affect both the quality and quantity of the sperm.

9. (a) Seminal plasma in human males are rich in fructose, calcium and certain enzymes. They provide a medium for transport of sperms, nourishes and activates sperms.
10. (d) Human seminal plasma is a complex mixture of proteins, glycoproteins, peptides, glycopeptides, and prostaglandins secreted by organs of the male reproductive tract. The components of this fluid have been implicated in the suppression of immune response, agonistic effects on sperm-egg binding, and promotion of successful implantation of the human embryo. Seminal plasma in humans is rich in fructose, calcium and certain enzymes.
11. (a) The human male reproductive system consists of a number of sex organs that are a part of the human reproductive process. In diagram of male reproductive system of human, the point indicated by A,B,C,D are vas deferens, seminal vesicle, prostate and bulbourethral gland.
12. (b) On the surface of the egg opposite to the point of sperm entry, the peripheral area of the egg becomes lighter in colour and assumes a grey appearance. This area is crescentric in shape and is known as the grey crescent.
13. (c) Interstitial cells = Leydig's cells are present in testes and secrete male hormone testosterone.
14. (c) In testis, the immature male germ cells or spermatogonia (2n) multiply by mitotic division and increase in number. Some spermatogonia (2n) known as primary spermatocytes divide by meiotic division to form secondary spermatocytes (n). The secondary spermatocytes undergo second meiotic division to produce spermatid which are transformed into spermatozoa (sperms) by the process called spermiogenesis.
15. (a) Sperm is viable for 2-3 days.
16. (b) Acrosome a small pointed structure at the tip of nucleus. It breaks down just before fertilization, releasing hydrolytic enzymes that assist penetration between follicle cells that surrounds the ovum, thus facilitating fertilization.
17. (a) The formation of sperms in mature human testes completed in three important phases in gametogenesis- multiplication, growth and maturation phase. During these phases primarily germ cells change into spermatogonia then spermatocyte during growth phase which change into spermatoids and spermatids into sperms.

NOTES

Spermatogenesis takes approximately 74 days for the formation of mature sperm.

18. (b) In human, at the end of the first meiotic division, the male germ cells differentrate into the secondary spermatocyte.
19. (a) After first meiotic division primary spermatocyte (diploid) gives rise to two secondary spermatocytes (haploid).
20. (d) Egg secretes fertilizin due to which acrosome of sperm secretes antifertilizin and due to their reaction sperm adheres to egg. The acrosome reaction is the reaction which occurs in the *acrosome* of the *sperm* as it approaches the *zona pellucida*. In mammals the acrosome reaction releases *hyaluronidase* and *acrosin*; their role in fertilization is not yet clear. It also alters a patch of pre-existing sperm *plasma membrane* so that it can fuse with the egg *plasma membrane*.
21. (a) Sperm has : (i) head in which acrosome & nucleus are present
    (ii) middle piece in which it contains many mitochondria
    (iii) A long & highly motile tail.
    (A short neck is also present between middle piece & head which has centrioles and may sometimes regarded as a part of middle piece)
22. (c) Primary spermatocyte (46) divides through meiosis to give two secondary spermatocytes (23). Each secondary spermatocyte divides through mitosis giving rise to two spermatids (23) which on spermeogenesis mature as sperms.
23. (c) Meiotic division of secondary oocyte is completed after the entry of sperm in secondary oocyte which lead to the formation of a large ovum and a tiny 2nd polar body.
24. **(a)** Extrusion of second polar body from egg nucleus occurs after entry of sperm into the secondary oocyte but before fertilisation. The entry of sperm into the ovum induces completion of the meiotic division of the secondary oocyte. Entry of sperm causes breakdown of metaphase promoting factor (MPF) and turns on anaphase promoting complex (APC).

NOTES

During gametogenesis, one cell becomes the secondary oocyte the other cell forms the first polar body. The secondary oocyte then commences meiosis 2 which arrests at metaphase and will not continue without fertilization. At fertilization meiosis 2 completes, forming a second polar body.

25. **(b)** The correct sequence for transport of sperm cells in male reproductive system is:
    Seminiferous tubules → Rete testis → Vasa efferentia→ Epididymis →Vas deferens →Ejaculatory duct → Urethra → Urethral meatus
26. (c) Zona pellucida is formed as a new membrane by secondary oocyte around itself.
27. (a) The corpus luteum is a temporary endocrine structure involved in ovulation and early pregnancy. The main secretory product of corpus luteum is progesterone, which is required for the establishment and maintenance of pregnancy.
28. (b) In the given figure
    III - marked portion is Infundibulum
    IV - marked portion is Fimbriae
    V - marked portion is Cervix
29. (b) The part of fallopian tube closest to the ovary is infundibulum. Infundibulum possess finger-like projections called fimbriae that help in collection of ovum after ovulation. It leads to wider part of oviduct called ampulla. The last part of oviduct is isthmus that has a narrow lumen and joins the uterus.

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30. (d) The gonadotropin (LH and FSH) increases gradually during the follicular phase, and stimulates follicular development as well as secretion of estrogens by the growing follicles. Both LH and FSH attain a peak level in the middle of cycle (about 14th day). Rapid secretion of LH leading to its maximum level during the mid-cycle called LH surge induces rupture of Graafian follicle and thereby the release of ovum (ovulation).
31. (c) The correct option is (c) because placenta secretes human chorionic gonadotropin (hCG). Zona pellucida is a primary egg membrane secreted by the secondary oocyte. The secretions of bulbourethral glands help in lubrication of the penis Leydig cells synthesise and secrete testicular hormones called androgens.

NOTES

The bulbourethral glands (also known as Cowper's glands) are a pair of pea shaped exocrine glands located posterolateral to the membranous urethra. They contribute to the final volume of semen by producing a lubricating mucus secretion.

32. (b) The correct sequence of the events are as follows.
Gametogenesis → Gamete transfer → Syngamy → Zygote Cell division (Cleavage) → Cell differentiation → Organogenesis
Gametogenesis is the formation of gametes (sperm and ovum) through spermatogenesis and oogenesis respectively.
Gamete transfer is the process of bringing together of male and female gamete for fertilisation.
Syngamy is fusion of gametes and leading to formation of zygote.
Cleavage is the repeated (mitotic) cell division.
Cell differentiation refers to specialisation of cell to perform specific function.
Organogenesis is the formation of organs.

33. (a) Ovulation is followed by the luteal phase during which the corpus luteum secretes oestrogen and progesterone hormones that exerts negative feedback on hypothalamus which in turn inhibits the release of FSH and LH. This prevents the development of new follicles during the luteal phase.

34. (c) Spermiogenesis is conversion of spermatids into spermatozoa whereas spermiation is the release of the sperms from sertoli cells into the cavity of seminiferous tubule.

35. (d) In proliferative phase, the follicles start developing, called follicular phase. Secretory phase is also called as luteal phase mainly controlled by progesterone secreted by corpus luteum. Menstruation involves breakdown of overgrown endometrial lining.

36. (b) The word ampulla is derived from the Latin word 'flask'. Being the second portion of the fallopian tube, it is the intermediate dilated portion which immediately curves over the ovary. This is the common site of human fertilization as both the ovum and sperms are simultaneously transported here.

37. (c) Ovulation is the process of the monthly release of the viable oocyte from the ovary between the time of menarche and menopause. During this time, there is a surge in the production of LH and FSH, termed as gonadotropins, thereby initiating estradiol and progesterone secretion from the ovary. Both the hormones are play an important in the menstrual cycle.

38. (d) Spermatogonium (spermatogonia) is diploid and contains 46 chromosomes. Some of the spermatogonia called primary spermatocytes periodically undergo meiosis and a primary spermatocyte complete the first meiotic division (reduction division) that leads to the formation of two equal, haploid cells called secondary spermatocytes that have only 23 chromosomes.

39. (d) Ovulation takes place in the middle of cycle (about 14th day) and during this phase increases in the levels of oestrogen hormone triggers the rapid secretion of LH from pituitary gland leading to its maximum level during the mid-cycle called LH surge that induces the rupture of Graafian follicle and release of ovum (ovulation).

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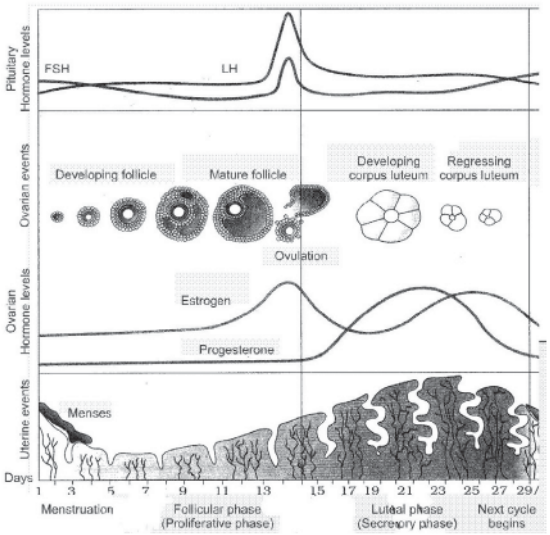
40. (a) Meiosis-II does not complete untill fertilization occurs in human females.

41. (c) Synthesis of estrogen and progesterone due to high level of hCG is a normal gonadotropic activity in a normal pregnant female.

42. (d)



During menstrual or bleeding phase which comprises of 3 - 5 days out of 28 days menstrual cycle, the production of LH from the anterior lobe of the pituitary gland is considerably reduced . The withdrawal of this hormone causes degeneration of corpus luteum and therefore, progesterone production is reduced. Production of estrogens is also reduced in this phase.

43. (b) The corpus luteum is a temporary endocrine structure in female mammals that is involved in the production of relatively high levels of progesterone. A marked in the figure shows primary follicle, a layer of granulosa cells, surrounds each primary oocyte. A large number of these follicles degenerate during the phase from birth to puberty.

44. (d) Pregnancy can be confirmed by detecting the presence of human chorionic gonadotropin (HCG) in blood or urine of pregnant woman. HCG is a hormone produced by the placenta after implantation. HCG plays an essential role in maintenance of corpus luteum and allows the secretion of the progesterone and estrogen hormone. Progesterone enriches the uterus with a thick lining of blood vessels and capillaries so that it can sustain the growing foetus.

NOTES

The placenta is fully formed by 18 to 20 weeks but continues to grow throughout pregnancy. At the time of delivery, it weighs about 1 pound.

45. (c) The menstrual cycle is the scientific term for the physiological changes that can occur in fertile women for the purposes of sexual reproduction and fertilization. The secretory phase in the human menstrual cycle is also called luteal phase and lasts for about 13 days. During secretory phase, the endometrium prepares for the implantation of an embryo and the corpus luteum is active and secretes progesterone hormone.

NOTES

A corpus luteum is a mass of cells that forms in an ovary and is responsible for the production of the hormone progesterone during early pregnancy. The role of the corpus luteum depends on whether or not fertilization occurs.

46. (a) During fertilisation in humans, many sperms reach close to the ovum. As sperm comes in contact with the zona pellucida layer of the ovum it induces changes in the membrane that blocks the entry of additional sperm. The secretions of acrosome helps one sperm enter cytoplasm of ovum through zona pellucida.

NOTES

The zona pellucida supports communication between oocytes and follicle cells during oogenesis protects oocytes, eggs, and embryos during development, and regulates interactions between ovulated eggs and free-swimming sperm during and following fertilization.

47. (a) At 14th day of normal human menstrual cycle rapid secretion of LH normally occurs.

48. (b) In Oogenesis, the second maturation division occurs until after the ovum has been penetrated by a sperm. Oogenesis involves the formation of haploid female gametes, ova from diploid egg mother cells, oogonia of ovary of female organism.

49. (b) The corpus luteum is essential for establishing and maintaining pregnancy in females. In the ovary, the corpus luteum secretes estrogens and progesterone, which are steroid hormones responsible for the thickening of the endometrium and its development and maintenance, respectively.

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NOTES

The endometrium changes throughout the menstrual cycle in response to hormones. During the first part of the cycle, the hormone estrogen is made by the ovaries. Estrogens hormone causes the lining of the endometrium to grow and thicken to prepare the uterus for pregnancy.

50. (d) Fertilization of ovum is the most likely root cause of when menstruation is not taking place in regularly cycling human female. In order for fertilization to occur, one of these sperm must attach itself to the ovum and penetrate its outer surface. The fertilized ovum will then continue travelling down the fallopian tube, taking several days until it reaches the uterus. When it arrives, it attaches itself to the lining of the uterus and continues to grow. If the ovum is not fertilized it will die and the progesterone and oestrogen hormone levels will drop. Without these hormones the prepared uterus lining breaks up and is released through the vagina. This is known as a 'period'.

NOTES

Menstruation is the biological process which involves bleeding from the vagina that happens about once a month, as a normal part of the menstrual cycle. It is also known as having a period. During this cycle, hormones make the lining of the uterus become thicker, getting ready in case of pregnancy. Hormones also cause an egg to be released from an ovary, which is known as ovulation. In case, fertilisation does not occur the lining of the uterus falls away and, along with some blood, flows out through the vagina.Diem nihi, vicerum, catiu quem mandic re norus iae aciamquem porionv ocupica; et

51. (b) In human female, the periodic discharge of blood, mucus and cellular debris from uterine wall from non-pregnant women of sexual maturity is known as menstrual cycle. Few hours before the start of menstruation, the spiral arterioles constrict one by one resulting into the blanched mucosa. The mucosa shrinks and the death of the blood deprived tissues takes place. Blood clotting doesn't occur due to presence of fibrinolysin.

NOTES

Fibrinolysins are several proteolytic enzymes that promote the dissolution of blood clots.

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52. (b) The progesterone and estradiol continue the hypertrophy of endometrial lining in the uterus and fallopian tubes and maintain it throughout pregnancy. Progesterone is also necessary for the proper implantation of the foetus in the uterine wall. It stimulates the endometrial glands to secrete a nutrient fluid for the foetus, hence the term secretory phase. The progesterone inhibits the release of FSH so that it may not develop additional follicles and eggs.
53. (c) Progesterone hormone which is secreted by the corpus luteum in the ovaries is responsible to stop ovulation (during pregnancy) and fixes the foetus to the uterine wall, facilitates placenta formation and controls the foetus development in uterus. If this hormone is withdrawn then fixation of foetus to uterine wall will not take place, formation of placenta will also not take place, ovulation starts from the ovaries and hence in human female menstruation starts.
54. (c) Since corpus luteum degenerates so progesterone also decreases rapidly (progesterone is essential for maintenance of pregnancy). Also estrogen continues to curve growth of the endometrium which ultimately becomes thick enough to break down and cause menstruation. Hence choice (c) is incorrect as estrogen secretion does not decreases further. Primary follicles start developing.
55. (a) After ovulation ovarian follicle, undergo several stages of degeneration. The follicular cells enlarge and fill with a yellow fluid to form corpus luteum.

NOTES

Secretion of hormones from the corpus luteum will stop within 14 days after ovulation if the oocyte is not fertilized and it then degenerates into a scar within the ovary, known as a corpus albicans.

56. (c) Luteinizing hormone causes ovulation. The remaining cells of ovarian follicle are stimulated by LH to develop corpus luteum.
57. (c) The 28 days human ovarian cycle is called menstrual cycle. On 14th day a mature ovarian follicle leaves ovary and comes into the fallopian tube.
58. (b) A glycoprotein fertilizin (composed of monosaccharides and amino acids) is secreted by a mature egg. Penetrating sperm also has some proteinaceous substance on its surface called antifertilizin. Due to the interaction between fertilizin & antifertilizin, the sperm adheres to the egg.

NOTES

Antifertilizin is an acid protein secreted by the acrosome. This makes the sperms stick to the surface of the egg.

59. (d) Estrous cycle is the characteristic of mammalian females other than primates. It is due to estrogen hormone. Estrous is the period during which ovulation occurs and the females mate with male.
60. (a) The entry of sperm stimulate the secondary oocyte to resume and complete the suspended meiosis II. This produces a haploid mature ovum and a second polar body. The second polar body and sperm tail immediately degenerate.
61. (b) Human female has X X chromosomes. When eggs formed each egg carries 22 autosomes and one X chromosome. In human male each sperm carries 22 autosomes and either X or Y-chromosomes.

62. (d) Sperm or male gamete fuses with egg or female gamete because of the attraction of their protoplast. Some chemicals are secreted by ovule or egg wall to attract the male gamete or sperm.

63. (a) Eggs are of 4 types regarding the amount of yolk present in them :
    (i) Alecithal Egg : Almost free of yolk eg. most mammals like man.
    (ii) Microlecithal Egg : Very small amount of yolk eg. Branchiostoma.
    (iii) Mesolecithal Egg : Moderate amount of yolk eg. Frog's egg
    (iv) Macrolecithal Egg : Large amount of yolk eg. Reptiles, birds and egg-laying mammals.

64. (a) Egg is liberated from the ovary (ovulation) at secondary oocyte stage when the meiosis II is arrested in secondary oocyte. It will be induced by the sperm.

65. (d) Foetal ejection reflex triggers release of oxytocin from the maternal anterior pituitary gland. Oxytocin acts on the uterine muscles and causes stronger uterine contractions.
Milk ejection reflex is caused by combined neurogenic and hormonal reflexes that involve release of oxytocin from posterior pituitary gland.
Relaxin, secreted by the ovary and placenta, causes the cervix to dilate and prepares the uterus for the action of oxytocin during labour. Oestrogen, secreted from ovary, is responsible for the development and regulation of the female reproductive system and secondary sex characteristics. Prolactin, secreted from anterior pituitary, stimulates breast development and milk production in women.

66. (a) The extraembryonic membranes are amnion, chorion, allantois and yolk sac. Amnion is derived from mesoderm on the outer side and ectoderm on the inner side. Chorion is formed from trophoectoderm and mesoderm, whereas allantois and yolk sac membrane have mesoderm on outerside and endoderm in inner side.

67. (d) The placenta is an endocrine gland that is only present during pregnancy. It relases hCG, hPL, progestogens, estrogens, etc. Human chorionic gonadotropic hormone (hCG) stimulates the corpus luteum during pregnancy to release estrogen and progesterone. Human placental lactogen (hPL) is involved in growth of body of mother and breast. Progesterone maintains pregnancy.

68. (c) The role of prolactin is not concerned with initiation of parturition in humans. Prolactin is responsible for milk synthesis in mammary glands. When the levels of estrogen and progesterone become low at parturition, then anterior pituitary activates to release prolactin.

NOTES
Prostaglandins are synthesized within the human fetal membranes such as amnion, chorion and deciduas. It plays an important role in ripening of the cervix, change membrane structure and also facilitates the contraction of myometrium.

69. (c) **Function of placenta** – The placenta facilitate the supply of oxygen and nutrients to the embryo and also removal of carbon dioxide and excretory/waste materials produced by the embryo. The placenta is connected to the embryo through an umbilical cord which helps in the transport of substances to and from the embryo. Placenta also acts as an endocrine tissue and produces several hormones like **human chorionic gonadotropin** (hCG), **human placental lactogen** (hPL) , **estrogens, progesterone** etc.

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NOTES
The umbilical cord is mostly made up of connective tissue known as Wharton's Jelly and has relatively few cells. The cord has one large umbilical vein and two umbilical arteries. These vessels transport blood to and from the placenta, where exchange between the mother and fetus takes place.

70. (a) Parturition is induced by a complex neuroendocrine mechanism. The signals for parturition originate from the fully developed foetus and the placenta which induce mild uterine contractions called foetal ejection reflex. This triggers release of oxytocin from the maternal pituitary.

71. (a) The signals for child birth (parturition) originate from the fully matured foetus and placenta which induce mild uterine contractions called **foetal ejection reflex**.

72. (c) Blastocyst is a thin-walled hollow structure in early embryonic development that contains a cluster of cells called the inner cell mass from which the embryo arises. The outer layer of cells gives rise to the placenta and other supporting tissues needed for fetal development within the uterus while the inner cell mass cells give rise to the tissues of the body. The blastocyst reaches the womb (uterus) around day 5, and implants into the uterine wall on about day 6.
73. (a) In vitro fertilization is a process where fertilization of egg occurs outside the mother's womb. This method is used as a major treatment for infertility. This method involves the removal of eggs from the female ovaries. This egg is then allowed to fertilize with sperm in a fluid medium in a test tube. The zygote is allowed to develop for a week. Either zygote or early embryo up to 8 blastomeres is then transferred into the fallopian tube to complete its further development. If the embryo is with more than 8 blastomeres, it is transferred into uterus for successful pregnancy. A baby conceived by fertilization that occurs outside mother body is called test tube baby.
74. (b) Parturition is the process of delivery of the foetus. The signals for parturition originate from the fully developed foetus and placenta that induce uterine contraction called foetal ejection reflex. This triggers the release of oxytocin hormone from pituitary. This in turn leads to expulsion of the baby out of uterus.
75. (b) In human beings, after one month of pregnancy, the embryo's heart is formed. By end of second month pregnancy, the foetus develops limbs and digits. By end of 12 weeks, major organ systems are formed. After fifth month, the first movement of foetus and appearance of hair on its head are observed. By the end of 24 weeks, the body is covered with hairs, eye lids separate and eyelashes are formed.
76. (a) Morula is a solid ball contained within the zone pellucida. It has almost equal quantity of cytoplasm as an uncleaved zygote but much more DNA.

NOTES

When the sperm approach the egg, they gets bind to the zona pellucida in a process known as sperm binding. This triggers the acrosome reaction, in which the enzymes of the acrosome are freed. These enzymes then begin to digest the zona pellucida and allow the sperm to tunnel toward the egg's plasma membrane.

77. (b) Foetal ejection reflex in human female is induced by fully developed foetus and placenta. When a woman is in a lithotomy or semi-sitting position, the Foetal Ejection Reflex is impaired and the increased pain caused by the sacrum's inability to move as the baby descends can be intolerable.
78. (a) A change in the amount of yolk and its distribution in the egg will affect pattern of cleavage. The pattern of cleavage is influenced by the amount of yolk in the egg. In eggs with less yolk, cleavages are equal, and the resulting blastomeres are of similar size. If the yolk is localized, such as in frog eggs, then cleavages are unequal, the cells derived from the yolky region (the vegetal pole) are larger than those derived from the region without yolk (the animal pole).
79. (d) Amnion is an extraembryonic membrane in human prevents desiccation of the embryo inside the uterus. Amnion is a membrane that encloses the embryo of reptiles, birds and mammals within the amniotic cavity. This cavity is filled with amniotic fluid, in which the embryo is protected from dessication and external pressure.

NOTES

Amniocentesis is a prenatal procedure which is recommended by doctor during pregnancy. The test checks for fetal abnormalities (birth defects) such as Down syndrome, cystic fibrosis or spina bifida. This test is performed between 16 and 20 weeks of the pregnancy.

80. (b) An organizer is a signal aligning center that directs the development of embryo or part of embryo, e.g. in amphibians, it is dorsal tip of blastophore.
81. (c) Cleavage in the human zygote is holoblastic i.e. it divides the zygote and the blastomeres completely into daughter cells. But it is unequal as the blastomeres differ in size.

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82. (b) Four extra-embryonic membranes are present in mammals which originally arise from trophoblast viz. amnion, chorion, allantois and yolk sac. The trophoblast is the outermost layer of cells in morula.

83. (c) Ectoderm produces – Liver, Epidermis, glands, hair, nervous system etc.
Endoderm produces – Pancreas, lining of urinary bladder etc.
Mesoderm produces – Dermis, most muscles, Kidneys, Gonads etc.

84. (a) Fusion of male and female gamete produces a zygote. Repeated division of the zygote is called cleavage forming a solid morula. After further division and rearrangement a fluid filled cavity surrounded by blastomeres - blastula is formed. The appearance of germ layers mark the gastrula.

85. (c) The ovum is released by the ovary is transported to the ampullary isthmic junction where fertilisation takes place. The mitotic division starts as the zygote moves through the isthmus of the oviduct called cleavage towards the uterus and forms 2, 4, 8 and 16 daughter cells called blastomeres. The embryo with 8 to 16 blastomeres is called morula.

86. (a) Gastrulation ends with the complete obliteration of blastocoel. The stage of three primary germ layers starts.

87. (b) On the basis of distribution of yolk the eggs are of following types :
(i) Homolecithal : Evenly distributed yolk.
(ii) Telolecithal : Most of the yolk near the vegetal pole, cytoplasm and nucleus lie near animal pole.
(iii) Centrolecithal : Centrally placed yolk surrounded by cytoplasm.

88. (a) The pattern of cleavage is determined by the amount of yolk and its distribution. In holoblastic cleavage, the segmentation lines pass through the entire egg. Hence, it divides egg completely. Egg in this type of cleavage contains moderate to sparse amount of yolk. For example, frog, human egg. In meroblastic cleavage, the sedimentation lines do not completely pass through the egg and remain confined to a part of the egg. Hence, it does not divide the egg completely egg in this type of cleavage contains a large amount of yolk. For e.g. insects and birds.

89. (b) Different types of segmentation or cleavages are found in animals depending upon the amount of yolk & its distribution:
Holoblastic : Complete division.
Meroblastic : Division occurs only in cytoplasm but not in yolk. eg. fishes.

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90. (b) Blastopore is the small slit like opening on the dorsal side of gastrocoel also known as dorsal lip.

91. (b) During cleavage size of cells do not increase (in fact the resultant blastomeres are smallest in size, because size of embryo doesn't increase and mitosis occurs repeatedly).

26 Reproductive Health

Trend Analysis with Important Topics & Sub-Topics

		2020		2019		2018		2017		2016	
Topic	Sub-Topics	Qns.	LOD	Qns.	LOD	Qns.	LOD	Qns.	LOD	Qns.	LOD
Reproductive Health/ Population Explosion & Birth Control	IUDs			1	A			1	A		
	Amniocentesis									1	A
	Birth Control Methods			1	A	1	A			1	D
Medical Termination of Pregnancy/ Sexually Transmitted Diseases/ Infertility	ARTs							1	D		
	STIs	1	A								

LOD - Level of Difficulty | E - Easy | A - Average | D - Difficult | Qns - No. of Questions

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Topic 1: Reproductive Health/Population Explosion & Birth Control

1. Select the option including all sexually transmitted diseases. *[2020]*
   (a) Gonorrhoea, Malaria, Genital herpes
   (b) AIDS, Malaria, Filaria
   (c) Cancer, AIDS, Syphilis
   (d) Gonorrhoea, Syphilis, Genital herpes
2. Which of the following is a correct statement ? *[2019, Odisa]*
   (a) IUDs suppress gametogenesis.
   (b) IUDs once inserted need not be replaced.
   (c) IUDs are generally inserted by the user herself.
   (d) IUDs increase phagocytosis of sperms in the uterus.
3. Which of the following contraceptive methods do involve a role of hormone? *[2019]*
   (a) Lactational amenorrhea, Pills, Emergency contraceptives
   (b) Barrier method, Lactational amenorrhea, Pills
   (c) CuT, Pills, Emergency contraceptives
   (d) Pills, Emergency contraceptives, Barrier methods
4. Select the hormone-releasing Intra-Uterine Devices. *[2019]*
   (a) Vaults, LNG-20
   (b) Multiload 375, Progestasert
   (c) Progestasert, LNG-20
   (d) Lippes Loop, Multiload 375
5. The contraceptive 'SAHELI' *[2018]*
   (a) blocks estrogen receptors in the uterus, preventing eggs from getting implanted.
   (b) increases the concentration of estrogen and prevents ovulation in females.
   (c) is a post-coital contraceptive.
   (d) is an IUD.
6. The function of copper ions in copper releasing IUD's is : *[2017]*
   (a) They inhibit gametogenesis
   (b) They make uterus unsuitable for implantation
   (c) They inhibit ovulation
   (d) They suppress sperm motility and fertilising capacity of sperms
7. In context of Amniocentesis, which of the following statement is incorrect ? *[2016]*
   (a) It is usually done when a woman is between 14-16 weeks pregnant.
   (b) It is used for prenatal sex determination
   (c) It can be used for detection of Down syndrome
   (d) It can be used for detection of Cleft palate

8. Which of the following approaches does not give the defined action of contraceptive ? *[2016]*
   (a) Barrier methods — prevent fertilization
   (b) Intra uterine devices — Increase phagocytosis of sperms, suppress sperm motility and fertilizing capacity of sperms
   (c) Hormonal contraceptives — Prevent/retard entry of sperms, prevent ovulation and fertilization
   (d) Vasectomy — Prevents spermatogenesis
9. Hysterectomy is surgical removal of: *[2015 RS]*
   (a) Prostate gland
   (b) Vas-deferens
   (c) Mammary glands
   (d) Uterus
10. Tubectomy is a method of sterilization in which: *[2014]*
   (a) small part of the fallopian tube is removed or tied up.
   (b) ovaries are removed surgically.
   (c) small part of vas deferens is removed or tied up.
   (d) uterus is removed surgically.
11. Which of the following is a hormone releasing Intra Uterine Device (IUD)? *[2014]*
   (a) Multiload 375 (b) LNG - 20
   (c) Cervical cap (d) Vault
12. Which of the following cannot be detected in a developing foetus by amniocentesis?
   (a) Sex of the foetus *[NEET 2013]*
   (b) Down syndrome
   (c) Jaundice
   (d) Klinefelter syndrome
13. One of the legal methods of birth control is : *[NEET 2013]*
   (a) by abstaining from coitus from day 10 to 17 of the menstrual cycle
   (b) by having coitus at the time of day break
   (c) by a premature ejaculation during coitus
   (d) abortion by taking an appropriate medicine
14. One of the following is **not** a method of contraception – which one? *[NEET Kar. 2013]*
   (a) Tubectomy
   (b) Condoms
   (c) Pills of a combination of oxytocin and vasopressin
   (d) Lippes loop
15. What is the figure given below showing in particular? *[2012]*

   (a) Ovarian cancer (b) Uterine cancer
   (c) Tubectomy (d) Vasectomy
16. Which one of the following is the most widely accepted method of contraception in India, as at present ? *[2011]*
   (a) Cervical caps
   (b) Tubectomy
   (c) Diaphragms
   (d) IUDs. (Intra uterine devices)
17. Cu ions released from copper - releasing Intra Uterine Devices (IUDs): *[2010]*
   (a) make uterus unsuitable for implantation
   (b) increase phagocytosis of sperms
   (c) suppress sperm motility
   (d) prevent ovulation
18. Given below are four methods (A-D) and their modes of action (a-d) in achieving contraception. Select their correct matching from the four options that follow: *[2008]*

	Method		Mode of Action
A.	The pill	(a)	Prevents sperms reaching cervix
B.	Condom	(b)	Prevents implantation
C.	Vasectomy	(c)	Prevents ovulation
D.	Copper T	(d)	Semen contains no sperms

Matching:
   (a) A-(c), B-(a), C-(d), D-(b)
   (b) A-(d), B-(a), C-(b), D-(c)
   (c) A-(c), B-(d), C-(a), D-(b)
   (d) A-(b), B-(c), C-(a), D-(d)
19. Copper-T is a device that prevents *[2000]*
   (a) implantation of blastocyst
   (b) ovulation
   (c) fertilization
   (d) egg maturation

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20. The permissible use of the technique amniocentesis is for *[2010]*
(a) detecting sex of the unborn foetus
(b) artificial insemination
(c) transfer of embryo into the uterus of the surrogate mother
(d) detecting any genetic abnormality

21. Amniocentesis is a technique *[1997]*
(a) by which the essential amino acids in the body can be estimated
(b) by which any chromosomal anomalies in the foetus can be detected
(c) in which the sex of the foetus can be reversed
(d) that can be used for correcting genetic disorders of the foetus

Topic 2: Medical Termination of Pregnancy/ Sexually Transmitted Diseases/Infertility

22. In which of the following techniques, the embryos are transferred to assist those females who cannot conceive? *[2020]*
(a) GIFT and ZIFT (b) ICSI and ZIFT
(c) GIFT and ICSI (d) ZIFT and IUT

23. Which of the following sexually transmitted diseases do not specifically affect reproductive organs ? *[2019, Odisa]*
(a) Chlamydiasis and AIDS
(b) Genital warts and Hepatitis-B
(c) Syphilis and Genital herpes
(d) AIDS and Hepatitis B

24. Which of the following sexually transmitted diseases is not completely curable? *[2019]*
(a) Gonorrhoea (b) Genital warts
(c) Genital herpes (d) Chlamydiasis

25. In case of a couple where the male is having a very low sperm count, which technique will be suitable for fertilisation? *[2017]*
(a) Gamete intracytoplasmic fallopian transfer
(b) Artificial Insemination
(c) Intracytoplasmic sperm injection
(d) Intrauterine transfer

26. Ectopic pregnancies are referred to as: *[2015 RS]*
(a) Implantation of embryo at site other than uterus.
(b) Implantation of defective embryo in the uterus
(c) Pregnancies terminated due to hormonal imbalance.
(d) Pregnancies with genetic abnormality.

27. A childless couple can be assisted to have a child through a technique called GIFT. The full form of this technique is : *[2015 RS]*
(a) Gamete intra fallopian transfer
(b) Gamete internal fertillization and transfer
(c) Germ cell internal fallopian transfer
(d) Gemete inseminated fallopian transfer

28. Assisted reproductive technology, IVF involves transfer of: *[2014]*
(a) Ovum into the fallopian tube.
(b) Zygote into the fallopian tube.
(c) Zygote into the uterus.
(d) Embryo with 16 blastomeres into the fallopian tube.

29. Artificial insemination mean: *[NEET 2013]*
(a) Transfer of sperms of husband to a test tube containing ova
(b) Artificial introduction of sperms of a healthy donor into the vagina
(c) Introduction of sperms of a healthy donor directly into the ovary
(d) Transfer of sperms of a healthy donor to a test tube containing ova

30. Which one of the following statements is correct regarding Sexually Transmitted Diseases (STD)? *[NEET Kar. 2013]*
(a) The chances of a 5 year boy contacting a STD are very little
(b) A person may contact syphilis by sharing milk with one already suffering from the disease
(c) Haemophilia is one of the STD
(d) Genital herpes and sickle-cell anaemia are both STD

31. The stage transferred into the uterus after induced fertilization of ova in the laboratory is
(a) Zygote *[NEET Kar. 2013]*
(b) Embryo at 4 blastomere stage
(c) Embryo at 2 blastomere stage
(d) Morula

32. The test-tube Baby Programme employs which one of the following techniques *[2012]*
(a) Intra cytoplasmic sperm injection (ICSI)
(b) Intra uterine insemination (IUI)
(c) Gamete intra fallopian transfer (GIET)
(d) Zygote intra fallopian transfer (ZIFT)

33. Medical Termination of Pregnancy (MTP) is considered safe up to how many weeks of pregnancy? *[2011]*
(a) Eight weeks (b) Twelve weeks
(c) Eighteen weeks (d) Six weeks

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34. The technique called gamete intrafallopian transfer (GIFT) is recommended for those females:
    (a) who cannot produce an ovum *[2011M]*
    (b) who cannot retain the foetus inside uterus.
    (c) whose cervical canal is too narrow to allow passage for the sperms
    (d) who cannot provide suitable environment for fertilisation
35. Consider the statements given below regarding contraception and answer as directed thereafter: *[2008]*
    (i) Medical Termination of Pregnancy (MTP) during first trimester is generally safe
    (ii) Generally chances of conception are nil until mother breast-feeds the infant upto two years
    (iii) Intrauterine devices like copper-T are effective contraceptives
    (iv) Contraception pills may be taken upto one week after coitus to prevent conception

    Which two of the above statements are correct?
    (a) ii and iii
    (b) iii and iv
    (c) i and iii
    (d) i and ii
36. Test tube baby is one who *[1996, 2003]*
    (a) is born out of artificial insemination
    (b) has undergone development in a test tube
    (c) is born out of the technique of fertilization *in vitro*
    (d) has been developed without fertilization

ANSWER KEY

1	(d)	6	(d)	11	(b)	16	(d)	21	(b)	26	(a)	31	(d)	36	(c)
2	(d)	7	(d)	12	(c)	17	(c)	22	(d)	27	(a)	32	(d)		
3	(a)	8	(d)	13	(d)	18	(a)	23	(d)	28	(b)	33	(b)		
4	(c)	9	(d)	14	(c)	19	(a)	24	(c)	29	(b)	34	(a)		
5	(a)	10	(a)	15	(c)	20	(d)	25	(b)	30	(a)	35	(c)		

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Hints & Solutions

1. (d) Gonorrhoea, Syphilis, Genital herpes are sexually transmitted diseases. Gonorrhoea is caused by a bacterium *Neisseria gonorrhoeae*. Syphilis is caused by a bacterium *Treponema pallidum*. Genital herpes is caused by a virus Type-II-Herpes simplex virus.
2. (d) IUDs (Intra uterine devices) of all types are in general treated as a foreign body thus inviting phagocytic cells to the uterus. It is a small, T-shaped plastic and copper device.
   IUDs increase phagocytosis of sperms within the uterus and Cu ions released suppress sperm motility and the fertilising capacity of sperms.
   IUDs need to be inserted by an experienced nurse and have to be replaced after few years depending on copper or hormonal level.
3. (a) In lactational amenorrhea, pills and emergency contraceptives methods, there is the involvement of hormones.
   Lactational amenorrhea (absence of menstruation) is based on the fact that ovulation and therefore the cycle do not occur during the period of intense lactation following parturition. Prolactin is the major hormone responsible for milk production and is present in sufficient quantities in almost all women to allow the establishment of normal lactation.
   Emergency contraception methods include emergency contraception pills (ECP), intrauterine device, e.g., LNG-20 (Levonorgestrel) and ulipristal acetate.
   CuT and barrier method do not involve any hormonal role.
4. (c) Progestasert and LNG-20 are hormone releasing IUDs (Intra Uterine Devices). These are the devices which are used in birth control by making uterus unsuitable for implantation and the cervix hostile to sperms.

5. (a) Saheli is world's first and only oral non steroidal contraceptive pill, dosage-once a week pill. Its functioning is based upon selective estrogen receptor modulation and prevents egg from getting implanted.
6. (d) Cu^{2+} interfere in the sperm movement, which suppress the sperm motility and fertilising capacity of sperms.

NOTES

The hormones present in the IUDs prevent pregnancy in two ways as hormonal IUDs make the mucus on cervix thicker and this mucus blocks sperm to fertilize the egg. Whereas the hormones in the IUD can also stop eggs from leaving ovaries (called ovulation), which means there's no egg for a sperm to fertilize.

7. (d) Amniocentesis (also referred to as amniotic fluid test or AFT) is a medical procedure used in prenatal diagnosis of chromosomal abnormalities and fetal infections, and also used for sex determination in which a small amount of amniotic fluid, which contains fetal tissues, is sampled from the amniotic sac. Cleft palate is a developmental abnormality which can only be detected by sonography.

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NOTES

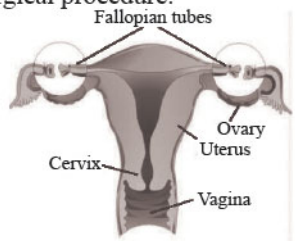
Amniocentesis is a prenatal procedure which is recommended by doctor during pregnancy. The test checks for fetal abnormalities (birth defects) such as Down syndrome, cystic fibrosis or spina bifida. This test is performed between 16 and 20 weeks of the pregnancy.

8. (d) Vasectomy is a surgical procedure for male sterilization or permanent contraception. During the procedure, the male vas deferens are severed and then tied or sealed in a manner so as to prevent sperm from entering into the seminal stream (ejaculate) and thereby prevent fertilization.
9. (d) A hysterectomy is a surgery in which woman's uterus is removed. It is adopted for the treatment of uterine fibroids and cancer of uterine zone.

NOTES

Uterine fibroids are non-cancerous growths in the uterus that can develop during a woman's childbearing years.

10. (a) Tubectomy also referred to as tubal sterilization is a surgical procedure done on women as a permanent method of contraception. In this method fallopian tubes are blocked so that the ova or eggs are prevented from travelling to the uterus from the ovary. This prevents any future pregnancies to occur after the surgical procedure.



11. (b) An intrauterine device (IUD) is a small contraceptive device, often 'T'-shaped, that contains either copper or levonorgestrel, which is inserted into the uterus. They are one form of long-acting reversible contraception which is the most effective types of reversible birth control. The LNG-20 is so-called because it releases 20 micrograms of levonorgestrel per 24 hours, compared with 30 micrograms of levonorgestrel in some mini-Pills.
12. (c) Jaundice cannot be detected in a developing foetus by amniocentesis. It is a foetal sex determination test based on chromosomal pattern in the amniotic fluid surrounding the developing embryo. It is now legally ban in India.
13. (d) Medical termination of pregnancy (MTP) or induced abortion become legal in India from 1971 with some strict conditions to avoid its misuse. Such restrictions are important to check indiscriminate and illegal female foeticides which are reported to be high in India. All the other options are of natural methods of contraception.
14. (c) Oxytocin is birth hormone and acts on the smooth muscles of our body and stimulates their contraction. Vasopressin acts mainly at the kidney and stimulates resorption of water and electrolytes and reduces loss of water through urine.

NOTES

Vasopressin is also called as anti-diuretic hormone (ADH).

15. (c) The figure shows the tubectomy. This is a surgical method to prevent pregnancy in women. In tubectomy small part of the

fallopian tube is removed or tied through a small cut in the abdomen or through vagina. It is very effective method but reversibility is very poor.

16. (d) Intra uterine device (IUD) is a method of contraception in India. The IUD is inserted in the woman's uterus through the cervix.

NOTES
The copper IUD (ParaGard) contains no hormones and thus prevents pregnancy for up to 10 years. ParaGard is an intrauterine device (IUD) that can provide long-term birth control (contraception).

17. (c) Cu ions released by copper releasing intra uterine devices suppresses sperm motility.
Intra-uterine devices are inserted by doctors in the uterus through vagina. They are available as the non-medicated IUDs, copper releasing IUDs and hormone releasing IUDs.

18. (a) A. The pill — Prevents ovulation
B. Condom — Prevents sperm reaching cervix
C. Vasectomy — Semen contains no sperms
D. Copper-T — Prevent implantation.

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19. (a) Copper 'T' is an intrauterine device which prevents the fertilized egg becoming implanted in the wall of the womb.

20. (d) Amniocentesis involves prenatal diagnosis of metabolic error and other genetic abnormalities.

21. (b) Amniocentesis is the most widely used method for prenatal detection of many genetic disorders.

NOTES
Aminocentesis is also used for determining the sex of the foetus.

22. (d) Option (d) is the answer because ART in which embryos are transferred, include ZIFT and IUT i.e. Zygote Intrafallopian Transfer and Intra Uterine Transfer respectively, both are embryo transfer (ET) methods.
Option (a), (b) and (c) are incorrect because in GIFT (Gamete Intrafallopian Transfer), gamete is transferred into the fallopian tube of female who cannot produce ova. ICSI is Intra cytoplasmic sperm injection in which sperm is directly injected into the ovum.

NOTES
In the second half of the 20th century, medically assisted procreation saw two major technological advances, namely gamete freezing and in vitro fertilization (IVF). Fertilization by intracytoplasmic sperm injection (ICSI), first developed in 1992, can overcome many causes of male infertility.

23. (d) AIDS and hepatitis B are sexually transmitted infections. However, they do not specifically affect the reproductive organs.
AIDS is HIV infection affecting the immune system and opportunistic pathogens can infect various body organs.
Hepatitis B is a viral (hepatitis B virus) infection that affects liver and can cause both acute and chronic disease.
Agents causing genital herpes, genital warts and chlamydiasis produce lesions on genital organs and also directly affect the reproductive system.

24. (c) Genital herpes is caused by two types of viruses- herpes simplex virus type 1 (HSV-1) and herpes simplex virus type 2 (HSV-2). At present there is no cure for type-II-herpes simplex virus. Other non curable STIs are hepatitis-B and HIV.

NOTES
Vaccines are available for the protection of STDs against infection with HPV, hepatitis A and hepatitis B. Other vaccines are under development, including those for HIV and herpes simplex virus (HSV).

25. (b) Infertility cases due to inability of the male partner to inseminate the female or due to very low sperm count in the ejaculates, could be corrected by using artificial insemination (AI) technique. In this procedure, semen is injected directly into the vagina or uterus.

26. (a) In ectopic pregnancies, the implantation of embryo does not occur in uterus but at other site.

NOTES
Ectopic pregnancy is also called tubal pregnancy and this condition arises when pregnancy occurs outside the uterus or in the fallopian tube. This condition develops due to the inability of the fertilized egg to make its way through the Fallopian tube into the uterus.

27. (a) GIFT (Gamete Intra Fallopian Transfer) is a technique helping to have a child.

> **NOTES** Gamete intrafallopian transfer (GIFT) is used for infertile women who are ovulating but have blocked oviducts (fallopian tubes) or for infertile couples who, for religious reasons, wish to avoid fertilization outside the human body.

28. (b) IVF (*In vitro* Fertilization) is the process of fertilization by manually combining an egg and sperm in a laboratory dish. The process involves monitoring and stimulating a woman's ovulatory process, removing ovum or ova (egg or eggs) from the woman's ovaries and letting sperm fertilise them in a fluid medium in a laboratory. The fertilised egg (zygote) is cultured for 2-6 days in a growth medium and is then transferred to the mother's uterus with the intention of establishing a successful pregnancy.

29. (b) In **Artificial Insemination** (AI) technique, the semen collected either from the husband or a healthy donor is artificially introduced either into the vagina or into the uterus (IUI – **intrauterine insemination**) of the female.

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30. (a) STDs are more common in 15-24 years age group. Gonorrhoea, syphilis, genital herpes, chlamydiasis, genital warts, trichomoniasis, hepatitis-B and AIDS are some of the common STDs. Haemophilia is sex-linked recessive disease, which show its transmission from unaffected carrier female to some of male progeny.

> **NOTES** Sickle cell anaemia is an autoimmune linked recessive trait in which both the partners are carrier for the gene.

31. (d) In Intra-Uterine Transfer (IUT) embryo with more than 8-blastomeres stage (morula) is used for transfer into the uterus.

> **NOTES** The 8 cell stage (actually consisting of 6-12 cells) develops by day 3 of human embryonic development, and involves a continuation of the process of embryonic genome activation (which is initiated at the 4-8 celled stages of the human embryo), results in the morula formation.

32. (d) Test tube baby programme employs Zygote Intrafallopian Transfer (ZIFT) Technique. In this technique, fusion of ovum and sperm is done outside the body of woman to form zygote which is allowed to divide forming 8 blastomeres, then it is transfered the fallopion tube of the woman.

33. (b) Medical termination of pregnancy is considered safe up to twelve weeks of pregnancy.

> **NOTES** Termination of pregnancy becomes more risky after the first trimester period of pregnancy as the foetus becomes intimately associated with the maternal tissues.

34. (a) Gamete Intrafallopian transfer (GIFT) is recommended for those females who cannot produce an ovum. In this process, the eggs of the donor woman are removed and in a form of mixture with sperm transferred into fallopian tube of another woman who cannot produce ovum, but can provide suitable environment for fertilization. Thus in GIFT, site of fertilization is fallopian tube, not laboratory.

35. (c) Statements i and iii are correct.
    - Medical Termination of Pregnancy (MTP) during first trimester is generally safe.
    - Intrauterine device like copper-T are effective contraceptives.

36. (c) In test tube baby, fertilization of the sperm and the ova is carried out in lab conditions (*in vitro*) and when the embryos have reached the 32-celled stage, it is implanted back into the uterus of the mother.

27 Principles of Inheritance and Variation

Trend Analysis with Important Topics & Sub-Topics

Topic	Sub-Topics	2020		2019		2018		2017		2016	
		Qns.	LOD	Qns.	LOD	Qns.	LOD	Qns.	LOD	Qns.	LOD
Mendel's law of Inheritance Inheritance of one gene/Inheritance of two genes/Linkage and Recombination	Co-dominance	1				1	A	1	D		
	Test cross									1	D
	Law of Inheritance					2	A			1	D
	Genetic Map			1	A						
	Linkage and Recombination			1	D	1	A				
	Incomplete Dominance			1	D			1	A		
	Multiple alleles										
	Chromosomal theory of Inheritance	1	A								
	Mohohybrid Cross	1	D					2	D	2	D
Sex Determination	Sex determination patterns			1	D						
Mutation/ Genetic Disorders	Mendelian disorder	1	D					1	D	1	D
	Chromosomal disorder			1	D	1	D	1	A	1	A

LOD - Level of Difficulty	E - Easy	A - Average	D - Difficult	Qns - No. of Questions

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Topic 1: Mendel's law of Inheritance Inheritance of one gene/Inheritance of two genes/Linkage and Recombination

1. Experimental verification of the chromosomal theory of inheritance was done by *[2020]*
   (a) Sutton (b) Boveri
   (c) Morgan (d) Mendel

2. Embryological support for evolution was disapproved by *[2020]*
   (a) Alfred Wallace (b) Charles Darwin
   (c) Oparin (d) Karl Ernst von Baer

3. The production of gametes by the parents, the formation of zygotes, the F1 and F2 plants, can be understood using *[2019, Odisha]*
   (a) Wenn diagram (b) Pie diagram
   (c) A pyramid diagram (d) Punnet square

4. In a marriage between male with blood group A and female with blood group B, the progeny had either blood group AB or B. What could be the possible genotype of parents? ***[2019, Odisha]***
   (a) IA i (Male) ; IB i (Female)
   (b) IA i (Male) ; IB IB (Female)
   (c) IA IA (Male) ; IB IB (Female)
   (d) IA IA (Male) ; IB i (Female)
5. In *Antirrhinum* (Snapdragon), a red flower was crossed with a white flower and in F_1 generation, pink flowers were obtained. When pink flowers were selfed, the F_2 generation showed white, red and pink flowers. Choose the incorrect statement from the following: ***[2019]***
   (a) This experiment does not follow the principle of dominance.
   (b) Pink colour in F_1 is due to incomplete dominance.
   (c) Ratio of F_2 is $\frac{1}{4}$ (Red): $\frac{1}{2}$ (Pink): $\frac{1}{4}$ (White)
   (d) Law of Segregation does not apply in this experiment.
6. What map unit (Centimorgan) is adopted in the construction of genetic maps? ***[2019]***
   (a) A unit of distance between two expressed genes, representing 10% cross over.
   (b) A unit of distance between two expressed genes, representing 100% cross over.
   (c) A unit of distance between genes on chromosomes, representing 1% cross over.
   (d) A unit of distance between genes on chromosomes, representing 50% cross over
7. Select the incorrect statement. ***[2019]***
   (a) Male fruit fly is heterogametic.
   (b) In male grasshoppers, 50% of sperms have no sex-chromosome.
   (c) In domesticated fowls, sex of progeny depends on the type of sperm rather than egg.
   (d) Human males have one, of their sex-chromosome much shorter than the other.
8. A woman has an X-linked condition on one of her X chromosomes. This chromosome can be inherited by ***[2018]***
   (a) Only daughters
   (b) Only sons
   (c) Both sons and daughters
   (d) Only grandchildren
9. Which of the following characteristics represent 'Inheritance of blood groups' in humans? ***[2018]***
   A. Dominance
   B. Co-dominance
   C. Multiple allele
   D. Incomplete dominance
   E. Polygenic inheritance
   (a) B, C and E (b) A, B and C
   (c) A, C and E (d) B, D and E
10. The genotypes of a husband and wife are I^AI^B and I^Ai.
    Among the blood types of their children, how many different genotypes and phenotypes are possible? ***[2017]***
    (a) 3 genotypes ; 4 phenotypes
    (b) 4 genotypes ; 3 phenotypes
    (c) 4 genotypes ; 4 phenotypes
    (d) 3 genotypes ; 3 phenotypes
11. Among the following characters, which one was not considered by Mendel in his experiments on pea ? ***[2017]***
    (a) Trichomes – Glandular or non-glandular
    (b) Seed – Green or Yellow
    (c) Pod – Inflated or Constricted
    (d) Stem – Tall or Dwarf
12. Which one from those given below is the period for Mendel's hybridisation experiments? ***[2017]***
    (a) 1840 - 1850 (b) 1857 - 1869
    (c) 1870 - 1877 (d) 1856 - 1863
13. A tall true breeding garden pea plant is crossed with a dwarf true breeding garden pea plant. When the F_1 plants were selfed the resulting genotypes were in the ratio of ***[2016]***
    (a) 1 : 2 : 1 :: Tall homozygous : Tall heterozygous : Dwarf
    (b) 1 : 2 : 1 :: Tall heterozygous : Tall homozygous : Dwarf
    (c) 3 : 1 : : Tall : Dwarf
    (d) 3 : 1 : : Dwarf : Tall

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14. Match the terms in Column-I with their description in Column-II and choose the correct option. *[2016]*

Column-I	Column-II
(a) Dominance	(i) Many genes govern a single character
(b) Codominance	(ii) In a heterozygous organism, only one allele expresses itself
(c) Pleiotropy	(iii) In a heterozygous organism, both alleles express themselves fully
(d) Polygenic inheritance	(iv) A single gene influences many characters

	(A)	(B)	(C)	(D)
(a)	(ii)	(i)	(iv)	(iii)
(b)	(ii)	(iii)	(iv)	(i)
(c)	(iv)	(i)	(ii)	(iii)
(d)	(iv)	(iii)	(i)	(ii)

15. In a test cross involving F_1 dihybrid flies, more parental type offspring were produced than the recombinant type offspring. This indicates *[2016]*
(a) the two genes are located on two different chromosomes.
(b) chromosomes failed to separate during meiosis.
(c) the two genes are linked and present on the same chromosome.
(d) both of the characters are controlled by more than one gene.

16. A cell at telophase stage is observed by a student in a plant brought from the field. He tells his teacher that this cell is not like other cells at telophase stage. There is no formation of cell plate and thus the cell is containing more number of chromosomes as compared to other dividing cells. This would result in *[2016]*
(a) Aneuploidy
(b) Polyploidy
(c) Somaclonal variation
(d) Polyteny

17. How many pairs of contrasting characters in pea plants were studied by Mendel in his experiments ? *[2015 RS]*
(a) Six (b) Eight
(c) Seven (d) Five

18. Which is the most common mechanism of genetic variation in the population of sexually reproducing organism? *[2015 RS]*
(a) Chromosomal aberrations
(b) Genetic drift
(c) Recombination
(d) Transduction

19. Alleles are *[2015 RS]*
(a) true breeding homozygotes
(b) different molecular forms of a gene
(c) heterozygotes
(d) different phenotype

20. In his classic experiments on Pea plants, Mendel did not use *[2015 RS]*
(a) Pod length (b) Seed shape
(c) Flower position (d) Seed colour

21. A man with blood group 'A' marries a woman with blood group 'B'. What are all the possible blood groups of their offsprings ? *[2015 RS]*
(a) A,B and AB only
(b) A,B,AB and O
(c) O only
(d) A and B only

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22. Multiple alleles are present : *[2015 RS]*
(a) At different loci on the same chromosome
(b) At the same locus of the chromosome
(c) On non-sister chromatids
(d) On different chromosomes

23. A gene showing codominance has: *[2015 RS]*
(a) alleles tightly linked on the same chromosome
(b) alleles that are recessive to each other
(c) both alleles independently expressed in the heterozygote
(d) one allele dominant on the other

24. The term 'linkage' was coined by : *[2015 RS]*
(a) T. Boveri (b) G. Mendel
(c) W. Sutton (d) T.H. Morgan

25. Fruit colour in squash in an example of : *[2014]*
(a) Recessive epistasis
(b) Dominant epistasis
(c) Complementary genes
(d) Inhibitory genes

26. In a population of 1000 individuals 360 belong to genotype AA, 480 to Aa and the remaining 160 to aa. Based on this data, the frequency of allele A in the population is: *[2014]*
(a) 0.4 (b) 0.5
(c) 0.6 (d) 0.7

27. If two persons with 'AB' blood group marry and have sufficiently large number of children these children could be classified as 'A' blood group: 'AB' blood group: 'B' blood group in 1 : 2 : 1 ratio. Modern technique of protein electrophoresis reveals presence of both 'A' and 'B' type proteins in 'AB' blood group individuals. This is an example of : ***[NEET 2013]***
    (a) incomplete dominance
    (b) Partial dominance
    (c) Complete cominance
    (d) Codominance
28. Which Mendelian idea is depicted by a cross in which the F_1 generation resembles both the parents? ***[NEET 2013]***
    (a) Law of dominance
    (b) Inheritance of one gene
    (c) Co-dominance
    (d) Incomplete dominance
29. Which of the following statements is not true of two genes that show 50% recombination frequency? ***[NEET 2013]***
    (a) The genes are tightly linked
    (b) The genes show independent assortment
    (c) If the genes are present on the same chromosome, they undergo more than one crossovers in every meiosis
    (d) The genes may be on different chromosomes
30. Genetic variation in a population arises due to ***[NEET Kar. 2013]***
    (a) Mutations only
    (b) Recombination only
    (c) Mutations as well as recombination
    (d) Reproductive isolation and selection
31. A certain road accident patient with unknown blood group needs immediate blood transfusion. His one doctor friend at once offers his blood.What was the blood group of the donor? ***[2012]***
    (a) Blood group B (b) Blood group AB
    (c) Blood group O (d) Blood group A
32. A test cross is carried out to ***[2012M]***
    (a) determine the genotype of a plant at F2.
    (b) predict whether two traits are linked.
    (c) assess the number of alleles of a gene.
    (d) determine whether two species or varieties will breed successfully.
33. F_2 generation in a Mendelian cross showed that both genotypic and phenotypic ratios are same as 1 : 2 : 1. It represents a case of: ***[2012]***
    (a) Co-dominance
    (b) Dihybrid cross
    (c) Monohybrid cross with complete dominance
    (d) Monohybrid cross with incomplete dominance
34. When two unrelated individuals or lines are crossed, the performance of F_1 hybrid is often superior to both parents. This phenomenon is called: ***[2011]***
    (a) heterosis (b) transformation
    (c) splicing (d) metamorphosis
35. A person with unknown blood group under ABO system, has suffered much blood loss in an accident and needs immediate blood transfusion. His one friend who has a valid certificate of his own blood type offers blood donation without delay. What would have been the type of blood group of the donor friend? ***[2011]***
    (a) Type B (b) Type AB
    (c) Type O (d) Type A
36. Test cross in plants or in *Drosophila* involves crossing ***[2011M]***
    (a) between two genotypes with recessive trait
    (b) between two F_1 hybrids
    (c) the F_1 hybrid with a double recessive genotype.
    (d) between two genotypes with dominant trait
37. Which one of the following conditions of the zygotic cell would lead to the birth of a normal human female child ? ***[2011M]***
    (a) Two X chromosomes
    (b) Only one Y chromosome
    (c) Only one X chromosome
    (d) One X and one Y chromosome
38. Which one of the following cannot be explained on the basis of Mendel's Law of Dominance? ***[2010]***
    (a) The discrete unit controlling a particular character is called a factor
    (b) Out of one pair of factors one is dominant, and the other recessive

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(c) Alleles do not show any blending and both the characters recover as such in F_2 generation.
(d) Factors occur in pairs

39. The genotype of a plant showing the dominant phenotype can be determined by:
(a) test cross *[2010]*
(b) dihybrid cross
(c) pedigree analysis
(d) back cross

40. Select the correct statement from the ones given below with respect to dihybrid cross. *[2010]*
(a) Tightly linked genes on the same chromosome show higher recombinations
(b) Genes far apart on the same chromosome show very few recombinations
(c) Genes loosely linked on the same chromosome show similar recombinations as the tightly linked ones
(d) Tightly linked genes on the same chromosome show very few recombinations

41. A common test to find the genotype of a hybrid is by *[2007]*
(a) crossing of one F_2 progeny with female parent
(b) studying the sexual behaviour of F_1 progenies
(c) crossing of one F_1 progeny with male parent
(d) crossing of one F_2 progeny with male parent.

42. Two genes R and Y are located very close on the chromosomal linkage map of maize plant. When RRYY and rryy genotypes are hybridized, the F_2 segregation will show *[2007]*
(a) segregation in the expected 9 : 3 : 3 : 1 ratio
(b) segregation in 3 : 1 ratio
(c) higher number of the parental types
(d) higher number of the recombinant types.

43. In pea plants, yellow seeds are dominant to green. If a heterozygous yellow seeded plant is crossed with a green seeded plant, what ratio of yellow and green seeded plants would you expect in F_1 generation ? *[2007]*
(a) 9 : 1 (b) 1 : 3
(c) 3 : 1 (d) 50 : 50

44. Inheritances of skin colour in humans is an example of *[2007]*
(a) point mutation
(b) polygenic inheritance
(c) codominance
(d) chromosomal aberration.

45. A human male produces sperms with the genotypes AB, Ab, aB, and ab pertaining to two diallelic characters in equal proportions. What is the corresponding genotype of this person? *[2007]*
(a) AaBB (b) AABb
(c) AABB (d) AaBb

46. Which one of the following is an example of polygenic inheritance ? *[2006]*
(a) Production of male honey bee
(b) Pod shape in garden pea
(c) Skin colour in humans
(d) Flower colour in *Mirabilis jalapa*

47. In Mendel's experiment with garden pea, round seed shape (RR) was dominant over wrinkled seeds (rr), yellow cotyledon (YY) was dominant over green cotyledon (yy). What are the expected phenotypes in the F_2 generation of the cross RRYY × rryy? *[2006]*
(a) only wrinkled seeds with yellow cotyledons
(b) only wrinkled seeds with green cotyledons
(c) Round seeds with yellow cotyledons, and wrinkled seeds with yellow cotyledons
(d) only round seeds with green cotyledons

48. Test cross involves *[2006]*
(a) crossing between two F_1 hybrids
(b) crossing the F_1 hybrid with a double recessive genotype
(c) crossing between two genotypes with dominant trait
(d) crossing between two genotypes with recessive trait

49. Phenotype of an organism is the result of *[2006]*
(a) cytoplasmic effects and nutrition
(b) environmental changes and sexual dimorphism
(c) genotype and environment interactions
(d) mutations and linkages

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50. How many different kinds of gametes will be produced by a plant having the genotype AABbCC ? ***[2006]***
(a) Four (b) Nine
(c) Two (d) Three

51. In order to find out the different types of gametes produced by a pea plant having the genotype AaBb, it should be crossed to a plant with the genotype: ***[2005]***
(a) AABB (b) AaBb
(c) aabb (d) aaBB

52. At a particular locus, frequency of 'A' allele is 0.6 and that of 'a' is 0.4. What would be the frequency of heterozygotes in a random mating population at equilibrium? ***[2005]***
(a) 0.36 (b) 0.16
(c) 0.24 (d) 0.48

53. The salivary gland chromosomes in the dipteran larvae, are useful in gene mapping because: ***[2005]***
(a) these are fused
(b) these are much longer in size
(c) these are easy to stain
(d) They have endoreduplicated chromosomes.

54. A woman with normal vision, but whose father was colour blind, marries a colour blind man. Suppose that the fourth child of this couple was a boy. This boy ***[2005]***
(a) may be colour blind or may be of normal vision
(b) must be colour blind
(c) must have normal colour vision
(d) will be partially colour blind since he is heterozygous for the colour blind mutant allele

55. Genes for cytoplasmic male sterility in plants are generally located in ***[2005]***
(a) cytosol
(b) chloroplast genome
(c) mitochondrial genome
(d) nuclear genome

56. Lack of independent assortment of two genes A and B in fruit fly *Drosophila* is due to ***[2004]***
(a) repulsion (b) recombination
(c) linkage (d) crossing over

57. The recessive genes located on X-chromosome in humans are always ***[2004]***
(a) lethal
(b) sub-lethal
(c) expressed in males
(d) expressed in females

58. A male human is heterozygous for autosomal genes A and B and is also hemizygous for hemophilic gene h. What proportion of his sperms will be abh? ***[2004]***
(a) $\frac{1}{8}$ (b) $\frac{1}{32}$
(c) $\frac{1}{16}$ (d) $\frac{1}{4}$

59. A self-fertilizing trihybrid plant forms ***[2004]***
(a) 8 different gametes and 64 different zygotes
(b) 4 different gametes and 16 different zygotes
(c) 8 different gametes and 16 different zygotes
(d) 8 different gametes and 32 different zygotes

60. In a certain plant, red fruit (R) is dominant over yellow fruit (r) and tallness (T) is dominant over shortness (t) .If a plant with RRTt genotype is crossed with a plant rrtt genotype, what will be the percentage of tall plants with red fruits in the progeny ? ***[2004]***
(a) 50% (b) 100%
(c) 75% (d) 25%

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61. *Nicotiana sylvestris* flowers only during long days and *N. tabacum* flowers only during short days. If raised in the laboratory under different photoperiods, they can be induced to flower at the same time and can be cross fertilized to produce self – fertile offspring. What is the best reason for considering *N. sylvestris* and *N. tabacum* to be separate species ? ***[2003]***
(a) They are morphologically distinct
(b) They cannot interbreed in nature
(c) They are reproductively distinct
(d) They are physiologically distinct

62. Which one of the following traits of garden pea studied by Mendel was a recessive feature ? ***[2003]***
(a) Round seed shape
(b) Axial flower position
(c) Green seed colour
(d) Green pod colour

63. The genes controlling the seven pea characters studied by Mendel are now known to be located on how many different chromosomes ? ***[2003]***
(a) Four (b) Seven
(c) Six (d) Five

64. Two crosses between the same pair of genotypes or phenotypes in which the source of the gametes are reversed in one cross, is known as *[2003]*
(a) reverse cross (b) test cross
(c) reciprocal cross (d) dihybrid cross

65. The linkage map of X-chromosome of fruit fly has 66 units, with yellow body gene (y) at one end and bobbed hair (b) gene at the other end. The recombination frequency between these two genes (y and b) should be *[2003]*
(a) 100% (b) 66%
(c) > 50% (d) < 50%

66. A gene is said to be dominant if *[2002]*
(a) it expresses its effect only in homozygous state
(b) it expresses its effect only in heterozygous condition
(c) it expresses its effect both in homozygous and heterozygous condition
(d) it never expresses its effect in any conditions

67. On selfing a plant of F_1 generation with genotype "AABbCC", the genotypic ratio in F_2 generation will be *[2002]*
(a) 3 : 1
(b) 1 : 2 : 1
(c) 9 : 3 : 3 : 1
(d) 27 : 9 : 9 : 9 : 3 : 3 : 3 : 1

68. There are three genes a, b, c. Percentage of crossing over between a and b is 20%, b and c is 28% and a and c is 8%. What is the sequence of genes on chromosome? *[2002]*
(a) b, a, c (b) a, b, c
(c) a, c, b (d) none of these

69. Independent assortment of genes does not take place when *[2001]*
(a) genes are located on homologous chromosomes
(b) genes are linked and located on same chromosomes
(c) genes are located on nonhomologous chromosomes
(d) all the above

70. When dominant and recessive alleles express itself together it is called *[2001]*
(a) codominance
(b) dominance
(c) amphidominace
(d) pseudodominance

71. Ratio of complementary genes *[2001]*
(a) 9 : 3 : 4 (b) 12 : 3 : 1
(c) 9 : 3 : 3 : 4 (d) 9 : 7

72. Two non-allelic genes produce new phenotype when present together but fail to do so independently are called? *[2001]*
(a) Epistatsis
(b) Polygene
(c) Non- complimentary genes
(d) Complimentary genes

73. Probability of four sons to a couple is *[2001]*
(a) $\frac{1}{4}$ (b) $\frac{1}{8}$
(c) $\frac{1}{16}$ (d) $\frac{1}{32}$

74. A and B genes are linked what shall be genotype of progeny in a cross between AB/ab and ab/ab? *[2001]*
(a) AAbb and aabb (b) AaBb and aabb
(c) AABB and aabb (d) None of these

75. Which one pair of the following parents is most likely to get a child who suffer from hemolytic disease of new born? *[2000]*
(a) Rh-negative mother and Rh-positive father
(b) Rh-positive mother and Rh-negative father
(c) Rh-negative mother and Rh-negative father
(d) Rh-positive mother and Rh-positive father

76. Which character studied by Mendel in garden pea (*Pisum sativum*) was dominant *[2000]*
(a) Wrinkled seed shape
(b) Green pod colour
(c) Green seed colour
(d) Terminal flower position

77. Molecular weight of chromosome of yeast cell is *[1999]*
(a) 2.56×10^9 (b) 40×10^9
(c) 0.5×10^9 (d) 1×10^9

78. In hybridisation Tt × tt gives rise to the progeny of ratio *[1999]*
(a) 1 : 1 (b) 1 : 2
(c) 2 : 1 (d) 1 : 2 : 1

79. How many base pairs are found in one genome of man? *[1999]*
(a) 7×10^4 (b) 2.8×10^7
(c) 3×10^9 (d) 4×10^9

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80. Crossing over in diploid organism is responsible for *[1998]*
(a) segregation of alleles
(b) dominance of genes
(c) linkage between genes
(d) recombination of linked alleles

81. How many genome types are present in a typical green plant cell? *[1998]*
(a) Two (b) Three
(c) More than five (d) More than ten

82. If Mendel had studied the 7 traits using a plant with 12 chromosomes instead of 14, in what way would his interpretation have been different ? *[1998]*
(a) He would have discovered blending or incomplete dominance
(b) He would not have discovered the law of independent assortment
(c) He would have discovered sex linkage
(d) He could have mapped the chromosome

83. How many different types of genetically different gametes will be produced by a heterozygous plant having the genotype: AABbCc? *[1998]*
(a) Two (b) Four
(c) Six (d) Nine

84. Radioactive thymidine when added to the medium surrounding living mammalian cells gets incorporated into the newly synthesized DNA. Which of the following types of chromatin is expected to become radioactive if cells are exposed to radioactive thymidine as soon as they enter the S-phase? *[1998]*
(a) Heterochromatin
(b) Euchromatin
(c) Both heterochromatin and euchromatin
(d) Neither heterochromatin nor euchromatin but only the nucleolus

85. A fruit fly is heterozygous for sex-linked genes. When mated with a normal female fruit fly, the male-specific chromosome will enter egg cells in the proportion of *[1997]*
(a) 1 : 1 (b) 1 : 2
(c) 3 : 1 (d) 7 : 1

86. After crossing between two plants, the progenies are found to be male-sterile. This phenomenon is found to be maternally inherited and is due to some genes which are present in *[1997]*
(a) nucleus (b) chloroplast
(c) mitochondrion (d) cytoplasm

87. Alleles that produce independent effects in their heterozygous condition are called
(a) codominant alleles *[1996]*
(b) epistatic alleles
(c) complementary alleles
(d) supplementary alleles

88. When two genetic loci produce identical phenotypes in *cis* and *trans* position, they are considered to be *[1995]*
(a) pseudoalleles (b) different genes
(c) multiple alleles (d) parts of same gene

89. In a dihybrid cross AABB × aabb, F_2 progeny of AABB, AABb, AaBB and AaBb occurs in the ratio of *[1994]*
(a) 1 : 1 : 1 : 1 (b) 9 : 3 : 3 : 1
(c) 1 : 2 : 2 : 1 (d) 1 :2 : 2 : 4

90. A cross between pure tall Pea plant with green pods and dwarf Pea plant with yellow pods will produce short F_2 plants out of 16 *[1994]*
(a) 9 (b) 3
(c) 4 (d) 1

91. A child of blood group O can not have parents of blood groups *[1994]*
(a) AB and AB/O (b) A and B
(c) B and B (d) O and O

92. Mendel studied inheritance of seven pairs of traits in Pea which can have 21 possible combinations. If you are told that in one of these combinations, independent assortment is not observed in later studies, your reaction will be *[1993]*
(a) Independent assortment principle may be wrong
(b) Mendel might not have studied all the combinations
(c) It is impossible
(d) Later studies may be wrong

93. A polygenic inheritance in human beings is
(a) Skin colour *[1993]*
(b) Phenylketonuria
(c) Colour blindness
(d) Sickle cell anaemia

94. Two dominant nonallelic genes are 50 map units apart. The linkage is *[1993]*
(a) cis type
(b) trans type
(c) complete
(d) absent/ Incomplete

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95. An organism with two identical alleles is
(a) dominant (b) hybrid *[1992]*
(c) heterozygous (d) homozygous

96. In a cross between AABB × aabb, the ratio of F_2 genotypes between AABB, AaBB, Aabb and aabb would be *[1992]*
(a) 9 : 3 : 3 : 1 (b) 2 : 1 : 1 : 2
(c) 1 : 2 : 2 : 1 (d) 7 : 5 : 3 : 1

97. A gene pair hides the effect of another. The phenomenon is *[1999]*
(a) epistasis
(b) dominance
(c) mutation
(d) none of the above

98. An allele is dominant if it is expressed in *[1992]*
(a) both homozygous and heterozygous states
(b) second generation
(c) heterozygous combination
(d) homozygous combination

99. A child of O-group has B-group father. The genotype of father will be *[1992]*
(a) $I^O I^O$ (b) $I^B I^B$
(c) $I^A I^B$ (d) $I^B I^O$

100. Out of 8 ascospores formed in *Neurospora* the arrangement is 2a : 4a : 2a showing *[1992]*
(a) No crossing over
(b) Some meiosis
(c) Second generation division
(d) First generation division

101. When a certain character is inherited only through female parent, it probably represents *[1992]*
(a) multiple plastid inheritance
(b) cytoplasmic inheritance
(c) incomplete dominance
(d) mendelian nuclear inheritance

102. Red (RR) *Antirrhinum* is crossed with white (WW) one. Offspring RW are pink. This is an example of *[1991]*
(a) dominant -recessive
(b) incomplete dominance
(c) hybrid
(d) supplementary genes

103. The allele which is unable to express its effect in the presence of another is called *[1991]*
(a) codominant (b) supplementary
(c) complementary (d) recessive

104. A dihybrid condition is *[1991]*
(a) tt Rr (b) Tt rr
(c) tt rr (d) Tt Rr

105. Mendel's last law is *[1991]*
(a) segregation
(b) dominance
(c) independent assortment
(d) polygenic inheritance

106. First geneticist/ father of genetics was *[1991]*
(a) de Vries (b) Mendel
(c) Darwin (d) Morgan

107. The contrasting pairs of factors in Mendelian crosses are called *[1991]*
(a) multiple alleles (b) allelomorphs
(c) alloloci (d) paramorphs

108. A man of A-blood group marries a women of AB blood group. Which type of progeny would indicate that man is heterozygous A? *[1991]*
(a) AB (b) A
(c) O (d) B

109. tt mates with Tt. What will be characteristic of offspring ? *[1990]*
(a) 75% recessive (b) 50% recessive
(c) 25% recessive (d) All dominant

110. ABO blood group system is due to *[1990]*
(a) multifactor inheritance
(b) incomplete dominance
(c) multiple allelism
(d) epistasis

111. In a genetic cross having recessive epistasis, F_2 phenotypic ratio would be *[1990]*
(a) 9 : 6 : 1 (b) 15 : 1
(c) 9 : 3 : 4 (d) 12 : 3 : 1

112. Cross between AaBB and aaBB will form *[1990]*
(a) 1 AaBB : 1aaBB (b) All AaBB
(c) 3 AaBB : 1 aaBB (d) 1 AaBB : 3 aaBB

113. Both husband and wife have normal vision though their fathers were colour blind. The probability of their daughter becoming colour blind is *[1990]*
(a) 0% (b) 25%
(c) 50% (d) 75%

114. Bateson used the terms coupling and repulsion for linkage and crossing over. Name the correct parent of coupling type alongwith its cross repulsion *[1990]*

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(a) Coupling AABB, aabb; Repulsion AABB, AAbb
(b) Coupling AAbb, aaBB; Repulsion AaBb, aabb
(c) Coupling aaBB, aabb; Repulsion AABB, aabb
(d) Coupling AABB, aabb : Repulsion AAbb, aaBB

115. Diploid chromosome number in humans is
(a) 46 (b) 44 ***[1989]***
(c) 48 (d) 42

116. Two linked genes a and b show 20% recombination. The individuals of a dihybrid cross between + +/ + + × ab/ab shall show gametes ***[1989]***
(a) + + 80 : ab : 20
(b) + + 50 : ab : 50
(c) + + 40 : ab 40 : + a 10 : + b : 10
(d) + + 30 : ab 30 : + a 20 : + b : 20

117. A normal green male maize is crossed with albino female. The progeny is albino because
(a) trait for albinism is dominant ***[1989]***
(b) the albinos have biochemical to destroy plastids derived form green male
(c) plastids are inherited from female parent
(d) green plastids of male must have mutated

118. What contribute to the success of Mendel ?
(a) Qualitative analysis of data ***[1988]***
(b) Observation of distinct inherited traits
(c) His knowledge of biology
(d) Consideration of one character at one time

119. Haploids are able to express both recessive and dominant alleles/mutations because there are
(a) many alleles for each gene ***[1988]***
(b) two alleles for each gene
(c) only one allele for each gene in the individual
(d) only one allele in a gene

Topic 2: Sex Determination

120. In our society women are blamed for producing female children. Choose the correct answer for the sex-determination in humans ***[NEET Kar. 2013]***
(a) Due to some defect in the women
(b) Due to some defect like aspermia in man
(c) Due to the genetic make up of the particular sperm which fertilizes the egg
(d) Due to the genetic make up of the egg

121. Which one of the following conditions correctly describes the manner of determining the sex in the given example? ***[2011]***
(a) Homozygous sex chromosomes (ZZ) determine female sex in birds.
(b) XO type of sex chromosomes determine male sex in grasshopper
(c) XO condition in human as found in Turner syndrome, determines female sex.
(d) Homozygous sex chromosomes (XX) produce male in *Drosophila.*

122. In *Drosophila*, the sex is determined by ***[2003]***
(a) whether the egg is fertilized or develops parthenogenetically
(b) the ratio of number of X-chromosomes to the sets of autosomes
(c) X and Y chromosomes
(d) the ratio of pairs of X-chromosomes to the pairs of autosomes

123. In which mode of inheritance do you expect more maternal influence among the offspring? ***[2006]***
(a) Cytoplasmic (b) Y-linked
(c) X-linked (d) Autosomal

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124. Crossing over that results in genetic recombination in higher organisms occurs between ***[2004]***
(a) sister chromatids of a bivalent
(b) non-sister chromatids of a bivalent
(c) two daughter nuclei
(d) two different bivalents

125. When a cluster of genes show linkage behaviour they ***[2003]***
(a) induce cell division
(b) do not show a chromosome map
(c) show recombination during meiosis
(d) do not show independent assortment

126. No. of barr body present in each somatic cell of a female is ***[2001]***
(a) 1 (b) 2
(c) 3 (d) 4

127. *Drosophila* flies with XXY genotype are females but in case of humans, such individuals are abnormal males (Klinefelter's syndrome). This indicates that ***[2000]***
(a) The Y chromosome has no role in sex determination
(b) In *Drosophila*, the Y chromosome is essential for sex determination

(c) The Y chromosome is male determining in humans
(d) The Y chromosome is female determining in *Drosophila*

128. Genetic identity of a human male is determined by *[1997]*
(a) autosomes (b) nucleolus
(c) sex chromosomes (d) cell organelles

129. An individual exhibiting both male and female sexual characteristics in the body is known as *[1996]*
(a) hermaphrodite (b) intersex
(c) gynandromorph (d) bisexual

130. Barr body in human female is formed by *[1996]*
(a) inactivation of paternal X-chromosome
(b) inactivation of maternal X-chromosome
(c) inactivation of both X-chromosomes
(d) inactivation of either the paternal or maternal X-chromosome

131. H.J.Muller was awarded Nobel Prize for his *[1996]*
(a) discovery that chemicals can induce gene mutations
(b) discovery that ionizing radiations can induce gene mutations
(c) work on gene mapping in *Drosophila*
(d) efforts to prevent the use of nuclear weapons.

132. Barr body in mammals represents *[1995]*
(a) all the heterochromatin in female cells
(b) Y-chromosomes in somatic cells of male
(c) all heterochromatin in male and female cells
(d) one of the two X-chromosomes in somatic cells of females

133. The polytene chromosomes were discovered for the first time in *[1995]*
(a) *Drosophila* (b) *Chironomus*
(c) *Musca nebulo* (d) *Musca domestica*

134. A fruitfly exhibiting both male and female traits is *[1994]*
(a) heterozygous (b) gynandromorph
(c) hemizygous (d) gynander

135. Sex is determined in human beings *[1993]*
(a) by ovum
(b) at time of fertilization
(c) 40 days after fertilization
(d) seventh to eight week when genitals differentiate in foetus

Topic 3: Mutation/Genetic Disorders

136. Select the correct match
(a) Phenylketonuria – Autosomal dominant trait
(b) Sickle cell anaemia – Autosomal recessive trait, chromosome-11
(c) Thalassemia – X linked
(d) Haemophilia – Y linked

137. Match the items of Column-I with Column-II :

Column-I	Column-II
(A) XX-XO method	(i) Turner's syndrome of sex determination
(B) XX-XY method	(ii) Female heterogametic of sex determination
(C) Karyotype-45	(iii) Grasshopper
(D) ZW-ZZ method of sex	(iv) Female homogametic determination

Select the correct option from the following :
(a) (A)-(iv), (B)-(ii), (C)-(i), (D)-(iii)
(b) (A)-(ii), (B)-(iv), (C)-(i), (D)-(iii)
(c) (A)-(i), (B)-(iv), (C)-(ii), (D)-(iii)
(d) (A)-(iii), (B)-(iv), (C)-(i), (D)-(ii)

138. In which genetic condition, each cell in the affected person, has three sex chromosomes XXY? *[2019, Odisha]*
(a) Turner's syndrome
(b) Thalassemia
(c) Klinefelter's syndrome
(d) Phenylketonuria

139. Thalassemia and sickle cell anemia are caused due to a problem in globin molecule synthesis. Select the correct statement : *[2017]*
(a) Both are due to a quantitative defect in globin chain synthesis
(b) Thalassemia is due to less synthesis of globin molecules
(c) Sickel cell anemia is due to a quantitative problem of globin molecules
(d) Both are due to a qualitative defect in globin chain synthesis

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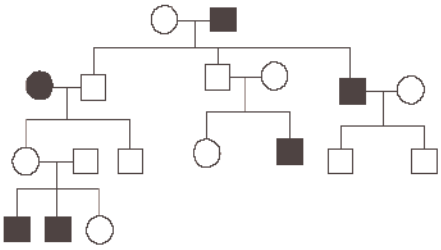
140. A disease caused by an autosomal primary non-disjunction is : *[2017]*
(a) Klinefelter's Syndrome
(b) Turner's Syndrome
(c) Sickel Cell Anemia
(d) Down's Syndrome

141. Which of the following most appropriately describes haemophilia ? *[2016]*
(a) Recessive gene disorder
(b) X - linked recessive gene disorder
(c) Chromosomal disorder
(d) Dominant gene disorder

142. Pick out the correct statements : *[2016]*
(1) Haemophilia is a sex-linked recessive disease
(2) Down's syndrome is due to aneuploidy
(3) Phenylketonuria is an autosomal recessive gene disorder.
(4) Sickle cell anaemia is a X-linked recessive gene disorder
(a) (1) and (4) are correct
(b) (2) and (4) are correct
(c) (1), (3) and (4) are correct
(d) (1), (2) and (3) are correct

143. In the following human pedigree, the filled symbols represent the affected individuals. Identify the type of given pedigree. *[2015 RS]*



(a) X- linked recessive
(b) Autosomal recessive
(c) X-linked dominant
(d) Autosomal dominant

144. A colour blind man marries a woman with normal sight who has no history of colour blindness in her family.
What is the probability of their grandson being colour blind ? *[2015 RS]*
(a) 1 (b) Nil
(c) 0.25 (d) 0.5

145. An abnormal human baby with 'XXX' sex chromosomes was born due to : *[2015 RS]*
(a) formation of abnormal ova in the mother
(b) fusion of two ova and one sperm
(c) fusion of two sperms and one ovum
(d) formation of abnormal sperms in the father

146. A pleiotropic gene: *[2015 RS]*
(a) is a gene evolved during Pliocene.
(b) controls a trait only in combination with another gene
(c) controls multiple traits in an individual.
(d) is expressed only in primitive plants

147. A man whose father was colour blind marries a woman who had a colour blind mother and normal father. What percentage of male children of this couple will be colour blind? *[2014]*
(a) 25% (b) 0%
(c) 50% (d) 75%

148. A human female with Turner's syndrome:
(a) has 45 chromosomes with XO. *[2014]*
(b) has one additional X chromosome.
(c) exhibits male characters.
(d) is able to produce children with normal husband.

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149. If both parents are carriers for thalassemia, which is an autosomal recessive disorder, what are the chances of pregnancy resulting in an affected child? *[NEET 2013]*
(a) 50% (b) 25%
(c) 100% (d) no chance

150. The incorrect statement with regard to Haemophilia is : *[NEET 2013]*
(a) It is a recessive disease
(b) It is a dominant disease
(c) A single protein involved in the clotting of blood is affected
(d) It is a sex-linked disease

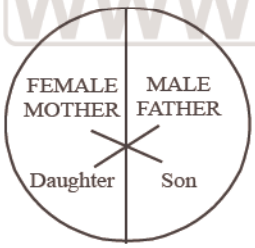
151. Which one is the **incorrect** statement with regards to the importance of pedigree analysis? *[NEET Kar. 2013]*
(a) It helps to trace the inheritance of a specific trait
(b) It confirms that DNA is the carrier of genetic information
(c) It helps to understand whether the trait in question is dominant or recessive
(d) It confirms that the trait is linked to one of the autosome

152. Down's syndrome in humans is due to *[NEET Kar. 2013]*
(a) Two 'Y' chromosomes
(b) Three 'X' chromosomes
(c) Three copies of chromosome 21
(d) Monosomy

153. A normal- visioned man whose father was colour. blind, marries a woman whose father was also colour blind. They have their first child as a daughter. what are the chance that this child would be colour blind ? *[2012]*
(a) 100% (b) zero percent
(c) 25% (d) 50 %

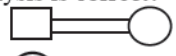
154. Which one of the following is a wrong statement regarding mutations? *[2012M]*
(a) Deletion and insertion of base pairs cause frame-shift mutations.
(b) Cancer cells commonly show chromosomal aberrations.
(c) UV and Gamma rays are mutagens.
(d) Change in a single base pair of DNA does not cause mutation.

155. Represented below is the inheritance pattern of a certain type of traits in humans.

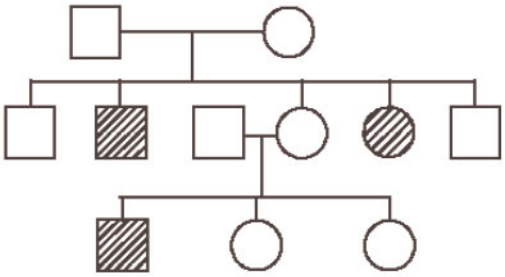


Which one of the following conditions could be an example of this pattern? *[2012M]*
(a) Thalassemia
(b) Haemophilia
(c) Phenylketonuria
(d) Sickle cell anaemia

156. Mutations can be induced with : *[2011]*
(a) infra red radiations
(b) I AA
(c) ethylene
(d) gamma radiations

157. Which one of the following symbols and its representation, used in human pedigree analysis is correct? *[2010]*
(a)  = mating between relatives
(b) = unaffected male
(c) = unaffected female
(d) = male affected

158. Study the pedigree chart given below:
What does it show? *[2009]*



(a) Inheritance of a condition like phenylketonuria as an autosomal recessive trait
(b) The pedigree chart is wrong as this is not possible
(c) Inheritance of a recessive sex - linked disease like haemophilia
(d) Inheritance of a sex -linked inborn error of metabolism like phenylketonuria

159. The genetic defect - Adenosine deaminase (ADA) deficiency may be cured permanently by: *[2009]*
(a) administering adenosine deaminase activators.
(b) introducing bone marrow cells producing ADA into cells at early embryonic stages.
(c) enzyme replacement therapy.
(d) periodic infusion of genetically engineered lymphocytes having functional ADA cDNA.

160. Sickle cell anaemia is: *[2009]*
(a) caused by substitution of valine by glutamic acid in the beta globin chain of haemoglobin
(b) caused by a change in a single base pair of DNA
(c) characterized by elongated sickle like RBCs with a nucleus
(d) an autosomal linked dominant trait

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161. Select the **incorrect** statement from the following: *[2009]*
(a) Galactosemia is an inborn error of metabolism
(b) Small population size results in random genetic drift in a population
(c) Baldness is a sex -limited trait
(d) Linkage is an exception to the principle of independent assortment in heredity

162. Point mutation involves: *[2009]*
(a) change in single base pair
(b) duplication
(c) deletion
(d) insertion

163. Which one of the following conditions in humans. is correctly matched with its chromosomal abnormality/linkage? *[2008]*
(a) Klinefelters syndrome-44 autosomes + XXY
(b) Colour blindness - Y-linked
(c) Erythroblastosis foetalis - X-linked
(d) Downs syndrome - 44 autosomes + XO

164. Haploids are more suitable for mutation studies than the diploids. This is because *[2008]*
(a) haploids are reproductively more stable than diploids
(b) mutagens penetrate in haploids more effectively than diploids
(c) haploids are more abundant in nature than diploids
(d) all mutations, whether dominant or recessive are expressed in haploids

165. If a colour blind woman marries a normal visioned man, their sons will be *[2006]*
(a) one-half colour blind and one-half normal
(b) three-fourths colour blind and one-fourth normal
(c) all colour blind
(d) all normal visioned

166. Cri-du-chat syndrome in humans is caused by the *[2006]*
(a) loss of half of the short arm of chromosome 5
(b) loss of half of the long arm of chromosome 5
(c) trisomy of 21st chromosome
(d) fertilization of an XX egg by a normal Y-bearing sperm

167. Both sickle cell anemia and Huntington's chorea are *[2006]*
(a) congenital disorders
(b) pollulant-induced disorders
(c) virus-related diseases
(d) bacteria - related diseases

168. Sickle cell anaemia has not been eliminated from the African population because *[2006]*
(a) it is not a fatal disease
(b) it provides immunity against malaria
(c) it is controlled by dominant genes
(d) it is controlled by recessive genes

169. G-6-P dehydrogenase deficiency is associated with haemolysis of: *[2005]*
(a) leucocytes (b) lymphocytes
(c) platelets (d) RBCs

170. Which of the following is not a hereditary disease? *[2005]*
(a) Cystic fibrosis (b) Thalassemia
(c) Haemophilia (d) Cretinism

171. Haemophilia is more commonly seen in human males than in human females because: *[2005]*
(a) a greater proportion of girls die in infancy
(b) this disease is due to a Y-linked recessive mutation
(c) this disease is due to an X-linked recessive mutation
(d) this disease is due to an X-linked dominant mutation

172. A women with 47 chromosomes due to three copies of chromosome 21 is characterized by: *[2005]*
(a) superfemaleness
(b) triploidy
(c) turner's syndrome
(d) down's Syndrome

173. A man with a certain disease marries a normal woman. They have eight children (3 daughters and 5 sons). All the daughters suffer from their father's disease but none of the sons are affected. Which of the following mode of inheritance do you suggest for this disease? *[2005]*
(a) Sex-linked recessive
(b) Sex-linked dominant
(c) Autosomal dominant
(d) Sex-limited recessive

174. A normal woman, whose father was colour-blind is married to a normal man. The sons would be *[2004]*
(a) 75% colour-blind (b) 50% color-blind
(c) all normal (d) all colour-blind

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175. One of the parents of a cross has a mutation in its mitochondria. In that cross, that parent is taken as a male. During segregation of F_2 progenies that mutation is found in *[2004]*
(a) one-third of the progenies
(b) none of the progenies
(c) all the progenies
(d) fifty percent of the progenies

176. After a mutation at a genetic locus the character of an organism changes due to the change in
(a) protein structure *[2004]*
(b) DNA replication
(c) protein synthesis pattern
(d) RNA transcription pattern

177. Christmas disease is another name for *[2003]*
(a) sleeping sickness
(b) haemophilia
(c) hepatitis B
(d) Down's syndrome

178. Pattern baldness, moustaches and beard in human males are examples of *[2003]*
(a) sex-determining traits
(b) sex linked traits
(c) sex limited traits
(d) sex influenced traits

179. Down's syndrome is caused by an extra copy of chromosome number 21. What percentage of offspring produced by an affected mother and a normal father would be affected by this disorder? *[2003]*
(a) 25% (b) 100%
(c) 75% (d) 50%

180. Which of the following is correct match? *[2002]*
(a) Down's syndrome — 21st chromosome
(b) Sickle cell anaemia — X-chromosome
(c) Haemophila — Y-chromosome
(d) Parkinson disease — X & Y chromosome

181. Which of the following is an example of sex linked disease? *[2002]*
(a) AIDS (b) Colour blindness
(c) Syphilis (d) Gonorrhoea

182. Which of the following is an example of pleiotropic effect? *[2002]*
(a) Haemophilia
(b) Thalassemia
(c) Sickle cell anaemia
(d) Colour blindness

183. A diseased man marries a normal woman. They have three daughters and five sons. All the daughters were diseased and sons were normal. The gene of this disease is *[2002]*
(a) sex-linked dominant
(b) sex-linked recessive
(c) sex-linked character
(d) autosomal dominant

184. In humans, male XXY and female XXXX occur due to *[2001]*
(a) aneuploidy
(b) euploidy
(c) autosomal syndrome
(d) none of these

185. Sickle cell anaemia is induced by *[2001]*
(a) change of amino acid in a-chain of haemoglobin
(b) change of amino acid in b-chain of haemoglobin
(c) change of amino acid in both a- and b-chain of haemoglobin
(d) change of amino acid in either a- or b-chain of haemoglobin

186. Mongoloid idiocy in humans is also known as
(a) Tay Sachs disease *[2000]*
(b) Klinefelter's syndrome
(c) Down's Syndrome
(d) Turner's Syndrome

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187. Which of the following is the main category of mutation? *[1999]*
(a) Genetic mutation
(b) Zygotic mutation
(c) Somatic mutation
(d) All of these

188. One child is haemophilic (sex-linked trait), while its fraternal twin brother is normal. Which one of the following informations is most appropriate? *[1999]*
(a) The mother must have been heterozygous
(b) The child is a monozygotic twin
(c) The other child is a female and the father is haemophilic
(d) The haemophilic child is a male

189. Red-green colour blindness in humans is governed by a sex-linked recessive gene. A normal woman whose father was colour blind marries a colour blind man. What proportion of their daughters is expected to be colourblind? *[1999]*
(a) 3/4 (b) 1/2
(c) 1/4 (d) All

190. In Down's syndrome, Karyotyping has shown that the disorder is associated with trisomy of chromosome number-21 usually due to *[1998]*
(a) non-disjunction during egg-cell formation
(b) non-disjunction during sperm-cell formation
(c) non-disjunction during formation of egg-cells and sperm-cells
(d) addition of extra chromosome during mitosis of the zygote

191. Mental retardation in man associated with sex chromosomal abnormality is usually due to
(a) increase in X complement *[1998]*
(b) moderate increase in Y complement
(c) large increase in Y complement
(d) reduction in X complement

192. The formation of multivalents at meiosis in a diploid organism is due to *[1998]*
(a) inversion
(b) deletion
(c) monosomy
(d) reciprocal translocation

193. A woman with two genes for haemophilia and a gene for colour blindness on one of the 'X' chromosomes marries a normal man. How will the progeny be *[1992]*
(a) haemophilic and colour-blind daughters
(b) 50% haemophilic colour-blind sons and 50% haemophilic sons
(c) 50% haemophilic daughters and 50% colour-blind daughters
(d) All sons and daughters haemophilic and colour-blind

194. Albinism is known to be due to an autosomal recessive mutation. The first child of a couple with normal skin pigmentation was an albino. What is the probability that their second child will also be an albino? *[1998]*
(a) 25% (b) 50%
(c) 75% (d) 100%

195. A person with the sex chromosomes XXY suffers from *[1997]*
(a) Down's syndrome
(b) Klinefelter's syndrome
(c) Turner's syndrome
(d) Gynandromorphism

196. Minor changes at gene level are described as
(a) Point mutations *[1997]*
(b) Chromosomal mutations
(c) Reverse mutations
(d) Forward mutations

197. A person with 47 chromosomes due to an additional Y chromosome suffers from a condition called *[1996]*
(a) Down's syndrome
(b) Superfemale
(c) Turner's syndrome
(d) Klinefelter's syndrome

198. The most striking example of point mutation is found in a disease called *[1995]*
(a) thalassemia
(b) night blindness
(c) down's syndrome
(d) sickle cell anaemia

199. A women with albinic father marries an albinic man. The proportion of her progeny is *[1994]*
(a) 2 normal : 1 albinic
(b) all normal
(c) all albinic
(d) 1 normal : 1 albinic

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200. Genes located on Y-chromosome are *[1994]*
(a) mutant genes (b) sex-linked genes
(c) autosomal genes (d) holandric genes

201. A colour blind mother and normal father would have *[1994]*
(a) colour blind sons and normal/carrier daughters
(b) colour blind sons and daughters
(c) all colour blind
(d) all normal

202. Haploids are preferred over diploids for mutation studies because in haploids *[1993]*
(a) recessive mutations express immediately
(b) dominant mutations express immediately
(c) mutations are readily induced
(d) tissue culture is easy

203. Of a normal couple, half the sons are haemophilic while half the daughters are carriers. The gene is located on *[1993]*
(a) X-chromosome of father
(b) Y-chromosome of father
(c) one X-chromosome of mother
(d) both the X-chromosomes of mother

204. Which of the following is suitable for experiment on linkage *[1993]*
(a) aaBB × aaBB (b) AABB × aabb
(c) AaBb × AaBb (d) AAbb × AaBB

205. Mr. Kapoor has Bb autosomal gene pair and d allele sex-linked. What shall be proportion of Bd in sperms *[1993]*
(a) Zero (b) 1/2
(c) 1/4 (d) 1/8

206. Of both normal parents, the chance of a male child becoming colour blind are *[1993]*
(a) no
(b) possible only when all the four grand parents had normal vision
(c) possible only when father's mother was colour blind
(d) possible only when mother's father was colour blind

207. Segregation of Mendelian factors (no linkage, no crossing over) occurs during *[1992]*
(a) anaphase I (b) anaphase II
(c) diplotene (d) metaphase I

208. In human beings, 45 chromosomes/single X/XO abnormality causes *[1992]*
(a) Down's syndrome
(b) Kinefelter's syndrome
(c) Turner's syndrome
(d) Edward's syndrome

209. Down's syndrome is due to *[1992]*
(a) crossing over
(b) linkage
(c) sex-linked inheritance
(d) nondisjunction of chromosomes

210. Blue eye colour is recessive to brown eye colour. A brown eyed man whose mother was blue eyed marries a blue-eyed woman. The children shall be *[1991]*
(a) both blue eyed and brown eyed 1 : 1
(b) all brown eyed
(c) all blue eyed
(d) blue eyed and brown eyed 3 : 1

211. Multiple alleles control inheritance of *[1991]*
(a) phenylketonuria
(b) colour blindness
(c) sickle cell anaemia
(d) blood groups

212. A colour blind girl is rare because she will be born only when *[1991]*
(a) her mother and maternal grand father were colour blind
(b) her father and maternal grand father were colour blind
(c) her mother is colour blind and father has normal vision
(d) parents have normal vision but grand parents were colour blind.

213. Which one is a hereditary disease? *[1990]*
(a) Cataract (b) Leprosy
(c) Blindness (d) Phenylketonuria

214. Haemophilia is more common in males because it is a *[1990]*
(a) Recessive character carried by Y chromosome
(b) Dominant character carried by Y chromosome
(c) Dominant trait carried by X chromosome
(d) Recessive trait carried by X chromosome

215. In Down's syndrome of a male child, the sex complement is *[1990]*
(a) XO (b) XY
(c) XX (d) XXY

216. A mother in a family of five daughters is expecting her sixth baby. The chance of its being a son is *[1988]*
(a) zero (b) 25%
(c) 50% (d) 100%

217. Mutations used in agriculture are commonly *[1988]*
(a) induced
(b) spontaneous
(c) lethal
(d) recessive and lethal

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ANSWER KEY

1	(c)	23	(c)	45	(d)	67	(b)	89	(d)	111	(c)	133	(b)	155	(b)	177	(b)	199	(d)
2	(d)	24	(d)	46	(c)	68	(a)	90	(c)	112	(a)	134	(b)	156	(d)	178	(c & d)	200	(d)
3	(d)	25	(b)	47	(c)	69	(b)	91	(a)	113	(a)	135	(b)	157	(a)	179	(d)	201	(a)
4	(b)	26	(c)	48	(b)	70	(a)	92	(b)	114	(d)	136	(b)	158	(a)	180	(a)	202	(a)
5	(d)	27	(d)	49	(c)	71	(d)	93	(a)	115	(a)	137	(d)	159	(b)	181	(b)	203	(c)
6	(c)	28	(c)	50	(c)	72	(d)	94	(d)	116	(c)	138	(c)	160	(b)	182	(c)	204	(b)
7	(c)	29	(a)	51	(c)	73	(c)	95	(d)	117	(c)	139	(b)	161	(c)	183	(a)	205	(c)
8	(c)	30	(c)	52	(d)	74	(b)	96	(c)	118	(d)	140	(d)	162	(a)	184	(a)	206	(d)
9	(b)	31	(c)	53	(d)	75	(a)	97	(a)	119	(c)	141	(b)	163	(a)	185	(b)	207	(a)
10	(b)	32	(a)	54	(a)	76	(b)	98	(a)	120	(c)	142	(d)	164	(d)	186	(c)	208	(c)
11	(a)	33	(d)	55	(c & d)	77	(a)	99	(d)	121	(b)	143	(b)	165	(c)	187	(a)	209	(d)
12	(d)	34	(a)	56	(c)	78	(a)	100	(c)	122	(b)	144	(c)	166	(a)	188	(a)	210	(a)
13	(a)	35	(c)	57	(c)	79	(c)	101	(b)	123	(a)	145	(a)	167	(a)	189	(b)	211	(d)
14	(b)	36	(c)	58	(a)	80	(d)	102	(b)	124	(b)	146	(c)	168	(b)	190	(c)	212	(b)
15	(c)	37	(a)	59	(a)	81	(b)	103	(d)	125	(d)	147	(c)	169	(d)	191	(a)	213	(d)
16	(b)	38	(c)	60	(a)	82	(b)	104	(d)	126	(a)	148	(a)	170	(d)	192	(d)	214	(d)
17	(c)	39	(a)	61	(c)	83	(b)	105	(c)	127	(c)	149	(b)	171	(c)	193	(b)	215	(b)
18	(c)	40	(d)	62	(c)	84	(b)	106	(b)	128	(c)	150	(b)	172	(d)	194	(a)	216	(c)
19	(b)	41	(c)	63	(a)	85	(a)	107	(b)	129	(c)	151	(b)	173	(b)	195	(b)	217	(a)
20	(a)	42	(c)	64	(c)	86	(c)	108	(d)	130	(d)	152	(c)	174	(b)	196	(a)		
21	(b)	43	(d)	65	(d)	87	(a)	109	(b)	131	(b)	153	(b)	175	(b)	197	(NA)		
22	(b)	44	(b)	66	(c)	88	(b)	110	(c)	132	(d)	154	(d)	176	(a)	198	(d)		

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Hints & Solutions

1. (c) Experimental verification of the chromosomal theory of inheritance was done by Morgan. Sutton and Boveri proposed chromosomal theory of inheritance but it was experimentally verified by T.H. Morgan.

> **NOTES** The development of the Chromosomal Theory of Inheritance signifies chromosomes as the genetic material which is responsible for Mendelian inheritance.

2. (d) Embryological support for evolution was disapproved by Karl Ernst von Baer, he noted that embryos never pass through the adult stages of other animals during embryonic development.

> **NOTES** The biogenetic law is a theory of development and **evolution proposed** by Ernst Haeckel in Germany in the 1860s. It is one of several recapitulation theories, which posit that the stages of development for an animal embryo are the same as other animal's adult stages or forms.

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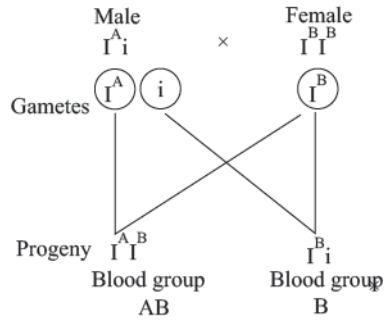
3. (d) Punnett square is a graphical representation of the possible genotypes of an offspring arising from a particular cross or breeding event. With the help of Punnett square the production of gametes, the formation of zygotes and the F1 and F2 plants can be understood.

> **NOTES** Punnett square is named after Reginald C. Punnett, who devised the approach. These tables can be used to examine the genotypical outcome probabilities of the offspring of a single trait (allele), or when crossing multiple traits from the parents. The Punnett square is a visual representation of Mendelian inheritance. It is important to understand the terms "heterozygous", "homozygous", "double heterozygote" (or homozygote), "dominant allele" and "recessive allele" when using the Punnett square method. For multiple traits, using the "forked-line method" is typically much easier than the Punnett square.

4. (b) Male with blood group A can have genotype IA i or IAIA.

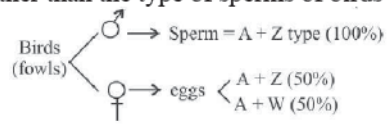
Female with blood group B can have genotype I^BI^B, or I^Bi



5. (d) Genes for flower colour in snapdragon shows incomplete dominance which is an exception of Mendel's first principle (*i.e.* Law of dominance), whereas Law of segregation is universally applicable. Incomplete dominance is a process when a dominant allele, or form of a gene, does not completely mask the effects of a recessive allele, and the organism's resulting physical appearance shows a blending of both alleles.

6. (c) 1 map unit represent 1% cross over. Map unit is used to measure genetic distance. This genetic distance is based on average number of cross over frequency.

7. (c) In birds female heterogamety is found thus sex of progeny depends on the types of egg rather than the type of sperms of birds (fowls).



8. (c) Woman acts as a carrier. Both son & daughter inherit X-chromosome. Although only son would be the diseased one.

$$X^cX \times XY$$
$$\downarrow$$
$$X^cX \quad X^cY \quad XX \quad XY$$

> **NOTES** Sex-linked diseases are passed down through families through one of the X or Y chromosomes. X and Y are sex chromosomes. Dominant inheritance occurs when an abnormal gene from one parent causes disease, even though the matching gene from the other parent is normal.

9. (b) IAIO, IBIO - Dominant-recessive relationship
I^AI^B - Codominance
I^A, I^B & I^O - Three different allelic forms of a gene (multiple allelism)

10. (b) Husband × Wife
I^AI^B I^Ai

♀ \ ♂	I^A	I^B
I^A	I^AI^A	I^AI^B
i	I^Ai	I^Bi

Number of genotypes = 4
Number of phenotypes = 3
I^AI^A and I^Ai = A
I^AI^B = AB
I^Bi = B

11. (a) During his experiments Mendel have taken seven characters in a pea plant. Among these, nature of trichomes i.e., glandular or non-glandular was not considered by Mendel.

12. (d) According to NCERT, Mendel conducted hybridisation experiments for 7 years on Pea plant between 1856 to 1863 and his data was published in 1865.

13. (a) Parents – TT × tt
(Tall) (Dwarf)
↓
F_1 generation Tt (Heterozygous Tall)
↓
On Selfing

	T	t
T	TT Tall	Tt Tall
t	Tt Tall	tt Dwarf

Phenotypic ratio : 3: 1 (Tall :Dwarf)
Genotypic ratio: 1:2:1 (Homozygous Tall : Heterozygous Tall : Dwarf)

14. (b)

15. (c) When two genes in a dihybrid cross are situated on the same chromosome, the proportion of parental gene combinations are much higher than the non-parental or recombinant type. This is also called incomplete linkage.

16. (b) This phenomenon is known as polyploidy, wherein the cells contain more than two paired (homologous) sets of chromosomes. Polyploidy is often seen in the case of plants. The major cause of polyploidy is the non-disjunction of sister chromatids during meiotic recombination. This condition is actually useful in development of new crop varieties.

17. (c) Seven pairs of contrasting characters were selected in pea plant and studied by Mendel in his experiment.

18. (c) The most common cause of variations is recombination in the organism which are reproduced by sexual way.

19. (b) Alleles are defined as alternative forms of the same gene.

20. (a) Mendel did not use pod length for his experiment.

21. (b) Possible genotype of man with blood group A × Possible genotype of woman with blood group B
$I^A I^A$, I^A i × $I^B I^B$, I^B i
If the genotype is
I^A i × I^B i
The possibility of resultant blood group may be A, B, AB and O.

22. (b) All alleles of a gene are situated on the same locus of chromosome in organisms.

23. (c) In codominance, both alleles are independently expressed in the heterozygote.

24. (d) Thomas Hunt Morgan won the Nobel Prize (1933) in physiology or medicine for the function of chromosomes in heredity.

25. (b) Epistasis is the phenomenon of suppression of phenotypic expression of gene by a nonallelic gene which shows its own effect. A dominant epistatic allele suppresses the expression of a nonallelic gene whether the latter is dominant or recessive. For example, fruit colour of Summer Squash (*Cucurbita pepo*) is governed by a gene which pruduces yellow colour in dominant state (Y-) and green colour in recessive state (yy).

26. (c) According to Hardy Weinberg principle,
$p^2 + 2pq + q^2 = 1$; $(p + q)^2 = 1$
(AA) p^2 = 360 out of 1000 individual

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or $p^2 = 36$ out of 100
$q^2 = 160$ out of 1000 or $q^2 = 16$ out of 100
so $q = \sqrt{.16} = .4$, As $p + q = 1$
so p is 0.6.

27. (d) ABO blood group system in human beings is an example of codominant, dominant recessive and multiple alleles. Blood groups are controlled by the gene I located on 9th chromosome that has 3 multiple alleles, out of which any two are found in a person. In codominance, both genes express themselves completely.
28. (c) In co-dominance, F_1 generation resembles both the parents. Ex : Blood group inheritance.
29. (a) Tightly linked genes show more linkage than crossing over.
30. (c) Crossing over leads to recombination of genetic material on the two chromosomes. Mutation results in alternation of DNA sequences and consequently results in change in the genotype and the phenotype of an organism. In addition to recombination, mutation is another phenomenon that leads to variation in DNA.
31. (c) Blood group O acts as universal donor.
32. (a) A test cross, first introduced by Gregor Mendel, is used to determine if an individual exhibiting a dominant trait is homozygous or heterozygous for that trait. It takes place between an individual with unknown genotype and recessive parent.
33. (d) Incomplete (partial or mosaic) dominance is the phenomenon where none of the two contrasting alleles or factors is dominant. The expression of the character in a hybrid or F_1 individual is intermediate or a fine mixture of the expression of the two factors (as found in homozygous state). Incomplete or mosaic inheritance is not an example of pre-Mendelian concept of blending inheritance because the parental types reappear in the F_2 generation. It is however, considered by some workers to be an example of quantitative inheritance where only a single gene pair is involved. F_2 phenotypic ratio is 1 : 2 : 1, similar to genotypic ratio.

NOTES

Pink snapdragons are a result of incomplete dominance. Cross-pollination between red snapdragons and white snapdragons result in pink when neither the white or the red alleles are dominant. The fruit color of eggplants is another example of incomplete dominance.

34. (a) Heterosis or hybrid vigor occurs when two unrelated individuals or lines are crossed, the performance of F_1 hybrid, which is often superior to both the parents.

NOTES

Heterosis is quantified on an individual or population basis as the difference in the performance of the hybrid relative to the average of the inbred parents (termed the mid-parent value). For quantitative genetic analysis, the deviation of the hybrid relative to the mid-parent is the relevant value.

35. (c) Type O blood group is considered the universal donor blood group. It can potentially be transfused to any patient regardless of their blood type. In emergency situation, this type of blood can be given to the patient.
36. (c) In test cross, genotype of an organism showing dominant phenotype is determined by crossing it with homozygous recessive genotype.
37. (a) Two X chromosomes would lead to the birth of normal human female child.
38. (c) According to Mendel's law of dominance, out of two contrasting allelomorphic factors only one expresses itself in an individual. The factor that expresses itself is called dominant while the other which has not shown its effect in the heterozygous individual is termed as recessive. The option (c) in the given question cannot be explained on the basis of law of dominance. It can only be explained on the basis of Mendel's law of independent assortment, according to which in a dihybrid cross, the two alleles of each character assort independently of the alleles of other character and separate at the time of gamete formation.
39. (a) Test cross is the cross of an individual having dominant phenotype with an individual having recessive phenotype. It is used to determine the genotype of a plant showing the dominant phenotype, that means to determine whether the individual exhibiting dominating characters are homozygous or heterozygous.

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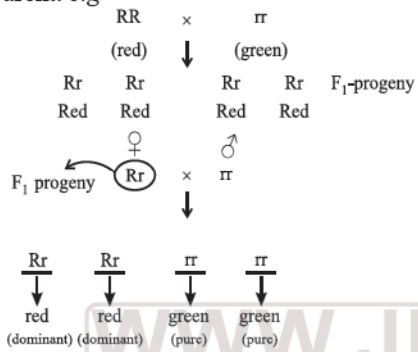
40. (d) Linkage is the inheritance of genes of same chromosome together and capacity of these genes to retain their parental combination in subsequent generation. The strength of linkage between two genes is inversely proportional to the distance between the two. This means, that greater the distance, lower is the linkage strength. Two linked genes show higher frequency of recombination if the distance between them is higher and lower frequency if the distance is smaller.

41. (c) Crossing of one F_1 progeny with male parent. *e.g*



To find the genotype of hybrid, test cross is done.

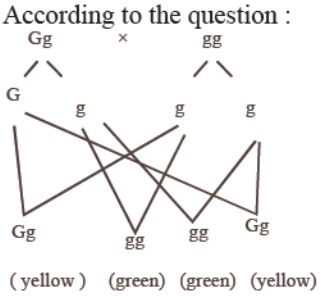
42. (c) When the linked genes are situated quite close, the chances of crossing over are highly reduced. Due to this, large number of parental gametes are formed and only few recombinant gametes are formed. This results in higher number of parental types in F_2 generation as compared to recombinants.

43. (d) Let GG ⇒ homozygous yellow seed plant.

Gg ⇒ heterozygous yellow seeded plant

gg ⇒ homozygous green seeded plant

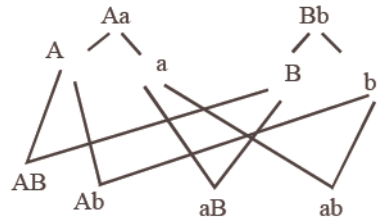
According to the question :



So, the ratio will be 50 : 50

44. (b) Inheritance of skin colour in human is controlled by three genes, A B and C which is polygenic inheritance.

45. (d)



46. (c) Polygenic inheritance is the inheritance of traits which are dependent on the no. of genes such as the skin colour of human beings. e.g., three genes A, B and C. Genotype AABBCC will have darkest skin colour and genotype aabbcc will have light skin colour. The number of each type of alleles in the genotype would determine the darkness or lightness of the skin of an individual.

NOTES Polygenic inheritance was discovered in 1909 by the Swedish scientist H. Nilsson-Ehle, who studied the inheritance of grain color in wheat by the analytical dissociation of the character.

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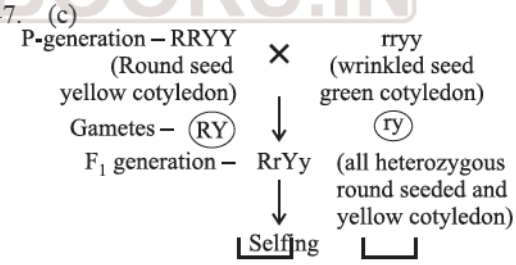
47. (c)



♀ \ ♂	RY	Ry	rY	ry
RY	RRYY Round seed yellow coty.	RRYy Round seed yellow coty.	RrYY Round seed yellow coty.	RrYy Round seed yellow coty.
Ry	RRYy Round seed yellow coty.	RRyy Round seed green coty.	RrYy Round seed yellow coty.	Rryy Round seed green coty.
rY	RrYY Round seed yellow coty.	RrYy Round seed yellow coty.	rrYY Wrinkled seed yellow coty.	rrYy Wrinkled seed yellow coty.
ry	RrYy Round seed yellow coty.	Rryy Round seed green coty.	rrYy Wrinkled seed yellow coty.	rryy Wrinkled seed green coty.

(F_2 generation)

So the ratio of Round seeded with yellow cotyledons : Round seeded green cotyledons : Wrinkled seeded yellow cotyledons : Wrinkled seeded green cotyledons is 9 : 3 : 3 : 1. So in

the F_2 generation, the round seeded character remains with yellow cotyledons & wrinkled seeds with yellow cotyledons.

48. (b) A cross of F_1 hybrid with its recessive homozygous parent is called the test cross. It is done to determine the genotype of a given plant. If the given plant has homozygous dominant traits then on test cross it gives all dominant trait plants but if it is heterozygous dominant then it gives dominant and recessive phenotypes in 1 : 1 ratio.

49. (c) Phenotype is the appearance of one organism while genotype is the gene complement it has from its ancestors. These genes only show their effect in phenotype but environment also plays an important role in this. Hence phenotype is a result of genotype and environmental interaction.

50. (c) It would make only two types of gametes, these are ABC & AbC.

51. (c) In order to find out the gamete or the genotype of an unknown individual, scientists perform a test cross. In test cross, the individual in question is crossed with the homozygous recessive parent. Hence the answer is aabb.

52. (d) The mathematical expression to calculate allele frequency can be given as p + q = 1. Where p represents the frequency of dominant allele and q represents the frequency of recessive allele. The bionomial expression of Hardy Weinberg's law to calculate genotype frequency is $p^2 + 2pq + q^2 = 1$
where p^2 = homozygous dominant
2pq = heterozygous dominant
q^2 = homozygous recessive.
Frequency of heterozygous individuals
$= 2 \times 0.6 \times 0.4 = 0.48$.

53. (d) Polytene chromosomes were first reported by EG Balbiani in 1881. They are quite common in salivary glands of insects and are therefore popularly called salivary gland chromosomes. Polytene chromosomes also occur in other organs of insects, antipodal cells (of embryo sac), endosperm cells and suspensor cell of embryo. The chromosomes can reach length of 200 μm and contain 1000 to 16000 times DNA as compared to the ordinary somatic chromosomes. The giant chromosomes are formed by somatic pairing between homologous chromosomes, and repeated replication (endomitosis) of their chromatids.

54. (a) Since the woman's father was colour blind, she would be a carrier of the colour blindness gene. When she marries a colour blind man, their progeny could be

Parent	X^cX	×	X^cY	
	Carrier Woman		Colour blind Man	
Progeny	X^cX^c	X^cY	XX^c	XY
	Colour blind son		Carrier daughter	

55. (c & d) Male sterility in plants can be controlled by nuclear genes or cytoplasm or by both. Three different mechanisms for control of male sterility in plants are :
(i) Genetic male sterility; (ii) Cytoplasmic male sterility; (iii) Cytoplasmic genetic male sterility. In maize, the genes for cytoplasmic control of male sterility are located in nucleus or mitochondria.

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56. (c) The lack of independent assortment in sweet pea and *Drosophila* is due to linkage.

57. (c) Males have only one X chromosome. Hence any gene present on the one X chromosome expresses itself in males. Females have two X chromosomes. The mutant allele must be present on both the X chromosomes to express itself phenotypically. If only one copy of allele is present, then the female only becomes a carrier showing no external manifestation of the gene. Sublethal condition can never arise in males.

58. (a) Chance of getting $a = \frac{1}{2}$

Chance of getting $b = \frac{1}{2}$

Chance of getting $h = \frac{1}{2}$

Chance of getting sperms with

$abh = \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} = \frac{1}{8}$

59. (a) A self-fertilising trihybrid plant forms 8 different gametes and 64 different zygotes. The genotype of trihybrid plant is AaBbCc. Number of gametes formed = $2^n = 2^3 = 8$
Here n = no. of heterozygosity = 3 in present case.
No. of zygotes formed = $8^2 = 64$.

60. (a) Parent : RRTt × rrtt

Gametes : RT, Rt rt

Offspring : RrTt (tall with red fruit) Rrtt (dwarf with red fruit)

Ratio = 1 : 1

61. (c) Similar species show interbreeding characters, *i.e.*, two organisms which breed freely in nature to produce fertile offspring belong to the same species. The two species are considered separate because they are reproductively distinct.

62. (c) Yellow seed colour is dominant over green seed colour.

63. (a) The seven traits are now known to be present on 4 chromosomes. But they do not show linkage, because of large distances between them on the chromosome.

64. (c) Dihybrid cross is made between individuals having contrasting traits in order to study the inheritance of two pairs of alleles. Test cross is a back cross between individual with a dominant trait and its recessive parent to know whether the individual is homozygous or heterozygous for the trait.

65. (d) Mapping of genes on chromosomes is based on the assumption that genes are arranged on the chromosome and that the percentage of crossing over (recombination frequency) between two genes is an index of their distance apart. Distances between genes is expressed as **map units,** where one map unit is defined as 1 per cent recombination. The recombination frequency will be 50% when two genes are located on different chromosomes or widely separated on the same chromosome.

66. (c) A dominant gene would lead to the expression of its phenotype irrespective of the fact whether its allelic gene is dominant or recessive.

67. (b)

F_1 parent : AABbCC × AABbCC

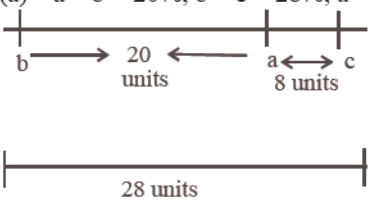
Gametes : ABC AbC

	ABC	AbC
ABC	AABBCC	AABbCC
AbC	AABbCC	AAbbCC

AABBCC – 1, AABbCC – 2, AAbbCC – 1

Genotypic ratio = 1 : 2 : 1

68. (a) a – b = 20%, b – c = 28%, a – c = 8%



Percent crossing over between two genes is proportional to the distance between them.

69. (b) Independent assortment of genes takes place only when they are located on separate non-homologus chromosomes. When two or more than two genes are located on same chromosome, independent assortment will not be possible.

70. (a) According to principle of dominance, out of the two factors of alleles representing different traits of a character, only one expresses itself. But when both express themselves it is codominance.

71. (d) In complementary gene interaction, both the non allelic pair independently produce similar phenotypes and when present together produce a new phenotype. So, that F_2 ratio 9 : 3 : 3 : 1 would become 9 : 7.

72. (d)

73. (c)

	(♀)		(♂)
Parents	XX	×	XY
Offspring	XX XX (daughters)	XY XY (sons)	

Probability of son = $\frac{2}{4} = \frac{1}{2}$

Probability of four son = $\left(\frac{1}{2}\right)^4 = \frac{1}{16}$

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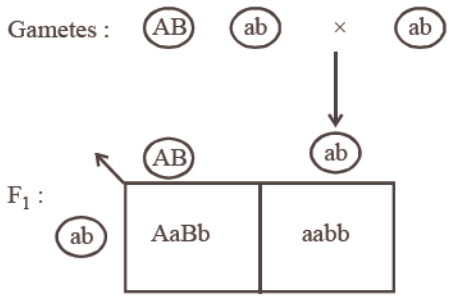
74. (b) Parents : AB/ab × ab/ab



75. (a) Hemolytic disease of the newborn occurs when a Rh^- mother conceives a Rh^+ child. Mother's blood starts producing antibodies against the foetal red blood cells.

76. (b) Round seed shape is dominant over wrinkled. Yellow seed colour is dominant over green seed colour Axial flower position is dominant over terminal.

77. (a) Molecular weight of chromosome of yeast cell is 2.56×10^9.

78. (a) Parents : Tt × tt

Gametes : T t × t

Progeny :

	T	t
t	Tt	tt

Ratio = 1 : 1

79. (c) The number of base pairs (bp) found in one genome of man is 3×10^9.

80. (d) Crossing over involves physical exchange of genetic material between non-sister chromatids of homologous chromosomes, which leads to recombination.

81. (b) Three types of genome occur in a typical green plant cell-nuclear genome, mitochondrial genome and chloroplast genome.

82. (b) If Mendel had studied a plant with 12 chromosomes, he would have encountered linked genes, and hence he would not have arrived at principle of independent assortment

83. (b) Different types of gametes produced will be ABC, AbC, ABc, Abc

84. (b) Heterochromatin is a specialised chromosome material which remains tightly coiled and stains darkly in interphase. Euchromatin is that portion of the chromosome that stains with low intensity and uncoils during interphase. In the beginning of S-sphase, DNA replication occurs. DNA replication can occur in diffuse/ less tightly coiled euchromatin.

85. (a) In sex determination, the male specific chromosome will have half as much chance as the other to enter the egg cell. Hence the proportion will be 1 : 1.

86. (c) Male sterlity occur due to cytoplasmic or cytoplasmic- genenic inheritance, *i.e.*, due to DNA present in mitochondrion or chloroplast under the *i.e.* control of extra-nuclear gene.

87. (a) Epistasis is the suppression of the normal phenotypic expression of the gene by a non-allelic gene. Complementary genes are two independent genes present on different gene loci which assist each other in expressing a trait. Supplementary genes are two independent genes present on different gene loci, each of which may produce its own trait and interact when present together in dominant state to produce a new trait.

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88. (b) Complementation test, also called *cis-trans* test, is for determining whether two mutations associated with a specific phenotype represent two different forms of the same gene (alleles) or are variations of two different genes. During the complementation test, if a phenotype is observed when a recessive mutation is combined in *trans* with another recessive mutation that has been mapped to the same area, it is concluded that these mutations are alleles of the same gene; neither allele produces a product that can restore wild-type function. However, if the *trans*- heterozygote exhibits a wild-type phenotype, it is concluded that the two mutations are alleles of different genes; each mutant has a functional version of the other gene.

NOTES

The complementation test was developed by American geneticist Edward B. Lewis. If the combination of two genomes containing different recessive mutations yields a mutant phenotype, then there are three possibilities: One mutation affects the expression of the other.

89. (d) Genotype is the genetic make up of an organism. The given 4 genotypes are present in 1 : 2 : 2 : 4 ratio.

90. (c) The two factors of each trait arrange or assort at random and are independent of each other in their distribution into the gametes and in the progeny.

Parent : TTyy × ttYY

Gametes : Ty, tY

F_1 : TtYy

Gametes : ♂ TY, Ty, tY, ty

Selfing : ♀

F_2 :

	TY	Ty	tY	ty
TY	TTYY (T)	TTYy (T)	TtYY (T)	TtYy (T)
Ty	TTYy (T)	TTyy (T)	TtYy (T)	Ttyy (T)
tY	TtYY (T)	TtYy (T)	ttYY (D)	ttYy (D)
ty	TtYy (T)	Ttyy (T)	ttYy (D)	ttyy (D)

Tall (T) - 12; Dwarf (D) - 4

91. (a) AB blood group possess the genotype I^AI^B. The alleles I^A and I^B are codominant as both express themselves when present together in an individual.

92. (b) Law of independent assortment is applicable to only those factors or genes which are located on different chromosomes. Probably the characters were present on the same chromosome and showed linkage which Mendel might not have studied.

93. (a) Polygenic inheritance show cumulative effect *i.e.* two independent dominant genes produce additive effect on an individual.

94. (d) Chromosome mapping is based on the fact that genes are linearly arranged on the chromosome and frequency of crossing over is directly proportional to the distance between two genes. Dominant genes show cis arrangement. At 50 map units cis is changed to *trans* & vice-versa hence no fixed linkage is present.

95. (d) Homozygous individuals have identical Mendelian factors or genes for a character (TT or tt). They are always pure for a particular trait (character).

96. (c) Genotype is the genetic make up of an individual irrespective of the Mendelian characters or genes impressing.

Parent : AABB × aabb

Gametes : AB, ab

F_1 : AaBb

	AB	Ab	aB	ab
AB	AABB	AABb	AaBB	AaBb
Ab	AABb	AAbb	AaBb	Aabb
aB	AaBB	AaBb	aaBB	aaBb
ab	AaBb	Aabb	aaBb	aabb

97. (a) Epistasis is the phenomenon of masking or supressing the phenotypic impression of a gene pair by a non allelic gene pair which expresses its own effect.

98. (a) Dominant alleles expresses itself in the homozygous as well as heterozygous condition. It is denoted by capital letter.

99. (d) The genotype of the child would be I^OI^O (recessive). Hence the genotype of the father can only be I^BI^O.

100. (c) In *Neurospora*, products of meiosis remain linearly arranged and undergo one mitosis. Crossing over occurs in four strand stage.

101. (b) Plasma genes present in the maternal cytoplasm are transmitted to offspring hence this type of inheritance is termed as cytoplasmic or maternal inheritance.

102. (b) Incomplete dominance is the phenomenon of none of the alleles being dominant, with the effect that the hybrid produced by crossing two pure individuals is a mixture between the parents.

103. (d) The allele which cannot express its effect in the hybrid or in the presence of dominant allele is termed as recessive. It is denoted by small letter.

104. (d) Dihybrid condition involves simultaneous inheritance of two pairs of Mendelian factors or genes.

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105. (c) According to the law of independent assortment, alleles of different characters located in different pairs of homologous chromosomes are independent of one another in their separation or segregation during gamete formation.

106. (b) Gregor Johann Mendel formulated the laws of heredity and is regarded as the father of genetics.

107. (b) Allelomorphs control different expressions or traits of the same character.

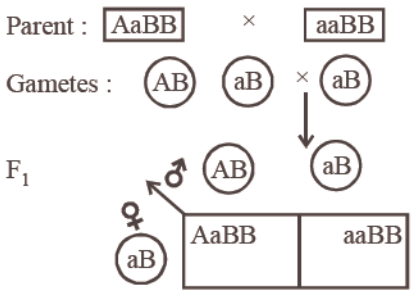
108. (d) $I^AI^O \times I^AI^B$ gives us the following genotypes I^AI^A, I^OI^B, I^AI^B and I^AI^O.

109. (b) On mating tt with Tt, 50% individual offspring are recessive and 50% are heterozygous dominant.

110. (c) A gene may have more than two alternative forms occupying the same locus on a chromosome. Such alleles are known as multiple alleles and the phenomenon is termed as multiple allelism. ABO blood group has 3 alleles– I^O, I^A or A, I^B or B.

111. (c) In recessive epistasis, the recessive alleles suppress the expression of a trait. Recessive epistasis is a type of intergenic interaction in which one non allelic gene can produce its effect independently in the dominant state but second gene can produce its effect when they are present together. Here homozygous recessive allele for a gene mask the expression of dominant allele of another gene.

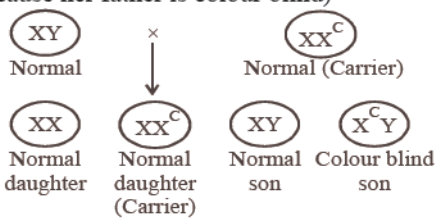
112. (a) Cross AaBB × aaBB gives 50% individuals having genotype AaBB and 50% individuals having genotype aaBB.



113. (a) The probability of the daughter becoming colour blind arises only when the father is also colour blind.

Husband – XY

Wife – XX^C (wife is carrier because her father is colour blind)



So, probability of their daughter becoming colour blind is 0%.

114. (d) Bateson and Punnett (1906) discovered coupling and repulsion in sweet pea (*Lathyrus odoratus*).

115. (a) Chromosomes occur in homologous pairs. Somatic cells have diploid number of chromosomes. Humans have 23 pairs *i.e.* 46 chromosomes. 22 pairs of autosomes and 1 pair of sex chromosomes i.e., XX in females and XY in males.

116. (c) Two linked genes a and b show 20% recombination. The individuals of a dihybrid cross between + + / + + × ab/ab shall show gametes + + 40 : ab40: + a 10 : +b : 10.

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117. (c) Maternal inheritance or cytoplasmic inheritance involves the transmission of plasma gene from the maternal cytoplasm to the offspring.

118. (d) Consideration of one character with two contrasting conditions at one time contributed to Mendel's success in proposing the laws of inheritance of traits. His choice of experimental plant as pea and use of statistical methods also contributed to his success.

119. (c) In haploid organisms every gene, irrespective of dominant or recessive and every mutation finds expression because there is only one allele for each gene in the haploid individual. Recessive allele is able to express as there is no alternative dominant allele for producing its masking effect on recessive allele.

120. (c) In case of humans, the sex determining mechanism is xy type. Out of 23 pairs of chromosomes, 22 pairs are exactly same in both males and females called autosomes. A pair of x chromosomes is present in the female, whereas the presence of an x and y chromosome

are determinant of male characteristic. in case the ovum fertilises with a sperm carrying x chromosome the zygote develops into a female (xx) and the fertilisation of ovum with y chromosome carrying sperm results into a male offspring.

121. (b) In grasshopper, the males lack a Y sex chromosome and have only an X chromosome. They produce sperm cells that contain either an X chromosome or no sex chromosome, which is designated as O.
122. (b) Calvin Bridges demonstrated that in *Drosophila*, the sex is determined by the ratio of the number of X chromosomes to the sets of autosomes.
123. (a) The genes of cytoplasmic characters occur outside the chromosome, in cytoplasm, they inherit their traits like chromosomal genes do. In a zygote formation, the cytoplasm comes from the mother's ova and hence the cytoplasmic characters must come from maternal side and this is the reason that cytoplasmic inheritance is also known as maternal inheritance.
124. (b) Crossing over occurs between non–sister chromatids of two homologous chromosomes. Homologous chromosomes form bivalent. Crossing over occurs between chromosomes in a nucleus.
125. (d) Linkage is the staying together of genes and their *en bloc* inheritance from generation to generation. Linked genes do not show independent assortment since they are present on the same chromosome.
126. (a) One Barr body is present in each somatic cell of female (XX).
127. (c) In human, the Y chromosome bears the androgenic factor or the male determining factor. Whereas in *Drosophila,* the ratio of sex chromosomes to autosomes is the factor determining sex of the individual.
128. (c) Allosomes or sex chromosomes determine the sex of the individual. The rest of the chromosomes are known as autosomes. Nucleolus is a spherical structure present in nucleus and involved in synthesis of ribosomes.
129. (c) Hermaphrodite or bisexual refers to an organism having both male and female sex organs. Gynandromorphs are individuals who exhibit both male and female characteristics.
130. (d) According to the principle of dosage compensation, one of the two X chromosomes in a female is inactivated at random. The inactivated X chromosome appears as the Barr body.
131. (b) H.J. Muller - study of effect of radiation on the living organisms. He was awarded nobel prize for discovering that ionising radiations can induce gene mutations.
132. (d) A Barr body is one of the X chromosomes in somatic cells of females. If there are more X chromosomes then there will be more Barr bodies.
133. (b) Polytene chromosomes are also called giant chromosomes. They consist of numerous parallel identical chromatids due to repeated duplication without division. They were first time observed by Balbiani in the salivary glands of *Chironomus*.

NOTES

Polytene chromosomes are formed when the products of multiple rounds of S-phase remain tightly associated to form one supersized chromosome. In particular polytene chromosomes are found in a specific subset of endopolyploid cells, which have undergone a variant cell cycle known as the endocycle.

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134. (b) A gynandromorph is an organism that contains both male and female characteristics. These characteristics can be seen in butterflies, where both male and female characteristics can be seen physically because of sexual dimorphism. A gynandromorph can have bilateral symmetry, one side female and one side male, or they can be *mosaic*, a case in which the two sexes aren't defined as clearly.
135. (b) Sex of human body is determined by the karyotype of the zygote or fertilised egg. Sex of the baby depends upon the sperm which fertilises the ovum.
136. (b) Phenylketonuria is an inborn error of metabolism is also inherited as the autosomal recessive trait. Sickle cell anemia is an autosomes linked recessive trait that can be transmitted from parents to the offspring when both the partners are carrier for the gene (or heterozygous). Thalassemia is an inherited

blood disorder that causes your body to have less hemoglobin than normal. Hemoglobin enables red blood cells to carry oxygen. Thalassemia can cause anemia, leaving you fatigued. Haemophilia is a sex linked recessive disease, which shows its transmission from unaffected carrier female to some of the male progeny.

137. (d) XX- XO type of sex determination is seen in crickets, grasshoppers, and some other insects. In all these organisms the female is XX and is the homogametic sex. The male is the heterogametic sex but only has one sex chromosome. The male in XX-XO systems produce gametes with (X) or without (O) a sex chromosome.

In XX -XY method of sex determination, the sex of an individual is determined by a pair of sex chromosomes. Females typically have two of the same kind of sex chromosome (XX), and are called the homogametic sex. Males typically have two different kinds of sex chromosomes (XY), and are called the heterogametic sex.

Turner's syndrome is also known as 45, X or 45, X,. It is a condition that affects only females, and results when one of the X chromosme (sex chromosomes) is missing or partially missing.

ZW-ZZ method of sex determination can be seen in some birds, butterflies, moths, and other organisms. Instead of X and Y chromosomes, they have Z and W chromosomes. The female is the heterogametic sex. In all these organisms female has a pair of dissimilar ZW chromosomes and male has two similar ZZ chromosomes.

138. (c) Klinefelter's syndrome is a chromosomal conditions in boys and men that can affect physical and intellectual development. It is caused due to presence of an additional copy of X-chromosome resulting into 44 + XXY type chromosome complement. Adult with this syndrome may have primary hypogonadism (decreased testosterone production), small or underscent testes, enlarged breast, tall stature etc.

NOTES

Klinefelter syndrome isn't passed down through families like some genetic diseases. Instead, it happens randomly from an error in cell division when a parent's reproductive cells are being formed and occurs only as a result of a random genetic error after conception. Most males with this condition produce little or no sperm. Its Treatment may include testosterone replacement and fertility treatment.

139. (b) Thalassemia is a quantitative problem of synthesising very few globin molecules while sickle cell anaemia is a qualitative problem of synthesising an incorrectly functioning globin.

140. (d) Down's syndrome is caused by non-disjunction of 21st chromosome i.e. Trisomy.

141. (b) Haemophilia A and haemophilia B are inherited in an X-linked recessive pattern. The genes associated with these conditions are located on the X chromosome, which is one of the two sex chromosomes. In males (who have only one X chromosome), one altered copy of the gene in each cell is sufficient to cause the condition. In females (who have two X chromosomes), a mutation would have to occur in both copies of the gene to cause the disorder. Because it is unlikely that females will have two altered copies of this gene, it is very rare for females to have haemophilia. A characteristic of X-linked inheritance is that fathers cannot pass X-linked traits to their sons.

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142. (d) Sickle cell disease is inherited in an autosomal recessive pattern.

143. (b) Autosomal recessive is a type of disorder in which two copies of an abnormal gene must be found for the disease in the affected person.

144. (c) XX × X^cY

Normal woman Colourblind man

(♀) \ (♂)	X^c	Y
X	XX^c	XY
X	XX^c	XY

The daughters of this couple will have normal eye sight but would be carrier. If one of the carrier daughter marries with normal eyed man,

XX^c × XY

Normal woman Normal man

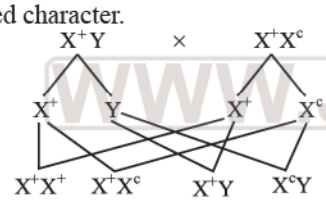
♀ \ ♂	X	Y
X	XX	XY
X^c	XX^c	X^cY

Only 25% grandson will show colourblindness.

145. (a) A human baby having abnormality with 'XXX' sex chromosomes is born due to evolution of abnormal ova in mother's ovary. This is caused due to non-disjunction of X chromosome in the mother.

146. (c) A pleiotropic gene regulates multiple traits (characteristics) in an individual.

147. (c) Colour blindness is a X-chromosome linked character.



∴ Colourblind male = 50%

148. (a) Turner's syndrome is a chromosomal condition that affects development in females. A human female with Turner's syndrome has 45 chromosomes with XO. The most common feature of Turner syndrome is short stature, which becomes evident by about age 5.

149. (b) Genotype of carrier parents is – Aa (male parent) × Aa (female parent)

♀ \ ♂	A	a
A	AA	Aa
a	Aa	*aa

AA → normal child (25%)
Aa → carrier child (50%)
aa → affected child (25%)

150. (b) Haemophilia is sex linked recessive disease in which a simple protein that is a part of protein cascade involved in clotting of blood is affected. Due to this, in an affected individual, a simple cut will result in non-stop bleeding.

151. (b) Pedigree is a chart showing the record of inheritance of certain genetic traits, abnormality or disease for two or more ancestral generations of an individual.

152. (c) Down's syndrome is the chromosomal disorder due to the presence of an additional copy of the chromosome number 21 (trisomy of 21). The affected individual is short statured with small round head, furrowed tongue and partially open mouth and mental development is retarted.

NOTES

Down syndrome is caused due to nondisjunction can occur during anaphase of mitosis, meiosis I, or meiosis II. During anaphase, sister chromatids (or homologous chromosomes for meiosis I), will separate and move to opposite poles of the cell, pulled by microtubules. In nondisjunction, the separation fails to occur.

153. (b) If a normal visioned man marries a woman whose father was also colourblind, then his wife would be carrier of this disease if her mother was normal. This trait is passed into children but daughters produced by this couple are carrier not the colourblind. 50% of sons would be colourblind.

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154. (d) Change in single base pair of DNA is also a type of mutation called point mutation. It is a type of mutation that causes the replacement of a single nucleotide with another nucleotide of the genetic material, DNA or RNA. For example, a point mutation is the cause of sickle cell disease.

155. (b) The inheritance pattern of a particular trait shown in the picture results in haemophilia. Haemophilia is a group of inherited blood disorders in which the blood does not clot properly. It is caused by a fault in one of the genes that determine how the body makes blood clotting factor VIII or IX. These genes are located on the X chromosome.

156. (d) Mutation can be induced by gamma radiation.

157. (a) Pedigree analysis is a record of the occurrence of a trait in several generations of a human family. In this, male members are shown by squares and female by circles. Sibs are represented horizontally on a line in order of birth. It helps us in giving information about genotype of an individual for trait under investigation.

158. (a) The chart shows the inheritance of a condition like phenylketonuria as an autosomal recessive trait. Parents need to be heterozygous as two of their children are known to be sufferer of the disease. It cannot be recessive sex linked inheritance because then the male parent would also be sufferer.

159. (b) By introducing bone marrow cells producing ADA into cells at early embryonic stages, the genetic defect adenosine deaminase (ADA) deficiency may be cured permanently. It is due to mutation.

160. (b) Sickle cell anaemia is caused by a change in a single base pair of DNA. Sickle cell anaemia is controlled by a single pair of alleles, Hb^A and Hb^S and the genotype Hb^S. Hb^S show the diseased phenotype. Sickle cell disease or sickle cell anaemia (or drepanocytosis), is a life-long blood disorder characterised by red blood cells that assume an abnormal, rigid, sickle shape. Sickling decreases the cells flexibility and results in a risk of various complications. '

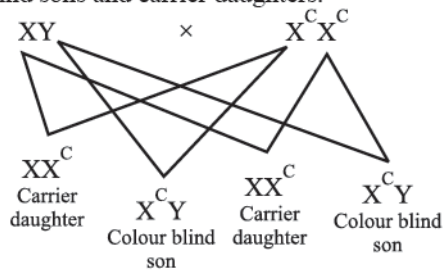
161. (c) Baldness is a sex influenced trait. The dominance of alleles may differ in heterozygotes of the two sexes.

162. (a) A point mutation is a simple change in one base of the gene sequence. This is equivalent to changing one letter in a sentence, such as in this example, where we change the 'c' in cat to an 'h':
Original: The fat cat ate the wee rat.
Point Mutation: The fat hat ate the wee rat.

163. (a) Klinefelter's syndrome is a genetic disorder affecting men in which an individual gains an extra X chromosome, so that the usual karyotype of XY is replaced by XXY. Symptoms of Klinefelter's syndrome named after U.S. physician H.P. Klinefelter, include female characteristics (such as breast enlargement).

164. (d) Haploids describes a nucleus cell or organism with a single set of unpaired chromosomes. The haploid number is designated as X. Reproductive cells, formed as a result of meiosis are haploid. Fusion of two such cells restores the normal diploid number. Therefore, haploids are more suitable for mutation studies than the diploids. This is because all mutations, whether dominant or recessive are expressed in haploids.

165. (c) Colour blindness is a X chromosome linked character. So they'll be having all colour blind sons and carrier daughters.



166. (a) Cri-du-chat syndrome in humans is caused by the partial deletion of the short arm of chromosome no. 5. This child has abnormalities in his/her facial expressions, mental retardation, they speak and cry like that of cat, heart does not work properly.

167. (a) Sickle cell anaemia is a biochemical disorder in which shape of RBCs become sickle-shaped due to the defective haemoglobin. Haemoglobin becomes useless for oxygen transport.
Huntington's Chorea in a disease in which atrophy of brain occurs resulting in respiratory irregulations, articulation of speech and irregular limb movements. They both are genetic diseases present in any person since birth hence congenital diseases.

168. (b) In sickle cell anaemia, RBCs become sickle shaped which are not supportive for the growth of malarial parasite *Plasmodium* so it provides immunity against malaria disease.

169. (d) Glucose-6-P dehydrogenase is the first enzyme of glucose oxidation during Pentose Phosphate Pathway. RBC contain haemoglobin which combines with oxygen to form oxyhaemoglobin which gives its oxygen for oxidation of food. In haemolysis, there is destruction of RBCs with release of haemoglobin into plasma resulting in jaundice. So, now RBCs cannot provide oxygen for oxidation of food thereby causing deficiency of G-6-P dehydrogenase.

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170. (d) **Cretinism :** In this disorder, the physical growth, mental growth and sexual growth in children is retarded. Such a dwarf and sterile child is called a cretin. It is due to hyposecretion of thyroid hormones.

Cystic fibrosis : It is a common disorder of caucasian race in which thick and more salty mucus blocks the respiratory tract. The homozygous recessive condition produces the defective protein which regulates chloride transport channel.

Thalassemia : Due to reduced production of α or β chains of haemoglobin. It is an autosomal recessive disorder.

Haemophilia : Sex linked disorder due to defective recessive gene.

171. (c) This disease is due to an X-linked recessive mutation. Males suffer from this disorder since they have only one X chromosome and hence express any trait on this chromosome.

172. (d) Down's syndrome is caused by the presence of an extra chromosome number 21 and the offspring has 47 chromosomes.

173. (b) The daughters receive one X chromosome from the father and one X chromosome from the mother. Since all the daughters suffer from their father's disease, the X chromosome from the father must be carrying a dominant trait.

174. (b) Normal woman with colour blind father would be a carrier.

Woman (X^cX) × Normal man (XY)

Progeny	X^cX normal but carrier daughter	XX normal daughter	X^cY colour blind son	XY normal son

50% of the sons would be colour blind.

175. (b) Mitochondrion is an organelle present in the cytoplasm. A zygote receives its cytoplasm from the female parent gamete. Hence in the given question, the F_2 progeny receive the mitochondrial genome from the female parent, so mutation is not passed to progeny.

176. (a) Change in genetic locus, changes the gene and in turn the amino acid it codes for. This alters the nature of protein synthesised which produces change in the organism. DNA replication is not affected neither the method of protein synthesis. Synthesis of RNA over DNA template is called transcription.

177. (b)

178. (c or d) Sex linked traits are those like colour blindness or hemophilia, which show criss-cross pattern of inheritance of certain genes together along with sex determining genes, because of their presence on the sex chromosomes. Sex limited characters express their effects only in one sex and not in the other e.g., breast development in females and beard and moustaches in males. Sex influenced characters appear due to the effect of particular sex hormone over different structures e.g. pattern baldness.

179. (d) 50% of ova will have (n + 1) chromosome which would, on fertilisation, yield abnormal zygotes (n + 1) + (n) = 2n + 1.

180. (a) Sickle cell anaemia is a genetic disorder caused by a defective allele on chromosome 11. Hemophilia is a sex linked recessive disorder. Down's syndrome is caused by trisomy of the 21st chromosome.

181. (b) AIDS is a viral disease. Syphilis and gonorrhoea are both sexually transmitted diseases. Colour blindness is a sex linked disease.

182. (c)

183. (a) Sex linked disorders follow criss-cross inheritance pattern in which affected father passes it on to his daughters. The daughters receive one of their X chromosome from their fathers.

184. (a) Aneuploidy is numerical change in the chromosome number in the genome. Euploidy is the phenomenon of having multiple or more than twice the number of genome.

185. (b) Sickle cell anaemia is a hereditary disorder of autosomal nature caused by mutation of the gene controlling b-chain of haemoglobin. It involves substitution of glutamine by valine.

186. (c) Down's syndrome develops due to trisomy of the 21st chromosome. Affected individual possess a characteristic appearance. They have short stature, small round head, broad forehead, open mouth and projecting lower lip (Mongoloid idiocy).

187. (a) Somatic mutation is the mutation occurring in somatic or body cells. Mutations occurring in germ cells which are transferable to the progeny is called germinal mutation. Mutation occuring in genes is called genetic mutation.

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188. (a) The mother must have been a haemophilic carrier (X^hX). One of the twins would have inherited the normal X chromosome and the other would have received the X chromosome carrying the gene for haemophilia.

189. (b) Normal woman whose father was colour blind would have received the X chromosome from her father (X^CY) →

Parents : (P_1) : (♀) X^cX × X^cY (♂)

↓

Progeny (F_1) :

X^cX^c	X^cX	X^cY	XY
colour blind daughter	normal daughter	colour blind son	normal son

190. (c) Down's syndrome caused by trisomy 21, arises due to an occassional non disjunction during meiosis when a gamete comes to possess an extra chromosome (n+1). Fusion with a normal gamete [n + (n+1)] produces trisomy.

191. (a) Mental retardness is usually found when there are more than two X chromosomes. About 1% of all mentally defective men have one or more extra X chromosomes.

192. (d) Inversion is a change in chromosomal architecture in which part of the chromosome gets inverted in its position so that the sequence of the genes in the inverted region is reversed. In deletion, a segment of a chromosome breaks and is lost. Monosomy is a type of deletion involving deficiency of one chromosome (2n – 1). In reciprocal translocation, there is a mutual exchange of segments between two non-homologous chromosomes.

193. (b) $X^{hc}X^h$ × XY h→ haemophilia

Female Male C→ colour blindness

$X^{hc}X$	$X^{hc}Y$	X^hX	X^hY
daughter (carrier)	haemophilic Colourblind son	daughter (carrier)	haemophilic son

194. (a) A child will be albino only if it is homozygous for albinism genes (since albinism is a recessive character). As parents have normal skin, it means they are heterozygous. As a result of cross between two heterozygous parents, 25% of the children will be homozygous recessive. The nature of the second child is not affected in any way by the nature of the first child because both are independent events.

195. (b) Down's syndrome develops due to trisomy of chromosome number 21. In Turner's syndrome, the effect appears due to fusion of a gamete without sex chromosome and a gamete with one X chromosome (44 + X). Klinefelter individuals are phenotypically males. The defect appears due to fusion of egg having unreduced sex complement (A + X X) with a gamete carrying Y chromosome (44 + XXY). Gynandromorphism occurs in *Drosophila.* In such individuals one half of the body shows male characters and the other half shows female characters.

196. (a) Gene mutation or point mutation is the change in expression of a gene caused by change in number, sequence and types of nucleotides. A mutation from a wild gene type to a new type is called forward mutation. Reversal of mutated gene to wild type is reverse mutation. Chromosomal mutations are changes in the morphology of chromosomes.

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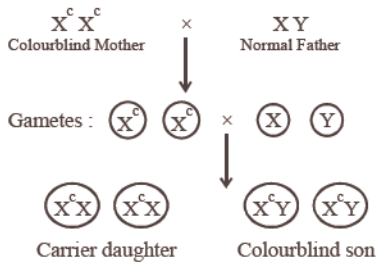
197. (NA) Klinefelter's syndrome is formed by the union of an XX egg and a normal Y sperm or normal X egg and abnormal XY sperm. The individual has 47 chromosomes (44 + XXY). Persons having XYY sex chromosomes (supermales) all also known as Jacob's syndrome.

198. (d) Sickle cell anaemia (in which nucleotide triplet GAG is changed to GUG) affects the β-globin chain of haemoglobin. Since these changes occur at a particular locus or point of a chromosome where specific gene is located, they are called as point mutation.

199. (d) The woman is heterozygous as albinic condition is recessive hence when she marries an albinic man, the offspring are 50% normal and 50% albinic.

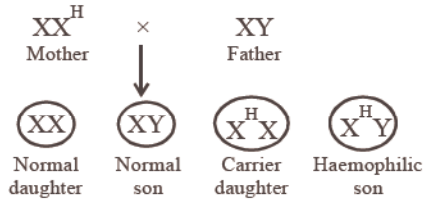
200. (d) Holandric genes are present on the differential region of the Y chromosome. The differential regions carry completely sex linked genes and they do not undergo crossing over.

201. (a) When a colour blind woman marries a normal man, the recessive homozygous gene is expressed in sons whereas the daughters become carriers.



202. (a) The haploid organisms readily express the phenotypes of the new mutations because there is no hindrance of dominance.

203. (c) Since half the sons are haemophilic so the genes for haemophilia is located on X chromosome of mother.



204. (b) Due to linkage, the genes present on same chromosome stay together during transmission. All other combinations except AABB × aabb show recombination which do not show linkage and hence not suitable for experiments on linkage.

205. (c) Genotype of Mr. Kapoor will be Bb d-hence one fourth of the sperms will have Bd.

206. (d) On crossing carrier colour blind woman with a normal man, the sons become colour blind. This is an example of criss cross inheritance. The genes for colourblindness is coming from mother's father.

207. (a) At anaphase I, actual segregation occurs, but two similar alleles occur in the dyad chromosome which separate at anaphase II.

208. (c) Turner's syndrome encompassess several chromosomal abnormalities, of which *monosomy* X is the most common. It occurs in 1 out of every 2500 female births. Instead of the normal XX sex chromosomes for a female, only one *X chromosome* is present and fully functional. This is called 45,X or 45,X0, although other genetic variants occur. In Turner's syndrome, female sexual characteristics are present but generally underdeveloped.

209. (d) Down's syndrome is due to non-disjunction of chromosomes. Non-disjunction means absence of separation of two homologous X chromosomes during anaphase-I of meiosis. Both X chromosomes go together to same pole. Other pole will receive no X chromosome.

210. (a) The brown eyed man will have the genotype Bb and his wife bb. Hence Bb × bb = Bb : bb. Hence ratio is 1 : 1.

211. (d) Blood groups in human are controlled by multiple alleles.

212. (b) The genotype of the mother has to be either $X^C X^C$ or X^CX and that of father to be X^CY so that the daughter becomes colour blind.

213. (d) Phenylketonuria is a human genetic disorder in which the body does not contain the enzyme phenylalanine hydroxylase (PAH), necessary to metabolise phenylalanine to tyrosine, and converts phenylalanine instead to phenylpyruvic acid. As PKU is an autosomal recessive genetic disorder each parent must have at least one defective allele of the gene for PAH, and the child must inherit a defective allele from each parent. As such, it is possible for a parent with a PKU phenotype to have a child without PKU if the other parent possesses at least one functional allele of the gene for PAH. A child of two parents with the PKU phenotype will always receive two defective alleles so will always have PKU. The gene for PAH is located on chromosome 12, at location 12q22-q24.2.

214. (d) Haemophilia is a sex linked recessive trait carried by X chromosome (also known as bleeder's disease).

215. (b) Down's syndrome is due to trisomy of 21st chromosome and is an autosomal abnormality.

216. (c) Humans have 22 pairs of autosomes and 1 pair of sex chromosomes which are XX in females and XY in males. So, everytime the chances of son or daughter is 50-50% depending upon which sex chromosome is contributed by father in sperm.

217. (a) Induced mutations are produced in response to external factors or chemicals called mutagens. In agriculture, mutagens are used to induce desired mutations in crop plants.

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28 Molecular Basis of Inheritance

Trend Analysis with Important Topics & Sub-Topics

		2020		2019		2018		2017		2016	
Topic	Sub-Topics	Qns.	LOD	Qns.	LOD	Qns.	LOD	Qns.	LOD	Qns.	LOD
The DNA/ RNA world	Experimental Proof for Genetic Material					1	D	1	A		
	DNA			1	E			1	E		
	RNA							1	A	1	A
	Nucleosome Model	1	D					1	A		
	Semiconservative Replication of DNA					1	A				
Replication/ Transcription/ Genetic Code/ Translation	Protein synthesis							1	D		
	DNA replication							1	A		
	Genetic Code			1	A					1	A
	Translation	1	A								
	Transcription	1	D	1	D	1	D	1	E		
Regulation of Gene Expression	Lac Operon			1	D	1	A			1	A
Human Genome Project/ DNA fingerprinting	DNA Printing							1	A		

LOD - Level of Difficulty | E - Easy | A - Average | D - Difficult | Qns - No. of Questions

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Topic 1: The DNA/RNA World

1. If the distance between two consecutive base pairs is 0.34 nm and the total number of base pairs of a DNA double helix in a typical mammalian cell is 6.6×10^9 bp, then the length of the DNA is approximately *[2020]*
   (a) 2.5 meters (b) 2.2 meters
   (c) 2.7 meters (d) 2.0 meters
2. Which of the following statements is correct? *[2020]*
   (a) Adenine pairs with thymine through one H-bond
   (b) Adenine pairs with thymine through three H-bonds
   (c) Adenine does not pair with thymine
   (d) Adenine pairs with thymine through two H-bonds
3. Which scientist experimentally proved that DNA is the sole genetic material in bacteriophage? *[2019, Odisa]*
   (a) Jacob and Monod
   (b) Beadle and Tautum
   (c) Messelson and Stahl
   (d) Hershey and Chase
4. The final proof for DNA as the genetic material came from the experiments of: *[2017]*
   (a) Hershey and Chase
   (b) Avery, Mcleod and McCarty
   (c) Hargobind Khorana
   (d) Griffith

5. DNA fragments are: ***[2017]***
   (a) Negatively charged
   (b) Neutral
   (c) Either positively or negatively charged depending on their size
   (d) Positively charged
6. Which of the following RNAs should be most abundant in animal cell? ***[2017]***
   (a) t-RNA (b) m-RNA
   (c) mi-RNA (d) r-RNA
7. The association of histone H1 with a nucleosome indicates: ***[2017]***
   (a) DNA replication is occurring.
   (b) The DNA is condensed into a Chromatin Fibre.
   (c) The DNA double helix is exposed.
   (d) Transcription is occurring.
8. A complex of ribosomes attached to a single strand of RNA is known as ***[2016]***
   (a) Polysome (b) Polymer
   (c) Polypeptide (d) Okazaki fragment
9. In sea urchin DNA, which is double stranded, 17% of the bases were shown to be cytosine. The percentages of the other three bases expected to be present in this DNA are : ***[2015 RS]***
   (a) G 17%, A 16.5%, T 32.5%
   (b) G 17%, A 33%, T 33%
   (c) G 8.5%, A 50%, T 24.5%
   (d) G 34%, A 24.5%, T 24.5%
10. Which one of the following is not applicable to RNA? ***[2015 RS]***
   (a) 5' phosphoryl and 3' hydroxyl ends
   (b) Heterocyclic nitrogenous bases
   (c) Chargaff's rule
   (d) Complementary base pairing
11. Transformation was discovered by: ***[2014]***
   (a) Meselson and Stahl (b) Hershey and Chase
   (c) Griffith (d) Watson and Crick
12. Uridine, present only in RNA is a ***[NEET Kar. 2013]***
   (a) Pyrimidine (b) Nucleoside
   (c) Nucleotide (d) Purine
13. If one strand of DNA has the nitrogenous base sequence at ATCTG, what would be the complementary RNA strand sequence ***[2012]***
   (a) TTAGU (b) UAGAC
   (c) AACTG (d) ATCGU
14. The unequivocal proof of DNA as the genetic material came from the studies on a ***[2011M]***
   (a) bacterium (b) fungus
   (c) viroid (d) bacterial virus
15. Infectious proteins are present in: ***[2010]***
   (a) Gemini viruses (b) Prions
   (c) Viroids (d) Satellite viruses
16. Which one of the following does not follow the central dogma of molecular biology? ***[2010]***
   (a) Pea (b) *Mucor*
   (c) *Chlamydomonas* (d) HIV
17. T.O. Diener discovered a: ***[2009]***
   (a) free infectious DNA
   (b) infectious protein
   (c) bacteriophage
   (d) free infectious RNA
18. Which one of the following pairs of nitrogenous bases of nucleic acids, is wrongly matched with the category mentioned against it? ***[2008]***
   (a) Thymine, Uracil - Pyrimidines
   (b) Uracil, Cytosine - Pyrimidines
   (c) Guanine, Adenine - Purines
   (d) Adenine, Thymine - Purines
19. The length of DNA molecule greatly exceeds the dimensions of the nucleus in eukaryotic cells. How is this DNA accommodated? ***[2007]***
   (a) super-coiling in nucleosomes
   (b) DNase digestion
   (c) through elimination of repititive DNA
   (d) deletion of non-essential genes.
20. A sequential expression of a set of human genes ***[2007]***
   (a) messenger RNA (b) DNA sequence
   (c) ribosome (d) transfer RNA.
21. During transcription, RNA polymerase holoenzyme binds to a gene promoter and assumes a saddle-like structure, what is it's DNA-binding sequence? ***[2007]***
   (a) AATT (b) CACC
   (c) TATA (d) TTAA
22. The two polynucleotide chains in DNA are ***[2007]***
   (a) discontinuous (b) antiparallel
   (c) semi-conservative (d) parallel.
23. Which antibiotic inhibits interaction between RNA and mRNA during bacterial protein synthesis? ***[2006]***
   (a) Neomycin (b) Streptomycin
   (c) Tetracycline (d) Erythromycin

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24. The following ratio is generally constant for a given species: *[2004]*
(a) $\frac{A+G}{C+T}$ (b) $\frac{T+C}{G+A}$
(c) $\frac{G+C}{A+T}$ (d) $\frac{A+C}{T+G}$

25. DNA template sequence of CTGATAGC is transcribed over mRNA as *[2004]*
(a) GUCTUTCG (b) GACUAUCG
(c) GAUTATUG (d) UACTATCU

26. Extranuclear inheritance occurs in *[2004]*
(a) peroxisome and ribosome
(b) chloroplast and mitochondria
(c) mitochondria and ribosome
(d) chloroplast and lysosome

27. Which form of RNA has a structure resembling clover leaf? *[2004]*
(a) rRNA (b) hn RNA
(c) m RNA (d) t RNA

28. Transformation experiment was first performed on which bacteria? *[2002]*
(a) *E.coli*
(b) *Diplococcus pneumoniae*
(c) *Salmonella*
(d) *Pasteurella pestis*

29. In a DNA percentage of thymine is 20% then what will be the percentage of guanine? *[2002]*
(a) 20% (b) 40%
(c) 30% (d) 60%

30. Extra-nuclear inheritance occurs in *[2001]*
(a) Killer strain in *Paramecium*
(b) Colour blindness
(c) Phenylketonuria
(d) Tay sach disease

31. Due to discovery of which of the following in 1980 the evolution was termed as RNA world? *[2001]*
(a) mRNA, tRNA, rRNA synthesise proteins
(b) In some virus RNA the genetic material
(c) RNA have enzymatic property
(d) RNA is not found in all cells

32. The transfer RNA molecule in 3D appears
(a) L-shaped (b) E-shaped *[2000]*
(c) Y-shaped (d) S-shaped

33. In DNA, when AGCT occurs, their association is as per which of the following pairs? *[1999]*
(a) AG-CT (b) AC-GT
(c) AT-GC (d) All of these

34. The *Pneumococcus* experiment proves that
(a) DNA is the genetic material *[1999]*
(b) Bacteria undergo binary fission
(c) Bacteria do not reproduce sexually
(d) RNA sometime controls the production of DNA and proteins

35. How many base pairs (bp) are found in the haploid genome of humans? *[1999]*
(a) 2.9×10^9 (b) 4×10^8
(c) 7×10^9 (d) 3×10^9

36. The eukaryotic genome differs from the prokaryotic genome because *[1998]*
(a) genes in the former case are organized into operons
(b) the DNA is complexed with histones in prokaryotes
(c) repetitive sequences are present in eukaryotes
(d) the DNA is circular and single stranded in prokaryotes

37. Reverse transcriptase is *[1994]*
(a) RNA dependent RNA polymerase
(b) DNA dependent RNA polymerase
(c) DNA dependent DNA polymerase
(d) RNA dependent DNA polymerase

38. Nucleotide arrangement in DNA can be seen by *[1993]*
(a) X-ray crystallography
(b) electron microscope
(c) ultracentrifuge
(d) light microscope

39. A DNA with unequal nitrogen bases would most probably be *[1993]*
(a) single stranded (b) double stranded
(c) triple stranded (d) four stranded

40. Who proved that DNA is basic genetic material? *[1993]*
(a) Griffith (b) Watson
(c) Boveri and Sutton (d) Hershey and Chase

41. The transforming principle of *Pneumococus* as found out by Avery, MacLeod and McCarty was *[1993]*
(a) mRNA (b) DNA
(c) protein (d) polysaccharide

42. Nucleosome core is made of *[1993]*
(a) H1, H2A, H2B and H3
(b) H1, H2A, H2B, H4
(c) H1, H2A, H2B, H3 and H4
(d) H2A, H2B, H3 and H4

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43. A nucleotide is formed of *[1991]*
(a) purine, pyrimidine and phosphate
(b) purine, sugar and phosphate
(c) nitrogen base, sugar and phosphate
(d) pyrimidine, sugar and phosphate

Topic 2: Replication/Transcription/ Genetic Code/Translation

44. The first phase of translation is *[2020]*
(a) Recognition of DNA molecule
(b) Aminoacylation of tRNA
(c) Recognition of an anti-codon
(d) Binding of mRNA to ribosome

45. From the following, identify the *correct combination* of salient features of Genetic Code. *[2019, Odisa]*
(a) Degenerate, Non-overlapping, Nonambiguous
(b) Universal, Non-ambiguous, Overlapping
(c) Degenerate, Overlapping, Commaless
(d) Universal, Ambiguous, Degenerate

46. In the process of transcription in Eukaryotes, the RNA polymerase I transcribes - *[2019, Odisa]*
(a) Precursor of mRNA, hnRNA
(b) mRNA with additional processing, capping and tailing
(c) tRNA, 5 srRNA and snRNAs
(d) rRNAs – 28 S, 18 S and 5.8 S

47. What initiation and termination factors are involved in transcription in Eukaryotes? *[2019, Odisa]*
(a) α and σ, respectively
(b) σ and ρ, respectively
(c) α and β, respectively
(d) β and γ, respectively

48. Match the following RNA polymerases with their transcribed products : *[2019, Odisa]*
(a) RNA polymerase I (i) tRNA
(b) RNA polymerase II (ii) rRNA
(c) RNA polymerase III (iii) hnRNA
Select the correct option from the following :
(a) (A)-(iii), (b)-(ii), (C)-(i)
(b) (A)-(i), (b)-(iii), (C)-(ii)
(c) (A)-(i), (b)-(ii), (C)-(iii)
(d) (A)-(ii), (b)-(iii), (C)-(i)

49. What will be the sequence of mRNA produced by the following stretch of DNA? *[2019, Odisa]*
3'ATGCATGCATGCATG 5' TEMPLATE STRAND
5' TACGTACGTACGTAC 3' CODING STRAND
(a) 3' AUGCAUGCAUGCAUG 3'
(b) 3' AUGCAUGCAUGCAUG 5'
(c) 5' UACGUACGUACGUAC 3'
(d) 3' UACGUACGUACGUAC 5'

50. AGGTATCGCAT is a sequence from the coding strand of a gene. What will be the corresponding sequence of the transcribed mRNA? *[2018]*
(a) AGGUAUCGCAU
(b) UGGTUTCGCAT
(c) UCCAUAGCGUA
(d) ACCUAUGCGAU

51. Select the correct match *[2018]*
(a) Alec Jeffreys - Streptococcus pneumoniae
(b) Alfred Hershey and Martha Chase - TMV
(c) Francois Jacob and Jacques Monod - Lac operon
(d) Matthew Meselson and F. Stahl - Pisum sativum

52. The experimental proof for semiconservative replication of DNA was first shown in a *[2018]*
(a) Fungus (b) Bacterium
(c) Virus (d) Plant

53. If there are 999 bases in an RNA that codes for a protein with 333 amino acids, and the base at position 901 is deleted such that the length of the RNA becomes 998 bases, how many codons will be altered? *[2017]*
(a) 11 (b) 33
(c) 333 (d) 1

54. During DNA replication, Okazaki fragments are used to elongate: *[2017]*
(a) The lagging strand towards replication fork.
(b) The leading strand away from replication fork.
(c) The lagging strand away from the replication fork.
(d) The leading strand towards replication fork.

55. Which one of the following is the starter codon? *[2016]*
(a) AUG (b) UGA
(c) UAA (d) UAG

56. Which one of the following is **wrongly** matched? *[2014]*
(a) Transcription – Writing information from DNA to tRNA.
(b) Translation – Using information in mRNA to make protein
(c) Repressor protein – Binds to operator to stop enzyme synthesis.
(d) Operon – Structural genes, operator and promoter.

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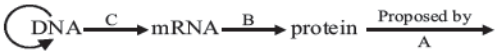
57. Which of the following is **not** a property of the genetic code? *[NEET Kar. 2013]*
(a) Universal (b) Non-overlapping
(c) Ambiguous (d) Degeneracy

58. 

The figure gives an important concept in the genetic implication of DNA. Fill the blanks A, B and C. *[NEET Kar. 2013]*
(a) A – Francis Crick; B – translation; C – transcription
(b) A – Maurice Wilkins; B – transcription; C – translation
(c) A – James Watson; B – replication; C – extension
(d) A – Erwin Chargaff; B – translation; C – replication

59. Removal of RNA polymerase III from nucleoplasm will affect the synthesis of : *[2012]*
(a) t RNA (b) hn RNA
(c) m RNA (d) r RNA

60. Which one of the following is not a part of a transcription unit in DNA ? *[2012]*
(a) The inducer (b) A terminator
(c) A promoter (d) The structural gene

61. Removal of introns and joining of exons in a defined order during transcription is called :
(a) Looping (b) Inducing *[2012]*
(c) Slicing (d) Splicing

62. Read the following four statements (A-D).
(a) In transcription, adenosine pairs with uracil.
(b) Regulation of lac operon by repressor is referred to as positive regulation.
(c) The human genome has approximately 50,000 genes.
(d) Haemophilia is a sex-linked recessive disease.
How many of the above statements are correct?
(a) Two (b) Three *[2012M]*
(c) Four (d) One

63. Given below is a sample of a portion of DNA strand. What is so special shown in it? *[2011]*
5' —— GAATTC —— 3'
3' —— CTTAAG —— 5'
(a) Replication completed
(b) Deletion mutation
(c) Start codon at the 5' end
(d) Palindromic sequence of base pairs

64. The one aspect which is not a salient feature of genetic code, is its being: *[2010]*
(a) degenerate (b) ambiguous
(c) universal (d) specific

65. What is **not** true for genetic code? *[2009]*
(a) It is nearly universal
(b) It is degenerate
(c) It is unambiguous
(d) A codon in mRNA is read in a non contiguous fashion

66. Removal of introns and joining the exons in a defined order in a transcription unit is called: *[2009]*
(a) tailing (b) transformation
(c) capping (d) splicing

67. Whose experiments cracked the DNA and discovered unequivocally that a genetic code is a 'triplet' *[2009]*.
(a) Hershey and Chase
(b) Morgan and Sturtevant
(c) Beadle and Tantum
(d) Nirenberg and Mathaei

68. Which one of the following pairs of codons is correctly matched with their function or the signal for the particular amino acid? *[2008]*
(a) GUU, GCU-Alanine
(b) UAG, UGA-Stop
(c) AUG, ACG-Start/Methionine
(d) UUA, UCA-Leucine

69. Polysome is formed by *[2008]*
(a) several ribosomes attached to a single mRNA
(b) many ribosomes attached to a strand of endoplasmic reticulum
(c) a ribosome with several subunits
(d) ribosomes attached to each other in a linear arrangement

70. Molecular basis of organ differentiation depends on the modulation in transcription by *[2007]*
(a) ribosome (b) transcription factor
(c) anticodon (d) RNA polymerase.

71. Telomerase is an enzyme which is a *[2005]*
(a) simple protein (b) RNA
(c) ribonucleoprotein (d) repetitive DNA

72. In a mutational event, when adenine is replaced by guanine, it is a case of *[2004]*
(a) frame shift mutation (b) transcription
(c) transition (d) transversion

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73. The telomeres of eukaryotic chromosomes consist of short sequences of *[2004]*
(a) thymine rich repeats
(b) cytosine rich repeats
(c) adenine rich repeats
(d) guanine rich repeats

74. During replication of a bacterial chromosome DNA synthesis starts from a replication origin site and *[2004]*
(a) RNA primers are involved
(b) is facilitated by telomerase
(c) moves in one direction of the site
(d) moves in bi-directional way

75. During translation initiation in prokaryotes, a GTP molecule is needed in *[2003]*
(a) association of 50 S subunit of ribosome with initiation complex
(b) formation of formyl-met-tRNA
(c) binding of 30 S subunit of ribosome with mRNA
(d) association of 30 S-mRNA with formyl-met-tRNA

76. Which one of the following triplet codes, is correctly matched with its specificity for an amino acid in protein synthesis or as 'start' or 'stop' codon ? *[2003]*
(a) UAC – Tyrosine (b) UCG – Start
(c) UUU – Stop (d) UGU – Leucine

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77. What would happen if in a gene encoding a polypeptide of 50 amino acids, 25th codon (UAU) is mutated to UAA? *[2003]*
(a) A polypeptide of 25 amino acids will be formed
(b) A polypeptide of 24 amino acids will be formed
(c) Two polypeptides of 24 and 25 amino acids will be formed
(d) A polypeptide of 49 amino acids will be formed

78. In the genetic code dictionary, how many codons are used to code for all the 20 essential amino acids ? *[2003]*
(a) 60 (b) 20
(c) 64 (d) 61

79. Degeneration of a genetic code is attributed to the *[2003]*
(a) third member of a codon
(b) first member of a codon
(c) second member of a codon
(d) entire codon

80. Out of 64 codons, 61 codons code for 20 types of amino acid. It is called *[2002]*
(a) degeneracy of genetic code
(b) overlapping of gene
(c) wobbling of codon
(d) universility of codons

81. Exon part of m- RNAs have code for *[2002]*
(a) protein (b) lipid
(c) carbohydrate (d) phospholipid

82. Types of RNA polymerase required in nucleus for RNA synthesis? *[2001]*
(a) 1 (b) 2
(c) 3 (d) 4

83. Gene and cistron words are sometimes used synonymously because *[2001]*
(a) one cistron contains many genes
(b) one gene contains many cistrons
(c) one gene contains one cistron
(d) one gene contains no cistron

84. Mutation generally produces *[2000]*
(a) polygenes (b) dominant genes
(c) recessive genes (d) lethal genes

85. Protein synthesis occurs *[2000]*
(a) on ribosmes present in cytosol as well as in mitochondria
(b) only on ribosomes attached to the nuclear envelope and endoplasmic reticulum
(c) only on the ribosomes present in cytosol
(d) on ribosomes present in the nucleolus as well as cytoplasm

86. One function of the telomeres in a chromosome is to *[2000]*
(a) indentify the correct number of the homologous pair of chromosomes
(b) help two chromatids to move towards poles
(c) "seal" the ends of chromosomes
(d) start RNA synthesis

87. Anticodon is an unpaired triplet of bases in an exposed position of *[2000]*
(a) mRNA (b) rRNA
(c) tRNA (d) sRNA

88. Initiation codon of protein synthesis (in eucaryotes) is *[2000]*
(a) GUA (b) GCA
(c) CCA (d) AUG

89. DNA replication is *[2000]*
(a) conservative and discontinuous
(b) semiconservative and semi discontinuous
(c) semiconservative and discontinuous
(d) conservative

90. What base is responsible for hot spots for spontaneous point mutations? *[1998]*
(a) Adenine (b) 5-bromouracil
(c) 5-methylcytosine (d) Guanine

91. DNA elements which can switch their position are called *[1998]*
(a) exons (b) introns
(c) cistrons (d) transposons

92. Genes that are involved in turning on or off the transcription of a set of structural genes are called *[1998]*
(a) Operator genes (b) Redundant genes
(c) Regulator genes (d) Polymorphic genes

93. Which step of translation does not consume a high energy phosphate bond ? *[1997]*
(a) Translocation
(b) Amino acid activation
(c) Peptidyl-transferase reaction
(d) Aminoacyl tRNA binding to active ribosomal site

94. Three codons causing chain termination are *[1997]*
(a) TAG, TAA, TGA
(b) GAT, AAT, AGT
(c) AGT, TAG, UGA
(d) UAG, UGA, UAA

95. A mutation at one base of the first codon, of a gene, produces a non-functional protein. Such a mutation is called *[1997]*
(a) nonsense mutation (b) missense mutation
(c) frameshift mutation (d) reverse mutation

96. If a completely radioactive double stranded DNA molecule undergoes two rounds of replication in a non-radioactive medium, what will be the radioactive status of the four resulting molecules? *[1997]*
(a) Half the number contain no radioactivity
(b) All four still contain radioactivity
(c) Three out of four contain radioactivity
(d) Radioactivity is lost from all four

97. Different mutations referrable to the same locus of a chromosome give rise to *[1997]*
(a) multiple alleles (b) pseudoalleles
(c) polygenes (d) oncogenes

98. During development of an organism, the product of one gene is required to activate another gene. Such gene products are called *[1997]*
(a) transcription factors (b) episomes
(c) coenzymes (d) catalase

99. In eukaryotes, after transcription of mRNA, some of its nucleotides are removed before it is translated into polypeptide. The nucleotides which are removed from mRNA are called *[1997]*
(a) exons
(b) upstream sequences
(c) unusual bases
(d) introns

100. Okazaki fragments are seen during *[1996]*
(a) transcription (b) translation
(c) replication (d) transduction

101. The translation termination triplet is *[1996]*
(a) UAU (b) UAA
(c) UAC (d) UGC.

102. In split genes, the coding sequences are called
(a) introns (b) operons *[1995]*
(c) exons (d) cistrons

103. Protein helping in opening of DNA double helix in form of replication fork is *[1994]*
(a) DNA gyrase
(b) DNA polymerase I
(c) DNA ligase
(d) DNA topoisomerase

104. Which is not involved in protein synthesis ?
(a) Transcription (b) Initition *[1994]*
(c) Elongation (d) Termination

105. Reverse transcriptase is *[1994]*
(a) RNA dependent RNA polymerase
(b) DNA dependent RNA polymerase
(c) DNA dependent DNA polymerase
(d) RNA dependent DNA polymerase

106. The number of base substitution possible in amino acid codons is *[1994]*
(a) 261 (b) 264
(c) 535 (d) 549

107. Out of A-T, G-C pairing, bases of DNA may exist in alternate valency state owing to arrangement called *[1994]*
(a) analogue substitution
(b) tautomerisational mutation
(c) frame-shift mutation
(d) point mutation

108. The process of translation is *[1993]*
(a) ribosome synthesis (b) protein synthesis
(c) dNA synthesis (d) rNA synthesis

109. During DNA replication, the strands separate by *[1993]*
(a) DNA polymerase
(b) topoisomerase
(c) unwindase/Helicase
(d) gyrase

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110. Because most of the amino acids are represented by more than one codon, the genetic code is
(a) overlapping (b) wobbling ***[1993]***
(c) degenerate (d) generate

111. *Escherichia coli* fully labelled with ^{15}N is allowed to grow in ^{14}N medium. The two strands of DNA molecule of the first generation bacteria have ***[1992]***
(a) different density and do not resemble parent DNA
(b) different density but resemble parent DNA
(c) same density and resemble parent DNA
(d) same density but do not resemble parent DNA

112. Khorana first deciphered the triplet codons of
(a) serine and isoleucine ***[1992]***
(b) cysteine and valine
(c) tyrosine and tryptophan
(d) phenylalanine and methionine

113. Experimental material in the study of DNA replication has been ***[1992]***
(a) *Escherichia coli*
(b) *Neurospora crassa*
(c) *Pneumococcus*
(d) *Drosophila melanogaster*

114. The process of transfer of genetic information from DNA to RNA/formation of RNA from DNA is ***[1991]***
(a) transversion (b) transcription
(c) translation (d) translocation

115. In the genetic dictionary, there are 64 codons as ***[1990]***
(a) 64 amino acids are to be coded
(b) 64 types of tRNAs are present
(c) there are 44 nonsense codons and 20 sense codons
(d) genetic code is triplet.

116. An octamer of 4 histones complexed with DNA forms ***[1990]***
(a) endosome (b) nucleosome
(c) mesosome (d) centromere

117. Genetic code consists of ***[1988]***
(a) adenine and guanine
(b) cytosine and uracil
(c) cytosine and guanine
(d) all the above

Topic 3: Regulation of Gene Expression

118. Non-membranous nucleoplasmic structures in nucleus are the site for active synthesis of ***[2019, Odisa]***
(a) tRNA (b) protein synthesis
(c) mRNA (d) rRNA

119. Under which of the following conditions will there be no change in the reading frame of following mRNA ? ***[2019]***
5′ AACAGCGGUGCUAUU 3′
(a) Insertion of G at 5th position
(b) Deletion of G from 5th position
(c) Insertion of A and G at 4th and 5th positions respectively
(d) Deletion of GGU from 7th, 8th and 9th positions

120. All of the following are part of an operon except ***[2018]***
(a) an operator (b) structural genes
(c) a promoter (d) an enhancer

121. Spliceosomes are not found in cells of; ***[2017]***
(a) Fungi (b) Animals
(c) Bacteria (d) Plants

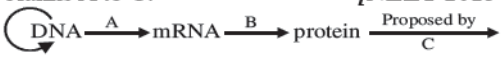
122. Which of the following is required as inducer(s) for the expression of Lac operon? ***[2016]***
(a) Glucose
(b) Galactose
(c) Lactose
(d) Lactose and galactose

123. Gene regulation governing lactose operon of *E.coli* that involves the lac I gene product is : ***[2015 RS]***
(a) Negative and inducible because repressor protein prevents transcription
(b) Negative and repressible because repressor protein prevents transcription
(c) Feedback inhibition because excess of b-galactosidase can switch off trascription
(d) Positive and inducible because it can be induced by lactose

124. Select the correct option: ***[2014]***

	Direction of RNA synthesis the template	Direction of reading of DNA strand
(a)	5′—3′	3′—5′
(b)	3′—5′	5′—3′
(c)	5′—3′	5′—3′
(d)	3′—5′	3′—5′

125. The diagram shows an important concept in the genetic implication of DNA. Fill in the blanks A to C. ***[NEET 2013***



(a) A-translation B - transciption C-Erwin Chargaff
(b) A-transcription B - translation C-Francis Crick
(c) A-translation B - extension C-Rosalind Franklin
(d) A-transcription B - replication C-James Watson

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126. Which enzymes will be produced in a cell in which there is a nonsense mutation in the lac Y gene? *[NEET 2013]*
(a) Lactose permease
(b) Transacetylase
(c) Lactose permease and transcetylase
(d) β- galactosidase

127. In an inducible operon, the genes are *[NEET Kar. 2013]*
(a) Always expressed
(b) Usually not expressed unless a signal turns them "on"
(c) Usually expressed unless a signal turns them "off"
(d) Never expressed

128. Which one of the following also acts as a catalyst in a bacterial cell ? *[2011]*
(a) 5s rRNA (b) sn RNA
(c) hn RNA (d) 23s rRNA

129. Select the two correct statements out of the four (a–d) given below about lac operon. *[2010]*
(i) Glucose or galactose may bind with the repressor and inactivate it
(ii) In the absence of lactose the repressor binds with the operator region
(iii) The z-gene codes for permease
(iv) This was elucidated by Francois Jacob and Jacque Monod
The correct statements are:
(a) (ii) and (iii) (b) (i) and (iii)
(c) (ii) and (iv) (d) (i) and (ii)

130. Semi-conservative replication of DNA was first demonstrated in: *[2009]*
(a) *Escherichia coli*
(b) *Streptococcus pneumoniae*
(c) *Salmonella typhimurium*
(d) *Drosophila melanogaster*

131. In the DNA molecule *[2008]*
(a) the total amount of purine nucleotides and pyrimidine nucleotides is not always equal
(b) there are two strands which run parallel in the $5' \rightarrow 3'$ direction
(c) the proportion of Adenine in relation to thymine varies with the organism
(d) there are two strands which run anti parallel one in $5' \rightarrow 3'$ direction and other in $3' \rightarrow 5'$

132. The okazaki fragments in DNA chain growth *[2007]*
(a) polymerize in the 3' - to - 5' direction and forms replication fork
(b) prove semi-conservative nature of DNA replication
(c) polymerize in the 5' - to - 3' direction and explain 3' - to - 5' DNA replication
(d) result in transcription.

133. One gene-one enzyme relationship was established for the first time in *[2007]*
(a) *Salmonella typhimurium*
(b) *Escherichia coli*
(c) *Diplococcus pneumoniae*
(d) *Neurospora crassa.*

134. One gene -one enzyme hypothesis was postulated by *[2006]*
(a) Hershey and Chase (b) A. Garrod
(c) Beadle and Tatum (d) R. Franklin

135. ***E.coli*** cells with a mutated z gene of the lac operon cannot grow in medium containing only lactose as the source of energy because: *[2005]*
(a) the lac operon is constitutively active in these cells
(b) they cannot synthesize functional beta-galactosidase
(c) in the presence of glucose, ***E.coli*** cells do not utilize lactose
(d) they cannot transport lactose from the medium into the cell

136. During transcription holoenzyme RNA polymerase binds to a DNA sequence and the DNA assumes a saddle like structure at that point. What is that sequence called? *[2005]*
(a) AAAT box (b) TATA box
(c) GGTT box (d) CAAT box

137. Which one of the following makes use of RNA as a template to synthesize DNA? *[2005]*
(a) DNA polymerase
(b) RNA polymerase
(c) Reverse transcriptase
(d) DNA dependant RNA polymerase

138. In transgenics, expression of transgene in target tissue is determined by *[2004]*
(a) enhancer (b) transgene
(c) promoter (d) reporter

139. What does "lac" refer to in what we call the lac operon? *[2003]*
(a) The number 1,00,000
(b) Lactose
(c) Lactase
(d) Lac insect

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140. During transcription, the DNA site at which RNA polymerase binds is called *[2003]*
(a) enhancer (b) promoter
(c) regulator (d) receptor

141. In *E.coli* during lactose metabolism repressor binds to *[2002]*
(a) regulator gene (b) operator gene
(c) structural gene (d) promoter gene

142. Jacob and Monod studied lactose metabolism in *E.coli* and proposed operon concept. Operon concept is applicable for *[2002]*
(a) all prokaryotes
(b) all prokaryotes and some eukaryotes
(c) all prokaryotes and all eukaryotes
(d) all prokaryotes and some protozoans

143. In negative operon *[2001]*
(a) co-repressor binds with repressor
(b) co-repressor does not bind with repressor
(c) co-repressor binds with inducer
(d) CAMP have negative effect on lac operon

144. In which direction m-RNA is synthesised on DNA template ? *[2001]*
(a) $5' \rightarrow 3'$ (b) $3' \rightarrow 5'$
(c) Both (a) and (b) (d) Any

145. At time of organogenesis genes regulate the process at different levels and at different time due to *[2001]*
(a) promoter (b) regulator
(c) intron (d) exon

146. In operon concept , regulator gene functions as *[1999]*
(a) repressor (b) regulator
(c) inhibitor (d) all of these

147. The RNA that picks up specific amino acids from the amino acid pool in the cytoplasm to ribosome during protein synthesis is called
(a) mRNA (b) tRNA *[1997]*
(c) rRNA (d) carrier RNA

148. The wild type *E. coli* cells are growing in normal medium with glucose. They are transferred to a medium containing only lactose as sugar. Which of the following changes takes place? *[1995]*
(a) The lac operon is repressed
(b) All operons are induced
(c) The lac operon is induced
(d) *E.coli* cells stop dividing

149. An environmental agent, which triggers transcription from an operon, is a *[1995]*
(a) regulator (b) inducer
(c) depressor (d) controlling element

150. The lac operon is an example of *[1995]*
(a) arabinose operon (b) inducible operon
(c) repressible operon (d) overlapping genes

151. In *Escherichia coli*, lac operon is induced by *[1994]*
(a) lactose (b) promoter gene
(c) β -galactosidase (d) I-gene

152. Binding of specific protein on regulatory DNA sequence can be studied by means of *[1993]*
(a) ultra centrifugation
(b) electron microscope
(c) light microscope
(d) X-ray crystallography

Topic 4: Human Genome Project / DNA Fingerprinting

153 Expressed Sequence Tags (ESTs) refers to:
(a) Genes expressed as RNA *[2019]*
(b) Polypeptide expression
(c) DNA polymorphism
(d) Novel DNA sequences

154. Match the following genes of the Lac operon with their respective products: *[2019]*
(A) i gene (i) β-galactosidase
(B) z gene (ii) Permease
(C) a gene (iii) Repressor
(D) y gene (iv) Transacetylase
Select the **correct** option.

	(A)	(B)	(C)	(D)
(a)	(i)	(iii)	(ii)	(iv)
(b)	(iii)	(i)	(ii)	(iv)
(c)	(iii)	(i)	(iv)	(ii)
(d)	(iii)	(iv)	(i)	(ii)

155. Which of the following is not required for any of the techniques of DNA fingerprinting available at present ? *[2016]*
(a) Polymerase chain reaction
(b) Zinc finger analysis
(c) Restriction enzymes
(d) DNA-DNA hybridization

156. Satellite DNA is important because it : *[2015 RS]*
(a) shows high degree of polymorphism in population and also the same degree of polymorphism in an individual, which is heritable from parents to children.
(b) does not code for proteins and is same in all members of the population
(c) codes for enzymes needed for DNA replication
(d) codes for proteins needed in cell cycle.

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157. One of the most frequently used techniques in DNA fingerprinting is *[NEET Kar. 2013]*
(a) AFLP (b) VNTR
(c) SSCP (d) SCAR

158. Which of the following forms the basis of DNA Finger printing? *[2012M]*
(a) The relative proportions of purines and pyrimidines in DNA.
(b) Satellite DNA occurring as highly repeated short DNA segments.
(c) The relative difference in the DNA occurrence in blood, skin and saliva.
(d) The relative amount of DNA in the ridges and grooves of the fingerprints.

159. In history of biology, human genome project led to the development of : *[2011M]*
(a) biotechnology (b) biomonitoring
(c) bioinformatics (d) biosystematics

160. Satellite DNA is useful tool in: *[2010]*
(a) organ transplantation
(b) sex determination
(c) forensic science
(d) genetic engineering

161. DNA fingerprinting refers to *[2004]*
(a) molecular analysis of profiles of DNA samples
(b) analysis of DNA samples using imprinting devices
(c) techniques used for molecular analysis of different specimens of DNA
(d) techniques used for identification of fingerprints of individuals

162. The basis for DNA fingerprinting is *[1996]*
(a) occurrence of restriction fragment length polymorphism (RFLP)
(b) phenotypic differences between individuals
(c) availability of cloned DNA
(d) knowledge of human karyotype

ANSWER KEY

1	(b)	18	(d)	35	(d)	52	(b)	69	(a)	86	(c)	103	(a)	120	(d)	137	(c)	154	(c)	
2	(d)	19	(a)	36	(c)	53	(b)	70	(b)	87	(c)	104	(a)	121	(c)	138	(d)	155	(b)	
3	(d)	20	(b)	37	(d)	54	(c)	71	(c)	88	(d)	105	(d)	122	(c)	139	(b)	156	(a)	
4	(a)	21	(c)	38	(a)	55	(a)	72	(c)	89	(c)	106	(d)	123	(a)	140	(b)	157	(b)	
5	(a)	22	(b)	39	(a)	56	(a)	73	(d)	90	(c)	107	(b)	124	(a)	141	(b)	158	(b)	
6	(d)	23	(a)	40	(d)	57	(c)	74	(d)	91	(d)	108	(b)	125	(b)	142	(b)	159	(c)	
7	(b)	24	(c)	41	(b)	58	(a)	75	(a)	92	(c)	109	(c)	126	(d)	143	(a)	160	(c)	
8	(a)	25	(b)	42	(d)	59	(a)	76	(a)	93	(c)	110	(c)	127	(b)	144	(a)	161	(a)	
9	(b)	26	(b)	43	(c)	60	(a)	77	(b)	94	(d)	111	(c)	128	(d)	145	(b)	162	(a)	
10	(c)	27	(d)	44	(b)	61	(d)	78	(d)	95	(b)	112	(b)	129	(c)	146	(a)			
11	(c)	28	(b)	45	(a)	62	(a)	79	(a)	96	(a)	113	(a)	130	(a)	147	(b)			
12	(b)	29	(c)	46	(d)	63	(d)	80	(a)	97	(a)	114	(b)	131	(d)	148	(c)			
13	(b)	30	(a)	47	(*)	64	(b)	81	(a)	98	(a)	115	(d)	132	(c)	149	(b)			
14	(d)	31	(c)	48	(d)	65	(d)	82	(c)	99	(d)	116	(b)	133	(d)	150	(b)			
15	(b)	32	(a)	49	(c)	66	(d)	83	(c)	100	(c)	117	(d)	134	(c)	151	(a)			
16	(d)	33	(c)	50	(a)	67	(d)	84	(c)	101	(b)	118	(d)	135	(b)	152	(d)			
17	(d)	34	(a)	51	(c)	68	(b)	85	(a,b)	102	(c)	119	(d)	136	(b)	153	(a)			

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Hints & Solutions

1. (b) Length of DNA = [0.34 × 10–9] m × 6.6 × 109 bp = 2.2 m
Distance between 2 base pair in DNA helix = 0.34 nm = 0.34 × 10–9 m
Total number of base pair = 6.6 × 109 bp

2. (d) Based on the observation of Erwin Chargaff that for a double stranded DNA, the ratios between Adenine and Thymine and Guanine and Cytosine are constant and equals one. Adenine pairs with thymine through two H-bonds i.e., A = T and guanine pairs with cytosine with three H-bonds.

NOTES

Adenine and Thymine also have a favorable configuration for their bonds. They both have to -OH/-NH groups which can form hydrogen bridges. When one pairs Adenine with Cytosine, the various groups are in each others way. For them to bond with each other would be chemically unfavourable.

3. **(d)** Alfred Hershey and Martha Chase studied bacteriophages, or viruses that attack bacteria. In 1952, they conducted a series of experiments to prove that DNA is the genetic material. They labelled the protein of bacteriophages with radioactive sulphur and their DNA with radioactive phosphorus. The bacteriophages were allowed to infect bacteria. The protein coat is left behind when the viral DNA enters a bacterium.

NOTES

Hershey and Chase wanted to find out which part of the bacteriophage will enter the bacteria and pass on genetic material - protein coat or DNA core. The proteins were labeled with radioactive sulfur-35, while DNA contained radioactive phosphorus-32. When they joined labeled viruses and bacteria, they discovered that phosphorus-32 was present in the bacteria. This outcome supported Avery's theory that genes are located in the DNA of the cell.

4. (a) Hershey and Chase proved that DNA as genetic material. They used bacteriophage for their experiment.

5. (a) DNA fragments are negatively charged because of presence of phosphate group.

6. (d) Ribosomal RNA (rRNA) is most abundant in animal cell. It constitutes 80% of total RNA of the cell.

7. (b) The association of H1 protein indicates the complete formation of nucleosome which requires DNA condensation. The DNA is therefore in condensed form.

8. (a) A polysome or polyribosome is a complex of an mRNA molecule and two or more ribosomes, which is formed during the active translation process. They were initially named as ergosomes in 1963. However, further research by Jonathan Warner and Alex Rich characterized polysome.

9. (b) Chargaff's rule states that A = T and G ≡ C. The molar amount of adenine = molar amount of thymine. The molar amount of guanine = molar amount of cytosine.
Hence, G is 17%, so, C = 17%
A = 33%, so, T = 33%

10. (c) Chargaff's rule is not applicable to RNA

11. (c) Frederick Griffith (in 1928), a British Medical officer described the phenomenon of **bacterial transformation**. He carried out experiment with ***Streptococcus pneumoniae*** (bacterium causing pneumonia) which is used to infect mice. By using S Strain (heat killed) and R strain (live) it was concluded that R strain has been transformed by some material of S strain which makes R strain virulent and enable to synthesize smooth polysachharide.

12. (b) The combination of pentose sugar with nitrogenous bases (purines or pyrimidines) is called nucleoside. Examples are adenosine, guanosine, cytidine, thymidine and uridine.

13. (b) Sequence of DNA is ATCTG then sequence of m-RNA will UAGAC. As adenine base pairs with uracil and guanine with cytosine.

14. (d) Bacteriophage was used by Hershey and Chase to prove DNA as genetic material.

15. (b) Infections proteins are rich in prions. Prions are made of proteins without nucleic acid. It is the causal agent of scrapie disease of sheep.

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16. (d) HIV viruses does not follow central dogma. Central dogma is a one way flow of information from DNA to mRNA and then to protein.

$$DNA \underset{\text{reverse transcription}}{\overset{\text{transcription}}{\rightleftharpoons}} mRNA \xrightarrow{\text{translation}} \text{Protien}$$

17. (d) Theodor O. Diener discovered the Potato Spindle Tuber Viroid ("PSTVd"), the first viroid ever identified, in 1971. PSTVd is a small, circular RNA molecule. Dr. Diener discovered that the pathogen causing potato spindle tuber disease is not a virus, as previously believed, but a much smaller, free RNA molecule.
18. (d) Purine is an organic nitrogenous base sparingly soluble in water, that gives rise to a group of biologically important derivatives, notably adenine and guanine, which occur in nucleotides and nucleic acids (DNA and RNA).
19. (a) The nucleosome model explains the packaging of histone proteins and DNA in the chromatin material which forms the chromosome.
20. (b) A sequential expression of a set of human genes is the DNA sequence. Because gene is the functional part of DNA sequence.
21. (c) The DNA binding sequence for RNA polymerase is called TATA box.
22. (b) The two chains are antiparallel, one aligned in 5'→3' direction the other in 3' → 5' direction.
23. (a) Neomycin is the antibiotic which inhibits the translation of bacterial cell so that it can not affect the host cell.
24. (c) According to Chargaff purines and pyrimidines are in equal amounts. Purine (adenine) is equimolar with pyrimidine (thymine) and purine (guanine) is equimolar with pyrimidine (cytosine).
Base ratio $\frac{A + T}{C + G}$ is specific for species.
25. (b) During transcription, from the DNA template complementary mRNA is formed and thymine is replaced by uracil.
26. (b) In eukaryotic cells, two cytoplasmic organelles, mitochondria and chloroplast of green plants, contain their own genetic materials.
27. (d) rRNA occurs inside ribosomes. m RNA carries information from DNA to polypeptides. hnRNA are heterogenous nuclear RNA.
28. (b) Transformation is change in genetic material of an organism by obtaining genes from outside.
29. (c) According to Chargaff's rule, the ratio of purine bases to pyrimidine bases is equal. A = T, C = G.
If T is 20% then A is 20% and C and G are 30%, 30%.
30. (a) Colour blindness follows sex-linked inheritance. Phenylketonuria is an in born error of metabolism.
31. (c) Ribozymes are catalytically active RNA molecule discovered in 1980's. They are self splicing introns indicating their possible role as intermediates in the evolution of biological systems from abiotic substances.
32. (a) Kim et al (1973) suggested L shape model of t- RNA by X-Ray diffraction while studying phenyl alanine t - RNA of yeast.
33. (c) In DNA adenine always pairs with thymine and guanine always pairs with cytosine, this is called complementary base pairing.
34. (a) Griffith's experiment with *Pneumococcus* proves that DNA is the genetic material.
35. (d) The number of base pairs (bp) found in the haploid genome of humans is 3×10^9.
36. (c)
37. (d) H. Temin and D. Baltimore (1970) discovered that tumor viruses contain RNA as genetic material and replicate by synthesizing complementary DNA. This process is called reverse transcription and it is carried by an RNA dependent DNA polymerase called as reverse transcriptase.
38. (a) In 1953 Wilkins obtained very fine X-ray crystallographic pictures of DNA from which Watson and Crick developed the double helix model of DNA.
39. (a) A single strand of DNA would not possess complementary base pairs. Hence nitrogenous bases are unequal in number.
40. (d) Hershey and Chase (1952) worked on ***Escherichia coli*** and conclusively proved that DNA is the genetic material.
41. (b) The transforming chemical discovered by Griffith in his experiments with ***Pneumococcus***, was confirmed as DNA by Avery, McLeod and McCarty.

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42. (d) The four histone proteins constituting the core of nucleosome are H2A, H2B, H3, H4.
43. (c) Nucleotide is a unit of DNA , which is formed of nitrogenous bases (urines & Pyrimidines), sugar (Pentose) & phosphate.
44. (b) The first phase of translation involves activation of amino acid in the presence of ATP and linked to their cognate tRNA - a process commonly called as charging of tRNA or aminoacylation of tRNA.

NOTES

Mutations in transfer RNA genes reduce the ability of the tRNA to add amino acids to proteins, slowing protein production. Mutations that affect mitochondrial tRNAs impair the ability of mitochondria to provide energy for cells or to control blood sugar levels.

45. (a) Genetic code is the sequence of nucleotides in deoxyribonucleic acid (DNA) and ribonucleic acid (RNA) that determines the amino acid sequence of proteins. Genetic code is universal, unambiguous, non overlapping and degenerate in nature.

NOTES

Over the course of several years, Marshall Nirenberg, Hargobind Khorana and Severo Ochoa and their colleagues elucidated the genetic code - showing how nucleic acids with their 4-letter alphabet determine the order of the 20 kinds of amino acids in proteins. Even in organisms that don't use the "standard" code, the differences are relatively small, such as a change in the amino acid encoded by a particular codon. A genetic code shared by diverse organisms provides important evidence for the common origin of life on Earth

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46. (d) During transcription in eukaryotes, RNA polymerase I transcribes 5.8S, 18S and 28S rRNA. Eukaryotic transcription is carried out in the nucleus of the cell and proceeds in three sequential stages: initiation, elongation, and termination. Eukaryotes require transcription factors to first bind to the promoter region and then help recruit the appropriate polymerase.

NOTES

The state of chromatin structure at a specific region in eukaryotic DNA, along with the presence of specific transcription factors, works to regulate gene expression in eukaryotes. However, this complex interplay between proteins that serve as transcriptional activators or repressors and accessibility to the regulatory sequence is still just part of the story. Epigenetic mechanisms, including DNA methylation and imprinting, noncoding RNA, post-translational modifications, and other mechanisms, further enrich the cellular portfolio of gene expression control activities.

47. (*) The sigma factor (σ) causes RNA polymerase to bind to the correct sites on DNA to initiate transcription (i.e. promoters). σ destabilises the complex between core polymerase and non-promoter DNA and decreases the amount of time it is bound. It enhances the affinity and increases the amount of time that holoenzyme ($\alpha 2\beta\beta'\sigma$) is bound to promoter, i.e. it facilitates a random search for promoters.

NOTES

None of the answers given is correct according to the question.
Termination factor is a protein signal that regulates the transcription of RNA to preserve gene expression integrity and is present in both eukaryotes and prokaryotes, although the process in bacteria is more widely understood. The most extensively studied and detailed transcriptional termination factor is the Rho (ρ) protein of E. coli. The process of transcriptional termination is less understood in eukaryotes, which have extensive post-transcriptional RNA processing, and each of the three types of eukaryotic RNA polymerase have a different termination system. In RNA polymerase I, Transcription termination factor binds downstream of the pre-rRNA coding regions, causing the dissociation of the RNA polymerase from the template and the release of the new RNA strand. In RNA polymerase II, the termination occurs via a polyadenylation/ cleaving complex. The 3' tail on the ending of the strand is bound at the polyadenylation site, but the strand will continue to code. The newly formed amino acids are removed one at a time by the cleavage factors CSTF and CPSF, in a process that is still not fully understood. The remainder of the strand is disengaged by a 5′-exonuclease when the transcription is finished. RNA polymerase III terminates after a series of uracil polymerization residues in the transcribed mRNA. Unlike in bacteria and in polymerase I, the termination RNA hairpin needs to be upstream to allow for correct cleaving.

48. (d) RNA polymerase is an enzyme that is responsible for copying a DNA sequence into an RNA sequence during the process of transcription. In eukaryotes, there are three types of RNA polymerases.
(i) RNA polymerase I transcribes rRNAs genes.
(ii) RNA polymerase II transcribes hnRNAs.
(iii) RNA polymerase III transcribes tRNAs and 5srRNA.

49. (c) 5' TACGTACGTACGTAC 3' (Coding strand)
5' UACGUACGUACGUAC 3' (m-RNA)
In m-RNA at the place of thymine in coding strand uracil remain present.

50. (a) Coding strand and mRNA have the similar nucleotide sequence except, Thymine (T) is replaced by Uracil (U) in mRNA.

51. (c) Francois Jacob and Jacque Monod proposed the model of gene regulation known as operon model/lac operon. Alec Jeffreys gave DNA fingerprinting technique. Matthew Meselson and F. Stahl gave semi-conservative DNA replication in E.coli. Alfred Hershey and Martha Chase proved DNA as genetic material not protein.

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52. (b) Semi-conservative DNA replication was first shown in bacterium Escherichia coli by Matthew Meselson and Franklin Stahl.

53. (b) If deletion happens at 901st position then the remaining 98 bases specifying for 33 codons of amino acids will be altered.

54. (c) Two DNA polymerase molecules simultaneously work at the DNA fork, one on the leading strand and the other on the lagging strand.
DNA polymerase synthesizes each Okazaki fragment at lagging strand in 5′-3′ direction. As the replication fork opens further, new Okazaki fragments appear. The first Okazaki fragment appears away from the replication fork and thus the direction of elongation would be away from replication fork.

55. (a) The start codon is the first codon of a messenger RNA (mRNA) transcript translated by a ribosome. The start codon always codes for methionine in eukaryotes and a modified Met (fMet) in prokaryotes. The most common start codon is AUG.

56. (a) Process of copying genetic information from DNA to RNA is called **transcription**. At a time only one DNA strand is being transcribed into RNA. The strand of DNA with polarity 3' → 5' act as **template strand** and the DNA strand with polarity 5' → 3' act as **coding strand**.

57. (c) Genetic code is the relationship of amino acid sequence in a polypeptide and nucleotide/ base sequence in mRNA/antisense strand of DNA.
It is **universal,** *i.e.*, a codon specifies the same amino acid in all organisms, **non-overlapping**, *i.e.*, adjacent codons are independent with no base being member of two codons, **degeneracy**, *i.e.*, some amino acids are coded by more than one codon, hence the code is degenerate, **unambiguous,** *i.e.*, one codon codes for only one amino acid.

58. (a) In this question A is francis crick, B is translation and C is transcription. It is unidirectional flow of information from DNA to mRNA (transcription) and then decoding the information present in mRNA in the formation of polypeptide chain or protein (translation).

59. (a) Removal of RNA polymerase III from nucleoplasm will affect the synthesis of tRNA while RNA polymerase I forms r-RNA and RNA polymerase II form m-RNA in eukaryotes.

60. (a) Transcription unit consists of promoter, structural gene & terminator.

61. (d) Removal of introns by spliceosome in hnRNA and joining of exons by DNA liagse in a defined order during transcription is called splicing.

62. (a) Statement A & D is correct
Regulation of *lac* operon by repressor is referred as negative regulation. In negative regulation, a repressor molecule binds to the operator of an operon and terminates transcription. In positive regulation, an activator interacts with the RNA polymerase in the promoter region to initiate transcription.
Human genome contains some 20,000-25,000 genes billion bases.

63. (d) The sample of a portion of DNA strand shown in the figure is palindromic sequence of base pairs.

64. (b) Genetic code is non-ambiguous. There is no ambiguity for a particular codon. A particular codon will always code for the same amino acid, where ever it is found.
65. (d) The genetic code consists of 64 triplets of nucleotides. These triplets are called codons. With three exceptions, each codon encodes for one of the 20 amino acids used in the synthesis of proteins. That produces some redundancy in the code. Most of the amino acids being encoded by more than one codon. The genetic code can be expressed as either RNA codons or DNA codons.
66. (d) Splicing is the removal of introns and joining the exons in a defined order in a transcription unit. In molecular biology, splicing is a modification of RNA after transcription, in which introns are removed and exons are joined.
67. (d) Nirenberg and Mathaei (1961) experimentally proved that a single amino acid is determined by a sequence of three nitrogen bases. The sequence of three nitrogen bases determining a single amino acid is called a triplet code. Nirenberg and Mathaei experiments cracked the DNA and discovered unequivocally that a genetic code is a triplet.
68. (b) GCU indicates alanine but GUU indicates valine.
Stop codons are UAG, UGA and UAA
AUG is the most common start codon which codes for methionine.
UUA indicates leucine but UCA indicates serine.
69. (a) Polysome (Polyribosome) is a complex formed by several ribosomes attached to a single mRNA molecule in the process of translation.
70. (b)
71. (c) Telomerase is a ribonucleoprotein which synthesises G rich strand of telomeres in DNA. It adds specific DNA sequence repeats ("TTAGGG" in all vertebrates) to the 3' end of DNA strands in the telomere regions, which are found at the ends of eukaryotic chromosomes. The telomeres contain condensed DNA material, giving stability to the chromosomes. The enzyme is a reverse transcriptase that carries its own RNA molecule, which is used as a template when it elongates telomeres, which are shortened after each replication cycle. Telomerase was discovered by Carol W. Greider in 1984.
72. (c) In transition, a purine is replaced by another purine base (A with G or vice-versa). In transversion, a purine is replaced by a pyrimidine base or vice-versa. Frameshift mutation is a type of mutation where the reading of codons is changed due to insertion or deletion of nucleotides. Transcription is the formation of RNA over the template of DNA.
73. (d) Telomeres are non sticky terminal ends of the chromosomes. It has heterochromatin and repetitive DNA.
74. (d) Replication begins at the *ori* - origin of replication and proceeds on both sides from the *ori*. Unidirectional replication is rare. RNA primers are involved in both prokaryotes and eukaryotes.
75. (a) For the formation of initiation complex during translation of *m*RNA, GTP is also required. The initiator AUG codes for the formylmethionine in prokaryotes.
76. (a) AUG is initiation codon. UCG codes for serine, UUU codes for phenylalanine, UGU codes for cysteine.
77. (b) UAA is the stop codon. Therefore at 25th amino acid the synthesis of polypeptide stops. So, a polypeptide of 24 amino acids is formed.
78. (d) Out of a total of 64 codons, 3 codons do not make any sense. Hence only 61 codons are used in the formation of the 20 essential amino acids (polypeptides).
79. (a) According to the Wobble hypothesis, tRNA anticodon has the ability to wobble at its 5′end by pairing with even non-complementary base of mRNA codon. It corresponds to third base degeneracy of the codons.
80. (a) Out of 64 codons, only 3 signify stop codons. There are more than one codon for most of the amino acids, the genetic code is non-overlapping. Three successive nucleotides or bases code for only one amino acid. Wobbling refers to the third base degeneracy.
81. (a) Exons are the coding part of mRNA.
82. (c) Eukaryotes have three types of RNA polymerases :

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(i) RNA polymerase I - It is found in nucleus and is responsible for rRNA (28S, 18S and 5.8S) synthesis.

(ii) RNA polymerase II - It is found in nucleoplasm and is responsible for mRNA synthesis.

(iii) RNA polymerase III - It is found in nucleoplasm and is responsible for tRNA and 5S rRNA synthesis.

83. (c) Cistron is that segment of DNA which specifies synthesis of a polypeptide.

84. (c)

85. (a or b)

86. (c) The telomere is a region of repetitive nucleotide sequences at each end of a chromosome which acts to protect the terminal ends of chromosomes. This prevents chromosomal disintegration and prevents the ends of the chromosome from being processed as a double strand DNA break, which could lead to chromosome-to-chromosome telomere fusions.

87. (c) tRNA works as an adaptor molecules for carrying amino acid to the mRNA template during protein synthesis. It bears anticodon and recognises the specific codon on mRNA.

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88. (d) The initiation codon is the codon which initiates the protein synthesis. They are AUG for methionine and GUG for valine.

89. (c) In semi conservative replication of DNA in each replica one half is the old strand and the other half is a new strand synthesised over it. Also, one strand is synthesised continuously and other discontinuously, hence called discontinuous.

90. (c) The term "hot spots" was used by Benzer for the sites which are more mutable than other sites. Studies in 1978 revealed that 5-methylcytosine residues occur at the position of each hot spot.

91. (d) Transposons are sequences of DNA that can move around to different positions within the genome of a single cell, and the process is called transposition. In the process, they can cause mutations and change the amount of DNA in the genome. Transposons are also called "jumping genes" or "mobile genetic elements". Discovered by Barbara McClintock early in her career, the topic went on to be a Nobel winning work in 1983. There are a variety of mobile genetic elements, and they can be grouped based on their mechanism of transposition.

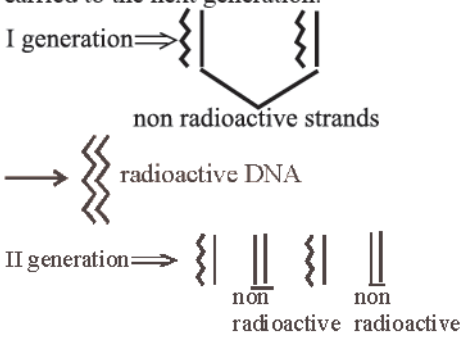
92. (c) A regulator gene is a gene involved in controlling the expression of one or more other genes. In prokaryotes, regulator genes often code for repressor proteins. Repressor proteins bind to operators or promoters, preventing RNA polymerase from transcribing RNA.

93. (c) Only the peptidyl transferase reaction does not require energy. The aminoacyl-tRNA binding to ribosome involves elongation factors and energy (GTP). Amino acid activation requires energy (the cleavage of ATP to AMP and PPi). Translocation requires an elongation factors and energy (GTP).

94. (d) Termination codons are the stop signals which when encountered cause termination of polypeptide synthesis. They are UAA (ochre), UAG (amber) and UGA (opal). Codons are determined by the sequence of bases on the DNA. Thymine is not present on RNA.

95. (b) A mutation bringing about early stoppage of polypeptide formation is called nonsense mutation. Frame shift mutation is a type of gene mutation where the reading of codons is changed due to insertion or deletion of nucleotides.

96. (a) DNA replication is semiconservative. *i.e.* at each replication one of the parental strands is retained and a new daughter strand is obtained. Thus only half of the parental DNA molecule is carried to the next generation.



97. (a) Multiple alleles are multiple alternatives or alleles of the same gene which occur in the population of same species. Pseudoalleles are two or more genes that have functional

similarity and they may behave like two or more alleles of the same gene. Polygenes are the genes controlling quantitative inheritances. Oncogenes are the cancer causing genes.

98. (a) In eukaryotes, separate protein factors take part in recognition and initiation during transcription. They are called transcription factors. Coenzymes are non-protein organic cofactors which get loosely attached to apoenzymes during the functioning of holoenzymes.
99. (d) Eukaryote RNAs contain non coding intervening segments called introns. The process of removal of introns through cutting and joining the essential coding sequences (exons) is called splicing.
100. (c) Replication of DNA is discontinuous over the lagging strand i.e., over this strand only small stretches of DNA are built due to opposite running of DNA template. The small stretches of DNA are called Okazaki fragments.
101. (b) Termination codons (triplet) are the stop signals which when encountered cause termination of polypeptide synthesis. The termination codons are UAA, UAG and UGA.
102. (c) The parts of a gene, which become part of mRNA and code for different regions of the proteins are called exons.
103. (a) DNA gyrase participates in the unwinding of DNA helix during replication.
104. (a) Protein synthesis involves initiation, elongation and termination. Transcription is the process of synthesis of RNA from DNA.
105. (d) The phenomenon of making DNA over RNA genome through enzyme reverse transcriptase is called reverse transcription or teminism.
106. (d) Codons are 64 in number. Out of this, 61 codes for amino acids. Each codon possesses 3 bases, each of which can undergo transition and transversion. ($61 \times 3^2 = 549$)
107. (b) The tautomer forms of nitrogen bases are imino-tautomer instead of amino group (*e.g.* cytosine, adenine) or enol instead of the keto group (*e.g.* thymine, guanine).
Tautomers are organic compounds that are interconvertible by a chemical reaction called tautomerisation. The concept of tautomers that are interconvertible by tautomerisations is called tautomerism. Tautomerism is a special case of structural isomerism and can play an important role in non-canonical base pairing in DNA and especially RNA molecules.
108. (b) Translation is the synthesis of protein synthesis occurs over ribosomes which are also referred to as protein factories.
109. (c) Unwindase or helicase takes part in separation of two DNA strands. In prokaryotes, helicase or unwindase is assisted by gyrase in this function.
110. (c) All amino acids are specified by more than one codon (except Tryptophan and Methionine). Hence they are degenerate.
111. (c) After one generation in ^{14}N medium DNA of bacteria settled at a level intermediate between heavy and light bands due to semi conservative DNA replication.
112. (b) Hargobind Khorana first deciphered the triplet codon of cysteine and valine.
113. (a) Meselson and Stahl (1958) raised *Escherichia coli* on ammonium chloride having heavy isotope of nitrogen for several generations to study semi-conservative replication of DNA.
114. (b) Central dogma of protein synthesis explains a unidirectional or one way flow of information from DNA to RNA (transcription) and from RNA to polypeptide (translation).
115. (d) Genetic code is triplet coding for one amino acid in a polypeptide chain. There are four different types of nucleotides - A, U, G, and C. Since a code is a triplet thus 64 ($4\times4\times4$) distinct triplet of bases determine the 20 amino acids. But out of 64, only 61 code for 20 amino acids. Three codons that do not code for any amino acids are terminator or non sense codons (UAG, UGA and UAA). Still in 61 triplet codons there is an excess 41 codons and therefore more than one codon codes for same amino acid.
116. (b) Nucleosomes are oblate spherical structure having an octamer of four histone proteins (constituting 2 molecules of each type).
117. (d) Genetic code is the relationship of amino acid sequence in a polypeptide chain and base sequence of mRNA. It includes adenine, guanine, cytosine and uracil.

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118. (d) Nucleolus is non-membranous nucleoplasmic structure in nucleus. Nucleolus is the site of ribosomal RNA (rRNA) synthesis.

119. (d) There will be no change in reading frame of m-RNA by deletion of GGU from 7th, 8th, and 9th position.

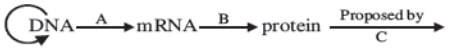
120. (d) Unlike eukaryotes in prokaryotes the genes are organised into operon. Operon is a co-ordinated group of genes which are all transcribed together & regulate a metabolic pathway as a unit.

121. (c) In eukaryotes, spliceosomes are used in removal of introns during post-transcriptional processing of hnRNA. They are absent in prokaryotes.

122. (c) *Lac* operon is an inducible operon. Lactose is the substrate for the enzyme beta-galactosidase and it also regulates switching on and off of the operon. Hence, it is termed as inducer. Inducer functions by disabling repressors. The gene is expressed because an inducer binds to the repressor. The binding of the inducer to the repressor prevents the repressor from binding to the operator. RNA polymerase can then begin to transcribe structural genes.

123. (a) *Lac* operon under control of repressor shows a negative regulation. Operon has inducible nature.

124. (a) Synthesis of RNA exhibits several features that are synonymous with DNA replication. RNA synthesis requires accurate and efficient initiation, elongation proceeds in the 5'→3' direction (i.e. the polymerase moves along the template strand of DNA in the 3'→5' direction), and RNA synthesis requires distinct and accurate termination.

125. (b) 

In this question A is transcription, B - translation and C is Francis Crick (central dogma) It is unidirectional flow of information from DNA to mRNA (transcription) and then decoding the information present in mRNA in the formation of polypeptide chain or protein (translation).

126. (d) A nonsense mutation is the one which stops polypeptide synthesis due to formation of a terminating or nonsense codon e.g. ATT (UAA), ATC (UAG), ACT (UGA). The lactose or *lac* operon of *Escherichia coli* contains structural genes (*z*, *y*, *a*). If y codes for termination of polypeptide chain then only the product of '*z*' gene transcribe to form β galactosidase.

127. (b) Inducible operons are usually switched off. This is a type of operon which is switched on when a chemical called inducer is present. the inducer is almost always a substrate.

128. (d) 23S rRNA acts as a catalyst in a bacterial cell.

129. (c) Jacob and Monod proposed the *lac* operon of *E. coli.* The *lac* operon contains a promoter, an operator, and three structural genes called z, y, and a, coding for the enzyme, β galactosidase, permease and transacetylase respectively. The lac regulator gene, designated as i gene, codes for repressor. In the absence of the inducer, the repressor binds to the *lac* operator, preventing RNA polymerase from binding to the promoter and thus transcribing the structural gene.

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130. (a) Semiconservative replication of DNA was first demonstrated in *Escherichia coli. E. coli* is a common type of bacteria that can get into food, like beef and vegetables. The strange thing about these bacteria is that they are not always harmful to you. *E. coli* normally lives inside your intestines, where it helps your body breakdown and digest the food you eat.

131. (d) In the DNA molecule, there are two strands which run anti parallel, one is 5' - 3' direction and other in 3' -5' direction. The two strands are held together by hydrogen bonds between their bases. Adenine (A), a purine of one chain is exactly opposite to thymine (T), a pyrimidine of the other chain. Similarly, cytosine (C), a pyrimidine lies opposite to guanine (G), a purine. This allows a sort of lock & key arrangment between large sized purine & small sized pyrimidine. It is strengthened by the appearance of hydrogen bonds between the two.

132. (c) Okazaki fragments in DNA are linked up by the enzyme DNA ligase. Replication always occurs in 5' - 3' direction. Okazaki fragments synthesised on 3' - 5' DNA template, join to form lagging strand.

133. (d) It was given by Geneticists George W. Beadle and E. L. Tatum which states that each gene in an organism controls the production of a specific enzyme. It is the enzyme that catalyses the reactions that leads to the phenotype of the organism.
134. (c) Beadle & Tatum postulated the theory of 'One gene-one enzyme' in which they stated that in any living cell there are number of genes present on chromosomes in a linear fashion. One single gene controls the synthesis of one particular enzyme (or protein) in the cell which is responsible for its phenotypic character.
135. (b) Operons are segments of genetic material which function as regulated unit or units that can be switched on and switched off. An operon consists of one to several structural genes. (Three in *lac* operon)
These are genes which produce mRNAs for forming polypeptides / proteins / enzymes. Z (produces enzyme β galactosidase for splitting lactose into glucose and galactose). Y (produces enzyme galactoside permease required for entry of lactose) and A (produces enzyme thiogalactoside trans- acetylase).
The three structural genes of the operon produce a single polycistronic mRNA.
136. (b) About 28 base pairs from transcription start site are TATA boxes. After 40 bases from TATA boxes appears LAAT boxes. Both of these sequence serve as recognition site in eukaryotic promoters (Transcription in eukaryotic genes in a far more complicated process than in prokaryotes)
137. (c) Reverse transcriptase (RNA dependent DNA polymerase) is present in some retroviruses e.g., HIV virus.
138. (d) Transgenic organisms are genetically modified organisms.
139. (b) Lactose operon in *E.coli* is a catabolic pathway in which the structural genes remain switched off unless the inducer (Lactose) is present in the medium.
140. (b) Regulator is a gene which forms a biochemical for suppressing the activity of operator gene. Promoter is the gene which provides the point of attachment to RNA polymerase required for transcription of structural genes.
141. (b) Regulator gene forms a biochemical for suppressing the activity of operator gene. Promoter gene is the gene which provides point of attachment to RNA polymerase required for transcription of structural genes. Structural genes are genes which transcribe m RNA for polypeptide synthesis.
142. (b) Gene regulation of eukaryotes is complex as compared to that of prokaryotes.
143. (a) In negative (repressible) operon, the repressor co-repressor complex binds with the operator. The free repressor cannot bind to the operator.
144. (a) The enzyme polymerase can synthesize the bases only in $5' \rightarrow 3'$ direction.
145. (b) Introns are non coding intervening sequences on DNA but exons are the coding sequences.
146. (a) Regulator gene produces a biochemical for suppressing the activity of the operator gene.
147. (b) mRNA or messenger RNA brings coded information from DNA to form polypeptides. rRNA or ribosomal RNA occurs inside ribosomes and is involved in protein synthesis.
148. (c) If *Escherichia coli* bacteria grow in normal glucose medium and when transferred to a medium containing lactose, then the lac operon is induced.
149. (b) The inducer is an environmental agent, which triggers transcription from an operon. The inducer or effector molecule are small sized which can bind to a regular protein.
150. (b) The lac operon consists of a promotor gene, an operator gene and structural genes. There are three structural genes designated as z, y and a, which code for the enzymes β-galactosidase, lac permease and transacetylase respectively. It is an example of inducible operon.
151. (a) Lac operon is an inducible operon system. Which remains switched off normally but becomes operational in the presence of inducer lactose.
152. (d) X-ray crystallography is a technique to study the binding of specific protein on regulatory DNA. X-ray crystallography or single-crystal X-ray diffraction is an analytical technique which uses the diffraction pattern produced by bombarding a single crystal

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with X-rays to solve the crystal structure. The diffraction pattern is recorded and then analyzed or "solved" to reveal the nature of the crystal. This technique is widely used in chemistry and biochemistry to determine the structures of an immense variety of molecules, including inorganic compounds, DNA, and proteins.

153. (a) Expressed Sequence Tags (ESTs) are DNA sequences (genes) that are expressed as mRNA for protein synthesis. These are used in human Genome Project.

NOTES

Expressed Sequence Tags are small pieces of DNA sequence (usually 200 to 500 nucleotides long) that are generated by sequencing either one or both ends of an expressed gene. First, each gene (DNA) must be converted, or transcribed, into messenger RNA (mRNA)--RNA that serves as a template for protein synthesis.

154. (c) Lac operon consist of one regulatory genes (*i* gene) and three structural genes (*z, y*, and *a)*.
- *i* gene codes for Repressor.
- *z* gene codes for Beta-galactosidase.
- *y* gene codes for Permease.
- *a* gene codes for Transacetylase.

155. (b) Zinc-finger analysis is used for protein analysis. The zinc finger proteins are a super family of proteins involved in numerous activities of plant growth and development.

156. (a) Satellite DNA displays high degree of polymorphism in population and also the same degree of polymorphism in an individual, which is inherited from parents to children (offsprings).

157. (b) The technique of DNA fingerprinting was developed by Dr. Alec Jeffrey in 1984. It is a technique generally using repeated sequences (repetitive DNA) in the human genome that produces a pattern of band that is unique for every individuals. These short nucleotide repeats vary in number from person to person and are called **variable number of tandem repeat (VNTR).** VNTR belongs to class of satellite DNA referred to as minisatellite.

158. (b) DNA fingerprinting is a test to identify and evaluate the genetic information-called DNA (deoxyribonucleic acid)-in a person's cells. DNA fingerprinting is a form of identification based on sequencing specific non-coding portions of DNA that are known to have a high degree of variability from person to person. These sections are known as Tandem repeats. The test is used to determine whether a family relationship exists between two people, to identify organisms causing a disease, and to solve crimes.

159. (c) Common activities in bioinformatics include mapping and analysing DNA and protein sequences, aligning different DNA *etc.* are the part of human genome project.

160. (c) Satellite DNA is useful in forensic science. The polymorphism of minisatellite, microsatellite and minivariant repeats is analysed for DNA finger printing, DNA profiling. It helps in the resolution of crimes, legal disputes etc.

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161. (a) DNA fingerprinting is the technique of determining nucleotide sequences of certain areas of DNA which are unique to each individual. DNA contains noncistronic hypervariable repeat sequences called VNTR. DNA fingerprinting involves the identification of these VNTRs.

162. (a) DNA fingerprinting is a technique to identify a person on the basis of his DNA which is specific for every individual. This technique for the first time was developed by Alec Jeffreys and his colleagues at Leicester University in U.K. DNA of an individual carries specific sequences of nucleotides which are repeated many times throughout the length of DNA. This reveals polymorphism in DNA. These are inherited. Each individual inherits these repeats from his/her parents which are used as genetic markers in personal identity test.

29 Evolution

Trend Analysis with Important Topics & Sub-Topics

		2020		2019		2018		2017		2016	
Topic	Sub-Topics	Qns.	LOD	Qns.	LOD	Qns.	LOD	Qns.	LOD	Qns.	LOD
Origin of Life/ Evidences for Evolution/ Adaptive Radiation/ Mechanism of Evolution	Origin of Life	1	D							1	A
	Mechanism of Evolution	1	A	1	E	2	E/E	1	D	2	A/A
Hardy-Weinberg Principle/ Origin and Evolution of Man	Evolution of Man			2	D/A						

LOD - Level of Difficulty | E - Easy | A - Average | D - Difficult | Qns - No. of Questions

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Topic 1: Origin of Life/Evidences for/ Evolution/Adaptive Radiation/ Mechanism of Evolution

1. From his experiments, S.L. Miller produced amino acids by mixing the following in a closed flask *[2020]*
   (a) CH_3, H_2, NH_4 and water vapor at 800°C
   (b) CH_4, H_2, NH_3 and water vapor at 600°C
   (c) CH_3, H_2, NH_3 and water vapor at 600°C
   (d) CH_4, H_2, NH_3 and water vapor at 800°C
2. Flippers of Penguins and Dolphins are examples of *[2020]*
   (a) Convergent evolution
   (b) Industrial melanism
   (c) Natural selection
   (d) Adaptive radiation
3. Which of the following refer to correct example(s) of organisms which have evolved due to changes in environment brought about by anthropogenic action? *[2020]*
   (a) Darwin's Finches of Galapagos islands.
   (b) Herbicide resistant weeds.
   (c) Drug resistant eukaryotes.
   (d) Man-created breeds of domesticated animals like dogs.
   (a) (a) and (c) (b) (b), (c) and (d)
   (c) only (d) (d) only (a)
4. A population of a species invades a new area. Which of the following condition will lead to adaptive radiation? *[2019]*
   (a) Area with many habitats occupied by a large number of species.
   (b) Area with large number of habitats having very low food supply.
   (c) Area with a single type of vacant habitat.
   (d) Area with many types of vacant habitats.
5. In Australia, marsupials and placental mammals have evolved to share many similar characteristics. This type of evolution may be referred to as *[2019]*

(a) Convergent evolution
(b) Adaptive radiation
(c) Divergent evolution
(d) Cyclical evolution

6. In a species, the weight of newborn ranges from 2 to 5 kg. 97% of the newborn with an average weight between 3 to 3.3 kg survive whereas 99% of the infants born with weights from 2 to 2.5 kg or 4.5 to 5 kg die. Which type of selection process is taking place? *[2019]*
(a) Directional selection
(b) Stabilising selection
(c) Disruptive selection
(d) Cyclical selection

7. According to Hugo de Vries, the mechanism of evolution is *[2018]*
(a) Multiple step mutations
(b) Saltation
(c) Minor mutations
(d) Phenotypic variations

8. Among the following sets of examples for divergent evolution, select the incorrect option :
(a) Forelimbs of man, bat and cheetah *[2018]*
(b) Heart of bat, man and cheetah
(c) Eye of octopus, bat and man
(d) Brain of bat, man and cheetah

9. The similarity of bone structure in the forelimbs of many vertebrates is an example of *[2018]*
(a) Homology
(b) Analogy
(c) Adaptive radiation
(d) Convergent evolution

10. Which of the following represents order of Horse'? *[2017]*
(a) Perissodactyla (b) Caballus
(c) Ferus (d) Equidae

11. Which of the following structures is homologus to the wing of a bird? *[2016]*
(a) Dorsal fin of a Shark
(b) Wing of a Moth
(c) Hind limb of Rabbit
(d) Flipper of Whale

12. Following are the two statements regarding the origin of life *[2016]*
(A) The earliest organisms that appeared on the earth were non-green and presumably anaerobes.
(B) The first autotrophic organisms were the chemoautotrophs that never released oxygen.
Of the above statements which one of the following options is correct?
(a) (A) is correct but (B) is false.
(b) (B) is correct but (A) is false.
(c) Both (A) and (B) are correct.
(d) Both (A) and (B) are false.

13. Analogous structures are a result of *[2016]*
(a) Divergent evolution
(b) Convergent evolution
(c) Shared ancestry
(d) Stabilizing selection

14. Forelimbs of cat, lizard used in walking; forelimbs of whale used in swimming and forelimbs of bats used in flying are an example of: *[2014]*
(a) Analogous organs
(b) Adaptive radiation
(c) Homologous organs
(d) Convergent evolution

15. Which one of the following are analogous structures? *[2014]*
(a) Wings of Bat and Wings of Pigeon.
(b) Gills of Prawn and Lungs of Man.
(c) Thorns of *Bougainvillea* and Tendrils of *Cucurbita*
(d) Flippers of Dolphin and Legs of Horse

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16. The eye of octopus and eye of cat show different patterns of structure, yet they perform similar function. This is an example of: *[NEET 2013]*
(a) Homologous organs that have evolved due to divergent evolution.
(b) Analogous organs that have evolved due to convergent evolution.
(c) Analogous organs that have evolved due to divergent evolution.
(d) Homologous organs that have evolved due to convergent evolution.

17. The process by which organisms with different evolutionary history evolve similar phenotypic adaptations in response to a common environmental challenge, is called :
(a) Convergent evolution *[NEET 2013]*
(b) Non-random evolution
(c) Adaptive radiation
(d) Natural selection

18. Variation in gene frequencies within populations can occur by chance rather than by natural section. The is referred to as: *[NEET 2013]*
(a) Genetic drift (b) Random mating
(c) Genetic load (d) Genetic flow

19. According to Darwin, The organic evolution is due to: ***[NEET 2013]***
    (a) Interspecific competition
    (b) Competition within closely related species
    (c) Reduced feeding efficiency in one species
    (d) Intraspecific competition
20. Random unidirectional change in allele frequencies that occurs by chance in all populations and especially in small populations is known as ***[NEET Kar. 2013]***
    (a) Mutation (b) Migration
    (c) Natural selection (d) Genetic drift
21. The finch species of Galapagos Islands are grouped according to their food sources. Which of the following is not a finch food? ***[NEET Kar. 2013]***
    (a) Seeds (b) Carrion
    (c) Insects (d) Tree buds
22. Evolution of different species in a given area starting from a point and spreading to other geographical areas is known as: ***[2012]***
    (a) Adaptive radiation
    (b) Natural selection
    (c) Migration
    (d) Divergent evolution
23. Which one of the following options gives one correct example each of convergent evolution and divergent evolution? ***[2012]***

	Convergent evolution	**Divergent evolution**
(a)	Eyes of octopus and mammals	Bones of forelimbs of vertebrates
(b)	"Thorns of Bougainvillia and tendrils of Cucurbita"	Wings of butterflies and birds
(c)	Bones of forelimbs of vertebrates	Wings of butterfly and birds
(d)	"Thorns of Bougainvillia and tendrils of Cucurbita"	Eyes of Octopus and mammals

24. The idea of mutations was brought forth by ***[2012M]***
    (a) Gregor Mendel, who worked on Pisum sativum.
    (b) Hugo de Vries, who worked on evening primrose.
    (c) Hardy Weinberg, who worked on allele frequencies in a population.
    (d) Charles Darwin, who observed a wide variety of organisms during sea voyage.
25. Darwin's finches are a good example of:
    (a) Industrial melanism ***[2010]***
    (b) Connecting link
    (c) Adaptive radiation
    (d) Convergent evolution
26. *Peripatus* is a connecting link between: ***[2009]***
    (a) Mollusca and Echinodermata
    (b) Annelida and Arthropoda
    (c) Coelenterata and Porifera
    (d) Ctenophora and Platyhelminthes
27. Which one of the following scientists name is correctly matched with the theory put forth by him? ***[2008]***
    (a) Weismann - Theory of continuity of Germplasm
    (b) Pasteur - Inheritance of acquired characters
    (c) De Vries - Natural selection
    (d) Mendel - Theory of Pangenesis
28. Darwinism finches are an excellent example of ***[2008]***
    (a) adaptive radiation
    (b) seasonal migration
    (c) brood parasitism
    (d) connecting links
29. Thorn of *Bougainvillea* and tendril of cucurbita are example of ***[2008]***
    (a) analogous organs
    (b) homologous organs
    (c) vestigial organs
    (d) retrogressive evolution
30. Which one of the following pairs of items correctly belongs to the category of organs mentioned against it? ***[2008]***
    (a) Thorn of *Bougainvillea* and tendril of Cucurbita - Analogous organs
    (b) Nictitating membrane and blind spot in human eye - Vestigial organs
    (c) Nephridia of earthworm and malpighian tubules of Cockroach - Excretory organs
    (d) Wings of honey bee and wings of crow - Homologous organs

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31. Which one of the following is incorrect about the characteristics of protobionts (coacervates and microspheres) as envisaged in the biogenic origin of life? *[2008]*
(a) They were able to reproduce
(b) They could separate combinations of molecules from the surroundings
(c) They were partially isolated from the surroundings
(d) They could maintain an internal environment

32. When two species of different genealogy come to resemble each other as a result of adaptation, the phenomenon is termed *[2007]*
(a) microevolution
(b) co-evolution
(c) convergent evolution
(d) divergent evolution

33. Which one of the following statement is correct? *[2007]*
(a) There is no evidence of the existence of gills during embryogenesis of mammals
(b) All plant and animal cells are totipotent
(c) Ontogeny repeats phylogeny
(d) Stem cells are specialize cells.

34. The concept of chemical evolution is based on *[2007]*
(a) interaction of water, air and clay under intense heat
(b) effect of solar radiation on chemicals
(c) possible origin of life by combination of chemicals under suitable environmental conditions
(d) crystallization of chemicals.

35. The finches of Galapagos islands provide an evidence in favour of *[2007]*
(a) evolution due to mutation
(b) retrogressive evolution
(c) biogeographical evolution
(d) special creation.

36. What is common between parrot, platypus and kangaroo? *[2007]*
(a) Toothless jaws
(b) Functional post-end tail
(c) Ovoparity
(d) Homeothermy

37. What is common to whale, seal and shark? *[2007]*
(a) Thick subcutaneous fat
(b) Convergent evolution
(c) Homoiothermy
(d) Seasonal migration.

38. Industrial melanism as observed in peppered moth proves that *[2007]*
(a) the melanic form of the moth has no selective advantage over lighter form in industrial area
(b) the lighter-form moth has no selective advantage either in polluted industrial area or non-polluted area
(c) melanism is a pollution-generated feature
(d) the true black melanic forms arise by a recurring random mutation

39. Adaptive radiation refers to *[2007]*
(a) evolution of different species from a common ancestor
(b) migration of members of a species to different geographical areas
(c) power of adaptation in an individual to a variety of environments
(d) adaptations due to geographical isolation.

40. One of the important consequences of geographical isolation is *[2007]*
(a) preventing speciation
(b) speciation through reproductive isolation
(c) random creation of new species
(d) no change in the isolated fauna.

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41. Which one of the following amino-acid was not found to be synthesized in Miller's experiment? *[2006]*
(a) Aspartic acid (b) Glutamic acid
(c) Alanine (d) Glycine

42. Evolutionary history of an organism is known as *[2006]*
(a) Ancestry (b) Paleontology
(c) Ontogeny (d) Phylogeny

43. An important evidence in favour of organic evolution is the occurrence of *[2006]*
(a) Analogous and vestigial organs
(b) Homologous organs only
(c) Homologous and analogous organs
(d) Homologous and vestigial organs

44. Animals have the innate ability to escape from predation. Examples for the same are given below. Select the **incorrect** example. *[2005]*
(a) Colour change in *Chameleon*
(b) Enlargement of body size by swallowing air in puffer fish
(c) Poison fangs in snakes
(d) Melanism in moths

45. Which one of the following experiments suggests that simplest living organisms could not have originated spontaneously from non-living matter? *[2005]*
(a) Larvae could appear in decaying organic matter.
(b) Microbes did not appear in stored meat
(c) Microbes appeared from unsterilized organic matter
(d) Meat was not spoiled, when heated and kept sealed in a vessel.

46. Which one of the following phenomena supports Darwin's concept of natural selection in organic evolution? *[2005]*
(a) Development of transgenic animals
(b) Production of 'Dolly', the sheep by cloning
(c) Prevalence of pesticide resistant insects
(d) Development of organs from 'stem cells' for organ transplantation

47. Using imprints from a plate with complete medium and carrying bacterial colonies, you can select streptomycin resistant mutants and prove that such mutations do not originate as adaptation. These imprints need to be used *[2005]*
(a) on plates with and without streptomycin
(b) on plates with minimal medium
(c) only on plates with streptomycin
(d) only on plates without streptomycin

48. de Vries gave his mutation theory on organic evolution while working on: *[2005]*
(a) *Pisum sativum*
(b) *Drosophila melanogaster*
(c) *Oenothera lamarckiana*
(d) *Althea rosea*

49. Presence of gills in the tadpole of frog indicates that *[2004]*
(a) fishes were amphibious in the past
(b) fishes evolved from frog-like ancestors
(c) frogs will have gills in future
(d) frogs evolved from gilled ancestors

50. Age of fossils in the past was generally determined by radio-carbon method and other methods involving radioactive elements found in the rocks. More precise methods, which were used recently and led to the revision of the evolutionary periods for different groups of organisms, includes *[2004]*
(a) study of carbohydrates/proteins in fossils
(b) study of the conditions of fossilization
(c) electron spin resonance (ESR) and fossil DNA
(d) study of carbohydrates/proteins in rocks

51. According to Oparin, which one of the following was ***not*** present in the primitive atmosphere of the earth *[2004]*
(a) Methane (b) Oxygen
(c) Hydrogen (d) Water vapour

52. Diversification in plant life appeared *[2004]*
(a) due to long periods of evolutionary changes
(b) due to abrupt mutations
(c) suddenly on earth
(d) by seed dispersal

53. In recent years, DNA sequences (nucleotide sequence) of mt-DNA and Y chromosomes were considered for the study of human evolution, because *[2003]*
(a) they can be studied from the samples of fossil remains
(b) they are small, and therefore, easy to study
(c) they are uniparental in origin and do not take part in recombination
(d) their structure is known in greater detail

54. Which one of the following sequences was proposed by Darwin and Wallace for organic evolution? *[2003]*
(a) Variations, natural selection, overproduction, constancy of population size
(b) Overproduction, variations, constancy of population size, natural selection
(c) Variations, constancy of population size, overproduction, natural selection
(d) Overproduction, constancy of population size, variations, natural selection

55. Industrial melanism is an example of *[2003]*
(a) defensive adaptation of skin against ultraviolet radiations
(b) drug resistance
(c) darkening of skin due to smoke from industries
(d) protective resemblance with the surroundings

56. In a random mating population in equilibrium, which of the following brings about a change in gene frequency in a non-directional manner? *[2003]*
(a) Migration (b) Mutations
(c) Random drift (d) Selection

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57. Convergent evolution is illustrated by *[2003]*
(a) dogfish and whale
(b) rat and dog
(c) bacterium and protozoan
(d) starfish and cuttle fish

58. Which one of the following describes correctly the homologous structures ? *[2003]*
(a) Organs appearing only in embryonic stage and disappearing later in the adult
(b) Organs with anatomical similarities, but performing different functions
(c) Organs with anatomical dissimilarities, but performing same function
(d) Organs that have no function now, but had an important function in ancestors

59. Darwin in his 'Natural Selection Theory' did not believe in any role of which one of the following in organic evolution ? *[2003]*
(a) Discontinuous variations
(b) Parasites and predators as natural enemies
(c) Survival of the fittest
(d) Struggle for existence

60. Random genetic drift in a population probably results from *[2003]*
(a) large population size
(b) highly genetically variable individuals
(c) interbreeding within this population
(d) constant low mutation rate

61. Which of the following are homologous organs? *[2002]*
(a) Wings of birds and locust
(b) Wings of birds (sparrow) and pectoral fins of fish
(c) Wings of bat and butterfly
(d) Legs of frog and cockroach

62. There is no life on moon due to the absence of
(a) O_2 (b) water *[2002]*
(c) light (d) temperature

63. Sequence of which of the followings is used to know the phylogeny? *[2002]*
(a) mRNA (b) rRNA
(c) tRNA (d) DNA

64. Two different species can not live for long duration in the same niche or habitat. This law is
(a) Allen's law *[2002]*
(b) Gause's hypothesis
(c) Dollo's rule
(d) Weisman's theory

65. Which of the following is most important for speciation ? *[2002]*
(a) Seasonal isolation
(b) Reproductive isolation
(c) Behavioural isolation
(d) Tropical isolation

66. In which condition the gene ratio remains constant for any species? *[2002]*
(a) Sexual selection (b) Random mating
(c) Mutation (d) Gene flow

67. Genetic drift operates only in *[1998, 02]*
(a) smaller Populations
(b) larger Populations
(c) mendelian Populations
(d) island Populations

68. Some bacteria are able to grow in Streptomycin containing medium due to
(a) natural selection *[2002]*
(b) Induced mutation
(c) reproductive isolation
(d) genetic drift

69. Similarities in organism with different genotype indicates *[2001]*
(a) Microevolution
(b) Macroevolution
(c) Convergent evolution
(d) Divergent evolution

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70. Darwin's theory of pangenesis shows similarity with theory of inheritance of acquired characters then what shall be correct according to it? *[2001]*
(a) Useful organs become strong and developed while useless organs become extinct. These organs help in struggle for survival
(b) Size of organs increase with ageing
(c) Development of organs is due to will power
(d) There should be come physical basis of inheritance

71. Occurrence of endemic species in South America and Australia is due to *[2001]*
(a) These species have been extinct from other regions
(b) Continental separation
(c) There is no terrestial route to these places
(d) Retrogressive evolution

72. Half life period of C is about *[2001]*
(a) 500 years (b) 5000 years
(c) 50 years (d) 5×10^4 years

73. Frequency of an allele in a isolated population may change due to *[2001]*
(a) genetic Drift (b) gene flow
(c) mutation (d) natural selection

74. Forthcoming generation are less adaptive than their parental generation due to *[2001]*
(a) natural selection (b) mutation
(c) genetic drift (d) adaptation

75. Which is not a vestigial part in humans?
(a) Segmental muscles of abdomen *[2000]*
(b) Finger nails
(c) Third molar
(d) Coccyx

76. During organ differentiation in *Drosophila* an organ is often modified to another organ such as wings could be replaced by legs. Genes responsible for such metamorphosis are called
(a) Homeotic genes *[2000]*
(b) Plastid genes
(c) Double dominant genes
(d) Complimentary genes

77. Darwin's finches provide an excellent evidence in favour of evolution. This evidence comes from the field of *[2000]*
(a) Biogeography (b) Anatomy
(c) Embryology (d) Palaentology

78. Homologous organs are *[1994, 99]*
(a) Wings of insects and Bat
(b) Gills of Fish and lungs of Rabbit
(c) Pectoral fins of Fish and fore limbs of Horse
(d) Wings of Grosshopper and Crow

79. Phenomenon of 'Industrial melanism' demonstrates *[1999]*
(a) natural selection
(b) induced mutation
(c) geographical isolation
(d) reproductive islolation

80. Life cannot originate from inorganic materials at present because of *[1998]*
(a) a very high amount of oxygen in the atmosphere
(b) very low atmospheric temperature
(c) absence of raw materials
(d) high degree of environmental pollution

81. Diversity in the type of beaks of finches adapted to different feeding habits on the Galapagos Islands, as observed by Darwin, provides evidence for *[1998]*
(a) Intraspecific variations
(b) Intraspecific competition
(c) Interspecific competition
(d) Origin of Species by natural selection

82. Which one of the following includes all homologous organs? *[1997]*
(a) The wing of butterfly, wing of bird, wing (patagia) of bat
(b) The fore limb of frog, wing of bird and fore limb of rabbit
(c) The thoracic leg of cockroach, the hind leg of frog and fore leg of rabbit
(d) The wing of bird, wing of bat and wing of "flying" lizard

83. The kind of evolution in which two species of different geneology come to resemble one another closely, is termed as *[1996]*
(a) progressive evolution
(b) convergent evolution
(c) parallel evolution
(d) retrogressive evolution

84. Identify the correct sequence in which the following substances have appeared during the course of evolution of life on earth *[1996]*
(a) Glucose, amino acids, nucleic acids, proteins
(b) Ammonia, amino acids, proteins, nucleic acids
(c) Water, amino acids, nucleic acids, enzymes
(d) Amino acids, ammonia, phosphates, nucleic acids

85. Which one of the following sets includes only the vestigial structures in man? *[1996]*
(a) Body hair, olecranon process, coccyx, patella
(b) Wisdom teeth, mammary glands, coccyx, patella
(c) Coccyx, nictitating membrane, vermiform appendix, ear muscles
(d) Coccyx, body hair, ear ossicles, vermiform appendix

86. Extremities, tail and ear are relatively shorter in animals living in cooler regions as compared to those inhabiting warmer zones. This is *[1996]*
(a) Bergman's Rule (b) Jordan's Rule
(c) Gloger's Rule (d) Allen's Rule

87. The presence of gill slits, in the embryos of all vertebrates, supports the theory of *[1995]*
(a) biogenesis (b) recapitulation
(c) metamorphosis (d) organic evolution

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88. The homologous organs are those that show similarity in *[1995]*
(a) size (b) origin
(c) function (d) appearance

89. The closely related morphologically similar sympatric populations, but reproductively isolated, are designated as *[1995]*
(a) clines (b) demes
(c) clones (d) sibling species

90. The change of the light-coloured variety of peppered moth *(Biston betularia)* to its darker variety *(Biston carbonaria)* is due to *[1995]*
(a) mutation
(b) regeneration
(c) genetic isolation
(d) temporal isolation

91. Frequency of a character increases when it is
(a) recessive (b) dominant *[1994]*
(c) inheritable (d) adaptable

92. Which one does not favour Lamarckian concept of inheritance of acquired characters?
(a) Lack of pigment in cave dwellers *[1994]*
(b) Absence of limbs in snakes
(c) Presence of webbed toes in aquatic birds
(d) Melanisation of Peppered Moth in industrial areas.

93. Two geographical regions separated by high mountains are *[1994]*
(a) Oriental and Australian
(b) Palaearctic and Oriental
(c) Nearctic and Palaearctic
(d) Neotropical and Ethiopian

94. Golden era/age of reptiles is *[1994]*
(a) palaeozoic (b) mesozoic
(c) recent (d) proterozoic

95. Evolutionary convergence is development of *[1993]*
(a) common set of characters in group of different ancestry
(b) dissimilar characters in closely related groups
(c) common set of characters in closely related groups
(d) random mating.

96. Weismann cut off tails of mice generation after generation but tails neither disappeared nor shortened showing that *[1993]*
(a) Darwin was correct
(b) Tail is an essential organ
(c) Mutation theory is wrong
(d) Lamarckism was wrong in inheritance of acquired characters.

97. Theory of Natural selection dwells on *[1993]*
(a) role of environment in evolution
(b) natural selection acting on favourable variations
(c) changes in gene complex resulting in heritable variations
(d) none of these

98. Genetic drift is change of *[1993]*
(a) gene frequency in same generation
(b) appearance of recessive genes
(c) gene frequency from one generation to next
(d) none of the above

99. The first organisms were *[1992]*
(a) Chemoautotrophs
(b) Chemoheterotrophs
(c) Autotrophs
(d) Eucaryotes

100. Which was absent in the atmosphere at the time of origin of life? *[1991]*
(a) NH_3 (b) H_2
(c) O_2 (d) CH_4

101. Parallelism is *[1990]*
(a) adaptive divergence
(b) adaptive divergence of widely separated species
(c) adaptive convergence of widely different species
(d) adaptive convergence of closely related groups

102. Basic principles of embryonic development were pronounced by *[1990]*
(a) Van Baer (b) Weismann
(c) Haeckel (d) Morgan

103. Evolution is *[1989]*
(a) progressive development of a race
(b) history and development of a race alongwith variations
(c) history of a race
(d) development of a race

104. "Continuity of germplasm" theory was given by *[1989]*
(a) de Vries (b) Weismann
(c) Darwin (d) Lamarck

105. Theory of inheritance of acquired characters was given by *[1989]*
(a) Wallace (b) Lamarck
(c) Darwin (d) De Vries

106. 'Origin' of species' was written by *[1989]*
(a) Oparin (b) Weismann
(c) Lamarck (d) Darwin

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107. Humming bird and Hawk illustrate *[1988]*
(a) Convergent evolution
(b) Homology
(c) Adaptive radiation
(d) Parallel evolution

108. Phenomenon of organisms resembling others for escaping from enemies is *[1988]*
(a) Adaptation (b) Mimicry
(c) Homology (d) Analogy

Topic 2: Hardy-Weinberg Principle/Origin and Evolution of Man

109. Which of the following statements is correct about the origin and evolution of men? *[2019]*
(a) Neanderthal men lived in Asia between 1,00,000 and 40,000 years back.
(b) Agriculture came around 50,000 years back.
(c) The *Dryopithecus* and *Ramapithecus* primates existing 15 million years ago, walked like men.
(d) *Homo habilis* probably ate meat.

110. A gene locus has two alleles A, a. If the frequency of dominant allele A is 0.4, then what will be the frequency of homozygous dominant, heterozygous and homozygous recessive individuals in the population ? *[2019]*
(a) 0.36 (AA); 0.48 (Aa); 0.16 (aa)
(b) 0.16 (AA); 0.24 (Aa); 0.36 (aa)
(c) 0.16 (AA); 0.48 (Aa); 0.36 (aa)
(d) 0.16 (AA); 0.36 (Aa); 0.48 (aa)

111. Match the hominids with their **correct** brain size: *[2019]*
(a) *Homo habilis* (i) 900 cc
(b) *Homo neanderthalensis* (ii) 1350 cc
(c) *Homo erectus* (iii) 650 - 800 cc
(d) *Homo sapiens* (iv) 1400 cc

Select the **correct** option.

	(A)	(B)	(C)	(D)
(a)	(iii)	(i)	(iv)	(ii)
(b)	(iii)	(ii)	(i)	(iv)
(c)	(iii)	(iv)	(i)	(ii)
(d)	(iv)	(iii)	(i)	(ii)

112. Variations caused by mutation, as proposed by Hugo de Vries, are: *[2019]*
(a) random and directional
(b) random and directionless
(c) small and directional
(d) small and directionless

113. Which of the following had the smallest brain capacity? *[2015 RS]*
(a) *Homo sapiens*
(b) *Homo neanderthalensis*
(c) *Homo habilis*
(d) *Homo erectus*

114. A population will not exist in Hardy - Weinberg equilibrium if : *[2015 RS]*
(a) There are no mutations
(b) There is no migration
(c) The population is large
(d) Individuals mate selectively

115. Industrial melanism is an example of : *[2015 RS]*
(a) Natural selection (b) Mutation
(c) Neo Lamarckism (d) Neo Darwinism

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116. Dinosaurs dominated the world in which of the following geological era? *[NEET Kar. 2013]*
(a) Devonion (b) Coenozoic
(c) Jurassic (d) Mesozoic

117. The extinct human who lived 1,00,000 to 40,000 years ago, in Europe, Asia and parts of Africa, With short stature, heavy eyebrows, retreating fore heads, large jaws with heavy teeth, stocky bodies, a lumbering gait and stooped posture was *[2012]*
(a) *Homo habilis*
(b) Neanderthal human
(c) Cro-magnan humans
(d) *Ramapithecus*

118. What was the most significant trend in evolution of modern man (*Homo sapiens*) from his ancestors? *[2011]*
(a) Upright posture
(b) Shortening of jaws
(c) Binocular vision
(d) lncreasing brain capacity

119. In the case of peppered moth (*Biston betularia*) the black - coloured form became dominant over the light- coloured form in England during industrial revolution. ***[2009]***
This is an example of:
(a) appearance of the darker coloured individuals due to very poor sunlight
(b) protective mimicry
(c) inheritance of darker colour character acquired due to the darker environment
(d) natural selection whereby the darker forms were selected

120. Which one of the following in birds, indicates their reptilian ancestry? [***2008]***
(a) Scales on their hind limbs
(b) Four-chambered heart
(c) Two special chambers crop and gizzard in their digestive tract
(d) Eggs with a calcareous shell

121. Among the human ancestors the brain size was more that 1000 cc in ***[2007]***
(a) *Homo erectus*
(b) *Ramapithecus*
(c) *Homo habilis*
(d) *Homo neanderthalensis*

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122. Select the correct statement from the following? ***[2007]***
(a) Fitness is the end result of the ability to adapt and get selected by nature
(b) All mammals except whales and camels have seven cervical vertebrae
(c) Mutations are random and directional
(d) Darwinian variations are small and directionless.

123. Jurassic period of the mesozoic era was characterised by ***[2006]***
(a) Radiation of reptiles and origin of mammal-like reptiles
(b) Dinosaurs become extinct and angiosperms appeared
(c) Flowering plants and first dinosaurs appeared
(d) Gymnosperms were dominant plants and first birds appeared

124. Which one of the following is ***not*** a living fossil? ***[2006]***
(a) *Sphenodon* (b) *Archaeopteryx*
(c) *Peripatus* (d) King crab

125. Which of the following is the relatively most accurate method for dating of fossils? ***[2005]***
(a) Radio-carbon method
(b) Potassium-argon method
(c) Electron-spin resonance method
(d) Uranium-lead method

126. There are two opposing views about origin of modern man. According to one view *Homo erectus* in Asia were the ancestors of modern man. A study of variation of DNA however suggested African origin of modern man. What kind of observation on DNA, variation could suggest this? ***[2005]***
(a) Greater variation in Asia than in Africa
(b) Greater variation in Africa than in Asia
(c) Similar variation in Africa and Asia
(d) Variation only in Asia and no variation in Africa

127. What kind of evidence suggested that man is more closely related with chimpanzee than with other hominoid apes? ***[2004]***
(a) Evidence from DNA from sex chromosomes only
(b) Comparison of chromosomes morphology only
(c) Evidence from fossil remains, and the fossil mitochondrial DNA alone
(d) Evidence from DNA extracted from sex chromosomes, autosomes and mitochondria

128. In which era reptiles were dominant? ***[2002]***
(a) Coenozoic era (b) Mesozoic era
(c) Palaeozoic era (d) Archaeozoic era

129. According to fossils discovered up to present time origin and evolution of man was started from ***[2002]***
(a) France (b) Java
(c) Africa (d) China

130. Which of following is closest relative of man?
(a) Chimpanzee (b) Gorilla ***[2001]***
(c) Orangutan (d) Gibbon

131. Which of the following is correct order of evolutionary history of man? ***[2001]***
(a) Peking man, *Homo sapiens*, Neanderthal, Cro-magnon
(b) Peking, Neanderthal, *Homo sapiens*, Cro-magnon
(c) Peking man, Heidelberg man, Neanderthal, Cro-magnon
(d) Peking man, Neanderthel, *Homo sapiens*, Heidelberg man

132. *Homo sapiens* evolved during ***[2000]***
(a) Pleistocene (b) Oligocene
(c) Pliocene (d) Miocene

133. Which of the following primate is the closest relative of humans? ***[2000]***
(a) Rhesus monkey (b) Orangutan
(c) Gorilla (d) Gibbon

134. Which one of the following features is closely related with the evolution of humans? ***[2000]***
(a) Loss of tail
(b) Shortening of jaws
(c) Binocular vision
(d) Flat nails

135. In general, in the developmental history of a mammalian heart, it is observed that it passes through a two-chambered fish-like heart, three-chambered frog-like heart and finally to four-chambered stage. To which hypothesis can this above cited statement be approximated?
(a) Hardy-Weinberg Law ***[1998]***
(b) Lamarck's Principle
(c) Biogenetic Law
(d) Mendelian Principles

136. The age of the fossil of *Dryopithecus* on the geological time scale is ***[1998]***
(a) 5×10^6 years back
(b) 25×10^6 years back
(c) 50×10^6 years back
(d) 75×10^6 years back

137. Which one of the following statements is correct? ***[1998]***
(a) Cro-Magnon man's fossil has been found in Ethiopia
(b) *Homo erectus* is the ancestor of man
(c) Neanderthal man is the direct ancestor of *Homo sapiens*
(d) *Australopithecus* is the real ancestor of modern man

138. Common origin of man and chimpanzee is best shown by ***[1997]***
(a) Banding pattern in chromosomes number 3 and 6
(b) Cranial capacity
(c) Binocular vision
(d) Dental formula

139. Which one of the following statements about fossil human species is correct? ***[1997]***
(a) Fossils of *Homo neanderthalensis* have been found recently in South America
(b) Neanderthal man and Cro-Magnon man did exist for sometime together
(c) *Australopithecus* fossils have been found in Australia
(d) *Homo erectus* was preceded by *Homo habilis*

140. In the evolution of man, several changes occured in the ancestral characters. Which one of the following changes is irrelevant in this context? ***[1996]***
(a) Loss of tail from body
(b) Increase in the ability to communicate with others and develop community behaviour
(c) Change of diet from fruits, hard nuts and roots to softer food
(d) Perfection in the structure and working of hand for tool-making

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141. Which one of the following is regarded as the direct ancestor of modern man ? ***[1996]***
(a) *Homo erectus* (b) *Ramapithecus*
(c) *Homo habilis* (d) *Australopithecus*

142. 'Golden Age of Dinosaurs'/Age of reptiles was ***[1994]***
(a) Mesozoic (b) Coenozoic
(c) Palaeozoic (d) Psychozoic

143. The earliest fossil form in the phylogeny of Horse is ***[1994]***
(a) Merychippus (b) Mesohippus
(c) Eohippus (d) Equus.

144. Correct order is ***[1991]***
(a) Palaeozoic → Archaeozoic → Coenozoic
(b) Archaeozoic → Palaeozoic → Proterozoic
(c) Palaeozoic → Mesozoic → Coenozoic
(d) Mesozoic → Archaeozoic → Proterozoic

ANSWER KEY

1	(d)	16	(b)	31	(b)	46	(c)	61	(b)	76	(a)	91	(d)	106	(d)	121	(d)	136	(b)
2	(d)	17	(a)	32	(c)	47	(c)	62	(b)	77	(a)	92	(d)	107	(c)	122	(a)	137	(b)
3	(b)	18	(a)	33	(c)	48	(c)	63	(b)	78	(c)	93	(b)	108	(b)	123	(d)	138	(a)
4	(d)	19	(d)	34	(c)	49	(d)	64	(b)	79	(a)	94	(b)	109	(a)	124	(b)	139	(d)
5	(a)	20	(d)	35	(c)	50	(c)	65	(b)	80	(a)	95	(a)	110	(c)	125	(c)	140	(c)
6	(b)	21	(b)	36	(d)	51	(b)	66	(b)	81	(d)	96	(d)	111	(c)	126	(a)	141	(a)
7	(b)	22	(a)	37	(b)	52	(a)	67	(a)	82	(b)	97	(c)	112	(b)	127	(d)	142	(a)
8	(c)	23	(a)	38	(d)	53	(c)	68	(a)	83	(b)	98	(c)	113	(c)	128	(b)	143	(c)
9	(a)	24	(b)	39	(a)	54	(b)	69	(c)	84	(b)	99	(b)	114	(d)	129	(c)	144	(c)
10	(a)	25	(c)	40	(b)	55	(d)	70	(d)	85	(c)	100	(c)	115	(a)	130	(a & b)		
11	(d)	26	(b)	41	(b)	56	(c)	71	(b)	86	(d)	101	(d)	116	(d)	131	(c)		
12	(c)	27	(a)	42	(d)	57	(a)	72	(b)	87	(b)	102	(a)	117	(b)	132	(c)		
13	(b)	28	(a)	43	(d)	58	(b)	73	(a)	88	(b)	103	(b)	118	(d)	133	(c)		
14	(c)	29	(b)	44	(c)	59	(a)	74	(b)	89	(d)	104	(b)	119	(d)	134	(a)		
15	(b)	30	(c)	45	(d)	60	(c)	75	(b)	90	(a)	105	(b)	120	(a & d)	135	(c)		

Hints & Solutions

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1. (d) In 1953, S.L. Miller, an American scientist created electric discharge in a closed flask containing CH_4, H_2, NH_3 and water vapor at 800°C.

NOTES: The **Miller-Urey experiment** provided the first evidence that organic molecules needed for life could be formed from inorganic components. Some scientists support the RNA world hypothesis, which suggests that the first life was self-replicating RNA.

2. (d) The correct option is (d) because flippers of Penguins and Dolphins are an example of analogous organs. Analogous structures are a result of convergent evolution.

NOTES: The concepts underlying convergent evolution can be traced back to Richard Owen, a British biologist who, despite doubting Darwin's theory of evolution, in the mid 1800s pointed out the difference between animals with body parts that are built similarly (homologues) and body parts that just have similar purposes.

3. (b) The correct option is (b) because herbicide resistant weeds, drug resistant eukaryotes and man-created breeds of domesticated animals like dogs are examples of evolution by anthropogenic action. Darwin's Finches of Galapagos islands are example of natural selection, adaptive radiation and founder's effect.

NOTES: **Anthropogenic** actions refer to the activities that are caused by human beings. The human activities like excessive use of herbicides, pesticides have resulted in the evolution and selection of only resistant varieties of pests.

4. (d) Adaptive radiation occurs when a single or small group of ancestral species rapidly diversifies into a large number of descendant species. Therefore, when a population of a species invades a new area with many type of vacant habitats, they face different environmental pressures and eventually adapt exhibiting adaptive radiation.

5. (a) In Australia, marsupials and placental mammals have evolved to share many similar characteristics. This type of evolution may be referred to as convergent evolution.

NOTES

Many placental mammals resemble the marsupial mammals not only in structure but also in leading similar ways of life. These similarities in these two different types of mammals (Marsupials and placentals) w.r.t. ancestors are due to living in the similar ecological niches. Hence, when two different types of organisms converge towards functional similarity one can conclude that convergent evolution has occurred.

6. (b) Stabilising selection is a type of natural selection in which the population mean stabilises on a particular non-extreme trait value. This is thought to be the most common mechanism of action for natural selection because most traits do not appear to change drastically over time. The result of stabilising is the over-representation in a specific trait. For example, human birth weight, the number of eggs a bird lays, and the density of cactus spines.
The given data shows stabilising selection as most of the newborn having average weight between 3 to 3.3 kg survive and babies with less and more weight have low survival rate.
7. (b) As per mutation theory which was given by Hugo de Vries state that the evolution is a discontinuous phenomenon or saltatory phenomenon/saltation.
8. (c) Divergent evolution demonstrates how species can have common (homologous) anatomical structures, whereas eye of octopus, bat and man are examples of analogous organs showing convergent evolution.
9. (a) Bird and bat wings are analogous, as forelimb is homologous. In different vertebrates, bones of forelimbs are similar but their forelimbs are adapted in different way as per their adaptation, show homology.
10. (a) Horse belongs to
Orders - Perissodactyla
Family - Equidae
Genus - *Equus*
Species - *ferus*
Subspecies - *caballus*
11. (d) Wings of a bird and flippers of a whale are modified forelimbs.

NOTES

In evolutionary biology, convergent evolution is the process whereby organisms not closely related (not monophyletic), independently evolve similar traits as a result of having to adapt to similar environments or ecological niches. When two or more organs or structures are basically similar to each other in construction but are modified to perform different functions, they are said to be serially homologous. An example of this is a bat's wing and a whale's flipper.

12. (c) Both statements are correct because primitive atmosphere was reducing and chlorophyll appeared later on. Chemoautotrophs were the first autotrophic organisms unable to perform photolysis of water and never released oxygen.
13. (b) Analogous structures are those that have the same function, but they are not derived from a common ancestor and have undergone different patterns of development i.e., Convergent evolution which is natural selection that favors the same type of structure in different ancestors.
14. (c) Organs which have a common fundamental anatomical plan and similar embryonic origin whatever varied functions they may perform are regarded as homologous organs. For examples the flippers of a whale, a bats wing, fore-limb of a horse, a bird's wing and forelimbs of human are structurally as well as functionally different.
15. (b) Analogous organs are those that perform similar functions but have entirely different embryonic origins.
16. (b) The eye of octopus and eye of cat show different patterns of structure, yet they perform similar functions. This is an example of analogous organs.
Analogous organs have evolved due to convergent evolution. Analogous organs have developed in the evolutionary process through adaptation of quite different organisms to similar mode of life.
17. (a) The wings is a classic example of convergent evolution. Flying insects, birds and bats same all evolved the capacity of flight independently. All four serve the same function and are similar in structure but anatomically different.

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18. (a) Genetic drift is variation in gene frequencies within populations can occur by chance rather than by natural selection, sometimes the change in allele frequency is so different in the new sample of population that they become a different species. The original drifted population becomes founders and the effect is called founder effect.
19. (d) According to Darwin the organic evolution is due to intraspecific competition. Individuals of same species have variation in characteristics. Those characteristics which enable some to survive better in natural conditions (climate, food, physical factors etc.) would outbreed others that are less-endowed to survive under such natural conditions. There, therefore, will survive more and hence are selected by nature . He called it natural selection and implied it as a mechanism of evolution.
20. (d) Genetic drift is random change in allele number and frequency in a gene pool due to chance (e.g., small size of population). It is caused by sampling error or error in gene pool sample that is to form the next generation. The sampling gene pool is generally small in size. Variability is also limited.
21. (b) Darwin observed an amazing diversity of creatures on galapagos islands. He realised that there were many varieties of finches in the same island like seed-eating, with altered beaks insectivorous and vegetarian finches. Carrion are dead bodies. No finches feed on carrion.
22. (a) Process of evolution of different species in a given area starting from a point and radiating to other area of geographical areas is called adaptive radiations.
    Example : Darwin's finches, Australian marsupials.
23. (a) Eyes of octopus and mammals is an example of convergent evolution because they both have different structures of eyes but evolving for the same function and hence having similarity.
    The forelimb consists of: Humerus, radius and ulna, carpals, metacarpals, digits or phalanges. The top of the humerus moves against (articulates with) the scapula at the shoulder joint. By changing the number, size and shape of the various bones, fore limbs have evolved to fit different ways of life.
24. (b) Mutations are alterations of genetic material. They occur frequently during DNA duplication in cell division. The idea of mutations was brought forth by Hugo de Vries. The plant on which de Vries had experimented was *Oenothera lamarckiana* (Evening primrose). The mutation observed by de Vries in *Oenothera lamarckiana* was chromosomal number variant.
25. (c) Darwin finches a good example of adaptive radiation. Adaptive radiation is a process of evolution of different species in a given geographical area starting from a point and radiating to other areas of geography.
26. (b) *Peripatus* is a genus of Onychophora (Velvet worms). It is said to be a living fossil because it has been unchanged for approximately 570 million years. *Peripatus* is a nocturnal carnivore. *Peripatus* is a connecting link between Annelida and Arthropoda. It feeds by trapping its prey (mostly small insects) in a white, sticky fluid it ejects from two antennae near its head. The fluid hardens on contact with the air and then the prey becomes immoblized.
27. (a) The theory of the continuity of the germplasm published by August Weismann (1834-1914) in 1886. It proposes that the contents of the reproductive cells (sperms and ova) are passed on unchanged from one generation to the next, unaffected by any changes undergone by the rest of the body. It thus rules out any possibility of the inheritance of acquired characteristics, and has become fundamental to Neo-Darwinian theory.
28. (a) Darwin's Finches are an excellent example of adaptive radiation. Adaptive radiation is the occurrence of the diversification of a single or small groups of species into a large number or descendents that occupy various ecological niches. This is an evolutionary process driven by natural selection.
29. (b) Thorn of *Bougainvillea* and tendril of *Cucurbita* are example of homologous organs.
30. (c) Nephridia of earthworm and malphigian tubules of cockroach belongs to excretory

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organs. Earthworm has a well developed excretory system which is composed of large number of minute, coiled and glandular segmentally arranged excretory tubules called the nephridia. Malphigian tubules of cockroach are extremely fine yellowish unbranched thread like structure present at the function of midgut and hindgut.

31. (b) Coacervate is an aggregate of macromolecules such as proteins, lipids and membrane, and contain enzymes that are capable of converting substance such as glucose into more complex molecules, such as starch. Coacervate droplets arise spontaneously under appropriate conditions and may have been the prebiological systems from which living organisms originated.

32. (c) The analogous organs show convergent evolution due to similar adaptions which do not support organic evolution.

33. (c) Ontogeny repeats phylogeny.

NOTES

The theory of recapitulation, also called the biogenetic law or embryological parallelism—often expressed using Ernst Haeckel's phrase "ontogeny recapitulates phylogeny"—is a historical hypothesis that the development of the embryo of an animal, from fertilization to gestation or hatching (ontogeny), goes through stages resembling or representing successive adult stages in the evolution of the animal's remote ancestors (phylogeny). It was formulated in the 1820s by Étienne Serres based on the work of Johann Friedrich Meckel, after whom it is also known as Meckel–Serres law.

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34. (c) The concept of chemical evolution is based on possible origin of life by combination of chemicals under suitable environmental conditions. The distribution of elements in the cosmos is the result of many processes in the history of the Universe. It provides us with a powerful tool to study the Big Bang, the density of baryonic matter, nucleosynthesis and the formation and evolution of stars and galaxies.

35. (c) The finches of Galapagos islands provides an evidence in favour of biogeographical evolution

36. (d) Only birds and mammals are homeothermous.

NOTES

The only known living homeotherms are birds and mammals, though ichthyosaurs, pterosaurs, plesiosaurs and non-avian dinosaurs are believed to have been homeotherms. Other species have various degrees of thermoregulation.

37. (b) The analogous organs show convergent evolution due to similar adaptation. They do not support organic evolution. Whale, seal and shark shows convergent evolution due to similar habitats.

38. (d) During the period when the number of coal-burning factories in England was increasing (during the so-called Industrial Revolution) it was noticed that the number of melanic individuals of the species of Peppered Moth (*Biston betularia*) was becoming more common. Originally rare in the population of normally light-colored moths, the frequency of the melanic form increased in polluted areas until it was over 90%. This change in color has come to be known as "industrial melanism."

39. (a) Adaptive radiation refers to evolution of different species from a common ancestor. The mammals are adapted for different mode of life i.e. they show adaptive radiation. They can be aerial (bat), aquatic (whale and dolphins), burrowing or fossorial (rat), cursorial (horse), scantorial (squarrel) or arboreal (monkey). The adaptive radiation, the term by osborn, is also known as Divergent evolution.

40. (b) Speciation takes place via reproductive isolation which is the most important consequence of geographical isolation.

41. (b) Glutamic Acid is one of the non-essential amino acids, closely related to glutamine. The two constitute a substantial fraction of the amino acids in many proteins (10–20% in many cases and up to 45% in some plant proteins). An important metabolic intermediate as well as a neurotransmitter molecule in the central nervous system, glutamic acid finds uses in medicine and biochemical research.

NOTES

Its sodium salt is the food flavour enhancer monosodium glutamate (MSG).

42. (d) Paleontology is the study of fossils. Ontogeny is the process of development of

organism in the embryo stage and phylogeny is known as the history of an organism through ages during evolution.

43. (d) Homologous organs represent the divergent evolution. These are the organs belonging to different organisms of different species may be for dissimilar function but they all have the same basic structure. On the other hand vestigial organs show that how a species evolved from its ancestors through the ages according to the use and disuse of organs.

NOTES

These are the organs which were sometime functional in humans (or may be any other organisms) but during the course of evolution their utility gradually decline and now they are present as non-functional and vestigial organs.

44. (c) Animals resist predation by cryptic coloration deceptive marking, behavioural defenses and possession of mechanical or chemical defenses. Examples are
colour change in *Chameleon*
Enlargement of body size by swallowing air in potter fish, Melanism in moths.

45. (d) Spallanzani's experiment : He boiled the meat and vegetables for more than an hour to prepare broth and placed them in open and sealed flasks. The maggots of housefly developed in the open flasks but did not appear in sealed flasks. This disapproved the theory of spontaneous creation. (Th. of abiogenesis).

46. (c) When DDT was sprayed to kill mosquitoes, there were only few mosquitoes which were already resistant to DDT, and hence survived. Most of the mosquitoes which were sensitive to DDT died.
Due to differential reproduction the resistant mosquitoes got more chances of reproduction and multiplied. After few generations most of the mosquitoes were resistant. The sensitive were very few. This supports Darwin's theory of natural selection and survival of the fittest.

47. (c) Adaptation is generally due to selection of pre-existing variations and not due to new mutations or variations. This tends to support Darwin's theory of natural selection. The basis was proved by replica plating experiment of Joshua Lederberg and Esther Lederberg. A number of sterile agar plates having antibiotic streptomycin were prepared. Bacteria were inoculated on the penicilling plates from the master plate by sterile velvet plate. Most bacterial colonies did not form replicas and inoculum died. Moreover a few colonies survived showing that they were resistant to streptomycin.

48. (c) *Pisum sativum* - Mendel
Drosophila melanogaster - T. H. Morgan.

NOTES

Hugo de Vries (1901) put forward a theory of evolution, called mutation theory. The theory states that evolution is a jerky process where new varieties and species are formed by mutations (= sports or discontinuous variations) that function as raw material of evolution.

49. (d) Amphibians have moved onto terrestrial habitat but they still need to go back to water for reproduction. The presence of gills in tadpole indicate that amphibians have evolved from fishes. Fishes are completely aquatic so the other three options are incorrect.

50. (c) ESR, Electron Spin Resonance measures number of charges occupying deep traps in crystal band gap.
Electron Paramagnetic Resonance (EPR) or **Electron Spin Resonance** (ESR) is a spectroscopic technique which detects species that have unpaired electrons, generally meaning that the molecule in question is a free radical if it is an organic molecule, or that it has transition metal ions if it is an inorganic complex. Because most stable molecules have a closed-shell configuration without a suitable unpaired spin, the technique is less widely used than nuclear magnetic resonance (NMR). The EPR was first discovered in Kazan State University by Soviet physicist Yevgeniy Zavoyskiy in 1944

51. (b) According to Oparin, the atmosphere of primitive earth was reducing because its atoms were most numerous and most reactive. Free oxygen was not present in significant amount. Large quantities of H_2, N_2, water vapour, CO_2, CH_4 and NH_3 were present.

52. (a) According to Darwin gradual accumulation of small variations gives rise to new species. Abrupt mutations do not give rise to new species . Plants arose by gradual

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adaptation to diverse habitats and not suddenly on earth. Seeded plants are just one group in the plant kingdom.

53. (c)

NOTES

The human Y chromosome is intriguing not only because it harbours the master-switch gene determining gender but also because of its unusual evolutionary trajectory. Previously an autosome, Y chromosome evolution has been characterized by massive gene decay.

54. (b) According to Darwinism there is differential reproduction, followed by struggle for existence, suitable variations are selected by nature-natural selection.

55. (d) The replacement of grey coloured moth by dark coloured melanic species due to industrial smoke is called industrial melanism. Initially on the lichen covered tree trunks, the mutant moths was more conspicuous due to its black colouration and was therefore more susceptible to predation by birds. The large scale burning of coal during industrial revolution resulted in the deposition of sooty particulate matter on tree trunks. Hence the grey coloured moths became more conspicuous to predatory birds. Thus the population of black moths increased considerably.

56. (c) Migration refers to the movement of individuals into and out of population. Mutation refers to random and sudden heritable variations or changes arising in the genetic constitution.

57. (a) Independent formation of functionally similar structures by unrelated organism is called convergent evolution.

58. (b) Those organs which have a common origin and are built on the same anatomical pattern, but perform different functions and are modified accordingly.

59. (a) In any population, there is always competition for space and food resources.

60. (c) Genetic drift describes random fluctuations in the numbers of gene variants in a population. Genetic drift takes place when the occurrence of variant forms of a gene, called alleles, increases and decreases by chance over time. These variations in the presence of alleles are measured as changes in allele frequencies.

NOTES

The bottleneck effect is an extreme example of genetic drift that happens when the size of a population is severely reduced. Events like natural disasters (earthquakes, floods, fires) can decimate a population, killing most individuals and leaving behind a small, random assortment of survivors.

61. (b) Homologous organs have same basic structure and origin but they differ in their external appearance and function.

62. (b) There is no life on moon due to absence of water. There are many other reasons for being no life on moon, life insufficient oxygens, unsuitable temperature etc.

63. (b) rRNA occurs inside ribosomes and involved in protein synthesis, mRNA brings coded information from DNA to form polypeptides. tRNA takes part in transferring amino acids from cellular pool to episomes for polymerization to form polypeptides.
Carl Woese gave the theory of life based on his discovery that the genes encoding ribosomal RNA are ancient and distributed over all lineages of life with little or no gene transfer. Therefore rRNA are commonly used to infer phylogeny.

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64. (b) Gause's hypothesis states that two different competing species cannot coexist together for a long in the same niche, one has to get eliminated by the other competing species, if they do coexist, then they do so as a result of niche differentiation, i.e. differentiation of then realized niches.

65. (b) Seasonal isolation refers to the differences in season of breeding that can isolate two varieties. Behavioural or ethological isolation refers to differences in behaviour like courtship rituals etc. to prevent mating. Mechanical isolation refers to the differences in the position, size and structure of animal genitalia which prevent reproductive contact and thus bring about isolation. Reproductive isolation is the prevention of interbreeds between the population of two different species.

66. (b) Mutation is any random sudden heritable change occurring in the genetic material. Sexual selection refers to selection of a mate by an organism.

67. (a) Genetic drift can operate only on smaller populations where its fluctuation can be observed in the proportion of allele distribution in the presence of external disturbances.
Genetic drift is the random change in allele number and frequency in a gene pool.

68. (a) Prevention of mating between two natural populations of the same or different spaces due to presence of barriers to interbreeding is called reproductive isolation. Genetic drift is the random change in the allele number and frequency in a gene pool. Natural selection is a type of force for evolutionary processes. Here, in this case, it allows the growth of only those bacteria which have resistance towards streptomycin.

69. (c) Microevolution is a series of changes within a species due to gene mutations and accumulation of variations.
Macroevolution is evolution in which taxa higher than the level of species are formed due to morphological and cytological changes. Formation of different functional forms of a basically similar structure is called divergent evolution.

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70. (d) According to both the views, 'something' is passed from parent to offspring which causes development of specific characters.

71. (b) These areas are geographically isolated from other continents by the oceanic barrier which has prevented uniform distribution of fauna.

72. (b) In 5000 years a given amount of radioactive carbon would decay to half initial concentration.

73. (a) Mutations are sudden inheritable variations which develop in the genetic system. Natural selection operates through differential reproduction.

74. (b) Natural selection operates through differential reproduction. Genetic drift is random change in the allele number and frequency in a gene pool.

75. (b) Human body contains about 180 vestigial organs coccyx, third molars (wisdom teeth) and muscles of abdomen etc.

76. (a) Homeotic genes are the group of genes involved in the embryonic development and control the pattern of body formation. Alleination in these gene found in flies like *Drosophila* result in development of legs in place of wings.

77. (a) Biogeography is the study of geographical distribution of organisms. Paleontology is the study of past life based on fossils and fossil impressions. Anatomy is the study of internal structure. Embryology is the study of development of embryo from zygote till it becomes an offspring.

78. (c) Organs that are similar in fundamental structure but different in functions are "Homologous organs", Richard Owen, introduced the term homologous. Pectoral fins of fish and fore limbs of horse similar in structure but different in functions are homologous organs.
Rest of the organs compared in the question are analogous organs.

79. (a) During industrial revolution in England the frequency of melanic forms of species of Peppered Moth (*Biston betularia*) increased in polluted areas. Generally the moths are light coloured. This change in colour is known as "Industrial melanism". The change was presumed to be a result of natural selection since the melanic moths better matched the blackened tree trunks where they rest during day.

80. (a) Synthesis of organic molecules from simple molecules is no longer possible because of the oxidizing atmosphere.

81. (d) Nature select those set of characters that are best adapted to the environment. This has resulted in the great diversity seen in the population of finches.

82. (b) Homologous organs are the organs having similar structural plan and origin but performing different functions. Analogous organs perform similar function but have different structural and developmental origin e.g. wings of birds, wings of bat and wings of insects are analogous organs.

83. (b) Progressive evolution is development of organisms with more elaborate and specialized structures from those having less elaborate features e.g. amphibians from reptiles.

Retrogressive or degenerative evolution is development of simpler forms from more complex ones. Such evolution has occurred in case of vestigial organs, parasitic forms, and in reduction of overspecialized structures such as wings in flightless birds. Parallel evolution is formation of similar traits in related groups of organisms independently due to similar requirement e.g. running of two toed deer and one toed Horse. Evolution of wings in insects and birds serve as example of convergent evolution.

84. (b) Elements present on the surface of the earth as well as in the early atmosphere combined to produce simple and compound molecules. Atmospheric elements produced molecules of Hydrogen, Nitrogen, Water, CO, CO_2, Ammonia, methane etc. UV-radiations, cosmic rays, lightening and heat made these to react amongst themselves and produce organ compounds like sugars, fatty acid, glycerol and amino acids.

$CH_4 + NH_3 + CO_2 + H_2O \rightarrow$ Amino acids

$CH_4 + NH_3 + CO_2 + N_2 + H_2 + H_2O \longrightarrow$ Purines + Pyrimidines

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85. (c) Vestigial organs are those organs which are non-functional in the possessor but were functional in their ancestors and in related animals. Human beings possess many vestigial organs like nictitating membrane in the eye, vermiform appendix at the end of caecum, coccyx and tail muscles, non-functional muscles of the pinna, wisdom teeth, segmental muscle of abdomen and nipples in males.

86. (d)

87. (b) In the embryos of all vertebrates, the presence of gill slits supports the theory of recapitulation (repeating the early stages of embryogenesis in earlier evolved animals).

88. (b)

89. (d) The sibling species are those species, which are born from a similar kind of parents having similar morphology. But they are reproductively isolated.

90. (a) The change in the colour of peppered moth is due to the mutation of single mendelian gene for the survival in the smoke-laden industrial environment. It is called Industrial melanism.

91. (d) Adaptable

NOTES

An adaptation or adaptive trait is a trait/ characteristic that has evolved in a population of organisms which provides a functional advantage. Adaptations increase the biological fitness of a population. Briefly describe how the trait evolved; e.g., mutation, genetic drifts, migration and/or natural selection.

92. (d) Melanisation of Peppered Moth in industrial areas.

93. (b) Dr. P. L. Sclater, 1858 divided the world into 6-regions on the basis of distribution of birds only, later in 1876 A.R. Wallace adopted it for all the animals. These six realms (regions) support evidence of organic evolution.

94. (b) Jurassic period of mesozoic era is known as the 'Age of reptiles'.

95. (a) Evolutionary convergence is a type of evolutionary pattern in which unrelated organisms/different species develop common set of characters / adaptive functional structures (analogous structures). They do not share common ancestor, related to one another in only the most distant sense.

96. (d) August Weismann, tested Lamarck's theory in 1904 by cutting off the tails of mice for 22 generations yet he failed to get tailless mouse. On the basis of the test he put forward the theory "continuity of germ plasm".

NOTES

According to him the character influencing the germ cells (reproductive) are inherited. Change in somatic cells are not transmitted to the next generations. Hugo de Vries proposed "Mutation theory".

97. (c) In 1859 Charles Darwin published his theory of natural selection in the book 'Origin of Species'. The theory is based on five important observations:

All species have great reproductive potential

Most populations are stable in size

Natural resources are limited

Individuals of a population have variations.

Most of the variations are heritable. Species with variations selected by nature.

98. (c) Genetic drift is also known as Sewall Wright effect. It refers to the random changes in gene frequencies in a population by chance, either due to intensive inbreeding or death of a small section of population by natural calamity. Its effect is more marked in small isolated population.

99. (b) Chemoheterotrophs were first organisms. They were prokaryotic like bacteria, anaerobes, as molecular oxygen was absent. They obtained energy by fermentation of some of the organic molecules present in the broth. Thus they absorbed organic molecules from outside for body building and energy.
    - Chemoautotrophs - Organisms that are capable to synthesize organic molecules from inorganic molecules.
    E.g., Nitrifying bacteria, sulphur reducing bacteria etc.
    - Autotrophs are photosynthesizing plants / organisms.
100. (c) Oxygen gas was not present due to reducing atmosphere, it only came to existence after the evolution of photosynthesis process.
101. (d) In convergent evolution similar adaptive functional structure develop in different species (unrelated group of organism). When convergent evolution is found in separate but closely related species (related evolutionary lineages) it is called parallel evolution.
    In parallel evolution the two species have a relatively recent common ancestors.
102. (a) Van Baer; 1828 put forward Baer's law which was later called as Biogenetic law of Ernst Haeckel, 1866. The law states that "Ontogeny repeats phylogeny". Ontogeny is the life history of an organism while phylogeny is the evolutionary history of the race of that organism.
103. (b) The term Evolution was given by Herbert Spencer that is "Descent with modifications". Evolution helps us to understand the history of life.
    Evolution is a process in which something changes into a different and usually more complete or better form over time and in response to environment. This results in descendents becoming different from ancestors.
104. (b) In the germplasm theory, inheritance in a multicellular organism only takes place by means of the germ cells: the gametes, such as egg cells and sperm cells. Genetic information cannot pass from soma to germplasm and on to the next generation. This is referred to as the Weismann barrier.
105. (b) One of the first attempts to explain the mechanism of evolution was made by Jean Baptiste de Lamarck. His theory was Inheritance of Acquired Characters. The theory states that the characters acquired during life time are passed on to the progeny and then to subsequent generations and new species are produced.
106. (d) The book "Origin of species" was written by Darwin.
107. (c) Adaptive radiation in evolution was developed by H.F. Osborn in 1898. It is also known as "Divergent evolution". It is development of different functional structures from a common ancestral form. Examples as mentioned in the questions. Whereas development of similar adaptive functional structures in unrelated groups of organism is adaptive convergence i.e. convergent evolution, e.g wings of insect, bird and bat. When convergent evolution is found in closely related species, it is called "Parallel Evolution" Example : development of running habit in deer (2 toed) and horse (1 toed).
    The evolutionary process in which many related species evolved from a single ancestors is called adaptive radiation.
108. (b) Adaptation is the evolutionary process in which population becomes better suited to its habitat. Mimicry is an example of long term adaptation, in which there is a close resemblance of an organism to the surrounding in order to avoid detection . e.g. leaf insect *Phyllium*. The term mimicry was introduced by Bates (1862).
    - Homology is phenomenon in which origin of organs are same but functions are different.
    e.g - Hand of human and fore limb of horse.
    - Analogy - Origin is different but functions are same of two different organs.
    e.g. - Wings of birds, wings of insects.
109. (a) Agriculture came around 10,000 years back and human settlements started.
    The *Dryopithecus* and *Ramapithecus* primates existing 15 mya. They are hairy and walked like gorillas and chimpanzees.
    Homo habilis probably did not eat meat. They were the first to make stone tools.

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NOTES

Neanderthals are an extinct species or subspecies of archaic humans who lived in Eurasia until about 40,000 years ago. They probably went extinct due to competition with or extermination by immigrating European early modern humans or due to great climatic change, disease, or a combination of these factors.

110. **(c)** Frequency of dominant allele (p) = 0.4
Frequency of recessive allele (q) = 1 – 0.4
= 0.6
Frequency of homozygous dominant individuals (AA)
$= p^2 = (0.4)^2 =$ **0.16(AA)**
Frequency of heterozygous individuals (Aa)
= 2pq = 2(0.4)(0.6) = **0.48(Aa)**
Frequency of homozygous recessive individuals (aa)
$= q^2 = (0.6)2 =$ **0.36(aa)**

111. (c) The correct match of the hominids and their brain sizes are:
Homo habilis – 650 - 800 c.c.
Homo neanderthalensis –1400 c.c.
Homo eractus –900 c.c.
Homo sapiens –1350 c.c.

112. (b) According to Hugo de Vries, mutations are random and directionless.
Hugo deVries believed that mutation caused speciation and hence called it saltation (single step large mutation).

113. (c) Brain capacity in decreasing order:-
Homo sapiens (1300 - 1600 c.c)
Homo neanderthalensis (approx. 1400 c.c.)
Homo eractus (600 - 700 c.c.)
Homo habilis (550 - 687 c.c.)
Thus the lowest brain capacity is of *Homo habilis* as shown above. *Homo habilis* lived in early pleistocene period and used tools of chipped stones.

114. (d) The theory of Hardy- Weinberg equilibrium states that in the absence of disturbance on the level of genetic structure, a population's existance will not continue. Thus mating should be in a random way.

115. (a) Industrial melanism occured in England due to industrial revolution. It caused black coating of moths for the adaptation in the present environment.

116. (d) Dinosaurs dominated the world in mesozoic era. In Triassic period, giant reptiles (dinosaurs) emerged. In Jurassic period, dinosaurs diversified and abundant (golden age of dinosaurs) and in cretaceous period, mass extinction of dinosaurs occurred.

117. (b) Neanderthals are an extinct species or subspecies of archaic humans who lived in Eurasia until about 40,000 years ago. They probably went extinct due to competition with or extermination by immigrating European early modern humans or due to great climatic change, disease, or a combination of these factors.

118. (d) The most significant trend in evolution of modern man (*Homo sapiens*) from his ancestors is development of brain capacity.

119. (d) In the case of peppered moth *(Biston betularia)* the black coloured form became dominant over the light coloured form in England during industrial revolution. This is an example of natural selection. This group is about species that gain protection from predators due to selection caused by nature.

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120. (a & d) Scales on their hind limbs and eggs with calcareous shell, indicates in birds about their reptilian ancestry.

121. (d) *Homo habilis* had a cranial capacity in the range of 680 - 720 c.c & that of . *Homo erectus erectus* 775 - 990 c.c., *Homo erectus pekinesis* 915-1200 c.c. *Homo nenderthalensis* 1300-1600 c.c.

122. (a) To survive in a particular environment, an organism needs to adapt in that environment. If the organism becomes successful in adapting then that organism is selected by nature .

123. (d) Jurassic period of meoszoic era was about 19-20 crore years ago & lasted for about 5.5-6 crore years. The climate was hot and damp. It is called the age of dinosaurs. Ist primitive bird *Archaeopteryx* evolved from reptiles. Ist angiosperm appeared as a dicotyledon but gymnosperms were dominant.

124. (b) *Archaeopteryx* is a fossile (dead) found from the mesozoic rocks. It is a connecting link between reptiles and birds.

125. (c) Electron Spin Resonance method is the most accurate method for dating of fossils.

126. (a) According to Neodarwinism variation is the root cause of evolution.
127. (d) DNA from sex chromosomes, autosomes and mitochondria reflect the entire genomic limit. Chromosome morphology is only partial.
128. (b) During the Mesozoic, or "Middle Life" Era, life diversified rapidly and giant reptiles, dinosaurs and other monstrous beasts roamed the Earth. The period, which spans from about 252 million years ago to about 66 million years ago, was also known as the age of reptiles or the age of dinosaurs.
129. (c) Africa is often called as the Cradle of Human Kind.
130. (a & b) Chimpanzee is the closest relative of man. Banding pattern of human chromosome number 3 and 6 are remarkably similar to that of chimpanzee indicating common origin for both.
131. (c) Peking man had a cranial capacity of about 1000cc. Heidelberg man is regarded as ancestor of Neanderthal man. *Cro-magnon* is the form of modern man living in Europe.
132. (c) Oligocene is masked by the rise of monkeys and apes. Miocene is masked by appearance of man like apes. Pliocene is characterized by origin of man.
133. (c) Chimpanzees and gorillas are our closest relatives among the living primates.
134. (a) Loss of a prehensile tail is associated with the gradual development of erect posture and bipedal gait.
135. (c) Hardy - Weinberg law is the principle of genetic equilibrium according to which in the absence of external environmental disturbances, a randomly mating population remains in genetic equilibrium. Lamarck postulated the theory of inheritance of acquired characters. Mendelian principles explained the inheritance of genetic characters from one generation to another.
136. (b) *Dryopithecus* lived about 20-25 million years ago.
137. (b) *Cro-Magnon* fossils have been found in Europe. Neanderthal man is a transitional stage. *Australopithecus* appeared in early Pleistocene.
138. (a) Cranial capacity shows an increase form apes to man which indicates increase in intelligence.
139. (d) *Cro-magnon* succeeded *Neanderthal*. Fossils of *Neanderthal* man have been found from Europe, Asia and North Africa. Fossils of *Australopithecus* have been found in Africa.
140. (c) During ancient period men eats hard nuts and hard roots (though they often take soft food also). Thus change in diet is the most irrelevant change in the evolution of man.
141. (a) Modern humans originated in Africa within the past 200,000 years and evolved from their most likely recent common ancestor, Homo erectus, which means 'upright man' in Latin. Homo erectus is an extinct species of human that lived between 1.9 million and 135,000 years ago.
142. (a) Jurassic period of Mesozoic era is known as "Golden age of Dinosaurs.
    - Coenozoic era is the age of insects, birds and mammals.
    - Palaeozoic era of fishes.
143. (c) Evolutionary history of horse was described by O.C. Marsh, 1879. Origin of horse took place in Eocene period and first fossil of horse was Eohippus found in North America.

Evolutionary trend of Horse :

Fossil : Eohippus → Mesohippus → Merychippus → Pliohippus → Equus
Period : (Eocene) (Oligocene) (Miocene) (Pliocene) Recent (Holocene)

144. (c) The correct Geological time scale of earth is
Precambrian → Palaeozoic →
(Era/Age of early life) Age of fishes
Mesozoic → Coenozoic
(Age of reptiles) (Age of mammals)
dinasaurs and cycads
A geological time scale is a diagram that details the history of Earths geology, noting major events like the formation of the Earth, the first life forms and mass extinctions. The first geological time scale was proposed in 1913 by the British geologist Arthur Holmes (1890-1965).
The history of the earth has been subdivided into eras, eras into periods and periods into major divisions.

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30 Human Health and Diseases

Trend Analysis with Important Topics & Sub-Topics

Topic	Sub-Topics	2020 Qns.	2020 LOD	2019 Qns.	2019 LOD	2018 Qns.	2018 LOD	2017 Qns.	2017 LOD	2016 Qns.	2016 LOD
Common Diseases in Humans	Mosquito-borne Illness					1	A				
	Typhoid			1	A						
	Diseases	1	D								
	Malaria	1	D								
Immunity	Graft Rejection			1	A			1	D		
	Lymphoid organs							1	A		
	Allergies									1	D
	Active and Passive Immunity	1	D							1	D
	Innate immunity			1	A						
	Auto-immunity					1	E				
AIDS/ Cancer	STIs							1	D		
	Cancer									1	A
Drug & Alcohol Abuse	Opiods			1	A	1	A				

LOD - Level of Difficulty | E - Easy | A - Average | D - Difficult | Qns - No. of Questions

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Topic 1: Common Diseases in Humans

1. Match the following diseases with the causative organism and select the correct option. *[2020]*

	Column-I		Column-II
(a)	Typhoid	(i)	Wuchereria
(b)	Pneumonia	(ii)	Plasmodium
(c)	Filariasis	(iii)	Salmonella
(d)	Malaria	(iv)	Haemophilus

	(A)	(B)	(C)	(D)
(a)	(iii)	(iv)	(i)	(ii)
(b)	(ii)	(i)	(iii)	(iv)
(c)	(iv)	(i)	(ii)	(iii)
(d)	(i)	(iii)	(ii)	(iv)

2. The infectious stage of *Plasmodium* that enters the human body is *[2020]*
   (a) Sporozoites
   (b) Female gametocytes
   (c) Male gametocytes
   (d) Trophozoites

3. Identify the **correct** pair representing the causative agent of typhoid fever and the confirmatory test for typhoid. *[2019]*
   (a) *Plasmodium vivax* / UTI test
   (b) *Streptococcus pneumoniae* / Widal test
   (c) *Salmonella typhi* / Anthrone test
   (d) *Salmonella typhi* / Widal test

4. In which disease does mosquito transmitted pathogen cause chronic inflammation of lymphatic vessels? *[2018]*
   (a) Elephantiasis (b) Ascariasis
   (c) Amoebiasis (d) Ringworm disease
5. Which of the following is not a sexually transmitted disease ? *[2015 RS]*
   (a) Acquired Immuno Deficiency Syndrome (AIDS)
   (b) Trichomoniasis
   (c) Encephalitis
   (d) Syphilis
6. The active form of *Entamoeba histolytica* feeds upon: *[2015 RS]*
   (a) mucosa and submucosa of colon only
   (b) food in intestine
   (c) blood only
   (d) erythrocytes; mucosa and submucosa of colon
7. Match each disease with its correct type of vaccine: *[2015 RS]*
   (A) Tuberculosis (i) harmless virus
   (B) Whooping cough (ii) inactivated toxin
   (C) Diphtheria (iii) killed bacteria
   (D) Polio (iv) harmless bacteria

	(A)	(B)	(C)	(D)
(a)	(iii)	(ii)	(iv)	(i)
(b)	(iv)	(iii)	(ii)	(i)
(c)	(i)	(ii)	(iv)	(iii)
(d)	(ii)	(i)	(iii)	(iv)

8. Which of the following endoparasites of humans does show viviparity ? *[2015 RS]*
   (a) *Enterobius vermicularis*
   (b) *Trichinella spiralis*
   (c) *Ascaris lumbricoides*
   (d) *Ancylostoma duodenale*
9. Which of the following diseases is caused by a protozoan ? *[2015 RS]*
   (a) Influenza (b) Babesiosis
   (c) Blastomycosis (d) Syphilis
10. Select the wrong statements : *[2015 RS]*
   (a) W.M. Stanley showed that viruses could be crystallized
   (b) The term '*contagium vivum fluidum*' was coined by M.W. Bejerinek
   (c) Mosaic disease in tobacco and AIDS in human being are caused by viruses
   (d) The viroids were dicovered by D.J. Ivanowski
11. Asthma may be attributed to *[2015 RS]*
   (a) bacterial infection of the lungs.
   (b) allergic reaction of the mast cell in the lungs
   (c) inflammation of the trachea
   (d) accumulation of fluid in the lungs
12. Infection of *Ascaris* usually occurs by : *[NEET 2013]*
   (a) Eating imperfectly cooked pork.
   (b) Tse-tse fly.
   (c) Mosquito bite.
   (d) Drinking water containing eggs of *Ascaris*.
13. Identify the site where *Wuchereria bancrofti* is normally found on human body *[NEET Kar. 2013]*
   (a) Lymphatic vessels of the lower limbs
   (b) Muscles of the legs
   (c) Blood vessels of the thigh region
   (d) Skin between the fingers
14. Motile zygote of Plasmodium occurs in: *[2012]*
   (a) Gut of female Anopheles
   (b) Salivary glands of Anopheles
   (c) Human RBCs
   (d) Human liver
15. Widal Test is carried out to test : *[2012]*
   (a) Malaria (b) Diabetes mellitus
   (c) HIV/AIDS (d) Typhoid fever
16. Common cold differs from pneumonia in, that : *[2012]*
   (a) Pneumonia is a communicable disease whereas the common cold is a nutritional deficiency disease.
   (b) Pneumonia can be prevented by a live attenuated bacterial vaccine whereas the common cold has no effective vaccine.
   (c) Pneumonia is caused by a virus while the common cold is caused by the bacterium *Haemophilus influenzae*.
   (d) Pneumonia pathogen infects alveoli whereas the common cold affects nose and respiratory passage but not the lungs.
17. Read the following four statements (A-D).
   (A) Colostrum is recommended for the new born because it is rich in antigens.
   (B) Chikungunya is caused by a Gram negative bacterium.
   (C) Tissue culture has proved useful in obtaining virus-free plants.
   (D) Beer is manufactured by distillation of fermented grape juice.
   How many of the above statements are wrong? *[2012M]*
   (a) Two (b) Three
   (c) Four (d) One

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18. Where will you look for the sporozoites of the malarial parasite? *[2011]*
    (a) Saliva of infected female *Anopheles* mosquito
    (b) Red blood corpuscles of humans suffering from malaria
    (c) Spleen of infected humans
    (d) Salivary glands of freshly moulted female *Anopheles* mosquito
19. Which one of the following is categorised as a parasite in true sense ? *[2011]*
    (a) The female *Anopheles* bites and sucks blood from humans
    (b) Human foetus developing inside the uterus draws nourishment from the mother
    (c) Head louse living on the human scalp as well as laying eggs on human hair
    (d) The cuckoo (koel) lays its eggs in crow's nest.
20. The pathogen *Microsporum* responsible for ringworm disease in humans belongs to the same kingdom of organisms as that of *[2011M]*
    (a) *Taenia*, a tapeworm
    (b) *Wuchereria*, a filarial worm
    (c) *Rhizopus*, a mould
    (d) *Ascaris*, a round worm
21. Which one of the following option gives the correct matching of a disease with its causative organism and mode of infection. *[2011M]*

	Disease	Causative Organisms	Mode of Infection
(a)	Typhoid	*Salmonella typhii*	With inspired air
(b)	Pneumonia	*Streptococcus pneumoniae*	Droplet Infection
(c)	Elephantiasis	*Wuchereria bancrofti*	infected water and food
(d)	Malaria	*Plasmodium vivax*	Bite of male *Anopheles* mosquito

22. Common cold is not cured by antibiotics because it is *[2011M]*
    (a) caused by a virus
    (b) caused by a Gram-positive bacterium
    (c) caused by a Gram-negative bacterium
    (d) not an infectious disease
23. Widal test is used for the diagnosis of *[2010]*
    (a) Malaria (b) Pneumonia
    (c) Tuberculosis (d) Typhoid
24. Ringworm in humans is caused by : *[2010]*
    (a) Bacteria (b) Fungi
    (c) Nematodes (d) Viruses
25. Match the disease in Column I with the appropriate items (pathogen/prevention/ treatment) in Column II. *[2008]*

Column I	Column II
1. Amoebiasis	(i) *Treponema pallidum*
2. Diphtheria	(ii) Use only sterilized food and water
3. Cholera	(iii) DPT Vaccine
4. Syphilis	(iv) Use oral rehydration therapy

    (a) (1) - (i), (2) - (ii), (3) - (iii), (4) - (iv)
    (b) (1) - (ii), (2) - (iv), (3) - (i), (4) - (iii)
    (c) (1) - (ii), (2) - (i), (3) - (iii), (4) - (iv)
    (d) (1) - (ii), (2) - (iii), (3) - (iv), (4) - (i)
26. The 'blue baby' syndrome results from *[2006]*
    (a) methaemoglobin
    (b) excess of dissolved oxygen
    (c) excess of TDS (total dissolved solids)
    (d) excess of chloride
27. Which one of the following is ***not*** correctly matched *[2004]*
    (a) *Glossina palpalis* - Sleeping sickness
    (b) *Culex pipiens* - Filariasis
    (c) *Aedes aegypti* - Yellow fever
    (d) *Anopheles culifacies* - Leishmaniasis
28. Which one of the following conditions though harmful in itself, is also a potential saviour from a mosquito borne infectious disease ? *[2003]*
    (a) Leukemia
    (b) Thalassemia
    (c) Sickle cell anaemia
    (d) Pernicious anaemia
29. *Salmonella* is related with *[2001]*
    (a) Typhoid (b) Polio
    (c) T.B. (d) Tetanus
30. Which of the following is most infectious disease? *[2001]*
    (a) Hepatitis - B (b) AIDS
    (c) Amoebiosis (d) Malaria
31. Correctly match sexually transmitted disease with its pathogen? *[2000]*
    (a) Syphilis – *Treponema pallidum*
    (b) AIDS – *Bacillus anthracis*
    (c) Urethritis – *Entamoeba gingivalis*
    (d) Gonorrhoea – *Leishmania donovani*

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32. Bovine spongiform encephalopathy, a bovine disease is related to which human disease ? *[2000]*
(a) Cerebral spondylitis
(b) Creutzfeldt-Jacob disease
(c) Encephalitis
(d) Kala-azar

33. For which of the following disease, there is preventive vaccine? *[2000]*
(a) AIDS (b) Hepatitis B
(c) Syphilis (d) Gonorrhea

34. It is not possible to apply Koch's postulates to *[1999]*
(a) Diptheria (b) Cholera
(c) Leprosy (d) Tuberculosis

35. Botulism caused by *Clostridium botulinum* affects the *[1998]*
(a) intestine
(b) neuromuscular junction
(c) spleen
(d) lymph glands

36. Typhoid fever is caused by *[1998]*
(a) *Salmonella* (b) *Shigella*
(c) *Escherichia* (d) *Giardia*

37. Which of the following symptoms indicate radiation sickness? *[1997]*
(a) Red and ulcerated skin
(b) Nausea and loss of hair
(c) Nausea and anaemia
(d) Ulcerated skin, nausea, loss of hair and anaemia

38. Diptheria is caused by *[1997]*
(a) poisons released from dead bacterial cells into the host tissue
(b) poisons released by living bacterial cells into the host tissue
(c) excessive immune response by the host's body
(d) poisons released by virus into the host tissues

39. Which one of the following diseases is now considered nearly eradicated from India ? *[1997]*
(a) Plague (b) Kala azar
(c) Small pox (d) Poliomyelitis

40. In which one of the following pairs of diseases both are caused by viruses ? *[1996]*
(a) Tetanus and typhoid
(b) Whooping cough and sleeping sickness
(c) Syphilis and AIDS
(d) Measles and rabies

41. Which of the following pair is not correctly matched? *[1995]*
(a) Dengue fever -arbovirus
(b) Plague - *Yersinia pestis*
(c) Syphilis - *Trichuris trichiura*
(d) Malaria - *Plasmodium vivax*

42. Which one of the sexually transmitted diseases is correctly matched with its pathogen? *[1994]*
(a) Urethritis – *Bacillus anthracis*
(b) Syphilis – *Treponema pallidum*
(c) Gonorrhoea – *Entamoeba histolytica*
(d) Soft sore – *Bacillus brevis*

43. A sexually transmitted disease caused by bacteria is *[1994]*
(a) Leprosy (b) aids
(c) Syphilis (d) Pertussis

44. If all ponds and puddles are destroyed, the organism likely to be destroyed is *[1993]*
(a) *Leishmania* (b) *Trypanosoma*
(c) *Ascaris* (d) *Plasmodium*

45. Schizogont stage of *Plasmodium* occurs in human cells *[1993]*
(a) Erthrocytes
(b) Liver cells
(c) Erythrocytes and liver cells
(d) Erythrocytes, liver cells and spleen cells

46. Give the correct matching of causative agent/ germ and disease *[1993]*
(a) *Anopheles* – malaria
(b) *Leishmania* – Sleeping sickness
(c) *Glossina* – Kala-azar
(d) *Wuchereria* – Filariasis

47. The part of life cycle of malarial parasite *Plasmodium vivax*, that is passed in female *Anopheles* is *[1992]*
(a) sexual cycle
(b) pre-erythrocytic schizogony
(c) exoerythrocytic schizogony
(d) post-erythrocytic schizogony

48. Who discovered *Plasmodium* in R.B.C of human beings ? *[1991]*
(a) Ronald Ross (b) Mendel
(c) Laveran (d) Stephens

49. Malignant tertian malarial parasite is *[1991]*
(a) *Plasmodium falciparum*
(b) *P. vivax*
(c) *P. ovale*
(d) *P. malariae*

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50. Amoebiasis is prevented by *[1990]*
    (a) eating balanced food
    (b) eating plenty of fruits
    (c) drinking boiled water
    (d) using mosquito nets
51. In hot summer and cold winter, the number of malaria cases as well as *Anopheles* declines, reappearance of malaria in humid warm conditions is due to *[1990]*
    (a) surving malarial parasites in human carriers
    (b) surviving sporozoites in surviving mosquitoes
    (c) monkeys
    (d) mosquito larvae in permanent waters
52. Malaria fever coincides with liberation of
    (a) cryptomerozoites *[1989]*
    (b) metacryptomerozoites
    (c) merozoites
    (d) trophozoites

Topic 2: Immunity

53. Identify the wrong statement with reference to immunity. *[2020]*
    (a) When ready-made antibodies are directly given, it is called "Passive immunity".
    (b) Active immunity is quick and gives full response.
    (c) Foetus receives some antibodies from mother, it is an example for passive immunity.
    (d) When exposed to antigen (living or dead) antibodies are produced in the host's body. It is called "Active immunity".
54. Humans have acquired immune system that produces antibodies to neutralise pathogens. Still innate immune system is present at the time of birth because it *[2019, Odisha]*
    (a) provides passive immunity.
    (b) is very specific and uses different macrophages.
    (c) produces memory cells for mounting fast secondary response.
    (d) has natural killer cells which can phagocytose and destroy microbes.
55. Colostrum, the yellowish fluid, secreted by mother during the initial days of lactation is very essential to impart immunity to the newborn infants because it contains: *[2019]*
    (a) Natural killer cells
    (b) Monocytes
    (c) Macrophages
    (d) Immunoglobulin A
56. Which of the following immune responses is responsible for rejection of kidney graft?
    (a) Auto-immune response
    (b) Humoral immune response
    (c) Inflammatory immune response
    (d) Cell-mediated immune response
57. Transplantation of tissues/organs fails often due to non-acceptance by the patient's body. Which type of immune-response is responsible for such rejections? *[2017]*
    (a) Cell - mediated immune response
    (b) Hormonal immune response
    (c) Physiological immune response
    (d) Autoimmune response
58. MALT constitutes about _____ percent of the lymphoid tissue in human body. *[2017]*
    (a) 20% (b) 70%
    (c) 10% (d) 50%
59. In higher vertebrates, the immune system can distinguish self-cells and non-self. If this property is lost due to genetic abnormality and it attacks self-cells, then it leads to *[2016]*
    (a) allergic response
    (b) graft rejection
    (c) auto-immune disease
    (d) active immunity
60. Antivenom injection contains preformed antibodies while polio drops that are administered into the body contain *[2016]*
    (a) Activated pathogens
    (b) Harvested antibodies
    (c) Gamma globulin
    (d) Attenuated pathogens
61. Which one of the following immunoglobulins does constitute the largest percentage in human milk? *[2015 RS]*
    (a) Ig M (b) Ig A
    (c) Ig G (d) Ig D
62. If you suspect major deficiency of antibodies in a person, to which of the following would you look for confirmatory evidences?
    (a) Serum albumins *[2015 RS]*
    (b) Haemocytes
    (c) Serum globulins
    (d) Fibrinogin in plasma

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63. Grafted kidney may be rejected in a patient due to : *[2015 RS]*
(a) Cell-mediated immune response
(b) Passive immune response
(c) Innate immune response
(d) Humoral immune response

64. The cell-mediated immunity inside the human body is carried out by : *[NEET 2013]*
(a) B-lymphocytes (b) Thrombocytes
(c) Erythrocytes (d) T-lymphocytes

65. In which one of the following options the two examples are correctly matched with their particular type of immunity. *[2012]*

	Examples	**Types of immunity**
(a)	Polymorphonuclear leukocytes and monocytes	Cellular barriers
(b)	Anti-tetanus and anti-snake bite injection	Active immunity
(c)	Saliva in mouth and Tear in eyes	Physical barriers
(d)	Mucus coating of epithelium lining the urinogenital tract-and the HCl in stomach	Physiological barriers

66. Which one of the following statements is correct with respect to immunity? *[2012M]*
(a) Preformed antibodies need to be injected to treat the bite by a viper snake.
(b) The antibodies against small pox pathogen are produced by T – lymphocytes.
(c) Antibodies are protein molecules, each of which has four light chains.
(d) Rejection of a kidney graft is the function of B-lymphocytes.

67. Which one of the following acts as a physiological barrier to the entry of micro-organisms in human body ? *[2011]*
(a) Epithelium of urogenital tract
(b) Tears
(c) Monocytes
(d) Skin

68. Select the correct statement with respect to diseases and immunisation? *[2011M]*
(a) If due to some reason B-and T-lymphocytes are damaged, the body will not produce antibodies against a pathogen
(b) Injection of dead / inactivated pathogens causes passive immunity
(c) Certain protozoans have been used to mass produce hepatitis B vaccine.
(d) Injection of snake antivenom against snake bite is an example of active immunisation

69. A person likely to develop tetanus is immunised by administering *[2009]*
(a) preformed antibodies
(b) wide spectrum antibiotics
(c) weakened germs
(d) dead germs

70. The letter T in T -lymphocyte refers to
(a) Thalamus (b) Tonsil *[2009]*
(c) Thymus (d) Thyroid

71. Use of anti-histamines and steroids give a quick relief from *[2009]*
(a) nausea (b) cough
(c) headache (d) allergy

72. To which type of barriers under innate immunity, do the saliva in the mouth and the tears from the eyes, belong? *[2008]*
(a) Cytokine barriers
(b) Cellular barriers
(c) Physiological barriers
(d) Physical barriers

73. If you suspect major deficiency of antibodies in a person to which of the following would you look for confirmatory evidence? *[2007]*
(a) serum globulins
(b) fibrinogen in the plasma
(c) haemocytes
(d) serum albumins

74. Increased asthmatics attacks in certain seasons are related to *[2007]*
(a) eating fruits preserved in tin containers
(b) inhalation of seasonal pollen
(c) low temperature
(d) hot and humid environment.

75. Antibodies in our body are complex *[2006]*
(a) steroids (b) prostaglandins
(c) glycoproteins (d) lipoproteins

76. The cell in the human body invaded by the human immuno-deficiency virus (HIV) is *[1999, 2006]*
(a) T-helper cell (b) Erythrocyte
(c) B-cell (d) Macrophage

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77. Damage to thymus in a child may lead to: *[2005]*
(a) a reduction in haemoglobin content of blood
(b) a reduction in stem cell production
(c) loss of antibody mediated immunity
(d) loss of cell mediated immunity

78. Short-lived immunity acquired from mother to foetus across placenta or through mother's milk to the infant is categorised as *[2003]*
(a) innate non-specific immunity
(b) active immunity
(c) passive immunity
(d) cellular immunity

79. What is true about T-lymphocytes in mammals? *[2003]*
(a) These are produced in thyroid
(b) There are three main types — cytotoxic T-cells, helper T-cells and suppressor T-cells
(c) These originate in lymphoid tissues
(d) They scavenge damaged cells and cellular debris

80. Reason of lung cancer *[2001]*
(a) Asbestos (b) Calcium fluoride
(c) Cement factory (d) Bauxite mining

81. Interferons are synthesized in response to *[2001]*
(a) Mycoplasma (b) Bacteria
(c) Viruses (d) Fungi

82. Small proteins produced by vertebrate cells in response to viral infections inhibiting viral multiplication are known as *[2000]*
(a) Lipoproteins (b) Immuglobulins
(c) Interferons (d) Antitoxins

83. Vaccines are *[1999]*
(a) treated bacteria or viruses or one of their proteins
(b) MHC (major histocompatibility complex) proteins
(c) curative medicines
(d) monoclonal antibodies

84. During blood typing agglutination indicates that the *[1999]*
(a) RBC carry certain antigens
(b) Plasma contains certain antigens
(c) RBC carry certain antibodies
(d) Plasma contains certain antibodies

85. Chemically an antibody is a *[1996, 99]*
(a) lipid (b) nucleoprotein
(c) protein (d) lipoprotein

86. If a certain person shows production of interferons in his body, the chances are that he has got an infection of *[1997]*
(a) typhoid (b) measles
(c) malaria (d) tetanus

87. Hypersensitivity to an allergen is associated with *[1996]*
(a) aberrant functioning of the immune mechanism
(b) increase in ambient temperature
(c) age of the individual
(d) food habits

88. Interferons are *[1996]*
(a) antiviral proteins
(b) antibacterial proteins
(c) anticancer proteins
(d) complex proteins

89. Passive immunity was discovered by *[1996]*
(a) Edward Jenner (b) Emil von Behring
(c) Robert Koch (d) Louis Pasteur

90. Which of the following diseases is due to an allergic reaction? *[1995]*
(a) Goitre (b) Skin cancer
(c) Hay fever (d) Enteric fever

91. A cell coded protein formed in response to infection with most animal viruses is *[1994]*
(a) Antigen (b) Antibody
(c) Interferon (d) Histone

92. Obstacle to large scale transplantation of organs is
(a) insufficiency of organ donors *[1994]*
(b) immunological rejection of foreign bodies
(c) religious or ethnic considerations
(d) lack of effective surgical techniques

93. Cells involved in immune mechanism are *[1993]*
(a) Erythrocytes (b) Lymphocytes
(c) Eosinophils (d) Thrombocytes

Topic 3: AIDS/Cancer

94. Which of the following statements is not true for cancer cells in relation to mutations ? *[2016]*
(a) Mutations in proto-oncogenes accelerate the cell cycle.
(b) Mutations destroy telomerase inhibitor.
(c) Mutations inactive the cell control.
(d) Mutations inhibit production of telomerase.

95. HIV that causes AIDS, first starts destroying:
(a) Leucocytes *[2015 RS]*
(b) Helper T- Lymphocytes
(c) Thrombocytes
(d) B- Lymphocytes

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96. Which of the following viruses is not transferred through semen of an infected male? *[2015 RS]*
(a) Human immunodeficiency virus
(b) Chikungunya virus
(c) Ebola virus
(d) Hepatitis B virus

97. At which stage of HIV infection does one usually show symptoms of AIDS:- *[2014]*
(a) Within 15 days of sexual contact with an infected person.
(b) When the infected retro virus enters host cells.
(c) When HIV damages large number of helper T-Lymphocytes.
(d) When the viral DNA is produced by reverse transcriptase.

98. Which one of the following is not a property of cancerous cells whereas the remaining three are ? *[2012]*
(a) They compete with normal cells for vital nutrients.
(b) They do not remain confined in the area of formation.
(c) They divide in an uncontrolled manner
(d) They show contact inhibition.

99. Which one of the following sets of items in the options 1 - 4 are correctly categorized with one exception in it? *[2012M]*

	Items	Category	Exception
(a)	UAA, UAG, UGA	Stop codons	UAG
(b)	Kangaroo, Koala, Wombat	Australian marsupials	Wombat
(c)	Plasmodium, Cuscuta, Trypanosoma	Protozoan parasites	Cuscuta
(d)	Typhoid, Pneumonia, Diphtheria	Bacterial diseases	Diphtheria

100. At which stage of HIV infection does one usually show symptoms of AIDS? *[2011]*
(a) When the infecting retrovirus enters host cells
(b) When viral DNA is produced by reverse trancriptase
(c) When HIV replicates rapidly in helper T-lymphocytes and damages large number of these
(d) Within 15 day of sexual contact with an infected person.

101. A certain patient is suspected to be suffering from Acquired Immuno Deficiency Syndrome. Which diagnostic technique will you recommend for its detection? *[2011]*
(a) ELISA (b) MRI
(c) Ultra sound (d) WIDAL

102. Which one of the following statements is correct with respect to AIDS? *[2010]*
(a) The HIV can be transmitted through eating food together with an infected person
(b) Drug addicts are least susceptible to HIV infection
(c) AIDS patients are being fully cured cent per cent with proper care and nutrition
(d) The causative HIV retrovirus enters helper T - lymphocytes thus reducing their numbers

103. Which of the following is a pair of viral diseases? *[2009]*
(a) Common cold, AIDS
(b) Dysentery, common cold
(c) Typhoid, tuberculosis
(d) Ringworm, AIDS

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104. Which one of the following statements is **correct**? *[2009]*
(a) Benign tumours show the property of metastasis.
(b) Heroin accelerates body functions.
(c) Malignant tumours occurs may exhibit metastasis.
(d) Patients who have undergone surgery are given cannabinoids to relieve pain.

105. AIDS is caused by HIV that principally infects: *[2005]*
(a) all lymphocytes (b) activator B cells
(c) cytotoxic T cells (d) T_4 lymphocytes

106. Which of the following statements is not true for retroviruses? *[2004]*
(a) DNA is not present at any stage in the life cycle of retroviruses
(b) Retroviruses carry gene for RNA-dependent DNA polymerase
(c) The genetic material in mature retroviruses is RNA
(d) Retroviruses are causative agents for certain kinds of cancer in man

107. ELISA is used to detect viruses, where *[2004]*
   (a) DNA-probes are required
   (b) Southern bloting is done
   (c) Alkaline phosphatase is the key reagent
   (d) Catalase is the key reagent
108. Cancer cells are more easily damaged by radiation than normal cells because they are
   (a) starved of mutation *[2004]*
   (b) undergoing rapid division
   (c) different in structure
   (d) non-dividing
109. Carcinoma refers to *[2003]*
   (a) benign tumours of the connective tissue
   (b) malignant tumours of the connective tissue
   (c) malignant tumours of the skin or mucous membrane
   (d) malignant tumours of the colon
110. ELISA is used to detect viruses where the key reagent is *[2003]*
   (a) RNase
   (b) alkaline phosphatase
   (c) catalase
   (d) DNA probe
111. Cancerous cells can easily be destroyed by radiations due to *[2002]*
   (a) rapid cell division (b) lack of nutrition
   (c) fast mutation (d) lack of oxygen
112. Human immuno deficiency virus (HIV) has a protein coat and a genetic material which is
   (a) single stranded DNA *[1998, 2000]*
   (b) double stranded DNA
   (c) single stranded RNA
   (d) double stranded RNA
113. Hybridoma cells are *[1999]*
   (a) nervous cells of frog
   (b) hybrid cells resulting from myeloma cells
   (c) only cells having oncogenes
   (d) product of spore formation in bacteria
114. Retroviruses are implicated as a cause for cancer in humans because they *[1996]*
   (a) carry gene for reverse transcriptase
   (b) may carry cellular proto-oncogenes in their genome
   (c) may carry v-oncogenes in their genome
   (d) carry single stranded RNA as their genetic material
115. Sarcoma is cancer of *[1994]*
   (a) epithelial tissue
   (b) mesodermal tissue
   (c) blood
   (d) endodermal tissues

Topic 4 Drugs & Alcohol Abuse

116. Coca alkaloid or cocaine is obtained from : *[2019, Odisha]*
   (a) *Datra*
   (b) *Papaver somniferum*
   (c) *Atropa belladonna*
   (d) *Erythroxylum coca*
117. Drug called 'Heroin' is synthesised by : *[2019]*
   (a) methylation of morphine
   (b) acetylation of morphine
   (c) glycosylation of morphine
   (d) nitration of morphine
118. Which part of poppy plant is used to obtain the drug "Smack"? *[2018]*
   (a) Flowers (b) Latex
   (c) Leaves (d) Roots
119. Which is the particular type of drug that is obtained from the plant whose one flowering branch is shown below? *[2014]*

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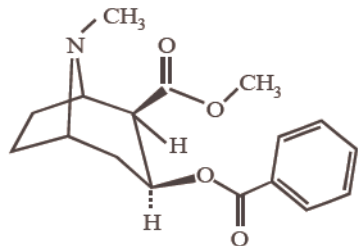
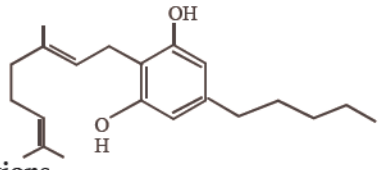
   (a) Hallucinogen (b) Depressant
   (c) Stimulant (d) Pain - killer
120. Which one of the following is a hallucinogenic drug? *[NEET Kar. 2013]*
   (a) Opium
   (b) Caffeine
   (c) Morphine
   (d) Lysergic acid diethylamide
121. Cirrhosis of liver is caused by the chronic intake of *[2012]*
   (a) Opium (b) Alcohol
   (c) Tobacco (Chewing) (d) Cocaine
122. Identify the molecules (a) and (b) shown below and select the right option giving their source and use. *[2012M]*
   (a)



(b) 

Options

	Molecule	Source	Use
(a)	(a) Cocaine	Erythroxylum coca	Accelerates the transport of dopamine
(b)	(b) Heroin	Cannabis sativa	"Depressant and slows down body functions"
(c)	(b) Cannabinoid	Atropa belladona	Produces hallucinations
(d)	(a) Morphine	Papaver somniferum	Sedative and pain killer

123. Select the correct statement from the ones given below? *[2010]*
   (a) Barbiturates when given to criminals make them tell the truth
   (b) Morphine is often given to persons who have undergone surgery as a pain killer
   (c) Chewing tobacco lowers blood pressure and heart rate
   (d) Cocaine is given to patients after surgery as it stimulates recovery

124. Which one of the following is the correct statement regarding the particular psychotropic drug specified? *[2008]*
   (a) Hashish causes after thought perceptions and hallucinations
   (b) *Opium* stimulates nervous system and causes hallucinations
   (c) Morphine leads to delusions and disturbed emotions
   (d) Barbiturates cause relaxation and temporary euphoria

125. A person showing unpredictable moods, outbursts of emotion, quarrelsome behaviour and conflicts with other is suffering from *[2006]*
   (a) Borderline personality disorder (BPD)
   (b) Mood disorders
   (c) Addictive disorders
   (d) Schizophrenia

126. Which one of the following depresses brain activity and produced feelings of calmness, relaxation and drowsiness? *[2005]*
   (a) Morphine (b) Valium
   (c) Amphetamines (d) Hashish

127. Which one of the following is correct match? *[2001]*
   (a) Reserpine — Tranquilizer
   (b) Cocaine — Opiate narcotic
   (c) Morphine — Hallucinogenic
   (d) Bhang — Analgesic

128. L. S. D. is *[2001]*
   (a) hallucinogenic (b) sedative
   (c) stimulant (d) tranquiliser

129. Which one of the following is an opiate narcotic? *[1997]*
   (a) Barbiturates (b) Morphine
   (c) Amphetamines (d) LSD

130. The use of *Cannabis* products (bhang, ganja, charas, marijuana or hashish) causes *[1997]*
   (a) depression of brain activity and feeling of calmness
   (b) alters thoughts, perceptions and feelings
   (c) suppresses brain function and relieves pain
   (d) stimulates the nervous system and increases alterness and activity.

131. Which one of the following is an Indian medicinal plant ? *[1996]*
   (a) *Saccharum officinarum*
   (b) *Rauwolfia serpentina*
   (c) *Oryza sativa*
   (d) *Solanum melongena*

132. The alkaloid ajmalicine is obtained from *[1995]*
   (a) *Atropa* (b) *Papaver*
   (c) *Curcuma* (d) Sarpgandha

133. Opiate narcotic is *[1993]*
   (a) Bhang (b) Charas
   (c) Heroin (d) Nicotine

134. Analgesic drugs *[1990]*
   (a) form tissues (b) relieve pain
   (c) relieve fatigue (d) cause pain

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ANSWER KEY																			
1	(a)	15	(d)	29	(a)	43	(c)	57	(a)	71	(d)	85	(c)	99	(c)	113	(b)	127	(a)
2	(a)	16	(d)	30	(a)	44	(d)	58	(d)	72	(c)	86	(b)	100	(c)	114	(b)	128	(a)
3	(d)	17	(a)	31	(a)	45	(c)	59	(c)	73	(a)	87	(a)	101	(a)	115	(b)	129	(b)
4	(a)	18	(a)	32	(b)	46	(d)	60	(d)	74	(b)	88	(a)	102	(d)	116	(d)	130	(b)
5	(c)	19	(c)	33	(b)	47	(a)	61	(b)	75	(c)	89	(a)	103	(a)	117	(b)	131	(b)
6	(d)	20	(c)	34	(c)	48	(c)	62	(c)	76	(a)	90	(c)	104	(c)	118	(b)	132	(d)
7	(b)	21	(b)	35	(b)	49	(a)	63	(a)	77	(d)	91	(c)	105	(d)	119	(a)	133	(c)
8	(b)	22	(a)	36	(a)	50	(c)	64	(d)	78	(c)	92	(b)	106	(a)	120	(d)	134	(b)
9	(b)	23	(d)	37	(d)	51	(b)	65	(a)	79	(c)	93	(b)	107	(c)	121	(b)		
10	(d)	24	(b)	38	(a)	52	(c)	66	(a)	80	(a)	94	(d)	108	(b)	122	(d)		
11	(b)	25	(d)	39	(c)	53	(b)	67	(d)	81	(c)	95	(b)	109	(c)	123	(b)		
12	(d)	26	(a)	40	(d)	54	(d)	68	(a)	82	(c)	96	(b)	110	(b)	124	(a)		
13	(a)	27	(d)	41	(c)	55	(d)	69	(c)	83	(a)	97	(c)	111	(a)	125	(a)		
14	(a)	28	(c)	42	(b)	56	(d)	70	(c)	84	(a)	98	(d)	112	(c)	126	(b)		

Hints & Solutions

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1. (a) Typhoid fever in humans is caused by pathogenic bacterium *Salmonella typhi*. Pneumonia is caused by *Streptococcus Pneumoniae* and *Haemophilus influenzae*. Filariasis or elephantiasis is caused by the filarial worm, *Wuchereria bancrofti* and *Wuchereria malayi*. Malaria is caused by different species of *Plasmodium*.

NOTES

The rupture of RBCs is associated with release of a toxic substance, **haemozoin**, which is responsible for the chill and high fever recurring every three to four days. There are two types of vaccine for pneumonia such as:
Pneumococcal conjugate vaccine or PCV13 and CDC recommend PCV13 for all children younger than 2 years old. Pneumococcal polysaccharide vaccine or PPSV23 and is recommended for all adults 65 years or older.

2. (a) *Plasmodium* enters the human body as sporozoites (Infectious stage) through the bite of Infected Female *Anopheles* mosquito.

NOTES

The malaria parasite life cycle involves two hosts. During a blood meal, a malaria-infected female Anopheles mosquito inoculates sporozoites into the human host. Sporozoites infect liver cells and mature into schizonts, which rupture and release merozoites.

3. (d) Typhoid is a bacterial infection that can lead to a high fever, diarrhoea, and vomiting. It is caused by the bacteria *Salmonella typhimurium (S. typhi)*.

NOTES

Typhoid is diagnosed by Widal test. Widal test was developed by Georges Ferdinand Widal in 1896 and helps to detect presence of salmonella antibodies in a patient's serum.

4. (a) Lymphatic filariasis, also known as elephantiasis, is a human disease caused by parasitic worms known as filarial worms. It is caused by roundworm, *Wuchereria bancrofti* and it is transmitted by culex mosquito.

5. (c) Encephalitis is a disease of inflammation of the brain. It is not transmitted sexually. Most commonly it is caused by a virus.

NOTES

Eastern equine encephalitis virus (EEEV) is a zoonotic alphavirus and arbovirus, and was first recognized in horses in 1831 in Massachusetts. The first confirmed human cases were identified in New England in 1938.

6. (d) *Entamoeba histolytica* is found in the colon. It feeds on mucosa and submucosa as well as phagocytose RBCs.

NOTES

The causal agent, *Entamoeba histolytica*, was discovered in Russia in 1873 by **Friedrich Losch**.

7. (b) Tuberculosis vaccine (BCG) has inactivated bacteria. In whooping cough vaccine, there are killed pathogens of *Bordetella pertussis* which cause whooping cough. In DPT diphtheria toxoid is present. Sabin polio vaccine contains inactivated virus.

NOTES

BCG vaccine contains a live, attenuated strain of *M. bovis* that was originally isolated from cattle with tuberculosis and cultured for a period of 13 years and a total of 231 passages. The BCG vaccine was first used to immunize humans in 1921.

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8. (b) *Trichinella spiralis* is an endoparasite found in human intestine. It is the smallest nematode producing larvae in large number. These larvae bore the intestine of human being and enter the blood and lymphatic systems.

NOTES

Trichinollosis is caused by consuming undercooked or raw meat (usually pork). *Trichinella spiralis* species is the common cause of human disease by eating raw or undercooked pork.

9. (b) Babesiosis is malaria like rare infectious disease caused by protozoon-*Babesia*. In this disease haemoglobinuric fever takes place.
10. (d) T.O. Dinear (1971) discovered the viroids which are smaller than viruses.
11. (b) A mast cell or a mastocyte is typically a white blood cell. It is a special kind of granulocyte, which is a part of the immune system and laden with histamine and heparin. Besides these, mast cells also secrete the prostaglandin (PG) D2, and leukotriene (LT) C4, which are capable of inducing bronchoconstriction and mucosal edema, both features of asthma.

NOTES

Prostaglandins and leukotrienes are potent eicosanoid lipid mediators derived from phospholipase-released arachidonic acid that are involved in numerous homeostatic biological functions and inflammation.

12. (d) *Ascaris*, an intestinal parasite causes **ascariasis.** Symptoms of these disease include internal bleeding, muscular pain, fever, anaemia and blockage of the intestinal passage. The eggs of the parasite are excreted along with the faeces of infected persons which contaminate soil, water, plants, etc. A healthy person acquires this infection through contaminated water vegetables, fruits, etc.
13. (a) *Wuchereria (W. bancrofti* and *W. malayi),* filarial worms causing chronic inflammation of the organs in which they live for many years, usually the lymphatic vessels of the lower limbs and the disease caused by them known as **elephantiasis** or **filariasis.** The genital organs are mainly affected, resulting in gross deformities. The pathogens are transmitted to a healthy person through the bite by the female mosquito vectors.
14. (a) Motile zygote of Plasmodium occurs in gut of female Anopheles. Zygote formed in stomach of mosquito about 9 to 10 days after sucking the blood of an infected human. Anopheles receives RBCs containing different stages of erthyrocytic cycle, including gametocyte. In its gut, all stages except the gametocytes are digested. The gametocytes remain unaffected by digestive enzymes of the mosquito, hatch out from the RBCs into the lumen of mosquito's stomach and form sperm and ovum by gametogenesis. Syngamy or fusion of male and female gamete.
15. (d) Widal test is carried out to test typhoid fever caused by *Salmonella typhii* bacteria. Typhoid vaccine is available.

NOTES

Widal test procedure involves the serum agglutination test to detect typhoid fever. Patients who are suffering from enteric fever will carry homologous antibodies in the serum. The slide method and the tube method are the two types of Widal test procedures.

16. (d) Common cold is most infectious viral disease caused by ***Rhino*** viruses which is transmitted through inhalation of droplets from infected person or through contaminated objects. Pneumonia is a bacterial disease caused by *Streptococcus pneumoniae* and *Haemophillus influenzae*. This serious disease of lungs spread by sputum of the patient.
17. (a) Statement (A) and (B) are wrong.
Colostrum is the first lacteal secretion (thin yellowish fluid) produced by the mammary gland of a mother prior to the production of milk. It is recommended for the new born because it is rich in IgA antibodies and minerals.
Chikungunya fever is a viral disease transmitted to humans by the bite of infected *Aedes aegypti* mosquitoes.
18. (a) Sporozoites of malarial parasite are found in saliva of infected female *Anopheles* mosquito.
19. (c) Head louse is an obligate ectoparasite of human scalp and as well as laying egg on human hair.
20. (c) *Microsporum* is a member of Deuteromycetes of fungi and *Rhizopus* is also fungi and member of Zygomycetes.
21. (b) Pneumonia disease is spread by the organism *Streptococcus pneumoniae* and the mode of infection is by droplet infection.
22. (a) Common cold is due to rhinovirus. Recent studies found that antibiotics do not kill this virus.
23. (d) Widal test is used for the diagnosis of typhoid. It is an agglutination test for the presence of antibodies against the *Salmonella* organisms, which cause typhoid fever.

NOTES

Salmonella typhimurium is a pathogenic Gram-negative bacteria predominately found in the intestinal lumen. Its toxicity is due to an outer membrane consisting largely of lipopolysaccharides (LPS) which protect the bacteria from the environment.

24. (b) Ring worm is a fungal disease caused by the dermatophyte fungal species of *Microsporum*, *Trichophyton* and *Epidermophyton*.
25. (d)

Amoebiasis	:	Use only sterilized food and water
Diphtheria	:	DPT Vaccine
Cholera	:	Use oral rehydration therapy
Syphilis	:	*Treponema pallidum*

26. (a) Infant methemoglobinemia is also called "blue baby syndrome." It is a condition where a baby's skin turns blue. This happens when there is not enough oxygen in the blood. Methemoglobinemia is a condition that some babies are born with (congenital) or some develop early in life (acquired).

NOTES

The most common cause of blue baby syndrome is water contaminated with nitrates. After a baby drinks formula made with nitrate-rich water, the body converts the nitrates into nitrites. These nitrites bind to the haemoglobin in the body, forming methemoglobin, which is unable to carry oxygen.

27. (d) Leishmaniasis in transmitted by sand fly *Phlebotomus argentipes*. *Anopheles* transmits malaria. The rest of the options are correct combinations.

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28. (c) A sickle cell anaemia affected person is more resistant to mosquito born infectious disease because the sickle - cell shaped RBCs are hostile to the protozoa *Plasmodium.*
Sickle cell anemia is a blood disease in which the red blood cells possess an abnormal crescent or sickle shape, when observed under microscope. It is an inherited disorder and is attributed to a single base substitution in the DNA sequence of the gene encoding the beta chain of haemoglobin. The sickle cell trait protects against malaria. In the sickled RBC, malaria parasites cannot survive, thus giving advantage to the anaemic patients.
29. (a) Tetanus is caused by *Clostridium tetani*. Tuberculosis is caused by *Mycobacterium tuberculosis*. Polio is caused by virus. *Salmonella typhi* causes typhoid fever. The incubation period is about two weeks. The patient first suffers from high fever of 40°C and continual headache.

30. (a) HBV causes serum hepatitis. It is most frequently transmitted by blood or by blood contaminated instruments.
31. (a) AIDS is caused by HIV virus and Gonorrhoea is caused by *Neisseria gonorrhoea*. Urethritis is inflammed of the urethra by bacteria.
32. (b) Bovine Spongiform Encephalopathy (BSE) is a total brain disease known to exist in beef and other dairy cattle in U.K. It is also known as mad cow disease. It is caused by prions.
Creutzfeldt- Jacob Disease (CJD) is a slow degenerative disease among human affecting central nervous system with dysfunction and degeneration of the brain. It has been suggested that a few people in Britain might have contracted CJD by eating BSE- infected beef. So both are related.
Encephalitis is an acute inflammation of the brain mostly due to viral infection.
33. (b) Hepatitis is a viral disease; two subgroups are hepatitis type A virus (HAV) and hepatitis type B virus (HBV). HBV causes serum hepatitis, it is most frequently transmitted by blood, products of blood or blood contaminated instruments. Since only adults are susceptible to HBV, but vaccines are available. While children and young adults are susceptible to HAV, no vaccines are acceptable.
34. (c) Koch's postulates are not applicable to the bacteria causing leprosy and syphilis. *Mycobacterium leprae* causing leprosy produces endospores on which Koch's postulates are not applicable, because *Mycobacterium leprae* cannot be cultured *in vitro*.
35. (b) Botulism is caused by the ingestion of food containing the toxin of *Clostridium botulinum*. Before the introduction of a strict canning code, the food canning industry was responsible for many deaths each year from botulism (Food poisoning).
Botulism is a rare but serious paralytic illness caused by a nerve toxin that is produced by the bacterium *Clostridium botulinum*. This bacterium produces an exotoxin which is highly toxic for the synaptic ends of the nerves where it blocks the release of acetylcholine which is a chemical necessary for the transmission of nerve impulse across the synapses.
36. (a) Typhoid fever is caused by *Salmonella typhi* (*S. typhosa*). This is fasillus type. Bacterial genus *Shigella* causes shigellosis or bacillary dysentry. *Escherichia coli* is a facultative anaerobe found in the intestine of human beings.
Giardia is a flagellate protozoan, *Glamblia* causes giardiasis a prolonged diarroheal disease of humans.
37. (d) Exposure to radiation results in the following immediate effects :
(i) Change in cell metabolism
(ii) Crystallization of haemoglobin
(iii) Breakdown of RBCs
(iv) Loss of hair, nails
(v) Impairment of vision and damage of different tissues
38. (a) Diptheria is a highly infectious disease caused by *Cornybacterium diptheriae* which liberates soluble toxin. The toxin affects nerves and cause double vision, difficulty in swallowing and paralysis of breathing muscles and limbs.
39. (c) Small pox, caused by *Variola* virus, is an acute highly communicable disease which has been irradicated not only from India but from the whole world.
40. (d) Tetanus and typhoid are caused by bacteria.
Whooping cough is caused by bacteria. Sleeping sickness is caused by parasitic flees. Syphilis is caused by bacteria while AIDS is final stage of HIV viral disease.
Measles and Rabies are caused by virus.
41. (c) 'Syphilis-*Trichuris tichiura*' is not correctly matched, because syphilis is caused by *Treponema pallidium* bacteria.
42. (b) Syphilis – *T. pallidum*
43. (c) Syphilis – *T. pallidum*
44. (d) *Plasmodium* is transmitted through female *Anopheles* mosquito to human and the most favourite dwelling place for *Anopheles* is water or moist places like ponds and puddles.
45. (c) Schizogont or asexual stage occurs in human erythrocytes and liver cells.

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46. (d) *Wuchereria* – Filariasis
47. (a) *Plasmodium vivax* completes sexual cycle or gamogony in female *Anopheles* mosquito. Asexual cycle is passed in man (schizogony).
48. (c) Laveran discovered *Plasmodium* in R.B.C of human beings and concluded that malaria is caused by *Plasmodium vivax*. Sir Ronal Ross (1896) was the first to observe oocytes of *Plasmodium* in female *Anopheles*.
49. (a) In human beings different types of malaria are caused by 4 different species of *Plasmodium*. They are :
    1. Benign tertian malaria – *Plasmodium vivax*.
    2. Malignant (Pernicious or cerebral) tertian malaria – *Plasmodium falciparum.*
    3. Quartan malaria – *Plasmodium malariae.*
    4. Mild tertian malaria – *Plasmodium ovale*.
50. (c) Amoebiasis or amoebic dysentery is caused by a parasite *Entamoeba histolytica* present in the upper part of large intestine of human.
    It is caused due to ingesting contaminated food or water with cyst (trophozoite) of *Entamoeba*. It feeds on R.B.C of intestinal blood capillaries and damages intestinal mucosa secreting an enzyme - histolysin.
51. (b)
52. (c) Malarial parasite, (*Plasmodium vivax*), Protist of class Sporozoa, digenetic parasite causes malarial fever in human. The malarial parasite was discovered by Laveran (1880). Sir Ronald Ross (1898) discovered that Malaria disease is spread by mosquitoes. Its life cycle completes in two organisms-Primary host, female *Anopheles mosquito* and man (Intermediate or Secondary host). It enters human blood-through sporozoites. Malarial fever begins with the release of merozoites in the liver cells, from RBC of human.
53. (b) The correct option is (b) because active immunity is slow and takes time to give its full effective response in comparison to passive immunity where pre-formed antibodies are administered.
54. (d) Innate immunity is non-specific and is accomplished by providing different types of barriers to the entry of foreign agent or any pathogen into our body.
    Through this immunity, the human body protects itself against foreign material that is percieved to be harmful.
    Natural killer cells are a type of lymphocytes which will produce proteins called perforins that create pores on plasma membrane of tumour cells and virally infected cells through which ECF enters and kill the cells.
    Passive immunity is specific and is a branch of humoral immunity.
    Innate immunity does not produce memory cells hence, no secondary immune response is seen.
55. (d) Colostrum, as a thin yellowish milk, is the first secretion for a few days after childbirth. Colostrum serves as an immune system enhancer to the new born infants. It contains immune cells, high protein and protective antibody (such as IgA) content. IgA help protect the mucous membranes in the throat, lungs, and intestines of the infant.
56. (d) Transplant rejection occurs when transplanted tissue is rejected by the recipient's immune system, which destroys the transplanted tissue. The body is able to differentiate self and nonself and the cell-mediated response, which is responsible for graft rejection.

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NOTES

Immunosuppressant plays an essential role during organ transplantation as they are used to prevent the body from either recognition or attacking the foreign organ via various immune responses.

57. (a) Cell mediated immune response causes non-acceptance or rejection of graft or transplanted tissues/organs.
    Transplant rejection is caused primarily by a cell-mediated immune response to HLA antigens expressed on donor antigen-presenting cells (APCs) transferred along with the transplanted organ. Recognition of donor HLA antigens on the cells of the graft induces vigorous T cell proliferation in the recipient.

NOTES

B cells and anti-HLA antibodies have recently been shown to play an important role in both acute and chronic allograft rejection. The presence of CD20+ B cells and plasma cells infiltrating allograft has been found to correlate with irreversible acute rejection episodes.

58. (d) MALT or Mucosa Associated Lymphoid Tissue constitutes about 50 percent of the lymphoid tissue in human body. It is scattered along mucosal lining in the human body.

NOTES Mucosa-associated lymphoid tissue (MALT) is scattered along mucosal linings in the human body and constitutes the most extensive component of human lymphoid tissue. These surfaces protect the body from an enormous quantity and variety of antigens.

59. (c) An autoimmune disease is a pathological state arising from an abnormal immune response of the body to substances and tissues that are normally present in the body.

NOTES Like **OPV,** inactivated poliovirus vaccine contains three poliovirus **strains,** Mahoney type 1, MEF-1 (Middle East Forces) type 2 and Saukett type 3. The vaccine is administered via the injectable route.

60. (d) Oral Polio Vaccine consists of a mixture of attenuated (weakened) poliovirus strains of all three poliovirus types.

NOTES OPV consists of a mixture of live attenuated poliovirus strains of each of the three serotypes, selected by their ability to mimic the immune response following infection with wild polioviruses, but with a significantly reduced incidence of spreading to the central nervous system.

61. (b) Colostrum contains high levels of lgA, which gives passive immunity to foetus.

NOTES IgA antibodies protect body surfaces that are exposed to outside foreign substances. This type of antibody is also found in saliva, tears, and blood. About 10% to 15% of the antibodies present in the body are IgA antibodies.

62. (c) Serum globulins test provides confirmatory evidence measuring the deficiency of antibodies (γ-globulin) in a person.

NOTES The concentration of serum globulin is calculated by the difference between the total serum protein and the albumin values.

63. (a) Cell-mediated immune response is a system which is specialized for a particular person.

64. (d) T – lymphocytes mediates cell mediated immunity (CMI). It is one of the two types of acquired immunity responsible for graft or transplant rejection.

NOTES Type IV hypersensitivity is often called delayed type hypersensitivity as the reaction takes two to three days to develop after graft rejection.

65. (a) Polymorphonuclear leukocytes named so, as they have multilobed nucleus or neutrophils and monocytes are the cellular barrier provide innate or nonspecific immunity. Cellular barriers are the internal defence or second live of defence.

66. (a) Preformed antibodies need to be injected to treat the bite by a viper snake. It is also a type of immunization which is called as passive immunization.
Antibodies, produced by B-cells, are typically made of basic structural units—each with two large heavy chains and two small light chains. B cells differentiate into plasma cells that secrete antibodies. Antibodies are proteins that bind to specific antigens and mark them for destruction by, for example, marking them more recognizable to phagocytic cells. Rejection of a kidney graft is not a function of B lymphocyte.

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67. (d) Skin has a metabolic function to prevent non- resident bacteria from developing.

68. (a) B and T-lymphocytes produce antibodies against pathogen in the body, if due to some reason B and T lymphocytes are damaged the body will not produce antibodies against a pathogen. Each B cell and T cell is specific for a particular antigen.

69. (c) Tetanus toxoid is a vaccine consisting of growth products of *Clostridium tetani* treated with formaldehyde serving as an active immunising agent. Hence it is weakened germs. The first tetanus toxoid (inactivated toxin) was produced in 1924 and was used successfully to prevent tetanus in the armed services during World War II. In the mid-1940s, tetanus vaccine was combined with diphtheria toxoid and inactivated pertussis vaccine to make the combination DTP vaccine for routine childhood immunization.

70. (c) The letter T in T-lymphocyte refers to thymus. In human anatomy, the thymus is an organ located in the upper anterior portion of the chest cavity just behind the sternum. The thymus gland is a pink-grey organ that lies underneath the top of the breast bone.
71. (d) The use of anti-histamines and steroids gives a quick relief from headache. Antihistamines are drugs that block the action of histamine (a compound released in allergic inflammatory reactions) at the H_1 receptor sites, responsible for immediate hypersensitivity reactions such as sneezing and itching.
72. (c) The saliva in the mouth and the tears from the eyes belongs to physiological barriers.
73. (a) Serum globulins →It makes 2 to 3% of plasma proteins. The α and β - globulin sent with the hormones to transport them the γ–globulin from antibodies.
74. (b) Pollen–grains of many species are responsible for some of the severe allergies and bronchial affliction in some people often lead to chronic respiratory disorders - asthma, bronchitis.
75. (c) Whenever our body gets attacked by some foreign invadors, our body's immune system produces some chemicals to kill or to react against the invader. These chemicals are actually made up of carbohydrates and proteins *i.e.* glycoproteins called antibody.
76. (a) AIDS is characterized by reduction in the number of helper T- lymphocytes because of HIV infection. It suppresses human immune system due to which any secondary infection may lead to death. T-lymphocytes are main cells of immune system.
77. (d) The thymus is a major gland of our immune system. The thymus is responsible for production of T (thymus dervied) lymphocytes from immature lymphocytes, a type of white blood cells responsible for cell mediated immunity. Cell mediated immunity is extremely important for raising immune response against bacteria, yeast, fungi, parasites and virus. It is also critical in protecting against cancer, autoimmune disorders like rheumatoid arthritis, allergies etc.
78. (c) Passive immunity.
79. (c) The lymphocytes which differentiate in the thymus are known as the T-lymphocytes. T-lymphocytes are responsible for the cellular immune response.
80. (a) Asbestos fibres present in atmosphere due to industrial emission cause lung cancers (asbestosis).
81. (c) Interferons are virus induced proteins produced by cells infected with virus.
82. (c) Lipoproteins are conjugated proteins having polypeptides in association with lipids. Immunoglobulins are the constituent of antibodies. Inteferons (INFs) are a group of three vertebrate glycoproteins (i.e. α, β, γ,) Out of these three α & β are produced within virally infected cells.
Interferon induces among adjacent cells, as antiviral state by inducing synthesis of the enzymes which inhibit the viral production cycle.
83. (a) Vaccine contains dead, attenuated form or antigen of a pathogen which can be injected to provide immunity towards that pathogen. Monoclonal antibodies are homogenous immunological reagents of defined specificity, so that these can be utilized for diagnosis and screening with certainty.
84. (a) Antibodies bind to specific antigens to produce large insoluble complexes which render them harmless and facilitate their destruction by other cells of the immune system this process is called agglutination.
85. (c) Antibodies are specific proteins synthesized by the host in response to an antigen. All antibody molecules are immunoglobulins.
86. (b) Interferons are produced in response to viral infections. Typhoid and tetanus are bacterial diseases. Malaria is caused by a protozoan. Measles is a viral disease.
87. (a) Allergy means all kinds of unwanted reactions manifested in the body due to hypersensitivity of substances called allergens. Allergy reactions occur due to liberation of histamine by tissue cells.
88. (a) Interferons are virus induced proteins produced by cells infected with viruses. They are antiviral in action.

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89. (a) Robert Koch is associated with Koch's postulates that help in determining whether a given micro-organism is pathogenic or not. Louis pasteur experimentally proved that all life originated from pre-existing life. Emil Von Behring was a German physiologist who received the 1901 Nobel Prize in physiology or medicine.

90. (c) Hay fever is due to some fungal spores sensitivity, which is an allergic disease with symptoms of bronchial asthma and skin rash and also with increase in eosinophil (white cells) of blood.

91. (c) A special defence system works specially against viral infection. It has no effect on micro-organism. Cells invaded by a virus produce an antiviral protein called interferon (IFN). The latter is released from the infected cell and on reaching the nearby non-infected cells it makes them resistant to the virus infection.

92. (b) The major obstacle in transplantation of organs is that the recipient body does not accept the donor's organ. The body defence mechanism reject and treat the transplanted organ as a foreign particle and reacts actively.

93. (b) Lymphocytes are the part of specific defence system called immune system.

94. (d) Telomerase production is increased in cancer. Telomerase has been examined in hundreds of studies as a potentially sensitive biomarker for screening, early cancer detection, prognosis or in monitoring as an indication of residual disease.

The enzyme telomerase adds TTAGGG repeats onto mammalian telomeres, which prevents their shortening. The activation of telomerase in malignant cancers seems to be an important step in tumorigenesis, whereby the cell gains the ability of indefinite proliferation to become immortal.

NOTES

Telomeres represent ends of all eukaryotic chromosomes and serve specialized biological role in maintaining genomic integrity by preventing end fusions and degradation. Various protein complexes associate with telomeres to either protect them from DNA damage machinery or maintain telomere length homeostasis.

95. (b) After infection, HIV starts to destroy the T-cells (T-helper lymphocytes). T cells are very important for the immune system. In the early stage of infection, the decline in numbers of T cells is observed.

NOTES

Immunosuppression is caused due to HIV infection is a resultant of several factors including defective innate signalling pathways, increased viral replication and virus load, gradual loss of peripheral CD4+ T cells and depletion of T lymphocytes at mucosal sites that collectively lead to progressive immune deficiency results in AIDS.

96. (b) The virus of chikunguniya is *Arbovirus* transmitted by *Aedes* mosquito. In this disease the patient feels fever lasting 2-7 days.

97. (c) HIV infection does usually show symptoms of AIDS When HIV damages large number of helper T-Lymphocytes (CD4 cells). AIDS is the stage of HIV infection that occurs when one immune system is badly damaged and one become vulnerable to infections and infection-related cancers called opportunistic infections. When the number of ones CD4 cells falls below 200 cells per cubic millimetre of blood (200 cells/mm3), one is considered to have progressed to AIDS.

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98. (d) Contact inhibition is a property of normal cell not of cancer cells. Due to this property they remain in contact with other cells inhibit their growth.

99. (c) UAG is also a stop codon. Wombats are also Australian marsupials. They are short-legged, muscular quadrupeds, approximately 1 metre (40 in) in length with a short, stubby tail. Diphtheria is an acute infectious disease caused by the bacteria *Corynebacterium diphtheriae*. Cuscuta, or Dodder plant, is not a protozoan. It is a parasitic vine that wraps around other plants for nourishment.

100. (c) When HIV replicates rapidly in helper T-lymphocytes and damages large number of these cells, at this stage infected persons start showing symptoms of AIDS.

101. (a) ELISA is an fundamental tool of clinical immunology and is used as an initial screen for HIV detection.

102. (d) AIDS (Acquired Immune Deficiency Syndrome) is caused by HIV retrovirus. The virus destroys the helper T lymphocytes thus reducing their numbers.
103. (a) Common Cold, AIDS is a pair of viral diseases. Viruses are a very common type of infectious disease. Viruses are the smallest life-form existing, since they are not even a single cell. It is almost like they are not alive at all. They are small strands of DNA-like cell material. A virus consists mostly of RNA and cannot survive without host cells.
104. (c) Malignant tumours may exhibit metastasis. Cancer (medical term: malignant neoplasm) is a class of diseases in which a group of cells display uncontrolled growth (division beyond the normal limits), invasion (intrusion on and destruction of adjacent tissues), and sometimes metastasis spread to other locations in the body via lymph or blood.
105. (d) AIDS virus infects T_4 lymphocytes (also called Helper cells). Cytotoxic T cells called T_8 lymphocytes.
106. (a) Retroviruses have RNA as the genetic material and hence they exhibit reverse transcription whereby DNA is synthesized on RNA template. They have reverse transcriptase as the enzyme.
107. (c) ELISA test is a technique used to detect and quantitate extremely small amount of a protein, antibody or antigen with the help of enzyme. The commonly used enzymes are peroxidase and alkaline phosphatase. Southern blotting and DNA probes are used in molecular analysis of DNA. Catalase is not involved in ELISA.
108. (b) Malignant cancer is caused by loss of control over cell's reproduction capacity. The cells undergo rapid division. Therefore, they are more easily damaged by radiations than normal cells.
109. (c) Carcinomas are malignant growths of the epithelial tissue that cover or line body organs.
110. (b) ELISA test is a technique which can detect any amount of an antibody or antigen with the help of an enzyme. The commonly used enzymes are alkaline phosphatase and peroxidase.
111. (a) The ability of radiations to kill cells is highest in the tissue with the highest number of dividing cells. Tumour cells proliferate rapidly. Hence, tumours are killed more rapidly by radiations.
112. (c) HIV is a spherical, enveloped virus of about 90-120 nm diameter. Its nucleocapsid is icosahedral and its genome consists of **a single-stranded RNA** filament segmented into two identical filaments and associated with a **"reverse transcriptase enzyme".**
113. (b) Myeloma is a type of cancer associated with abnormal production of irregular antibodies. It occurs in antibody producing cells that have lost their normal control.
Hybridomas are clones of hybrid cell resulting from fusion of normal antibody producing B-cells with myeloma cells.
114. (b) Cancer is initiated when the inactive protooncogenes are activated to cellular oncogenes which trigger uncontrolled cell multiplication.
115. (b) Sarcoma is a cancer of the connective or supportive tissue (bone, cartilage, fat, muscle, blood vessels) and soft tissue.The term comes from a Greek word meaning 'fleshy growth'. Bone tumors are also called sarcomas, but are in a separate category because they have different clinical and microscopic characteristics and are treated differently. Osteogenic sarcoma or osteosarcoma is one of the most common childhood bone cancers. Soft tissue sarcomas are more common in adults than in children.
In all, sarcomas constitute fewer than 1% of all cancers. Its treatment is made more difficult with the existence of more than 70 varieties. Gastrointestinal stromal tumor (GIST) is the most common form of sarcoma, with approximately 3000-3500 cases per year in the United States.
116. (d) Coca alkaloids or cocaine is obtained from, *Erythroxylum coca*, a native to South America.

NOTES

Cocaine, also known as coke, is a strong stimulant most frequently used as a recreational drug. It is commonly snorted, inhaled as smoke, or dissolved and injected into a vein. Mental effects may include loss of contact with reality, an intense feeling of happiness, or agitation.

117. (b) Heroin is synthesised by acetylation of morphine.
Heroin, commonly called smack and is chemically diacetylmorphine is made from the resin of poppy (*Papaver somniferum*) plants. Milky, sap-like opium is first removed from the pod of the poppy flower. This opium is refined to make morphine, then further refined into different forms of heroin. The synthesis of heroin is a simple one step acetylation reaction, and typically is performed by the addition of a large excess of acetic anhydride directly to

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morphine followed by heating the resulting solution to, or near, boiling. Generally the final product is isolated by treating the cooled reaction mixture with sodium carbonate and collecting the heroin base by filtration.

118. (b) 'Smack' also called as brown sugar/ Heroin is formed by acetylation of morphine. It is obtained from the latex of unripe capsule of Poppy plant (*Papaver somniferum*).

119. (a) The plant illustrated in diagram is *Datura* which has hallucinogenic properties. Hallucinogen is a substance that produces psychological effects normally associated only with dreams, schizophrenia, or religious visions. It produces changes in perception (ranging from distortions in what is sensed to perceptions of objects where there are none), thought, and feeling.

120. (d) Hallucinogens are drugs that cause illusions and delusions (hallucinations) and change the feelings or perception. Examples are Bhang, Charas, Hashish, Marijuana (all cannabinoids) and LSD (Lysergic acid diethylamide). Opium and morphine are opiate narcotics (opioids) having analgesic (pain relieving effect) while caffeine is a stimulant that increase the activity of nervous system, and cause awakening.

121. (b) Long term intake of alcohol causes damage to liver which is known as cirrhosis of liver with continued alcohol intake, there is destruction of hepatocytes and fibroblasts (cell which form fibres) and stimulation of collagean protein formation.

NOTES

Cirrhosis is a complication of liver disease that involves loss of liver cells and irreversible scarring of the liver. Alcohol consumption and viral hepatitis B and C are common cause of cirrhosis.

122. (d) Molecule (a) represents structure of morphine. Morphine is the most abundant alkaloid found in opium, the dried sap (latex) derived from shallowly slicing the unripe seedpods of the opium, or common and/or edible, poppy-*Papaver somniferum*. Morphine is a potent opiate analgesic drug that is used to relieve severe pain.

123. (b) Morphine is potent opioid analgesic that is often given to persons (who have undergone surgery) as a pain killer. It is mainly used to relieve severe and persistent pain. It is administrated by mouth, injection or suppositories.

124. (a) Hashish causes after thought perceptions and hallucinations. Hashish is a preparation of *Cannabis* composed of the compressed trichomes collected from the *Cannabis* plant. Psychoactive effects vary between types of Hashish but are usually the same as those of other *Cannabis* preparations such as marijuana. Hashish is generally prohibited to the same extent as all other forms of cannabis. It is consumed in much the same way as *Cannabis* buds, used by itself in miniature smoking pipes, vapourized, hot knifed, or smoked in joints mixed with tobacco, *Cannabis* buds or other herbs.

125. (a) In Borderline Personality Disorder (BPD) a person suffers from emotionally unstable personality, unpredictable moods, highly reactive, anxeity and irritability. While in Schizophrenia a person suffers from distorted thoughts, he/she shows some extreme responses, sometimes auditory hallucinations.

126. (b) Amphetamines bring about increased alertness and sleeplessness. Hashish is a hallucinogen. Valium is a tranquilizer. Valium depresses brain activity and produces feeling of calmness, relaxation and drowsiness. Morphine is an opiate narcotic.

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127. (a) Morphine is an opiate narcotic, Bhang is a hallucinogen, Reserpine derived form *Rauwolfia,* is used as tranquilizer, Cocaine is a stimulant.

128. (a) LSD or (Lysergic acid diethylamide) is an extract of ergot of fungus *Claviceps purpurea*. It is most powerful hallucinogen which causes horrible dreams, chronic psychosis etc.

129. (b) Opiate Narcotics are opium and its derivatives which suppress brain activity and relieve pain. Also called pain killers. These are extracted from unripe capsules of poppy plant (*Papaver somniferum*). eg. Morphine, Heroine.

130. (b) Tranquillizers bring about depression of brain activity and feeling of calmness. Stimulants stimulate the nervous system, and increase alertness and activity. Hallucinogens (*Cannabis* products) alters thoughts, perceptions and feelings.

131. (b) *Rauwolfia serpentina* belong to family *Apocynaceae*, its roots yield a chemical useful for high blood pressure.

132. (d) Sarpgandha botanically known as *Rauwolfia serpentina* belongs to family Apocyanceae. Its tuberous roots are used as medicines. Ajmalicin is isolated from Sarpgandha.

133. (c) Heroin is an opiate narcotic (opium derivative) Chemically it is diacetylmorphine.

134. (b) Analgesic drugs relieve pain eg. Ibrufen.

31 Strategies for Enhancement in Food Production

Trend Analysis with Important Topics & Sub-Topics

		2020		2019		2018		2017		2016	
Topic	Sub-Topics	Qns.	LOD	Qns.	LOD	Qns.	LOD	Qns.	LOD	Qns.	LOD
Animal Husbandry	Inbreeding			1	E			1	A		
	Cross-breeding	1	A								
Plant Breeding	Farming									1	A

LOD - Level of Difficulty | E - Easy | A - Average | D - Difficult | Qns - No. of Questions

Topic 1: Animal Husbandry

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1. By which method was a new breed 'Hisardale' of sheep formed by using Bikaneri ewes and Marino rams? *[2020]*
   (a) Mutational breeding (b) Cross breeding
   (c) Inbreeding (d) Out crossing
2. Select the incorrect statement regarding inbreeding. *[2019]*
   (a) Inbreeding depression cannot be overcome by out-crossing.
   (b) Inbreeding helps in elimination of deleterious alleles from the population.
   (c) Inbreeding is necessary to evolve a pure line in any animal.
   (d) Continued inbreeding reduces fertility and leads to inbreeding depression.
3. Select the **incorrect** statement. *[2019]*
   (a) Inbreeding increases homozygosity.
   (b) Inbreeding is essential to evolve purelines in any animal.
   (c) Inbreeding selects harmful recessive genes that reduce fertility and productivity.
   (d) Inbreeding helps in accumulation of superior genes and elimination of undesirable genes.
4. Homozygous purelines in cattle can be obtained by: *[2017]*
   (a) mating of unrelated individuals of same breed.
   (b) mating of individuals of different breed.
   (c) mating of individuals of different species.
   (d) mating of related individuals of same breed.
5. Outbreeding is an important strategy of animal husbandry because it : *[2015 RS]*
   (a) is useful in producing purelines of animals.
   (b) is useful in overcoming inbreeding depression.
   (c) exposes harmful recessive genes that are eliminated by selection.
   (d) helps in accumulation of superior genes.
6. Which one of the following pairs is mismatched? *[2007]*
   (a) *Apis indica* - honey
   (b) *Kenia lacca* - lac
   (c) *Bombyx mori* - silk
   (d) *Pila globosa* - pearl
7. Compared to a bull a bullock is docile because of *[2007]*
   (a) higher levels of cortisone
   (b) lower levels of blood testosterone
   (c) lower levels of adrenaline/noradrenaline in its blood
   (d) higher levels of thyroxine.
8. Which one of the following is a viral disease of poultry? *[2007]*
   (a) Coryza (b) New castle disease
   (c) Pasteurellosis (d) Salmonellosis.

9. Which one of the following is the most suitable medium for culture of *Drosophila melanogaster*? *[2006]*
(a) Agar agar (b) Ripe banana
(c) Cow dung (d) Moist bread

10. The world's highly prized wool yielding 'Pashmina' breed is *[2005]*
(a) goat
(b) sheep
(c) goat-sheep cross
(d) Kashmir sheep-Afghan sheep cross

11. Which endangered animal is the source of world's finest, lightest, warmest and most expensive wool the shahtoosh ? *[2003]*
(a) Chiru (b) Nilgai
(c) Cheetal (d) Kashmiri goat

12. In Lederberg's replica experiment what shall be used to obtain streptomycin-resistant strain? *[2001]*
(a) minimal medium and streptomycin
(b) complete medium and streptomycin
(c) only minimal medium
(d) only complete medium

13. Which one of the following statement is correct in relation to honey bees? *[2000]*
(a) *Apis indica* is the largest wild honey bee in India
(b) Honey is predominantly sucrose and arabinose
(c) Beewax is a waste product of honey bees
(d) Communication in honey bees was discovered by Karl Von Frisch

14. The worker honey bee normally lives for about
(a) 15 days (b) 30 days *[1999]*
(c) 90 days (d) 10 days

15. Which of the following has been recently used for increasing productivity of super milk cows? *[1997]*
(a) Artificial insemination by a pedigreed bull only
(b) Superovulation of a high production cow only
(c) Embryo transplantation only
(d) A combination of superovulation, artificial insemination and embryo transplantation into a 'carrier cow' (surrogate mother)

16. In the silk worm, if no juvenile hormone (JH) is present when it moults, it will *[1997]*
(a) die
(b) moult into another larval stage
(c) moult into pupa
(d) moult into an adult

17. Honey is *[1997]*
(a) acidic
(b) alkaline
(c) neutral
(d) acidic when fresh and alkaline when old

18. Pasteurization of milk involve heating for
(a) 60 minutes at about 90ºC *[1996]*
(b) 30 minutes at about 50ºC
(c) 30 minutes at about 65ºC
(d) 60 minutes at 100ºC

19. The earliest animal to have been domesticated by man was most likely the *[1996]*
(a) horse (b) cow
(c) dog (d) pig

20. Which one of the following is an exotic Indian fish ? *[1996]*
(a) *Catla catla*
(b) *Heteropneustes fossilis*
(c) *Cyprinus carpio*
(d) *Labeo rohita*

21. The silkworm silk is the product of *[1995]*
(a) cuticle of the larva
(b) cuticle of the adult
(c) salivary gland of the larva
(d) salivary gland of the adult

22. The process of mating between closely related individuals is *[1994]*
(a) self breeding (b) inbreeding
(c) hybridisation (d) heterosis

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Topic 2: Plant Breeding

23. Match Column-I with Column-II. *[2019]*

Column-I	Column-II
(A) Saprophyte	(i) Symbiotic association of fungi with plant roots
(B) Parasite	(ii) Decomposition of dead organic materials
(C) Lichens	(iii) Living on living plants or animals
(D) Mycorrhiza	(iv) Symbiotic association of algae and fungi

Choose the correct answer from the options given below:

	(A)	(B)	(C)	(D)
(a)	(i)	(ii)	(iii)	(iv)
(b)	(iii)	(ii)	(i)	(iv)
(c)	(ii)	(i)	(iii)	(iv)
(d)	(ii)	(iii)	(iv)	(i)

24. A system of rotating crops with legume or grass pasture to improve soil structure and fertility is called ***[2016]***
(a) Ley farming (b) Contour farming
(c) Strip farming (d) Shifting agriculture

25. Which part of the tobacco plant is infected by *Meloidogyne incognita* ? ***[2016]***
(a) Flower (b) Leaf
(c) Stem (d) Root

26. In plant breeding programmes, the entire collection (of plants/seeds) having all the diverse alleles for all genes in a given crop is called: ***[NEET 2013]***
(a) cross-hybridisation among the selected parents.
(b) evaluation and selection of parents.
(c) germplasm collection
(d) selection of superior recombinants.

27. Green revolution in India occurred during
(a) 1960.s (b) 1970.s ***[2012M]***
(c) 1980.s (d) 1950.s

28. Jaya and Ratna developed for green revolution in India are the varieties of ***[2011]***
(a) maize (b) rice
(c) wheat (d) bajra

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29. Himgiri developed by hybridisation and selection for disease resistance against rust pathogens is a variety of ***[2011]***
(a) chilli (b) maize
(c) sugarcane (d) wheat

30. Breeding of crops with high levels of minerals, vitamins and proteins is called ***[2010]***
(a) Somatic hybridisation
(b) Biofortification
(c) Biomagnification
(d) Micropropagation

31. An improved variety of transgenic basmati rice ***[2010]***
(a) does not require chemical fertilizers and growth hormones
(b) gives high yield and is rich in vitamin A
(c) is completely resistant to all insect pests and diseases of paddy
(d) gives high yield but has no characteristic aroma

32. Which of the following is **not** used as a biopesticide ? ***[2009]***
(a) *Trichoderma harzianum*
(b) Nuclear Polyhedrosis Virus (NPV)
(c) *Xanthomonas campestris*
(d) *Bacillus thuringiensis*

33. Which of the following plant species you would select for the production of bioethanol? ***[2009]***
(a) *Zea mays* (b) *Pongamia*
(c) *Jatropha* (d) *Brassica*

34. Which one of the following is being tried in India as a biofuel substitute for fossil fuels? ***[2008]***
(a) *Jatropha* (b) *Azadirachta*
(c) *Musa* (d) *Aegilops*

35. Consider the following four measures (a-d) that could be taken to successfully grow chickpea in an area where bacterial blight disease is common ***[2008]***
(1) Spray with Bordeaux mixture
(2) Control of the insect vector of the disease pathogen
(3) Use of only disease-free seeds
(4) Use of varieties resistant to the disease
Which two of the above measures can control the disease?
(a) 2 and 3 (b) 1 and 2
(c) 3 and 4 (d) 1 and 4

36. Which one of the following proved effective for biological control of nematodal disease in plants? ***[2008]***
(a) *Pisolithus tinctorius*
(b) *Pseudomonas cepacia*
(c) *Gliocladium virens*
(d) *Paecilomyces lilacinus*

37. Which one of the following is being utilized as a source of biodiesel in the Indian countryside? ***[2007]***
(a) Beetroot (b) Sugarcane
(c) *Pongamia* (d) *Euphorbia*

38. In maize, hybrid vigour is exploited by ***[2006, 2007]***
(a) crossing of two inbred parental lines
(b) harvesting seeds from the most productive plants
(c) inducing mutations
(d) bombarding the seeds with DNA.

39. Crop plants grown in monoculture are ***[2006]***
(a) free from intraspecific competition
(b) characterised by poor root system
(c) highly prone to pests
(d) low in yield

40. Farmers in a particular region were concerned that pre-mature yellowing of leaves of a pulse crop might cause decrease in the yield. Which treatment could be most beneficial to obtain maximum seed yield ? *[2006]*
(a) Treatment of the plants with cytokinins along with a small dose of nitrogenous fertilizer
(b) Removal of all yellow leaves and spraying the remaining green leaves with 2, 4, 5-trichlorophenoxy acetic acid
(c) Application of iron and magnesium to promote synthesis of chlorophyll
(d) Frequent irrigation of the crop

41. *Triticale,* the first man-made cereal crop, has been obtained by crossing wheat with *[2006]*
(a) pearl millet (b) sugarcane
(c) barley (d) rye

42. Curing of tea leaves is brought about by the activity of *[2006]*
(a) mycorrhiza (b) viruses
(c) fungi (d) bacteria

43. Parthenocarpic tomato fruits can be produced by *[2006]*
(a) treating the plants with low concentrations of gibberellic acid and auxins
(b) raising the plants from vernalized seeds
(c) treating the plants with phenylmercuric acetate
(d) removing androecium of flowers before pollen grains are released

44. Three crops that contribute maximum to global food grain production are *[2005]*
(a) Wheat, rice and maize
(b) Wheat, rice and barley
(c) Wheat, maize and sorghum
(d) Rice, maize and sorghum

45. India's wheat yield revolution in the 1960s was possible primarily due to *[2004]*
(a) hybrid seeds
(b) increased chlorophyll content
(c) mutations resulting in plant height reduction
(d) quantitative trait mutations

46. The most likely reason for the development of resistance against pesticides in insects damaging a crop is *[2004]*
(a) random mutations
(b) genetic recombination
(c) directed mutations
(d) acquired heritable chages

47. Which of the following plants are used as green manure in crop fields and in sandy soils? *[2003]*
(a) *Dichanthium annulatum* and *Azolla nilotica*
(b) *Crotalaria juncea* and *Alhagi camelorum*
(c) *Calotropis procera* and *Phyllanthus niruri*
(d) *Saccharum munja* and *Lantana camara*

48. Which of the following crops have been brought to India from New world? *[2002]*
(a) Cashewnut, potato, rubber
(b) Mango, tea
(c) Tea, rubber, mango
(d) Coffee

49. Reason of fast speciation in present day crop plants is *[2002]*
(a) mutation
(b) isolation
(c) polyploidy
(d) sexual reproduction

50. What is the best pH of soil for cultivation of plants? *[2001]*
(a) 3.4 – 5.4 (b) 6.5 – 7.5
(c) 4.5 – 8.5 (d) 5.6 – 6.5

51. Before European invader which vegetable was absent in India? *[2001]*
(a) Potato and Tomato
(b) Simla mirch and Brinjal
(c) Maize and Chichinda
(d) Brinjal and Lady's finger

52. Which statement is correct about centre of origin of plant? *[2001]*
(a) More diversity in improved varieties
(b) Frequency of dominant gene is more
(c) Climatic conditions more favourable
(d) None of these

53. *Triticale* has been evolved by intergeneric hybridization between *[2001]*
(a) wheat and rye (b) wheat and rice
(c) rice and maize (d) wheat and *Aegilops*

54. Which one of the following insecticides is more stable in the environment? *[1999]*
(a) DDT (b) Diazinon
(c) Camphechlor (d) Malathion

55. The first transgenic crop was *[1999]*
(a) pea (b) flax
(c) tobacco (d) cotton

56. The new varieties of plants are produced by
(a) selection and hybridization *[1999]*
(b) mutation and selection
(c) introduction and mutation
(d) selection and intro

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57. Exponential growth of cells is a characteristic feature of *[1999]*
    (a) tissue culture cells
    (b) multicellular organisms
    (c) unicellular organisms
    (d) embryo
58. Lathyrism which is caused by consumption of Khesari dal is a disease characterised by *[1998]*
    (a) reproductive failure, susceptibility to diabetes mellitus and skeletal abnormalities
    (b) retardation of body growth, precocious puberty and renal dysfunction
    (c) mental retardation, delay in the onset of puberty and cardiovascular abnormalities
    (d) gross skeletal deformation and thinning of collagen fibres and fibrils
59. Biological control component is central to advanced agricultural production. Which of the following is used as a third generation pesticide?
    (a) Insect repellants *[1998]*
    (b) Pheromones
    (c) Pathogens
    (d) Insect hormone analogues
60. Which of the following pesticides is an acetyl-cholinesterase inhibitor? *[1998]*
    (a) Y-BHC (b) Endosulfan
    (c) Malathion (d) Aldrin
61. Which one among the following chemicals is used for causing defoliation of forest trees?
    (a) Phosphon-D *[1998]*
    (b) Malic hydrazide
    (c) 2, 4-Dichlorophenoxy acetic acid
    (d) Amo-1618
62. What is Agent Orange? *[1998]*
    (a) Colour used in fluorescent lamps
    (b) A weedicide containing dioxin
    (c) A biodegradable insecticide
    (d) A hazardous chemical used in luminous paints
63. Of the world's top five crops in terms of annual production *[1997]*
    (a) all five belong to the family Poaceae (Gramineae)
    (b) four belong to Poaceae (Graminaeae) and one to Leguminosae
    (c) four belong to Poaceae (Gramineae) and one to Solanaceae
    (d) three belong to Poaceae (Gramineae), one to Leguminosae and one to Solanaceae.
64. The long-term prospects for a truly human civilization depend in a large measure on *[1996]*
    (a) the ability of humanity to moderate its fecundity
    (b) increasing the food production
    (c) colonization of underpopulated areas
    (d) control of human diseases
65. The rotenone is *[1995]*
    (a) an insect hormone
    (b) a bioherbicide
    (c) a natural herbicide
    (d) a natural insecticide
66. One of the major difficulties in the biological control of insect pests is the *[1995]*
    (a) practical difficulty of introducing the predator to specific areas
    (b) method is less effective as compared with the use of insecticides
    (c) predator does not always survive when transferred to a new environment
    (d) the predator develops a preference to other diets and may itself become a pest.
67. Reproducing new plants by cells instead of seeds is known as *[1995]*
    (a) mutation (b) tissue culture
    (c) antibiotics (d) biofertilizer
68. Haploid plant cultures are got from *[1994]*
    (a) leaves (b) root tip
    (c) pollen grain (d) buds
69. Most of our crop plants are *[1994]*
    (a) autopolyploid in origin
    (b) allopolyploid in origin
    (c) mixed genotypic in origin
    (d) heterozygous in origin
70. Which of the following plant cells will show totipotency? *[1993]*
    (a) Sieve tubes (b) Xylem vessels
    (c) Meristem (d) Cork cells
71. Which crop variety is not due to induced mutations ? *[1993]*
    (a) Reimei of Rice
    (b) Prabhat of Arhar
    (c) Sharbati Sonora of Wheat
    (d) Aruna of Castor

Topic 3: Single cell Proteins/Tissure Culture

72. Which of the following enhances or induces fusion of protoplasts ? *[2015 RS]*
    (a) Polyethylene glycol and sodium nitrate
    (b) IAA and kinetin
    (c) IAA and gibberellins
    (d) Sodium chloride and potassium chloride

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73. A technique of micropropagation is: *[2015 RS]*
(a) Somatic embryogenesis
(b) Protoplast fusion
(c) Embryo rescue
(d) Somatic hybridization

74. To obtain virus - free healthy plants from a diseased one by tissue culture technique, which part/parts of the diseased plant will be taken: *[2014]*
(a) Apical meristem only
(b) Palisade parenchyma
(c) Both apical and axillary meristems
(d) Epidermis only

75. Which of the following has maximum genetic diversity in India? *[NEET Kar. 2013]*
(a) Rice (b) Mango
(c) Wheat (d) Groundnut

76. Tissue culture technique can produce infinite number of new plants from a small parental tissue. The economic importance of the technique is in raising *[NEET Kar. 2013]*
(a) Variants through picking up somaclonal variations
(b) Genetically uniform population identical to the original parent
(c) Homozygous diploid plants
(d) Development of new species

77. Which part would be most suitable for raising virus-free plants for micropropagation? *[2012]*
(a) Bark (b) Vascular tissue
(c) Meristem (d) Node

78. Which one of the following is a case of wrong matching *[2012]*
(a) Somatic hybridization - Fusion of two diverse cells
(b) Vector DNA -Site for t-RNA synthesis.
(c) Micropropagation - *in vitro* production of plants in large numbers.
(d) Callus - Unorganised mass of cell produced in tissue culture

79. Consider the following four statements (A-D) and select the option which includes all the correct ones only. *[2012M]*
(1) Single cell *Spirulina* can produce large quantities of food rich in protein, minerals, vitamins etc.
(2) Body weight-wise the micro-organism *Methylophilus methylotrophus* may be able to produce several times more proteins than the cows per day.
(3) Common button mushrooms are a very rich source of vitamin C.
(4) A rice variety has been developed which is very rich in calcium.

Options:
(a) Statements (3), (4)
(b) Statements (1), (3) and (4)
(c) Statements (2), (3) and (4)
(d) Statements (1), (2)

80. Somaclones are obtained by *[2009]*
(a) plant breeding (b) irradiation
(c) genetic engineering (d) tissue culture

81. In order to obtain virus-free plants through tissue culture the best method is *[2006]*
(a) Embryo rescue (b) Anther culture
(c) Meristem culture (d) Protoplast culture

82. The technique of obtaining large number of plantlets by tissue culture method is called *[2004]*
(a) Plantlet culture (b) Organ culture
(c) Micropropagation (d) Macropropagation

83. Cellular totipotency is demonstrated by *[2003]*
(a) only bacterial cells
(b) only gymnosperm cells
(c) all plant cells
(d) all eukaryotic cells

84. In tissue culture medium, the embryoids formed from pollen grains is due to *[2002]*
(a) cellular totipotency
(b) organogenesis
(c) double fertilization
(d) test – tube culture

85. The reason why vegetatively reproducing crop plants are best suited for maintaining hybrid vigour is that *[1998]*
(a) once a desired hybrid has been produced there are few chances of losing it
(b) they have a longer life span
(c) they are more resistant to diseases
(d) they can be easily propagated

86. Haploid plant cultures are obtained from
(a) leaves (b) root tip *[1994]*
(c) pollen grains (d) buds

87. Haploid plants are preferred over diploids for mutation study because in haploids *[1993]*
(a) recessive mutation expresses immediately
(b) induction of mutations is easier
(c) culturing is easier
(d) dominant mutation expresses immediately

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88. Cellular totipotency was demonstrated by *[1991]*
(a) Theodore Schwann
(b) A.V. Leeuwenhoek
(c) F.C. Steward
(d) Robert Hooke

89. In crop improvement programme, haploids are important because they *[1989]*
(a) require one half of nutrients
(b) are helpful in study of meiosis
(c) grow better under adverse conditions
(d) form perfect homozygous

ANSWER KEY

1	(b)	10	(a)	19	(c)	28	(b)	37	(c)	46	(a)	55	(c)	64	(d)	73	(a)	82	(c)
2	(a)	11	(a)	20	(c)	29	(d)	38	(a)	47	(b)	56	(a)	65	(d)	74	(c)	83	(c)
3	(c)	12	(b)	21	(c)	30	(b)	39	(c)	48	(a)	57	(a)	66	(d)	75	(a)	84	(a)
4	(d)	13	(d)	22	(b)	31	(b)	40	(c)	49	(c)	58	(d)	67	(b)	76	(b)	85	(a)
5	(b)	14	(c)	23	(d)	32	(c)	41	(d)	50	(b)	59	(b)	68	(c)	77	(c)	86	(c)
6	(d)	15	(d)	24	(a)	33	(c)	42	(d)	51	(a)	60	(c)	69	(a)	78	(b)	87	(a)
7	(b)	16	(b)	25	(d)	34	(a)	43	(a)	52	(b)	61	(c)	70	(c)	79	(d)	88	(c)
8	(b)	17	(a)	26	(c)	35	(c)	44	(a)	53	(a)	62	(b)	71	(d)	80	(d)	89	(d)
9	(b)	18	(c)	27	(a)	36	(d)	45	(c)	54	(a)	63	(c)	72	(a)	81	(c)		

Hints & Solutions

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1. (b) Hisardale is a new breed of sheep developed in Punjab by crossing Bikaneri-ewe and Marino rams.
In cross-breeding, superior male of one breed are mated with superior females of another breed.

NOTES
India is the largest producers of milk in the world as there are 40 well defined breeds of cows and 13 well defined breeds of buffaloes are found in India.

2. (a) Inbreeding depression, the reduction of fitness caused by inbreeding, is a universal phenomenon that depends on past mutation, selection, and genetic drift. Inbreeding depression can be overcome by the following ways:
- Out breeding: The breeding of animals which are unrelated to each other and do not have come ancestors for 4-6 generations.
- Out crossing: Mating done with the animals of same breed but after 4-6 generations.
- Cross breeding: Superior male mated with superior female of another breed.
- Interspecific hybridisations: Male and female animal of two different related species.

NOTES
Inbreeding depression is the reduced biological fitness in a given population as a result of inbreeding, or breeding of related individuals. Population biological fitness refers to an organism's ability to survive and perpetuate its genetic material. Signs of inbreeding depression:
- Reduced fertility both in litter size and sperm viability.
- Increased genetic disorders.
- Fluctuating facial asymmetry.
- Lower birth rate.
- Higher infant mortality and child mortality.
- Smaller adult size.
- Loss of immune system function.
- Increased cardiovascular risks.

3. (c) Inbreeding exposes harmful recessive genes that are eliminated by selection. It also helps in accumulation of superior genes and elimination of less desirable genes. Therefore this is selection at each step & which increase the productivity of inbred population. Close and continued inbreeding usually reduces fertility and even productivity.

4. (d) Inbreeding increases homozygosity. So, mating of the related individuals of same breed will give homozygous purelines.

NOTES By inbreeding, individuals are further decreasing genetic variation by increasing homozygosity in the genomes of their offspring. The likelihood of deleterious recessive alleles to pair is significantly higher in a small inbreeding population than in a larger inbreeding population.

5. (b) Outbreeding is useful in the problem of inbreeding depression.

NOTES Out-breeding is the breeding of the unrelated animals, which may be between individuals of the same breed (but having no common ancestors), or between different breeds (cross-breeding) or different species (inter-specific hybridisation).

6. (d) From *Pinctada vulgaris*, pearl is obtained.

NOTES Pearls are made by marine oysters and freshwater mussels as a natural defence against an irritant such as a parasite entering their shell or damage to their fragile body. This creates a material called nacre, also known as mother-of-pearl, which encases the irritant and protects the mollusc from it.

7. (b) A bullock is docile (less aggressive animal which is easy to handle) because it has degenerated testes due to which it has low testosterone levels in blood.

NOTES Testosterone is a sex hormone and principle androgen secreted in males by testes. It stimulates the development of secondary sex organs, sexual characters and body tissues like muscles.

8. (b) New castle disease (ND) is a highly contagious, generalised viral disease of domestic poultry and wild birds characterised by gastro-intestinal, respiratory and nervous signs.

NOTES New castle disease is caused by the virus belongs to Paramyxoviruses.

9. (b) The most suitable culture medium for *Drosophila melanogaster* is ripe banana.
Drosophila melanogaster is commonly called as fruitfly and is often used in genetic and developmental biology researches. Moist bread is a culture medium for the fungus *Rhizopus* while Agar-agar is used as a tissue culture medium.

NOTES Ripe banana contains all essential nutrients such as carbohydrates, minerals and vitamins that are required for the growth of *Drosophila melanogester*.

10. (a) The world's highly prized wool yielding Pashmina breed is the under fur of Kashmiri and Tibetan goats.
Pashmina is an almost generic name for accessories made from a type of mohair that is obtained from a special breed of goat indigenous to high altitudes of the Himalayan Range Belt of Asia.

NOTES The name comes from *Pashmineh*, made from Persian *pashm* (= "wool"). The special goat's fleece has been used for thousands of years to make high-quality shawls that also bear the same name.

11. (a) Chiru is the source of world's finest, lightest, warmest and most expensive wool the shahtoosh. Chiru (also known as Tibetan antelope) are the mammals that live in the Tibetan plateau in Asia. People use their soft fine fur (called shahtoosh) to make shawls, causing chiru to become endangered as a result of hunting.

12. (b) This combination allows to select only streptomycin resistant strains and non resistant strains would die on medium containing antibiotic streptomycin.

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NOTES Replica plating is the technique by which each colony/clone is inoculated onto multiple plates according to a numbered scheme. This method allows each clone to be tested by a variety of methods, while retaining a master plate from which clones can be picked.

13. (d) Karl Von Frisch, carried out many experiments and determined that when a foraging bee returns to the hive, it performs a waggle dance. Honey is predominantly glucose and fructose. *Dorsata* is a bigger bee than *Apis indica* (a medium sized bee). Bees wax is secreted by special wax glands to make compartments.

14. (c) The worker honey bee normally lives for about 90 days.

NOTES The worker bee and the queen bee are both female, but only the queen bee can reproduce. All drones are male. Worker bees clean the hive, collecting pollen and nectar to feed the colony and they take care of the offspring. The drone's only job is to mate with the queen.

15. (d) In superovulation, a high milk yielding cow is induced to shed 4–6 eggs (instead

of one) every 6–8 weeks (instead of 20–21 days). The superovulated donor is artificially inseminated with semen from a quality bull. The embryos developing from the eggs so fertilised are flushed out. These good quality embryos are now transfered to surrogate mother for delivery.

NOTES

Artificial insemination (AI) is the process of collecting sperm cells from a male animal and manually depositing them into the reproductive tract of a female.

16. (b) The presence of juvenile hormone is necessary for metamorphosis to adult.

NOTES

Juvenile hormone (JH) was initially discovered in the 1930s as a factor that is secreted from the corpus allatum (CA) and inhibits insect metamorphosis. This hormone regulates the development, reproduction, diapause, and polyphenisms.

17. (a) The pH of honey ranges from 3.4 to 6.1, average being 3.9.
18. (c) Pasteurization of milk is a method of partial sterilization by heating milk at 60 – 70°C for 30 min.
19. (c) Dog was the first animal to be domesticated by man.
20. (c) *Catla catla* and *Labeo rohita* are the two Indian major carps whereas *Heteropneustes* is a catfish. *Cyprinus* is the exotic breed.
21. (c) The saliva from the salivary gland of silkworm is the component of silk and is produced by the larva of the silkworm (cocoon). The adult, which has a wingspan of about 2 in. (50 mm) and a thick, hairy body, lives only two or three days. The female lays 300–500 eggs. The pale, naked larvae fed on mulberry leaves until pupation begins, when they are about 3 in. (75 mm) long. They spin a cocoon of one continuous white or yellow silken thread, about 1,000 yards (900 m) long. The pupa is killed with hot air or steam to preserve the thread intact.

NOTES

The Chinese silkworm (B. mori) has been used in commercial silk production for centuries.

22. (b) Inbreeding leads to the expression of recessive characters, most of the time which are harmful.

NOTES

Heterosis refers to the phenomenon that progeny of diverse varieties of a species or crosses between species exhibit greater biomass, speed of development, and fertility than both parents.

23. (d) Saprophytes are organisms which live on dead organic matter and help in their decomposition.
Parasites is an organisms that live in or on other living plants and animals and dependent on them for their food.
Lichens represent a type of symbiotic association of algae and fungi, in which, both of them dependent on each other for their food and shelter.
Mycorrhiza is also a type of symbiotic association of fungi and plant roots, e.g., *Cycas* coralloid root.
24. (a) The growing of grass or legumes in rotation with grain or tilled crops as a soil conservation measure is called Ley farming.

NOTES

Strip cropping is a method of farming which involves cultivating a field partitioned into long, narrow strips which are alternated in a crop rotation system. It is used when a slope is too steep or when there is no alternative method of preventing soil erosion.

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25. (d) *Meloidogyne incognita* is a nematode (roundworm) in the family Heteroderidae. It is commonly called the "southern root-knot nematode" or the "cotton root-knot nematode".
26. (c) Germplasm collection is the first step of plant breeding programmes. As genetic variability is the root of any breeding programme. In many crops pre-existing genetic variability is available from wild relatives of the crop.

NOTES

Collection and preservation of all the different wild varieties, species and relatives of the cultivated species (followed by their characteristics) is a prerequisite for effective exploitation of natural genes available in the population. "Cross-hybridization" refers to the formation of double-stranded DNA, RNA, or DNA/RNA hybrids by complementary base pairing between two molecules that are not identical in sequence.

27. (a) Green revolution is the introduction of high-yielding varieties of seeds and the increased use of fertilizers and irrigation,

which provided the increase in production needed to make India self-sufficient in food grains, thus improving agriculture in India. Green revolution in India occurred in 1960.

NOTES

In 2000, maize hybrids that had twice the amount of the amino acids, lysine and tryptophan, compared to existing maize hybrids were developed. Wheat variety, Atlas 66, having high protein content, has been used as a donor for improving cultivated wheat.

28. (b) Jaya and Ratna are two rice varieties developed for green revolution in India.
    - The scientific name of Jaya is IET-723. This paddy variety takes about 130 days to grow and the grain is long, bold and white. Its yield is 50-60 quintals per hectare.
    - The scientific name of 'Ratna' is IET-1411. It takes about 130-135 days to grow. The grain is long, slender and white. Its yield is 45-50 quintal/hectare.
29. (d) 'Himgiri' developed by hybridisation and selection for disease resistance against rust pathogens is a variety of wheat. It is resistant to leaf/stripe rust and hill bunt.
30. (b) Breeding of crops with high levels of minerals, vitamin and minerals is called biofortification. This is most practical aspect to improve the health of people.
31. (b) An improved variety of transgenic basmati rice gives high yield and is rich in vitamin A.
32. (c) *Xanthomonas campestris* is not used as a biopesticide. *Xanthomonas campestris* is a plant pathogen that causes black rot in cotton plants.
33. (c) *Jatropha* is useful for production of bioethanol. *Jatropha* is a genus of approximately 175 succulent plants, shrubs and trees (some are deciduous, like *Jatropha curcas L.),* from the family Euphorbiaceae.The hardy *Jatropha* is resistant to drought and pests, and produces seeds containing 27-40% oil. Currently the oil from *Jatropha curcas* seeds is used for making biodiesel fuel in Philippines and in Brazil, where it grows naturally and in plantations in the southeast, and the north/northeast Brazil.

NOTES

Jatropha oil is being promoted as an easily grown biofuel crop in hundreds of projects throughout India and other developing countries.

34. (a) Jatropha is being tried in India as a biofuel substitute for fossil fuels. Biofuels are the fuels of biological origin. They constitute renewable form of energy.
    Energy problems can be solved upto a great extent by efficient and proper used of these biofuels.

NOTES

Biofuels are a renewable energy source, made from organic matter or wastes, that can play a valuable role in reducing carbon dioxide emissions. They are one of the largest sources of renewable energy in use today. In the transport sector, they are blended with existing fuels such as gasoline and diesel.

35. (c) Use of only disease free seeds and use of disease resistant varieties are the most important control measures that could be taken to successfully grow chickpea in an area where bacterial blight disease is common.
36. (d) *Paecilomyces* is a cosmopolitan filamentous fungus which inhabits the soil, decaying plants, and food products. Some species of *Paecilomyces* are isolated from insect. The telomorphs of *Paecilomyces* are classified in the genera *Cilromocleista*, *Talaromyces*. *Paecilomyces* is usually considered as a contaminant but may also cause infections in humans and animals.
37. (c) *Pongamia pinnata* is one of the few nitrogen fixing trees (NFTS) to produce seeds containing 30-40% oil. It is often planted as an ornamental and shade tree but now-a-days it is considered as alternative source for Bio- Diesel. This species is commonly called pongam, karanja, or a derivation of these names. *Pongami, Jatropha, Euphorbia* are petrocrops. However, in the Indian countryside, pongamia(kanjar) is being utilized as a source of biodiesel.
38. (a) Hybrid vigour is also called Hetorosis which is measured in terms of size growth rate / field and number of other characters. Hybridisation increases vigour and fertility. It is exploited by

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crosing of two in bred parental lines. It is best maintained in vegetatively reproducing crops because of genetic recombinations.

39. (c) Crop plants grown in monoculture are highly prone to pests.

40. (c) Because iron promotes the formation of chlorophyll and magnesium is an integral part of chlorophyll molecule so in the absence of these nutrients plants show chlorosis & leaves get yellow. Application of iron and magnesium to promote the synthesis of chlorophyll can cure the disease.

NOTES

The lack of iron is one of the more common nutrients associated with chlorosis. Manganese or zinc deficiencies in the plant will also cause chlorosis. The way to separate an iron deficiency from zinc or manganese deficiency is to check what foliage turned chlorotic first.

41. (d) *Triticale* is the Ist man made cereal which is made by the crossing of wheat (*Triticum aestivum*) and Rye (*Secale cereale*).

42. (d) For curing of tea, a bacteria *Micrococcus candicans* is used.
Curing of tea leaves is brought about by the activity of bacteria. It is essentially an oxidation, dry fermentation process, during which water is driven off the green colour is lost and the leaves assume a tougher texture and undergo chemical changes.
Mycorrhiza is a mutually beneficial association between fungi and the roots of higher plants. Virus and fungi are not involved in the curing process of tea leaves.

43. (a) Parthenocarpy is the development of fruits without prior fertilization which results in the formation of seedless fruits. In some plant species, parthenocarpic fruits are produced naturally or they may be induced by treatment of the unpollinated flowers with auxin.
Removal of androecium before pollen release is called emasculation which is helpful in preventing unwanted pollination.
Gibberellins and Auxins are known to induce parthenocarpy in plants. If a tomato plant is treated with a low concentration of auxin and gibberellic acid it'll produce fruits without fertilization i.e. parthenocarpic fruits.

NOTES

Vernalized seeds are treated at ion temperature for breaking dormancy. Phenyl Mercuric Acetate is an antitranspirant.

44. (a) Three crops that contribute maximum to global food grain production are Wheat, rice and maize, which belong to the family *Poaceae* (*Graminae*).

45. (c) Green revolution was possible due to hybridization. Increased chlorophyll extent has no effect on yield of crops. Hybrid plants were dwarf because of selection. Quantitative trait mutations are not involved in hybridization.

NOTES

In 1963, ICAR introduced many selections from CIMMYT include those developed by Norman Borlaug using Norin-10 as the source of dwarfing genes (CIMMYT-Centro International de Mejoramiento de Maiz Y Trigo).

46. (a) According to Darwin resistance to pesticides has a genetic basis due to presence of certain alleles. In the presence of pesticides, the insects devoid of the allele for resistance die while the ones having them survive. They are selected by nature.

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47. (b) *Crotolaria juncea* and *Alhagi camelorum* are among the plants which are used as green manures in India. These green manures help the soil through increasement of area and water holding capacities and fertility.

48. (a) Cashewnut, potato, rubber crops have been brought to India from New world.

49. (c) The phenomenon of having one or more genomes in addition to the normal for the species is called polyploidy.

NOTES

The gigas effect is often attributed to a larger volume of nuclear DNA causing increased cell size that result in an overall increase in organ size. Thus, polyploid plants often have larger flowers, leaves, pollen, seeds, and fruit, as well as more robust stems and an overall increase in plant size. Colchicine is a widely used mitotic inhibitor for the induction of polyploidy in plants during their cell division by inhibiting the chromosome segregation. It inhibits microtubule polymerization and thus assembly of the mitotic spindle.

50. (b) The best pH of soil for cultivation of plants is 6.5 – 7.5.

51. (a) Potato and tomato originated in the new world.

52. (b) Green manure comprises of a quick growing herbaceous crop. They are mixed with the soil to enrich the soil. They supply organic matter and also additional nitrogen.

53. (a) *Triticale* is a man made cereale produced by crossing two generate wheat (*Triticum*) and rye (*Secale*). Hexaploid *Triticale* was obtained by crossing *Triticum durum* and *Secale cereale*.

54. (a) DDT cannot be further metabolized into any stable byproduct.

55. (c) The first transgenic crop was tobacco developed in USA in 1986, it was herbicide resistant.

NOTES: The herbicide such as glyphosate resistance enables farmers to wipe out most weeds from the fields without damaging their crops. Glyphosate inhibits plant growth by blocking an enzyme known as EPSP synthase, which is involved in the production of certain amino acids and other molecules that account for as much as 35% of a plant's mass.

56. (a) Selection is picking up only those plants for reproduction which have desired qualities. Hybridization is crossing of two or more types of plants for bringing their traits together in the progeny. Introduction is taking a plant or a new variety from an area where it grows naturally to a region where it does not occur before.

57. (a) Tissue culture cells in culture usually follow a standard growth pattern. The first phase of growth after the culture is seeded is the lag phase, which is a period of slow growth when the cells are adapting to the culture environment. The lag phase is followed by the log phase (logarithmic phase), a period where the cells divide exponentially and consume the nutrients in the growth medium. When all the growth medium is spent (one or more of the nutrients is depleted) or when the cells occupy all of the available substrates, the cells enter the stationary phase.

NOTES: Gottileb Haberlandt is known as the father of Plant Tissue culture.

58. (d) Lathyrism which is caused by consumption of *Khesari dal* (*Lathyrus sativus*) is a disease characterised by gross skeletal deformation and thinning of collagen fibres and fibrils. Lathyrism is a disorder caused due to an excessive intake of the seeds of *Lathyrus sativus* (Kesari Dal) which affects the cross-linking of collagen causing thinning of collagen fibres. Collagen is the major protein of connective tissues and a defect in their cross-linking leads to skeletal deformation.

NOTES: The toxin produced by several members of the genus *Lathyrus* is 3-β-N-oxalyl-L-α, β-diaminopropionic acid (β-ODAP).

59. (b) Inorganic substances, oils, plant extracts used as insecticides are called first generation pesticides.
Synthetic organic compounds are known as second generation pesticides. Insect hormones are third generation pesticides.
Pheromones are the chemical substances which when released into an animal's surroundings, influence the behaviour or development of other individuals of the same species.
Insect hormone analogues help in trapping the insects by confusing them as they mimic the odour of pheromones.

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60. (c) **Malathion** is an *organophosphate parasympathetic* which binds irreversibly to *cholinesterase*. Malathion is an *insecticide* of relatively low human *toxicity*. However, malathion breaks down into malaoxon, which is 60 times more toxic than malathion. For this reason, if malathion is used or somehow enters an indoor environment, as it breaks down into malaoxon, it can seriously and chronically poison the occupants living or working in this environmnent.
Malathion present in untreated water is converted to malaoxon during the chlorination phase of water treatment, so malathion should not be used in waters that may be used as a source for drinking water, or any upstream waters.

NOTES: Malaoxon, the oxygen analog of malathion, inhibits acetylcholinesterase by phosphorylation of the serine moiety at the enzyme active site, with resultant acetylcholine accumulation and hyperstimulation at cholinergic neuroeffector and neuromuscular junctions, autonomic nerves, and brain.

61. (c) 2, 4-Dichlorophenoxy acetic acid is used for causing defoliation of forest trees.
2, 4-D or 2, 4 Dichlorophenoxy acetic acid is an auxin hormone. It stimulates the growth activities of the cells of the root due to which

roots get destroyed and thus plants finally destroys. 2, 4-D is used as a defoliant for broad leaved dicots.

62. (b) Agent orange has equal parts of 2, 4-D and 2, 4, 5-T and is found to contain highly poisonous chemical dioxin as impurities.

NOTES

Dioxins are a group of highly toxic chemical compounds that are harmful to health. They can cause problems with reproduction, development, and the immune system. They can also disrupt hormones and lead to cancer known as persistent environmental pollutants (POPs), dioxins can remain in the environment for many years.

63. (c) The top five crops are : Potato (which belongs to the family *Solanaceae*) and Wheat, Rice, Corn, Barley (which belongs to the family *Poaceae*).

64. (d) The long-term prospects for a truly human civilization depend in a large measure on control of human diseases.

65. (d) The rotenone is a natural insecticide with minimal or almost no side effects. It is an isoflavonoid extracted from the root of *Derris*.

NOTES

Rotenone interrupts aerobic cellular respiration by blocking electron transport in mitochondria through the inhibition of the enzyme NADH ubiquitone reductase, which prevents the availability of oxygen for cellular respiration.

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66. (d) Biological control refers the use of living organisms like natural predators and parasites to reduce pest population and control diseases. However, they may become pest as they can develop a preference to other diets.

67. (b) Culture is the term generally used for artificial growth. The plant tissue culture actually refers to the growth of plant cells, tissues and organs on artificial nutrient media.

68. (c) All other are diploid. Best method of haploid plant culture is pollen grain culture.

69. (a) The polyploidy which occurs within a species and results due to multiplication of the same set of chromosomes is called autopolyploidy.

NOTES

Autopolyploidy results from a failure of the chromosomes to separate during meiosis. The resulting offspring a generally fertile as they have an even number of chromosomes.

70. (c) Xylem vessels and cork cells are dead while sieve tube cells do not possess nuclei. Totipotency is the ability of the cell that can generate the whole plant from the single cell or the tissue by continuous division. Meristem is the tissue formed by the group of cell that has the ability to divide continuously. Whereas xylem vessels and cork cells are dead while sieve tube cells do not possess nuclei and has lost the ability to divide.

71. (d) It was genetically modified to get high lipid contents. Reimei of Rice is a Gamma-rays induced mutated variety of rice. Prabhat'- an extra early variety of red gram. The mutant variety Sharbati Sonora was officialy approved in 1967. It was developed by irradiation of seeds with gamma rays. Main improved attributes of mutant variety are amber grain color, early maturity, bread and chapati making and high protein content.

The mutant variety Aruna was officialy approved in 1969. It was developed by treatment of castor seeds with thermal neutrons. Main improved attributes of mutant variety are very early maturity (120 days instead of 270 days as original variety), yield slightly higher.

NOTES

Castor oil is a triglyceride, which chemically is a glycerol molecule with each of its three hydroxyl group esterifies with a long-chain fatty acid. Its major fatty acid is the unsaturated, hydroxylated 12-hydroxy, 9-octadecenoic acid, known as ricinoleic acid.

72. (a) Polyethylene glycol and sodium nitrate play an important role in the fusion of protoplasts from the same or different species. It is done for the formation of somatic hybrid cells. This process is adopted when normal sexual reproduction is not possible for the production of hybrids

NOTES

In 1974, Kao and Michayluk from Canada discovered another fusion inducing chemical polyethylene glycol (PEG) which is the most effective agent discovered so far. Many fusion experiments are performed by a polyethylene glycol. PEG induces protoplast aggregation and subsequent fusion.

73. (a) Development of embryo like structure from explant by the method of tissue culture, is called somatic embryogenesis.

NOTES

Somatic embryogenesis was discovered by German Botanist, Haberlandt, who prophesied in the early 1900s that vegetative cells of plants can be induced to form embryos.

74. (c) To obtain virus - free healthy plants from a diseased one by tissue culture technique, both apical and axillary meristems of the diseased

plant will be taken. Plant tissue culture is used to maintain or grow plant cells, tissues or organs under sterile conditions on a nutrient culture medium of known composition.

NOTES Plant tissue culture is widely used to produce clones of a plant in a method known as micro propagation.

75. (a) During the period 1960 to 2000 rice production went up from 35 million tonnes to 89.5 million tonnes. This was due to the development of semi-dwarf varieties of rice. there are 2,00,000 varieties of rice in India.

76. (b) The method of producing thousands of plants through tissue culture is called micro-propagation. Each of these plants will be genetically identical to the original plant from which they were grown, *i.e.*, they are somaclones. Many important food plants like tomato, banana, apple have been produced on commercial scale using this method.

77. (c) Meristem is most suitable for raising virus free plants for micropropagation.

78. (b) Vector DNA are the DNA molecules that can carry a foreign DNA segment and replicate inside the host cells. Vector DNA may be plasmids, a bacteriophage, cosmids, yeast artificial chromosomes.

79. (d) Spirulina is rich in protein, vitamins and minerals. 250 gram biomass of *Methylophilus methylotrophus* produces 25 tonne protein/day while cow of 250 Kg produces only 200 gm. protein/day.

NOTES Common button mushrooms are a very rich source of vitamin D. A rice variety has been developed which is very rich in iron content.

80. (d) Genetic variation present among plant cells during tissue culture is called somaclonal variation. The term somaclonal variation is also used for the genetic variation present in plants regenerated from a single culture. This variation has been used to develop several useful varieties against resistance to diseases and pests, better yield, better quality etc.

NOTES In 1981, Larkin and Scowkraft coined a general term **"somaclonal variation"** for plant variants derived from any form of cell or tissue cultures.

81. (c) Meristem culture is done for the development of virus free plants. Meristematic tissue cell can be taken either from shoot or root tip.

NOTES Meristem culture was developed by Morel and Martin in 1952 for rivers eliminating from Dahlia. Orchid Cymbidium was micropropagated using meristem culture by Morel in 1965.

82. (c) The method of producing thousands of plants through tissue culture is called micropropagation. Each of these plants will be genetically identical to the original plant, from which they were grown, i.e., they are somaclones. Many important food plants like tomato, banana, apple, etc., have been produced on commercial scale using this method.

NOTES Cornell University botanist Frederick Campion Steward discovered and pioneered micropropagation and plant tissue culture in the late 1950s and early 1960s.

83. (c) Cellular totipotency is exhibited only by plant cells wherein the plant cells retain the ability to deactivate and form the new dividing cells.

84. (a) Cellular totipotency is the ability, shown by many living cells to form all types of tissue that constitute the mature organism.

85. (a) In vegetative reproduction the same genotype can be propagated from one generation to the next.

86. (c) All others are diploid but pollen grain is haploid.

87. (a) Mutations are generally recessive so they are not expressed in their heterozygous condition. If plant is haploid then mutation can express themselves.

88. (c) F.C. Steward & co-workers in 1964 raised the entire carrot plant from carrot-root culture. They established the cellular totipotency i.e. capacity of a cell to develop a new plant. However the idea of totipotency was given earlier by German botanist Gottlieb Haberlandt. He tried to grow isolated leaf cell but could not succeed.

89. (d) In crop improvement programme, haploids are very important because they form perfect homozygotes which are helpful to get a pure line.

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32 Microbes in Human Welfare

Trend Analysis with Important Topics & Sub-Topics

Topic	Sub-Topics	2020		2019		2018		2017		2016	
		Qns.	LOD	Qns.	LOD	Qns.	LOD	Qns.	LOD	Qns.	LOD
Microbes in Household/ Industrial Products/ Sewage Treatment	Microbes in Sewage Treatment Plant	1	A	1	A			1	A		
	Micorbes in Industrial production	1	D	1	A			1	A	1	D
	Microbes in Household Products			1	A	1	A				
Microbes in Production of Biogas/ Bio-control agents/ Biofertiliser	Microbes in Biogas production									1	A
	Microbes as Bio-control agent			1	A						

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LOD - Level of Difficulty | E - Easy | A - Average | D - Difficult | Qns - No. of Questions

Topic 1: Microbes in Household/Industrial Products/ Sewage Treatment

1. Match the following columns and select the correct option. *[2020]*

	Column-I		Column-II
(a)	*Clostridium butylicum*	(i)	Cyclosporin-A
(b)	*Trichoderma polysporum*	(ii)	Butyric Acid
(c)	*Monascus purpureus*	(iii)	Citric Acid
(d)	*Aspergillus niger*	(iv)	Blood cholesterol lowering agent

	(A)	(B)	(C)	(D)
(a)	(ii)	(i)	(iv)	(iii)
(b)	(i)	(ii)	(iv)	(iii)
(c)	(iv)	(iii)	(ii)	(i)
(d)	(iii)	(iv)	(ii)	(i)

2. Which of the following is put into Anaerobic sludge digester for further sewage treatment? *[2020]*
   (a) Floating debris
   (b) Effluents of primary treatment
   (c) Activated sludge
   (d) Primary sludge

3. Match the following organisms with the products they produce: *[2019]*

(a)	*Lactobacillus*	(i)	Cheese
(b)	*Saccharomyces cerevisiae*	(ii)	Curd
(c)	*Aspergillus niger*	(iii)	Citric acid
(d)	*Acetobacter aceti*	(iv)	Bread
		(v)	Acetic acid

Select the correct option.

	(a)	(b)	(c)	(d)
(a)	(ii)	(iv)	(v)	(iii)
(b)	(ii)	(iv)	(iii)	(v)
(c)	(iii)	(iv)	(v)	(i)
(d)	(ii)	(i)	(iii)	(v)

4. Which of the following is a commercial blood cholesterol lowering agent? *[2019]*
   (a) Cyclosporin A (b) Statin
   (c) Streptokinase (d) Lipases
5. Which of the following in sewage treatment removes suspended solids? *[2017]*
   (a) Secondary treatment
   (b) Primary treatment
   (c) Sludge treatment
   (d) Tertiary treatment
6. Which of the following is correctly matched for the product produced by them ? *[2017]*
   (a) *Methanobacterium* : Lactic acid
   (b) *Penicillium notatum* : Acetic acid
   (c) *Sacchromyces cerevisiae* : Ethanol
   (d) *Acetobacter aceti* : Antibiotics
7. The guts of cow and buffalo possess:*[2015 RS]*
   (a) *Chlorella* spp.
   (b) Methanogens
   (c) Cyanobacteria
   (d) *Fucus* spp.
8. What gases are produced in anaerobic sludge digesters? *[2014]*
   (a) Methane and CO_2 only
   (b) Methane, Hydrogen Sulphide and CO_2
   (c) Methane, Hydrogen Sulphide and O_2
   (d) Hydrogen Sulphide and CO_2
9. During sewage treatment, biogases are produced which include : *[NEET 2013]*
   (a) methane, oxygen, hydrogen sulphide
   (b) hydrogen sulphide, methane, sulphur dioxide
   (c) hydrogen sulphide, nitrogen, methane
   (d) methane, hydrogen sulphide, carbon dioxide
10. A good producer of citric acid is: *[NEET 2013]*
   (a) *Pseudomonas*
   (b) *Clostridium*
   (c) *Saccharomyces*
   (d) *Aspergillus*
11. *Monascus purpureus* is a yeast used commercially in the production of : *[2012]*
   (a) ethanol
   (b) streptokinase for removing clots from the blood vessels.
   (c) citric acid
   (d) blood cholesterol lowering statins
12. A patient brought to a hospital with myocardial infarction is normally immediately given: *[2012]*
   (a) Penicillin (b) Streptokinase
   (c) Cyclosporin-A (d) Statins
13. Yeast is used in the production of *[2012]*
   (a) Citric acid and lactic acid
   (b) Lipase and pectinase
   (c) Bread and beer
   (d) Cheese and butter
14. Which one of the following is an example of carrying out biological control of pests/ diseases using microbes ? *[2012]*
   (a) *Trichoderma* sp. against certain plant pathogens
   (b) Nucleopolyhedrovirus against white rust in *Brassica*
   (c) Bt - cotton to increase cotton yield
   (d) Lady bird beetle against aphids in mustard
15. The domestic sewage in large cities *[2012M]*
   (a) has a high BOD as it contains both aerobic and anaerobic bacteria.
   (b) is processed by aerobic and then anaerobic bacteria in the secondary treatment in Sewage Treatment Plants (STPs).
   (c) when treated in STPs does not really require the aeration step as the sewage contains adequate oxygen.
   (d) has very high amounts of suspended solids and dissolved salts.
16. Read the following statement having two blanks (A and B):
   "A drug used for -------- (A) -------- patients is obtained from a species of the organism ------- (B) --------."
   The one correct option for the two blanks is

	Blank - A	Blank - B *[2011M]*
(a)	Heart	*Penicillium*
(b)	Organ-transplant	*Trichoderma*
(c)	Swine flu	*Monascus*
(d)	AIDS	*Pseudomonas*

17. Which one of the following is a wrong matching of a microbe and its industrial product, while the remaining three are correct ? *[2011M]*
   (a) Yeast - statins
   (b) *Acetobacter aceti* - acid
   (c) *Clostridium butylicum* - lactic acid
   (d) *Aspergillus niger* - citric acid
18. Ethanol is commercially produced through a particular species of : *[2011]*
   (a) *Saccharomyces* (b) *Clostridium*
   (c) *Trichoderma* (d) *Aspergillus*

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19. Which one of the following pairs is wrongly matched? ***[2009]***
    (a) Alcohol - nitrogenase
    (b) Fruit juice - pectinase
    (c) Textile - amylase
    (d) Detergents - lipase
20. *Trichoderma harzianum* has proved a useful microorganism for ***[2008]***
    (a) bioremediation of contaminated soils
    (b) reclamation of wastelands
    (c) gene transfer in higher plants
    (d) biological control of soil-borne plant pathogens
21. Modern detergents contain enzyme preparations of: ***[2008]***
    (a) Acidophiles (b) Alkaliphiles
    (c) Thermoacidophiles (d) Thermophiles
22. Human insulin is being commercially produced from a transgenic species of ***[2008]***
    (a) *Escherichia* (b) *Mycobacterium*
    (c) *Rhizobium* (d) *Saccharomyces*
23. Probiotics are ***[2007]***
    (a) cancer inducing microbes
    (b) new kind of food allergens
    (c) live microbial food supplement
    (d) safe antibiotics
24. Which one of the following pairs is wrongly matched ? ***[2007]***
    (a) Yeast - ethanol
    (b) Streptomycetes - antibiotic
    (c) Coliforms - vinegar
    (d) Methanogens - gobar gas.
25. Which one of the following pairs is not correctly matched? ***[2004]***
    (a) *Streptomyces* - Antibiotic
    (b) *Serratia* - Drug addiction
    (c) *Spirulina* - Single cell protein
    (d) *Rhizobium* - Biofertilizer
26. Dough kept overnight in warm weather becomes soft and spongy because of ***[2004]***
    (a) absorption of carbon dioxide from atmosphehre
    (b) fermentation
    (c) cohesion
    (d) osmosis
27. The term antibiotic was first used by ***[2003]***
    (a) Flemming (b) Pasteur
    (c) Waksman (d) Lister
28. During the formation of bread it becomes porous due to release of CO_2 by the action of ***[2002]***
    (a) Yeast (b) Bacteria
    (c) Virus (d) Protozoans
29. Industrial production of ethanol from starch is brought about by ***[2000]***
    (a) *Saccharomyces* (b) *Lactobacillus*
    (c) *Azotobacter* (d) *Penicillium*
30. Which one of the following micro-organisms is used for production of citric acid in industries? ***[1998]***
    (a) *Penicillium citrinum*
    (b) *Aspergillus niger*
    (c) *Rhizopus nigricans*
    (d) *Lactobacillus bulgaris*
31. Yeast *Saccharomyces cerevisiae* is used in the industrial production of ***[1998]***
    (a) citric acid (b) tetracycline
    (c) ethanol (d) butanol
32. Which one thing is not true about antibiotics? ***[1996]***
    (a) The term "antibiotic" was coined by Selman Waksman in 1942
    (b) First antibiotic was discovered by Alexander Flemming
    (c) Each antibiotic is effective only against one particular kind of germ
    (d) Some persons can be allergic to a particular antibiotic
33. The organism, used for alcoholic fermentation, is ***[1995]***
    (a) *Pseudomonas* (b) *Penicillium*
    (c) *Aspergillus* (d) *Saccharomyces*

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Topics 2: Microbes in production of Biogas/ as Bio-control Agents/as Biofertilisers

34. Which of the following statements about methanogens is *not correct* ? ***[2019, Odisa]***
    (a) They produce methane gas.
    (b) They can be used to produce biogas.
    (c) They are found in the rumen of cattle and their excreta.
    (d) They grow aerobically and breakdown cellulose-rich food.
35. Among the following pairs of microbes, which pair has both the microbes that can be used as biofertilisers? ***[2019, Odisa]***
    (a) *Aspergillus and Cyanobacteria*
    (b) *Aspergillus and Rhizopus*
    (c) *Rhizobium and Rhizopus*
    (d) *Cyanobacteria and Rhizobium*

36. A biocontrol agent to be a part of an integrated pest management should be *[2019, Odisa]*
(a) Species-specific and inactive on nontarget organisms.
(b) Species-specific and symbiotic.
(c) Free living and broad spectrum.
(d) Narrow spectrum and symbiotic.

37. Select the correct group of biocontrol agents. *[2019]*
(a) Bacillus thuringiensis, Tobacco mosaic virus, Aphids
(b) Trichoderma, Baculovirus, Bacillus thuringiensis
(c) Oscillatoria, Rhizobium, Trichoderma
(d) Nostoc, Azospirillium, Nucleopolyhedrovirus

38. Which of the following can be used as a biocontrol agent in the treatment of plant disease? *[2019]*
(a) *Trichoderma* (b) *Chlorella*
(c) *Anabaena* (d) *Lactobacillus*

39. Which of the following is wrongly matched in the given table ? *[2016]*

	Microbe	Product	Application
(a)	*Trichoderma polysporum*	Cyclosporin A	immunosuppressive drug
(b)	*Monascus purpureus*	Statins	lowering of blood cholesterol
(c)	*Streptococcus*	Streptokinase	removal of clot from blood vessel
(d)	*Clostridium butylicum*	Lipase	removal of oil stains

40. The primitive prokaryotes responsible for the production of biogas from the dung of ruminant animals, include the *[2016]*
(a) Halophiles (b) Thermoacidiophiles
(c) Methanogens (d) Eubacteria

41. Match the following list of microbes and their importance: *[2015 RS]*

(A)	Saccharomyces cerevisiae	(i)	Production of immunosuppressive agents
(B)	Monascus Purpureus	(ii)	Ripening of Swiss cheese
(C)	Trichoderma polysporum	(iii)	Commercial production of ethanol
(D)	Propionibacterium sharamanii	(iv)	Production of blood cholestrol lowering agents

	(A)	(B)	(C)	(D)
(a)	(iv)	(iii)	(ii)	(i)
(b)	(iv)	(ii)	(i)	(iii)
(c)	(iii)	(i)	(iv)	(ii)
(d)	(iii)	(iv)	(i)	(ii)

42. Microbe used for biocontrol of pest butterfly caterpillars is *[NEET Kar. 2013]*
(a) *Trichoderma sp.*
(b) *Saccharomyces cerevisiae*
(c) *Bacillus thuringiensis*
(d) *Streptococcus sp.*

43. Which one of the following microbes forms symbiotic association with plants and helps them in their nutrition *[2012]*
(a) *Azotobacter* (b) *Aspergillus*
(c) *Glomus* (d) *Trichoderma*

44. A nitrogen-fixing microbe associated with Azolla in rice fields is: *[2012]*
(a) *Spirulina* (b) *Anabaena*
(c) *Frankia* (d) *Tolypothrix*

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45. In gobar gas, the maximum amount is that of
(a) butane (b) methane *[2012M]*
(c) propane (d) carbon dioxide

46. An organism used as a biofertilizer for raising soyabean crops is *[2011]*
(a) *Azotobacter* (b) *Azospirillum*
(c) *Rhizobium* (d) *Nostoc*

47. Which one of the following help in absorption of phosphorus from soil by plants? *[2011]*
(a) *Glomus* (b) *Rhizobium*
(c) *Frankia* (d) *Anabaena*

48. Which one of the following is not a biofertilizer? *[2011]*
(a) *Agrobacterium* (b) *Rhizobium*
(c) *Nostoc* (d) *Mycorrhiza*

49. A common biocontrol agent for the control of plant diseases is *[2010]*
(a) Baculovirus
(b) *Bacillus thuringiensis*
(c) *Glomus*
(d) *Trichoderma*

50. The common nitrogen fixer in paddy fields is *[2010]*
(a) *Rhizobium* (b) *Azospirillum*
(c) *Oscillatoria* (d) *Frankia*

51. Which one of the following is not used in organic farming? ***[2010]***
(a) *Glomus* (b) Earthworm
(c) *Oscillatoria* (d) Snail

52. Select the correct statement from the following? ***[2010]***
(a) Biogas is produced by the activity of aerobic bacteria on animal waste
(b) *Methanobacterium* is an aerobic bacterium found in rumen of cattle
(c) Biogas, commonly called gobar gas, is pure methane
(d) Activated sludge-sediment in settlement tanks of sewage treatment plant is a rich source of aerobic bacteria

53. Which one of the following is linked to the discovery of Bordeaux mixture as a popular fungicide? ***[2008]***
(a) Bacterial leaf blight of rice
(b) Downy mildew of grapes
(c) Loose smut of wheat
(d) Black rust of wheat

54. For retting of jute the fermenting microbe used is ***[2005]***
(a) Methophilic bacteria
(b) Butyric acid bacteria
(c) *Helicobactor pylori*
(d) *Streptococcus lactin*

55. Which of the following is pair of bio-fertilizers? ***[2001]***
(a) *Azolla* and BGA
(b) *Nostoc* and legumes
(c) *Rhizobium* and grasses
(d) *Salmonella* and *E. coli*

56. The aquatic fern, which is an excellent biofertiliser is ***[1999]***
(a) *Azolla* (b) *Salvinia*
(c) *Marsilia* (d) *Pteridium*

57. Due to which of the following organisms, yield of rice has been increased ? ***[1999]***
(a) *Anabaena* (b) *Bacillus popilliae*
(c) *Sesbania* (d) *Bacillus polymexa*

58. Which one of the following is non-symbiotic biofertilizer? ***[1998]***
(a) *Azotobacter* (b) *Anabaena*
(c) *Rhizobium* (d) VAM.

59. Farmers have reported over 50% higher yields of rice by using the biofertilizer ***[1998]***
(a) *Azolla pinnata*
(b) *Cyanobacteria*
(c) *Legume-Rhizobium* symbiosis
(d) Mycorrhiza

60. Which of the following is likely to be achieved in the coming two decades? ***[1997]***
(a) A complete understanding of the brain-mind interaction
(b) Control of cancer
(c) Correction of genetic basis of diabetes mellitus
(d) Production of biodegradable plastic rather than cellulose by higher plants

61. Gobar gas contains mainly ***[1997]***
(a) $CH_4 + CO_2$ (b) $CH_4 + O_2$
(c) $CO_2 + H_2$ (d) $CO_2 + SO_2$

62. *Azotobacter* and *Bacillus polymyxa* are the examples of ***[1996]***
(a) symbiotic nitrogen-fixers
(b) non-symbiotic nitrogen-fixers
(c) ammonifying bacteria
(d) disease-causing bacteria

63. Non-symbiotic nitrogen fixers are ***[1994]***
(a) *Azotobacter* (b) *Pseudomonas*
(c) soil fungi (d) blue-green algae

64. A nonphotosynthetic aerobic nitrogen fixing soil bacterium is ***[1994]***
(a) *Rhizobium* (b) *Clostridium*
(c) *Azotobacter* (d) *Klebsiella*

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ANSWER KEY

1	(a)	8	(b)	15	(b)	22	(a)	29	(a)	36	(a)	43	(c)	50	(b)	57	(a)	64	(c)
2	(c)	9	(d)	16	(b)	23	(c)	30	(b)	37	(b)	44	(b)	51	(d)	58	(a)		
3	(b)	10	(d)	17	(c)	24	(c)	31	(c)	38	(a)	45	(b)	52	(d)	59	(a)		
4	(b)	11	(d)	18	(a)	25	(b)	32	(c)	39	(d)	46	(c)	53	(b)	60	(b)		
5	(b)	12	(b)	19	(a)	26	(b)	33	(d)	40	(c)	47	(a)	54	(b)	61	(a)		
6	(c)	13	(c)	20	(d)	27	(c)	34	(d)	41	(d)	48	(a)	55	(a)	62	(b)		
7	(b)	14	(a)	21	(b)	28	(a)	35	(d)	42	(c)	49	(d)	56	(a)	63	(a)		

Hints & Solutions

1. (a) *Clostridium butylicum* (a bacterium) is used for the production of butyric acid. An bioactive molecule, cyclosporin A, that is used as an immunosuppressive agent in organ-transplant patients, is produced by the fungus *Trichoderma polysporum*. Statins produced by the yeast *Monascus purpureus* have been commercialized as blood-cholesterol lowering agents. It acts by competitively inhibiting the enzyme responsible for synthesis of cholesterol. *Aspergillus niger* (a fungus) is used for the commercial production of citric acid.
2. (c) The sediment in settlement tank is called activated sludge. A small part of the activated sludge is pumped back into aeration tank. Remaining major part of the sludge is pumped into large tank called anaerobic sludge digesters.
3. (b) Microbes are used in production of several household and industrial products –
   - *Lactobacillus* – Production of curd
   - *Saccharomyces cerevisiae* – Bread making
   - *Aspergillus niger* – Citric acid production
   - *Acetobacter aceti* – Acetic acid
4. (b) Statins are drugs that can lower blood cholesterol.
   It is obtained from a yeast (Fungi) called *Monascus purpureus*.
   They work by blocking a substance, body needs to make cholesterol.
5. (b) Primary treatment is a physical process which involves two process, i.e. filtration and sedimentation of big solid waste.
6. (c) *Saccharomyces cerevisiae* commonly know as Brewer's yeast, causes fermentation of carbohydrates and produces ethanol.
7. (b) Methanogens (microorganisms producing methane) are found in the guts of ruminant animals e.g. cows and buffalloes.
8. (b) Anaerobic digestion is a series of processes in which microorganisms break down biodegradable material in the absence of oxygen, used for industrial or domestic purposes to manage waste and/or to release energy. The process of anaerobic digestion produces a biogas, consisting of methane (it will burn), carbon dioxide (it does not burn) and traces of other contaminant gases.
9. (d) The major component of biogas is methane (about 50-68%) which is highly inflammable . The other gases are carbon dioxide (25 - 35%), hydrogen (1 - 5%) , nitrogen (2 - 7%), Oxygen (0 - 0.1%) and rarely hydrogen sulfide. Biogas is a "mixture of gases" produced from degradable organic matter by the activity of various anaerobic bacteria that offers a low cost alternative for energy requirements.

   NOTES The main aim of sewage treatment is to produce environmentally safe sewage water, called effluent, and a solid waste, called sludge or biosolids, suitable for disposal or reuse of water.
10. (d) A good source of citric acid is *Aspergillus niger* (a fungus). Apart from citric acid, oxalic acid, gallic acid, gluconic acid are extracted from fungus.
11. (d) *Monascus purpureus* is a yeast used in the production of statins which are used in lowering blood cholestrol.

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   NOTES Statin is a class of drugs used as an blood-cholesterol lowering agent and is also known as HMG CoA reductase inhibitors, works in the liver to prevent cholesterol formation. This reduces the amount of cholesterol circulating in the blood. Statins are most effective at lowering LDL (bad) cholesterol. They also help lower triglycerides (blood fats) and raise HDL (good) cholesterol.
12. (b) Streptokinase is immediately given to dissolve the thrombus carring myocardial infarction.

   NOTES Thrombolytic drugs dissolve blood clots by activating plasminogen, which forms a cleaved product called plasmin. Plasmin is a proteolytic enzyme that is capable of breaking cross-links between fibrin molecules, which provide the structural integrity of blood clots.
13. (c) *Saccharomyces cervisiae* is a yeast used in making bread (Baker's yeast) and commercial production of ethanol.
14. (a) A biological control being developed for use in the treatment of plant disease is the fungus *Trichoderma*. *Trichoderma* species are free-living fungi that are very common in the root ecosystems. They are effective biocontrol agents of several plant pathogens.

15. (b) Sewage treatment is the process of removing contaminants from wastewater and household sewage, both runoff (effluents) and domestic. It includes physical, chemical, and biological processes to remove physical, chemical and biological contaminants. Sewage treatment generally involves three stages, called primary, secondary and tertiary treatment. It is processed by aerobic and then anaerobic bacteria in the secondary treatment in Sewage Treatment Plants (STPs).

NOTES

The Ministry of Environment and Forests has initiated Ganga Action Plan and Yamuna Action Plan to save these major rivers of our country from pollution.

16. (b) *Trichoderma* is a species of filamentous fungi. Cyclosporin A is immunosuppressive drug obtained from *Trichoderma* and used in organ transplantation.

NOTES

Cyclosporine stops white blood cells from attacking a transplanted organ. It works by weakening the immune system of the body as the white blood cells fight against foreign substances such as transplanted organ.

17. (c) *Clostridium butylicum* industrially produces butyric acid.
18. (a) *Saccharomyces cerevisiae* is commercially used to produce ethanol. *S. cerevisiae* is a yeast which helps in alcoholic fermentation in which sugars such as glucose, fructose and sucrose are converted into cellular energy and produce ethanol.
19. (a) Alcohol and nitrogenase pair is wrongly matched. Ethanol produces alcohol.
20. (d) *Trichoderma harzianum* has proved a useful microorganism for biological control of soil borne plant pathogens. *Trichoderma harzianum* is a fungus that is also used as a fungicide. It is used for foliar application, seed treatment and soil treatment for suppression of various disease causing fungal pathogens. Commercial biotechnological products such as 3 Tac have been useful for treatment of *Botrytis*, *Fusarium*, *Penicillium sp*. It is also used for manufacturing enzymes.

NOTES

Different strains of Trichoderma sp. play an important role in the bioremediation of soil that are contaminated with pesticides and herbicides. They have the ability to degrade a wide range of insecticides: organochlorines, organophosphates and carbonates.

21. (b) Modern detergent contain enzymes preparations of alkaliphiles. Alkaliphiles live in alkaline environments like soda lakes, or alkaline soil. The pH level in alkaline substances is from about 9 to 11 on the pH scale. The alkaliphiles keep an alkaline level of about pH 9 inside the cells, but the environment has a higher level of alkalinity. Alkaliphiles can keep the right pH level by pumping in hydrogen ions in out at the right rate.
22. (a) Human insulin is being commercially produced from a transgenic species of *Escherichia coli*. *E. coli* is a bacterium that is commonly found in the lower intestine of warm blooded animals. The bacteria can also be grown easily and its genetics are comparatively simple and easily manipulated, making it one of the best studied prokaryotic model organisms, and an important species in biotechnology.
23. (c) Probiotics are defined as live microorganisms, including *Lactobacillus* species, *Bifidobacterium* species and yeasts, that may beneficially affect the host upon ingestion by improving the balance of the intestinal microflora. The dietary use of live microorganisms has a long history.

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NOTES

Probiotics supplementing with Bifidobacterium and Lactobacillus strains for 1–2 months can improve anxiety, depression, autism, Obsessive-compulsive disorder (OCD) and memory.

24. (c) Coliforms are a broad class of bacteria found in our environment, including the feces of man and other warm-blooded animals. The presence of coliform bacteria in drinking water may indicate a possible presence of harmful, disease-causing organisms.
25. (b) *Rhizobium* is a symbotic nitrogen fixing bacteria. *Streptomyces* is a source for streptomycin. *Spirulina* is a rich source of vitamin B_1 and proteins.

NOTES

Serratia is a genus of gram negative, facultatively anaerobic, rod-shaped bacteria of the enterobacteriaceae family. The most common species S. marcescens, is normally the only pathogen and usually causes nosocomial infections.

26. (b) Dough kept overnight in warm weather becomes soft and spongy because of fermentation. It is a metabolic process that converts sugar into acids, gasses and or

alcohol. It occurs in yeast and bacteria, but also in oxygen-starved muscle cells, as in case of lactic acid fermentation so, fermentation occured in dough causes conversion of sugars to acids or alcohols and CO_2 which makes the dough soft and spongy.

27. (c) The term antibiotics was coined by Waksman but the first known antibiotic, penicillin was extracted from fungi *Penicillium notatum* by Alexander Flemming in 1944. Antibiotics are the chemicals that are produced from the living organisms, used to kill another living organisms. About 2300 antibiotics discovered so far e.g. Streptomycin, Tetracycline etc.

28. (a) Yeast carry out fermentation, releasing CO_2 making bread soft and porous. Hence, *Saccharomyces* is referred to as baker's yeast.

29. (a) Yeast helps in ethyl alcohol formation. *Lactobacillus* is the milk bacteria while is the free living nitrogen fixing bacteria and *Penicillium* is the source of Penicillin.

30. (b) *Aspergillus niger* is known as guinea pig of kingdom fungi. The main source of commercial preparation of citric acid is the fermentation of sugar with *Aspergillus niger*.

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NOTES

Aspergillus niger is a haploid filamentous fungus which is used for waste management and biotransformations in addition to its industrial uses, such as production of citric acid and extracellular enzymes.

31. (c) Yeast performs alcoholic fermentation because of enzyme 'zymase'. It is used in the production of ethyl alcohol or ethanol.

$$\underset{\text{Glucose}}{C_6H_{12}O_6} \xrightarrow[\text{Yeast}]{\text{Zymase}} \underset{\text{Ethyl alcohol}}{2C_2H_5OH} + 2CO_2 \uparrow$$

32. (c) 'Each antibiotic is effective only against one particular kind of germ' is not correct.

33. (d) Fermentation refers to the breakdown of organic substances, particularly carbohydrates, under anaerobic conditions. *Saccharomyces cerevisiae* is used for fermenting carbohydrate. The ethyl alcohol and carbon dioxide are formed at the end of the process.

34. (d) Methanogens are anaerobic unicellular organisms that release methane as a waste product of cellular metabolism.

NOTES

Methanogens are present as endosymbionts in many free-living marine and freshwater anaerobic protozoa, where they are often closely associated with hydrogenosomes, organelles that produce H_2, CO_2, and acetate from the fermentation of polymeric substrates. The products of the hydrogenosomes are substrates for methanogenesis.

35. (d) Biofertilisers are organisms that enrich the nutrient quality of the soil. The main sources of biofertilisers are bacteria, fungi and cyanobacteria. Cyanobacteria like *Anabaena, Nostoc* etc. and *Rhizobium (which form root modules in leguminous plants)* are able to fix atmospheric nitrogen into organic forms which is used by the plant as nutrients.
Rhizopus and Aspergillus are used in production of other compounds of human benefit.

36. (a) Biocontrol agents are natural enemies like parasitism, predation and other mechanisms for controlling the plant pests. They play an important role in controlling the plant pests like nematodes weeds, insects, and mites and also helps in maintaining and balancing the plant species along with their natural enemies. A good biocontrol agent should be species-specific and inactive on non-target organisms.

NOTES

Biological control agents are released into crops in a number of ways. These can be placed in crops as adults, as pupae in moth eggs, in satchels with food, on a card, or spread in a carrier. Additionally, there are non-insect beneficial organisms that can be applied as a spray to crops. These include Heliothis Nuclear Polyhedris Virus (NPV) and Bacillus thuringiensis (Bt).

Examples of biocontrol agent:

- Aphidius - parasitoid of aphids
- Cucumeris - predatory mite of thrips
- Encarsia - parasitoid of whitefly
- Entomopathogenis nematodes - insecticidal nematodes
- Hypoapsis - predatory mite of fungus gnats
- Green lacewing - predator of aphids and moth eggs
- Montdorensis - predator of thrips
- Persimilis - predatory mite of two spotted mite
- Trichogramma - egg parasitoid of a range of insect pests

37. (b) Biocontrol agents are those natural organisms like parasitism, predation and other mechanisms which play an important role in controlling the plant pests like nematodes weeds, insects, and mites and helps in maintaining and balancing the plant species along with their natural enemies. Fungus *Trichoderma*, Baculoviruses (NPV) and *Bacillus thuringiensis* are used as biocontrol agents.
Rhizobium, Nostoc, Azospirillum and *Oscillatoria* are used as biofertilisers, whereas TMV is a pathogen and aphids are pests that harm crop plants.

NOTES The most common species of fungi used in this type of biocontrol is Trichoderma harzianum.

38. (a) *Trichoderma* is a very effective biological mean for plant disease management especially the soil born. It is a free-living fungus which is common in soil and root ecosystems. It reduces growth, survival or infections caused by pathogens by different mechanisms like competition, antibiosis, mycoparasitism, hyphal interactions, and enzyme secretion.
39. (d) *Clostridium butylicum* is used for butyric acid production
40. (c) Methanogens are microorganisms that produce methane as a metabolic byproduct in anoxic conditions. They are obligate anaerobic ancient and primitive bacteria. They are involved in methanogenesis.
41. (d) A - (iii), B - (iv), C - (i), D - (ii)
42. (c) Microbial biocontrol agent that can be introduced in order to control butterfly caterpillars is the bacteria *Bacillus thuringiensis (Bt)*. They sprayed onto vulnerable plants, where they eaten by the insect larvae. In the gut of the larvae, the toxin is released and the larvae get killed. The bacterial disease will kill the caterpillars, but leave other insects unharmed.
43. (c) *Glomus* is endomycorrhiza that helps in absorption of nutrition specially phosphorus from soil.
44. (b) *Anabaena azollae* resides in the leaf cavities of the fern *Anabaena*. It fixes nitrogen. A part of the fixed nitrogen is excreted in the cavities and becomes available to the fern. The decaying fern plants release the same for utilization of the rice plants.
45. (b) In gobar gas the maximum amount of methane which is produced by methanogenic bacteria. Gobar gas is a gas mixture which is generated when organic compounds are fermented in the absence of air (anaerobic fermentation). Biogas contains 50% – 70% methane, 30% – 40% carbon dioxide, and traces of hydrogen, hydrogen sulphide and nitrogen.

NOTES Methane is a combustible gas, which means it can be burned. It can be used as a fuel for cooking and lighting.

46. (c) *Rhizobium* is a nitrogen fixing bacteria, which acts as a biofertilizer in soil to produce soyabean crops.
47. (a) *Glomus aggregatum* is a mycorrhizal fungus used as a soil inoculant in agriculture and horticulture. Its purpose is to increase the surface area of roots for nutrient absorption like phosphorus.
48. (a) *Agrobacterium* is a soil borne pathogen responsible for affecting many higher species of plant. But *Rhizobium*, *Nostoc* and *Mycorrhiza* are biofertilizers.
49. (d) A common biocontrol agent for control of plant diseases is *Trichoderma. Trichoderma* is a tree living fungus that exert biocontrol over several plant pathogens for the control of plant diseases. It is the natural method of pest and pathogen control.
50. (b) The common nitrogen fixer in paddy field is *Azospirillum*. It is an anaerobic bacteria that forms loose association with roots of paddy crops.
51. (d) Organic farming involves use of organic wastes and other biological material along with beneficial microbes to release nutrients to crop to increase the soil fertility in an ecofriendly, and pollution tree environment. *Glomus,* earthworm and *Oscillatoria* can be used in organic farming while snail cannot.
52. (d) Activated sludge is a process for treating sewage and industrial wastewaters using air and a biological floc composed of bacteria and protozoans. During the process, the primary effluent is taken to aeration tank that contain large number of aerobic heterotrophic microbes. They form flocs that digest a lot of organic matter. As the biological oxygen demand of waste water is reduced, it is passed into settling tank to undergo sedimentation.

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The sediment of the settling tank is called activated sludge that is a rich source of **aerobic bacteria**. Hence, the statement (d) is correct.
Biogas is produced by anaerobic breakdown of biomass with the help of methanogenic bacteria. It is made up of methane, carbon dioxide with traces of nitrogen, hydrogen sulphide and hydrogen.

NOTES
Methanobacterium is an anaerobic bacterium that is found in rumen of cattle and is helpful in the breakdown of cellulose.

53. (b) Downy mildew of grapes disesase is linked to the discovery of Bordeux mixture as a popular fungicide. Bordeux mixture was discovered by Millardet in France in 1882. Bordeux mixture is prepared by dissolving 40g of copper sulphate and 40 g of calcium hydroxide in 5 litres of water. Bordeux mixture is used primarily as a fungicide, it was first used to control downy mildew disease of grape-vine caused by a fungus, *Plasmopara viticola*.

NOTES
The first pesticide to be used commercially was bordeux mixture.

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54. (b) Butyric acid bacteria, *Clostridium butylicum* causes the retting of fibres. Retting is a stage in the manufacturing of vegetable fibers, especially the bast fibers. It is the process of submerging plant stems such as flax, jute, hemp or kenaf in water, and soaking them for a period of time to loosen the fibers from the other components of the stem. Retting can also be done by letting the cut crop stand in the fields in the wet fall, called "dew retting". Bacterial action attacks pectin and lignin, freeing the cellulose fibres. The stems are then removed and washed and subjected to mechanical processing to remove the soft tissue and then dried so that all that remains are the fibres.The process is caused by *Clostridium butylicum*.
55. (a) *Azolla* and blue green algae- *Anabaena* form biofertilizer in rice fields.
56. (a) *Azolla* is a freshwater fern harbouring a bluegreen alga - *Anabaena* in its leaf cavities. The alga fixes atmospheric nitrogen and releases nitrogenous compounds in leaf cavities. This symbiotic system is the main source of algal biofertilizer in rice fields.
57. (a) *Azolla* is a freshwater fern harboring a bluegreen alga - *Anabaena* in its leaf cavities. The alga fixes atmospheric nitrogen and releases nitrogenous compounds in leaf cavities. This symbiotic system is the main source of algal biofertilizer in rice fields. When rice paddies are flooded in the spring, they can be inoculated with *Azolla*, which then quickly multiplies to cover the water, suppressing weeds. As the plants die, they contribute nitrogen to the rice plants, and as the rice paddy dries out, the *Azolla* eventually die, making an exceptional green manure.
58. (a) *Azotobacter* is a free living nitrogen fixing bacterium, *Rhizobium* is symbiotic and found in the root nodules of leguminous plants, *Anabaena* occurs in assoction with *Azolla*. VAM is vesicular arbuscular mycorrhiza.
59. (a) Farmers have reported over 50% higher yields of rice by using the biofertilizer *Azolla pinnata*.
60. (b) Control of cancer is likely to be achieved in the coming two decades.
61. (a) Gobar gas contains mainly $CH_4 + CO_2$.
62. (b) *Azotobacter* and *Bacillus polymyxa* are the examples of non-symbiotic nitrogen-fixers.
63. (a) *Azotobacter* are nonsymbiotic, free living nitrogen fixing bacteria.
(c) *Azotobacter* is a free living soil bacterium able to take up dinitrogen from the soil and fix it into organic nitrogenous material like aminoacid. *Clostridium* is anaerobic free living soil N_2 fixing bacteria. *Rhizobium* is symbiotic N_2 fixing bacteria.
64. (c) *Azotobacter* is a free living soil bacterium able to take up dinitrogen from the soil and fix it into organic nitrogenous material like aminoacid.

NOTES
Clostridium is anaerobic free living soil N2 fixing bacteria. Rhizobium is symbiotic N2 fixing bacteria.

33 Biotechnology: Principles and Processes

Trend Analysis with Important Topics & Sub-Topics

Topic	Sub-Topics	2020		2019		2018		2017		2016	
		Qns.	LOD	Qns.	LOD	Qns.	LOD	Qns.	LOD	Qns.	LOD
Principles of Biotechnology/ Tools of Recombinant DNA Technology	Electrophoresis	1	A					2	A		
	PCR					1	A			1	E
	EcoRI	1	D								
	Restriction Enzymes	2	D	1	A					1	E
	Cloning vectors	1	A			1	A	1	E	1	E
Process of Recombinant DNA Technology	Downstreaming Processing							1	A		
	DNA Isolation			1	A						

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LOD - Level of Difficulty	E - Easy	A - Average	D - Difficult	Qns - No. of Questions

Topic 1: Principles of Biotechnology/ Tools of Recombinant DNA Technology

1. Match the organism with its use in biotechnology. *[2020]*

(a) *Bacillus thuringiensis* (i) Cloning vector
(b) *Thermus aquaticus* (ii) Construction of first rDNA molecule
(c) *Agrobacterium tumefaciens* (iii) DNA polymerase
(d) *Salmonella typhimurium* (iv) Cry proteins

Select the correct option from the following:

	(A)	(B)	(C)	(D)
(a)	(iv)	(iii)	(i)	(ii)
(b)	(iii)	(ii)	(iv)	(i)
(c)	(iii)	(iv)	(i)	(ii)
(d)	(ii)	(iv)	(iii)	(i)

2. In gel electrophoresis, separated DNA fragments can be visualized with the help of *[2020]*
(a) Ethidium bromide in UV radiation
(b) Acetocarmine in UV radiation
(c) Ethidium bromide in infrared radiation
(d) Acetocarmine in bright blue light

3. Bt cotton variety that was developed by the introduction of toxin gene of *Bacillus thuringiensis* (Bt) is resistant to *[2020]*
(a) Fungal diseases (b) Plant nematodes
(c) Insect predators (d) Insect pests

4. Identify the wrong statement with regard to Restriction Enzymes. *[2020]*
(a) They cut the strand of DNA at palindromic sites.
(b) They are useful in genetic engineering.
(c) Sticky ends can be joined by using DNA ligases.
(d) Each restriction enzyme functions by inspecting the length of a DNA sequence.

5. The specific palindromic sequence which is recognized by EcoRl is *[2020]*
   (a) 5' - GGAACC - 3'
   3' - CCTTGG - 5'
   (b) 5' - CTTAAG - 3'
   3' - GAATTC - 5'
   (c) 5' - GGATCC - 3'
   3' - CCTAGG - 5'
   (d) 5' - GAATTC - 3'
   3' - CTTAAG - 5
6. The sequence that controls the copy number of the linked DNA in the vector, is termed *[2020]*
   (a) Ori site
   (b) Palindromic sequence
   (c) Recognition site
   (d) Selectable marker
7. A selectable marker is used to : *[2019, Odisa]*
   (a) Mark a gene on a chromosome for isolation using restriction enzyme.
   (b) Help in eliminating the non-transformants, so that the transformants can be regenerated.
   (c) Identify the gene for a desired trait in an alien organism.
   (d) Select a suitable vector for transformation in a specific crop.
8. Given below are four statements pertaining to separation of DNA fragments using Gel electrophoresis. Identify the incorrect statements. *[2019, Odisa]*
   (i) DNA is negatively charged molecule and so it is loaded on gel towards the Anode terminal.
   (ii) DNA fragments travel along the surface of the gel whose concentration does not affect movement of DNA.
   (iii) Smaller the size of DNA fragment, larger is the distance it travels through it.
   (iv) Pure DNA can be visualised directly by exposing to UV radiation.
   Choose correct answer from the options given below :
   (a) (i), (ii) and (iv) (b) (i), (iii) and (iv)
   (c) (i), (ii) and (iii) (d) (ii), (iii) and (iv)
9. An enzyme catalysing the removal of nucleotides from ends of DNA is : *[2019, Odisa]*
   (a) Protease (b) DNA ligase
   (c) Endonuclease (d) Exonuclease
10. Match the following enzymes with their functions: *[2019, Odisa]*

	Column-I		Column-II
(A)	Restriction endonuclease	(i)	Joins the DNA fragments
(B)	Restriction exonuclease DNA	(ii)	Extends primers on genomic template
(C)	DNA ligase	(iii)	Cuts DNA at specific position
(D)	Tag polymerase	(iv)	Removes nucleotides from the ends of DNA

   Select the correct option from the following:
   (a) (A)-(ii), (B)-(iv), (C)-(i), (D)-(iii)
   (b) (A)-(iii), (B)-(i), (C)-(iv), (D)-(ii)
   (c) (A)-(iii), (B)-(iv), (C)-(i), (D)-(ii)
   (d) (A)-(iv), (B)-(iii), (C)-(i), (D)-(ii)
11. The two antibiotic resistance genes on vector pBR322 are for *[2019, Odisa]*
   (a) Tetracycline and Kanamycin
   (b) Ampicillin and Tetracycline
   (c) Ampicillin and Chloramphenicol
   (d) Chloramphenicol and Tetracycline
12. Which one of the following equipments is essentially required for growing microbes on a large scale, for industrial production of enzymes? *[2019]*
   (a) BOD incubator (b) Sludge digester
   (c) Industrial oven (d) Bioreactor
13. Following statements describe the characteristics of the enzyme Restriction Endonuclease. Identify the **incorrect** statement. *[2019]*
   (a) The enzyme cuts DNA molecule at identified position within the DNA.
   (b) The enzyme binds DNA at specific sites and cuts only one of the two strands.
   (c) The enzyme cuts the sugar-phosphate backbone at specific sites on each strand.
   (d) The enzyme recognizes a specific palindromic nucleotide sequence in the DNA.
14. Which of the following is commonly used as a vector for introducing a DNA fragment in human lymphocytes? *[2018]*
   (a) Retrovirus (b) Ti plasmid
   (c) pBR 322 (d) λ phage

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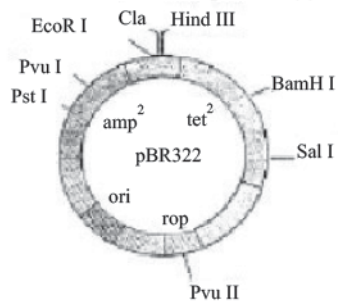
15. The correct order of steps in Polymerase Chain Reaction (PCR) is *[2018]*
    (a) Extension, Denaturation, Annealing
    (b) Annealing, Extension, Denaturation
    (c) Denaturation, Annealing, Extension
    (d) Denaturation, Extension, Annealing
16. The DNA fragments separated on an agarose gel can be visualised after staining with: *[2017]*
    (a) Acetocarmine (b) Aniline blue
    (c) Ethidium bromide (d) Bromophenol blue
17. A gene whose expression helps to identify transformed cell is known as : *[2017]*
    (a) Vector (b) Plasmid
    (c) Structural gene (d) Selectable marker
18. What is the criterion for DNA fragments movement on agarose gel during gel electrophoresis? *[2017]*
    (a) The smaller the fragment size, the farther it moves
    (b) Positively charged fragments move to farther end
    (c) Negatively charged fragments do not move
    (d) The larger the fragment size, the farther it moves
19. Which of the following is not a feature of the plasmids? *[2016]*
    (a) Independent replication
    (b) Circular structure
    (c) Transferable
    (d) Single - stranded
20. The taq polymerase enzyme is obtained from
    (a) *Thermus aquaticus* *[2016]*
    (b) *Thiobacillus ferroxidans*
    (c) *Bacillus subtilis*
    (d) *Pseudomonas putida*
21. Which of the following is a restriction endonuclease? *[2016]*
    (a) Hind II (b) Protease
    (c) DNase I (d) RNase
22. The cutting of DNA at specific locations became possible with the discovery of *[2015 RS]*
    (a) Probes
    (b) Selectable markers
    (c) Ligases
    (d) Restriction enzymes
23. The DNA molecule to which the gene of interest is integrated for cloning is called: *[2015 RS]*
    (a) Vector (b) Template
    (c) Carrier (d) Transformer
24. An analysis of chromosomal DNA using the Southern hybridization technique **does not** use:
    (a) Electrophoresis (b) Blotting *[2014]*
    (c) Autoradiography (d) PCR
25. Which vector can clone only a small fragment of DNA? *[2014]*
    (a) Bacterial artificial chromosome
    (b) Yeast artificial chromosome
    (c) Plasmid
    (d) Cosmid
26. During the process of isolation of DNA, chilled ethanol is added to *[NEET Kar. 2013]*
    (a) Remove proteins such as histones
    (b) Precipitate DNA
    (c) Break open the cell to release DNA
    (d) Facilitate action of restriction enzymes
27. The colonies of recombinant bacteria appear white in contrast to blue colonies of non-recombinant bateria because of: *[NEET 2013]*
    (a) Insertional inactivate of alphaga-lactosidase in non-recombinant bacteria
    (b) Insertional inactivation of alpha-galactosidase in recombinant bacteria
    (c) Inactivation of glycosidase enzyme in recombinant bacteria
    (d) Non-recombinant bacteria containing beta-galactosidase
28. Genes of interest can be selected from a genomic library by using *[NEET Kar. 2013]*
    (a) Restriction enzymes (b) Cloning vectors
    (c) DNA probes (d) Gene targets
29. The figure below is the diagrammatic representation of the *E.Coli* vector pBR 322. Which one of the given options correctly identifies its certain component (s)? *[2012]*



    (a) *ori* - original restriction enzyme
    (b) *rop*-reduced osmotic pressure
    (c) *Hind* III, *EcoRI* - selectable markers
    (d) amp^R, tet^R - antibiotic resistance genes

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30. A single strand of nucleic acid tagged with a radioactive molecule is called : *[2012]*
(a) Vector (b) Selectable marker
(c) Plasmid (d) Probe

31. Which one of the following represents a palindromic sequence in DNA? *[2012M]*
(a) 5' - GAATTC - 3'
3' - CTTAAG - 5'
(b) 5' - CCAATG - 3'
3' - GAATCC - 5'
(c) 5' - CATTAG - 3'
3' - GATAAC - 5'
(d) 5' - GATACC - 3'
3' - CCTAAG - 5'

32. Which one of the following techniques made it possible to genetically engineer living organism
(a) Recombinant DNA techniques *[2011M]*
(b) X-ray diffraction
(c) Heavier isotope labelling
(d) Hybridization

33. There is a restriction endonuclease called *EcoRI*. What does "co" part in it stand for? *[2011]*
(a) colon (b) coelom
(c) coenzyme (d) *coli*

34. Which one of the following is used as vector for cloning genes into higher organisms? *[2010]*
(a) Baculovirus
(b) *Salmonella typhimurium*
(c) *Rhizopus nigricans*
(d) Retrovirus

35. Which one of the following palindromic base sequences in DNA can be easily cut at about the middle by some particular restriction enzyme?
(a) 5'.....CGTTCG.....3' *[2010]*
3'.....ATGGTA.....5'
(b) 5'.....GATATG.....3'
3'.....CTACTA.....5'
(c) 5'.....GAATTC.....3'
3'.....CTTAAG.....5'
(d) 5'.....CACGTA.....3'
3'.....CTCAGT.....5'

36. DNA or RNA segment tagged with a radioactive molecule is called *[2010]*
(a) Vector (b) Probe
(c) Clone (d) Plasmid

37. Restriction endonucleases are enzymes which *[2010]*
(a) make cuts at specific positions within the DNA molecule
(b) recognize a specific nucleotide sequence for binding of DNA ligase
(c) restrict the action of the enzyme DNA polymerase
(d) remove nucleotides from the ends of the DNA molecule

38. Stirred tank bioreactors have been designed for *[2010]*
(a) addition of preservatives to the product
(b) purification of the product
(c) ensuring anaerobic conditions in the culture vessel
(d) availability of oxygen throughout the process

39. Polyethylene glycol method is used for *[2009]*
(a) biodiesel production
(b) seedless fruit production
(c) energy production from sewage
(d) gene transfer without a vector

40. Which one of the following is commonly used in transfer of foreign DNA into crop plants?
(a) *Meloidogyne incognita* *[2009]*
(b) *Agrobacterium tumefaciens*
(c) *Penicillium expansum*
(d) *Trichoderma harzianum*

41. The linking of antibiotic resistance gene with the plasmid vector became possible with *[2008]*
(a) DNA ligase (b) Endonucleases
(c) DNA polymerase (d) Exonucleases

42. Gel electrophoresis is used for *[2008]*
(a) cutting of DNA into fragments
(b) separation of DNA fragments according to their size
(c) construction of recombinant DNA by joining with cloning vectors
(d) isolation of DNA molecule

43. What is antisense technology? *[2008]*
(a) A cell displaying a foreign antigen used for synthesis of antigens
(b) Production of somaclonal variants in tissue cultures
(c) When a piece of RNA that is complementary in sequence is used to stop expression of a specific gene
(d) RNA polymerase producing DNA

44. Chromosomes in a bacterial cell can be 1 – 3 in number and *[2003]*
(a) can be circular as well as linear within the same cell
(b) are always circular
(c) are always linear
(d) can be either circular or linear, but never both within the same cell

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45. In bacteria, plasmid is *[2002]*
    (a) extra – chromosomal material
    (b) main DNA
    (c) non-functional DNA
    (d) repetitive gene
46. Introduction of food plants developed by genetic engineering is not desirable because *[2002]*
    (a) economy of developing countries may suffer
    (b) these products are less tasty as compared to the already existing products
    (c) this method is costly
    (d) there is danger of entry of viruses and toxins with introduced crop
47. Two bacteria found to be very useful in genetic engineering experiments are *[1998]*
    (a) *Escherichia* and *Agrobacterium*
    (b) *Nitrobacter* and *Azotobacter*
    (c) *Rhizobium* and *Diplococcus*
    (d) *Nitrosomonas* and *Klebsiella*
48. The plasmids pesent in the bacterial cells are *[1997]*
    (a) circular double helical DNA molecules
    (b) circular double helical RNA molecules
    (c) linear double helical DNA molecules
    (d) linear double helical RNA molecules.

Topic 2: Process of Recombinant DNA Technology

49. Choose the correct pair from the following *[2020]*
    (a) Polymerases – Break the DNA into fragments
    (b) Nucleases – Separate the two strands of DNA
    (c) Exonucleases – Make cuts at specific positions within DNA
    (d) Ligases – Join the two DNA molecules
50. DNA precipitation out of a mixture of biomolecules can be achieved by treatment with: *[2019]*
    (a) Isopropanol
    (b) Chilled ethanol
    (c) Methanol at room temperature
    (d) Chilled chloroform
51. The process of separation and purification of expressed protein before marketing is called:
    (a) Downstream processing *[2017]*
    (b) Bioprocessing
    (c) Postproduction processing
    (d) Upstream processing
52. *In vitro* clonal propagation in plants is characterized by: *[2014]*
    (a) PCR and RAPD
    (b) Northern blotting
    (c) Electrophoresis and HPLC
    (d) Microscopy
53. Commonly used vectors for human genome sequencing are: *[2014]*
    (a) T-DNA
    (b) BAC and YAC
    (c) Expression Vectors
    (d) kT/A Cloning Vectors
54. DNA fragments generated by the restriction endonucleases in a chemical reaction can be separated by : *[NEET 2013]*
    (a) Polymerase chain reaction
    (b) Electrophoresis
    (c) Restriction mapping
    (d) Centrifugation
55. PCR and Restriction Fragment Length Polymorphism are the methods for : *[2012]*
    (a) Study of enzymes
    (b) Genetic transformation
    (c) DNA sequencing
    (d) Genetic Fingerprinting
56. Which one is a **true** statement regarding DNA polymerase used in PCR *[2012]*
    (a) It is used to ligate introduced DNA in recipient cell
    (b) It serves as a selectable marker
    (c) It is isolated from a virus
    (d) It remains active at high temperature
57. For transformation, micro-particles coated with DNA to be bombarded with gene gun are made up of : *[2012]*
    (a) Silver or Platinum (b) Platinum or Zinc
    (c) Silicon or Platinum (d) Gold or Tungsten
58. Biolistics (gene-gun) is suitable for *[2012M]*
    (a) DNA finger printing.
    (b) Disarming pathogen vectors.
    (c) Transformation of plant cells.
    (d) Constructing recombinant DNA by joining with vectors.
59. In genetic engineering, the antibiotics are used
    (a) as selectable markers. *[2012M]*
    (b) to select healthy vectors.
    (c) to keep the cultures free of infection.
    (d) as sequences from where replication starts.

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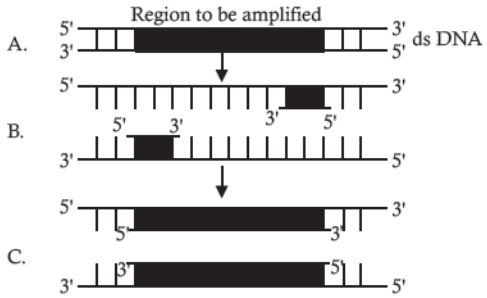
60. The figure below shows three steps (A, B, C) of Polymerase Chain Reaction (PCR). Select the option giving correct identification together with what it represents? *[2012M]*



(a) B - Denaturation at a temperature of about 98°C separating the two DNA strands.
(b) A - Denaturation at a temperature of about 50°C.
(c) C - Extension in the presence of heat stable DNA polymerase.
(d) A - Annealing with two sets of primers.

61. Agarose extracted from sea weeds finds use in: *[2011]*
(a) Spectrophotometry (b) Tissue culture
(c) PCR (d) Gel electrophoresis

62. What is true for plasmid? *[2001]*
(a) Plasmids are widely used in gene transfer
(b) These are found in virus
(c) Plasmid contains gene for vital activities
(d) These are main part of chromosome

63. In bacterial chromosomes, the nucleic acid polymers are *[1996]*
(a) linear DNA molecule
(b) circular DNA molecule
(c) of two types-DNA and RNA
(d) linear RNA molecule

64. The plasmid *[1995]*
(a) helps in respiration
(b) genes found inside nucleus
(c) is a component of cell wall of bacteria
(d) is the genetic part in addition to DNA in micro-organisms

65. Organelle/organoid involved in genetic engineering is *[1994]*
(a) plasmid (b) mitochondrion
(c) golgi apparatus (d) lomasome

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ANSWER KEY

1	(a)	8	(a)	15	(c)	22	(d)	29	(d)	36	(b)	43	(c)	50	(b)	57	(d)	64	(d)
2	(a)	9	(d)	16	(c)	23	(a)	30	(d)	37	(a)	44	(b)	51	(a)	58	(c)	65	(a)
3	(d)	10	(c)	17	(d)	24	(d)	31	(a)	38	(d)	45	(a)	52	(a)	59	(a)		
4	(c)	11	(b)	18	(a)	25	(c)	32	(a)	39	(d)	46	(d)	53	(b)	60	(c)		
5	(d)	12	(d)	19	(d)	26	(b)	33	(d)	40	(b)	47	(a)	54	(b)	61	(d)		
6	(a)	13	(b)	20	(a)	27	(d)	34	(d)	41	(a)	48	(a)	55	(d)	62	(a)		
7	(b)	14	(a)	21	(a)	28	(c)	35	(c)	42	(b)	49	(a)	56	(d)	63	(b)		

Hints & Solutions

1. (a) *Bacillus thuringiensis* is a source of Cry- proteins. *Thermus aquaticus* is a source of thermostable DNA polymerase (*Taq polymerase*) used in PCR. *Agrobacterium tumefaciens* is a cloning vector. The construction of 1st recombinant DNA molecule was performed using native plasmid of *Salmonella typhimurium*.

NOTES

The enzyme Taq polymerase was discovered by Thomas Brock's in 1969. The first recombinant DNA was constructed by Stanley Cohen and Herbert Boyer in 1972. They cut the piece of DNA from a plasmid carrying antibiotic resistance gene in the bacterium Salmonella typhimurium and linked it to the plasmid of Escherichia coli.

2. (a) The separated DNA fragments can be visualised only after staining the DNA with Ethidium bromide followed by exposure to UV radiation.
3. (d) Bt cotton is resistant to cotton bollworm (Insect pest). *cry* I Ac and *cry* II Ab genes have been introduced in cotton to protect it from cotton bollworm. This makes Bt cotton as biopesticide.
4. (c) Restriction endonucleases make cuts at specific positions within the DNA. They function by inspecting the length of a DNA sequence. Restriction endonuclease binds to the DNA and cut the two strands of double helix at specific points in their sugar-phosphate backbones. They are used in genetic engineering to form recombinant molecules of DNA. DNA ligases join the DNA fragments.

NOTES

The restriction enzyme prevents replication of the phage DNA by cutting it into many pieces. Restriction enzymes were named for their ability to restrict, or limit, the number of strains of bacteriophage that can infect a bacterium.

5. (d) The correct option is (d) because the specific palindromic sequence which is recognised by *Eco*RI is
5' - GAATTC - 3'
3' - CTTAAG - 5'

NOTES

EcoRI creates 4 nucleotide sticky ends with 5' end overhangs of AATT. The nucleic acid recognition sequence where the enzyme cuts is G/AATTC, which has a palindromic, complementary sequence of CTTAA/G.

6. (a) The correct option is (a) because *ori* sequence is responsible for controlling the copy number of the linked DNA in the vector. Ori *i.e.* origin of replication is responsible for initiation of replication.

NOTES

The high AT-content results in the low thermodynamic stability of the region which accounts for its role in the process of replication initiation. At the AT-rich regions, the initial DNA helix destabilization (opening) is induced by binding an initiator protein to its respective recognition sequences situated nearby.

7. (b) Selectable marker is a gene introduced into a cell, especially a bacterium or to cells in culture that confers a trait suitable for artificial selection. Selectable markers help in identification and elimination of non-transformants whilst permitting selective growth of transformants.
Note: Selectable marker genes are conditionally dominant genes that confer an ability to grow in the presence of applied selective agents that are normally toxic to plant cells or inhibitory to plant growth, such as antibiotics and herbicides. Genes that are frequently used to select transformed plant tissues include nptII, hpt, bar, and gox, that confer resistance to kanamycin, hygromycin, phosphinothricin, and glyphosate, respectively. Commonly used selectable marker systems include neomycin phosphotransferase, hygromycin phosphotransferase, phosphoinothricin acetyltransferase, and glyphosate oxidoreductase.

NOTES

Use of nptII in concert with the antibiotic kanamycin has become the most widely used selectable marker.

8. (a)
- DNA fragments are negatively charged molecules. They are separated by forcing them to move towards positive electrode i.e. anode.
- Increasing the concentration of a gel reduces the migration speed of DNA.
- DNA fragment can not be visualised directly but can be visualised under UV light after staining with ethidium bromide.

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9. (d) Restriction enzymes belong to a larger class of enzymes called nucleases. Nucleases are of two different kinds: exonucleases (which remove nucleotides from the end of a DNA molecule) and endonucleases (which break internal phosphodiester bonds at palindromic sites that are highly specific).
DNA ligase helps in ligating/joining DNA fragments. Proteases is an enzyme which breaks down proteins and peptides.

NOTES

DNA Polymerase I possesses a 3′→5′ exonuclease activity or "proofreading" function, which lowers the error rate during DNA replication, and also contains a 5′→3′ exonuclease activity, which enables the enzyme to replace nucleotides in the growing strand of DNA by nick translation.

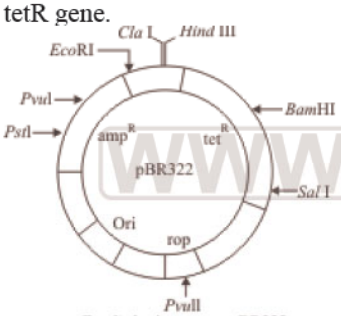
10. (c) Restriction endonuclease cleaves DNA in to fragments at or near specific recognition sites within the molecule known as restriction sites.
Restriction exonucleases cleave off nucleotides one at a time from the 3' or 5' ends of DNA and RNA chains.

DNA ligase facilitates the joining of DNA strands together by catalysing the formation of a phosphodiester bond.

Taq polymerase is a thermostable DNA polymerase I named after the thermophilic bacterium Thermus aquaticus from which it was originally isolated by Chien et al. in 1976. It attaches nucleotides to a DNA template, thereby copying the DNA.

11. (b) E.coli cloning vector pBR322 contains antibiotic resistance genes for Ampicillin (ampR) and Tetracycline (tetR) as selectable markers.

Selectable markers help in selecting those host cells which contain the transformed vectors and eliminate the non-transformants. Plasmid pBR322 has a variety of unique recognition sites for restriction endonucleases. Two unique sites—PstI and PvuI—are located within the ampR gene and BamHI and SalI are within the tetR gene.



E.coli cloning vector pBR322

NOTES

Insertion of the DNA fragment into the plasmid using enzyme PstI or PvuI places the DNA insert within the gene ampR, which makes ampR non-functional.

Bacterial cells containing such a recombinant pBR322 will be unable to grow in the presence of ampicillin but will grow on tetracycline

12. (d) To produce enzyme in large quantity, equipment required are bioreactors. Large scale production involves use of bioreactors.

Note: In 1990, Anderson and Schwarz licensed patents for the rotating wall bioreactor technology and founded Synthecon Inc. in Houston, Texas, to commercialize the device.

13. (b) A restriction enzyme or restriction endonuclease is an enzyme that cleaves DNA into fragments at or near specific recognition sites within molecules known as restriction sites. Restriction enzymes are one class of the broader endonuclease group of enzymes. Each restriction endonuclease functions by inspecting the length of a DNA sequence. Once it finds its specific recognition sequence, it will bind to the DNA and cut each of the two strands of the double helix at specific points in their sugar phosphate backbone. These enzymes predictably cut both strands because the sequences they recognize are palindromic. That is the recognition sequences of identical bases on both DNA strands.

14. (a) Retrovirus is a type of RNA virus that inserts a copy of its genome into the DNA of a host cell that it invades, thus changing the genome of that cell. Retrovirus is commonly used as vector for introducing a DNA fragment in human lymphocyte.

15. (c) PCR is based on three simple steps required for any DNA synthesis reaction: (i) denaturation of the template into single strands; (ii) annealing of primers to each original strand for new strand synthesis; and (iii) extension of the new DNA strands from the primers.

16. (c) Ethidium bromide (EtBr) is used to stain the DNA fragments and will appear as orange coloured bands when kept under UV light.

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NOTES

Ethidium bromide dye is most commonly used for the detection of DNA/ RNA. It is a DNA intercalating agent, inserting itself into the spaces between the base pairs of the double helix. It possesses UV absorbance maxima at 300 and 360 nm.

17. (d) Selectable markers in recombinant DNA technology, helps in identification and elimination of non-transformants and selectively permits the growth of the transformants.

18. (a) DNA fragments during gel electrophoresis, separate (resolve) according to their size due to sieving effect provided by agarose gel.

NOTES

Loading buffer is used in gel and SDS-PAGE electrophoresis in order to increases the density of the sample. DNA loading buffers contains a coloured dye and a density agent. The density agent serves to enhance the density of the DNA sample allowing the DNA to sink into the bottom of the well. The dye adds visibility to the DNA sample and also serves as a tracking dye allowing the user to monitor the DNA migration during electrophoresis.

19. (d) Plasmid is an extra chromosomal, double stranded circular DNA.
20. (a) The *Taq* polymerase enzyme is obtained from *Thermus aquaticus* which lives in hot springs.

NOTES
The function of Taq DNA polymerase in PCR is to amplify or synthesise DNA or gene of interest for various downstream application. It's a type of thermostable DNA polymerase, can work at higher temperature as well.

21. (a) A restriction enzyme or restriction endonuclease is an enzyme that cuts DNA at or near specific recognition nucleotide sequences known as restriction sites. *Hind* II among these is a type of restriction endonuclease.

NOTES
A restriction enzyme is a protein that recognizes a specific, short nucleotide sequence and cuts the DNA only at that specific site, which is known as restriction site or target sequence. More than 400 restriction enzymes have been isolated from the bacteria that manufacture them.

22. (d) Restriction enzymes are used to cut DNA at specific locations.
23. (a) A vector is a DNA molecule which is used as a vehicle to carry the gene of interest to another cell.
24. (d) PCR is a technique for enzymatically replicating DNA without using a living organism such as *E. coli* or Yeast. It is commonly used in medical and biological research labs for a variety of tasks like detection of hereditary diseases, identification of genetic fingerprints etc.

NOTES
Blotting is the transfer of the fragmented DNA sequence to the nitrocellulose membrane or nylon membrane. The process is done by either electroblotting or capillary blotting. The DNA molecule is saturated using a NaCl solution and permanently fixed using either UV radiation or drying.

25. (c) Plasmids are small extranuclear circular DNAs which carry extrachromosomal genes in bacteria and some fungi. They replicate independently. The best known vectors which are also available commerciallly are pBR322 and pUC-18.
26. (b) Ethanol is non-polar molecule while DNA is a polar molecule, it has a net negative charge due to the phosphate groups attached to it. When DNA is placed into a solution of 100% ethanol, it becomes insoluble and precipitates out of solution.

NOTES
The role of alcohol in DNA extraction is to precipitate DNA into a visible form. The salts neutralize the negative charge of the negatively charged phosphate in DNA and the isopropanol /ethanol removes the hydration shell of H2O molecules around the phosphate.

27. (d) Alternative selectable markers have been developed which differentiate recombinant from non-recombinants on the basis of their ability to produce colour in the presence of chromogenic substrate. In this , a recombinant DNA is inserted within the coding sequence of an enzyme β-galactosidase. This results into inactivation of the enzyme, which is referred to as **insertional inactivation**. The presence of chromogenic substrate give blue coloured colonies of the plasmid in the bacteria does not have an insert. Presence of insert results into insertional inactivation of the galactosidase and the colonies do not produce any colour, these are identified as recombinant colonies.

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NOTES
Insertional inactivation is a technique used in recombinant DNA technology and involves inactivation of a gene by inserting a fragment of DNA into the middle of its coding sequence.

28. (c) A hybridization probe is a fragment of DNA of variable length which is used in DNA samples to detect the presence of nucleotide sequence (the DNA target) that are complementary to the sequence in the probe. The probe hybridize to single–stranded DNA whose base sequence allow probe target base-pairing due to complementarity between the probe and target.
29. (d) In pBR 322
ori-represents site of origin or replication
rop-represents those proteins that take part in replication of plasmid.
Hind III, *EcoRI*- Recoginition sites of Restriction endonucleases
amp^R and tet^R - They are antibiotic resistant gene part

NOTES
The Rop protein (Repressor of Protein) is involved in stabilizing the interaction between RNA I and RNA II, which in turn prevents the replication of pBR322.

30. (d) A single strand DNA or RNA tagged with radioactive molecule that is used in hybridization of DNA or RNA is called **probe**.

NOTES Probe is used to locate specific alleles of genes and to screen patients for heritable conditions, drug responses or health risks.

31. (a) A palindromic sequence is a nucleic acid sequence (DNA or RNA) that is the same whether read 5' (five-prime) to 3' (three prime) on one strand or 5' to 3' on the complementary strand with which it forms a double helix.
5' - GAATTC - 3'
3' - CTTAAG - 5'
It is a palindromic sequence of DNA cut by restriction enzyme EcoRI.

32. (a) Recombinant DNA technology is the process of joining together two DNA molecules from two different species that are inserted into a host organism to produce new genetic combination.

33. (d) *EcoRI* is an endonuclease enzyme isolated from strains of *E.coli* and a part of restriction modified system. So *co* part stands for *coli*.

34. (d) Retrovirus has the ability to transform normal cells into cancerous cells. Hence, it can used as a vector for cloning desirable genes into animal cells.

35. (c) Palindromic sequences in DNA molecule are group of bases that forms the same sequence when read in both forward and backward direction. In the given question, only option (c) represent a palindromic sequence.

36. (b) DNA or RNA segment tagged with a radioactive molecule is called probe. They are used to detect the presence of complementary sequences in nucleic acid samples. Probes are used for identification and isolation of DNA and RNA.

37. (a) Restriction endonucleases are enzymes that makes cuts at specific positions within the DNA molecule. They acts as molecular scissors. They recognise specific base sequence at palindrome sites in DNA duplex and cut its strands.

38. (d) A stirred-tank bioreactor is a cylindrical or curved base to facilitate the mixing of the reaction content. It has been designed for availability of oxygen throughout the process.

39. (d) Direct gene transfer is the transfer of naked DNA into plant cells but the presence of rigid plant cell wall acts as a barrier to uptake. Therefore protoplasts are the favoured target for direct gene transfer. Polyethylene glycol mediated DNA uptake is a direct gene transfer method that utilizes the interaction between polyethylene glycol, naked DNA, salts and the protoplast membrane to effect transport of the DNA into the cytoplasm.

40. (b) *Agrobacterium tumefaciens* is the causal agent of crown gall disease (the formation of tumours) in over 140 species of dicot. This disease caused by a DNA plasmid (Ti plasmid) carried by bacterium and transferred to the plant cells. Ti plasmid has widely used in plant engineering as a vector in order to inject gene in host plant to form transgenic plant.

NOTES Crown gall infection is spread by movement of infested soil, by infected plant material, and via budding and grafting tools.

41. (a) The linking of antibiotic resistance gene with the plasmid vector became possible with DNA ligase. DNA ligase is an enzyme that is able to join together two portions of DNA and therefore plays an important role in DNA repair. DNA ligase is also used in recombinant DNA technology as it ensures that the foreign DNA is bound to the plasmid into which it is incorporated.

NOTES DNA ligase is an enzyme which can connect two strands of DNA together by forming a bond between the phosphate group of one strand and the deoxyribose group on another.

42. (b) Gel electrophoresis is a technique far separation of DNA fragments according to their size. DNA is negatively charged so in gel tank when electricity is passed, DNA move towards positive electrode.

43. (c) An RNA molecule whose base sequence is complementary to that of the RNA transcript of a gene, *i.e.* the sense RNA, such as a messenger RNA (mRNA). Hence, an antisense RNA can undergo base pairing with its complementary mRNA sequence. This blocks gene expression, either by preventing access for ribosome to translate the mRNA or by triggering degradation of the double stranded RNA by ribonuclease enzymes. Antisense RNA and DNA both have therapeutic potential for modifying the activity of disease causing genes.

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44. (b) Prokaryotes (bacteria) have only circular chromosomes.
45. (a) A plasmid is an independent, circular, self-replicating DNA molecule that carries only a few genes. The number of plasmids in a cell generally remains constant from generation to generation.

NOTES

Plasmids are semi-autonomous molecules and exist in cells as extra chromosomal genomes, although some plasmids can be inserted into a bacterial chromosome, where they become a permanent part of the bacterial genome.

46. (d) Plants developed by genetic engineering are called transgenic plants or genetically modified crops from which genetically modified food is produced. For their production micro-organisms (bacteria, virus) are used. So, by consuming them there is a danger of entry of viruses and toxins causing different types of allergies and other health hazards to human beings.
47. (a) *Escherichia* and *Agrobacterium* are both used as vectors in genetic engineering. *Nitrobacter* converts nitrites to nitrates. It is a free living nitrogen fixing bacteria. *Nitrosomonas* converts ammonia to nitrite. *Rhizobium* is a symbiotic nitrogen fixing bacteria living in the root nodules of leguminous plants. *Diplococcus pneumoniae* causes pneumonia.
48. (a) Plasmids are the extrachromosomal double stranded DNA.
49. (a) Ligases join the two DNA molecules. DNA **ligase** is an enzyme which can connect two strands of DNA together by forming a bond between the phosphate group of one strand and the deoxyribose group on another. It is used in cells to join together the Okazaki fragments which are formed on the lagging strand during DNA replication.

NOTES

DNA Ligase I Deficiency Leads to Replication-Dependent DNA Damage and Impacts Cell Morphology without Blocking Cell Cycle Progression.

50. (b) During the isolation of desired gene, chilled ethanol is used for the precipitation of DNA. Ethanol is used in DNA extraction to force the DNA to precipitate in a solution. In order to collect a DNA sample, cells are broken down through agitation, and then mixed with water, salt and ethanol to create an aqueous solution. Ethanol along with salt work to prevent the DNA from dissolving into the water, instead causing it to precipitate out so it can be separated and extracted using a centrifuge.

NOTES

Since DNA is insoluble in ethanol and isopropanol, the addition of alcohol, followed by centrifugation, will cause the DNA proteins to come out of the solution. When DNA concentration in the sample is heavy, the addition of ethanol will cause a white precipitate to form immediately.

51. (a) The various stages of processing that occur after the completion of fermentation or biosynthetic stage which include separation and purification of product called downstream processing.

NOTES

The most important objective in downstream processing is to maximize product recovery and, at the same time, minimize the cost of production.

52. (a) Now a days PCR and RAPD technique are used for the characterisation of *in vitro* clonal propagation in plants.

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NOTES

Random amplified polymorphic DNA (RAPD) is a PCR based technique for identifying genetic variation. It involves the use of a single arbitrary primer in a PCR reaction, resulting in the amplification of many discrete DNA products.

53. (b) Human genome sequencing is a process that determines the complete DNA sequence of an organism's genome at a single time. This requires sequencing all of an organism's chromosomal DNA as well as DNA contained in the mitochondria and, for plants, in the chloroplast. Commonly used vectors for human genome sequencing are BAC (Bacterial artificial chromosome) and YAC (Yeast artificial chromosome).

NOTES

A P1-derived artificial chromosome (PAC) is a DNA construct that was derived from the DNA of P1 bacteriophage.

54. (b) In a chemical reaction DNA fragments generated by restriction endonucleases, can be separated by gel electrophoresis. Since DNA fragments are negatively charged molecules, they can be separated by forcing them to

move towards the anode under an electric field through a medium/matrix. The DNA fragments separate according to their size through sieving effect provided by matrix.

55. (d) PCR and RFLP are the methods used for genetic fingerprinting. DNA fragmentation plays an important part in forensics, especially that of DNA profiling. Restriction fragment length polymorphism (RFLP) analyses the variable lengths of DNA fragments which are formed from the digestion of a DNA sample with a restriction endonuclease. They are then hybridized with DNA probes that bind to a complementary DNA sequence in the sample.

NOTES

In polymerase chain reaction (PCR), DNA sample is amplified from a single copy to millions of copies of DNA. It used to amplify a specific region of a DNA strand. Most PCR methods amplify DNA fragments of between 0.1 and 10 kilo base pairs (kb), although some techniques allow amplification of fragments up to 40 kb in size.

56. (d) The name of DNA polymerase used in PCR is *Taq* DNA polymerase extracted from a thermophilic bacteria. It is a relatively thermostable enzyme which is used in PCR during denaturation, which requires high temperature.

57. (d) For gene transfer into the host cell without using vector microparticles made of tungsten and gold coated with foreign DNA are bombarded into target cells at a very high velocity.

NOTES

The metal particles, usually gold or tungsten are used for coating in gene gun and are accelerated to high speed by the rapid release of high pressure helium in the gene gun into the target cells.

58. (c) Biolistic it is direct gene transferred method for constructing recombinant DNA. The gene gun was invented by John C. Sanford with Edward Wolf. A gene gun can be used to genetically infect cells or whole organisms with foreign DNA by aiming the barrel of the gun and firing. The microshot projectiles in the biolistic gene gun are made of microscopic (or nano) sized gold or platinum powders. These expensive powders are soaked in DNA or RNA (in raw or plasmid form) that are engineered for insertion into the genome of the cells or organisms under the gun.

59. (a) Antibiotics are powerful medicines that fight bacterial infections. They either kill bacteria or keep them from reproducing. In genetic engineering, the antibiotics are used as selectable markers.

60. (c) PCR is a technique for enzymatically replicating DNA without using a living organism such as *E. coli* or yeast.
The correct steps shown in the above figure are:
A – Denaturation at a temperature of about 94° to 98°C. During the denaturation, the double stranded DNA open to single stranded DNA, and all enzymatic reactions stop.
B – Annealing (binding of DNA primer to the separated strands. Occurs at 50° to 65°C, which is lower than the optimal temperature of the DNA polymerases)
C – Extension or elongation of the strands using the DNA primer with heat-stable DNA polymerases, most frequently *Taq* (*Thermus aquaticus*) at 72ºC.

NOTES

PCR is commonly used in medical and biological research labs for a variety of tasks like detection of hereditary diseases, identification of genetic fingerprints etc.

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61. (d) In gel electrophoresis agarose extracted from sea weed used as gel agarose, made of 0.7% gel show good resolution of large DNA and 2% gel will show good resolution of small fragments.

62. (a) Plasmids are small intranuclear circular DNAs which carry extra chromosomal genes in bacteria.

63. (b) Bacterial chromosomes comprises of circular DNA.

64. (d) The term 'plasmid' was introduced by Lederberg in 1952 for extragenomic DNA segment. It is a small circular molecule of DNA found in bacterial cell in addition to the larger circular bacterial DNA.

65. (a) Besides nuclear DNA, bacteria possesses extranuclear DNA (outside the nucleoid region) called as plasmid which can replicate independently. Due to this property plasmid holds great importance in genetic engineering. Plasmid can be taken out of bacteria and made to combine with desired DNA segment.

NOTES

A plasmid carrying DNA of other organism known as cosmid, can be introduced into any desired cell. This is the basis of genetic engineering.

34 Biotechnology and Its Applications

Trend Analysis with Important Topics & Sub-Topics

Topic	Sub-Topics	2020		2019		2018		2017		2016	
		Qns.	LOD	Qns.	LOD	Qns.	LOD	Qns.	LOD	Qns.	LOD
Biotechnological Applications in Agriculture	Genetically Modified Crops			1	A						
	Cotton bollworm	1	A	1	A						
	Genetically Modified Organisms	1	D								
Biotechnological Applications in Medicine	ADA deficiency	1	D								
	Recombinant insulin production	1	D								
Transgenic Animals/ Ethical Issues	Ethical Issues					2	A				
	Transgenic animals					1	A				

LOD - Level of Difficulty | E - Easy | A - Average | D - Difficult | Qns - No. of Questions

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Topic 1: Biotechnological Applications in Agriculture

1. In RNAi, the genes are silenced using : *[2019, Odisa]*
   (a) ds - DNA (b) ds - RNA
   (c) ss - DNA (d) ss - RNA
2. Which of the following is true for Golden rice? *[2019]*
   (a) It is vitamin A enriched, with a gene from daffodil.
   (b) It is pest resistant, with a gene from Bacillus thuringiensis.
   (c) It is drought tolerant, developed using Agrobacterium vector.
   (d) It has yellow grains, because of a gene introduced from a primitive variety of rice.
3. What triggers activation of protoxin to active Bt toxin of Bacillus thuringiensis in boll worm? *[2019]*
   (a) Body temperature
   (b) Moist surface of midgut
   (c) Alkaline pH of gut
   (d) Acidic pH of stomach
4. Which part of the tobacco plant is infected by *Meloidogyne incognita* ? *[2016]*
   (a) Flower (b) Leaf
   (c) Stem (d) Root
5. The crops engineered for glyphosate are resistant/ tolerant to : *[2015 RS]*
   (a) Bacteria (b) Insects
   (c) Herbicides (d) Fungi
6. In *Bt* cotton, the *Bt* toxin present in plant tissue as pro-toxin is converted into active toxin due to: *[2015 RS]*
   (a) Acidic pH of the insect gut
   (b) Action of gut micro-organisms
   (c) Presence of conversion factors in insect gut
   (d) Alkaline pH of the insect gut
7. Golden rice is a genetically modified crop plant where the incorporated gene is meant for biosynthesis of : *[2015 RS]*
   (a) Vitamin C (b) Omega 3
   (c) Vitamin A (d) Vitamin B

8. Pollen tablets are available in the market for:
   (a) *In vitro* fertilization **[2014]**
   (b) Breeding programmes
   (c) Supplementing food
   (d) *Ex situ* conservation
9. Which of the following *Bt* crops is being grown in India by the farmers? **[NEET 2013]**
   (a) Cotton (b) Brinjal
   (c) Soyabean (d) Maize
10. RNA interference involves **[NEET Kar. 2013]**
   (a) Synthesis of mRNA from DNA
   (b) Synthesis of cDNA from RNA using reverse transcriptase
   (c) Silencing of specific mRNA due to complementary RNA
   (d) Interference of RNA in synthesis of DNA
11. Consumption of which one of the following foods can prevent the kind of blindness associated with vitamin 'A' deficiency? **[2012]**
   (a) '*Flavr Savr*' tomato (b) Canolla
   (c) Golden rice (d) Bt-Brinjal
12. Tobacco plants resistant to a nematode have been developed by the introduction of DNA that produced (in the host cells) **[2012M]**
   (a) both sense and anti-sense RNA
   (b) a particular hormone
   (c) an antifeedant
   (d) a toxic protein
13. The most common substrate used in distilleries for the production of ethanol is **[2011]**
   (a) corn meal (b) soya meal
   (c) ground gram (d) molasses
14. The process of RNA interference has been used in the development of plants resistant to **[2011]**
   (a) nematodes (b) fungi
   (c) viruses (d) insects
15. Silencing of mRNA has been used in producing transgenic plants resistant to: **[2011M]**
   (a) bollworms (b) nematodes
   (c) white rusts (d) bacterial blights
16. Consider the following statements (A-D) about organic farming: **[2011M]**
   (A) Utilizes genetically modified crops like *Bt* cotton
   (B) Uses only naturally produced inputs like compost
   (C) Does not use pesticides and urea
   (D) Produces vegetables rich in vitamins and minerals

   Which of the above statements are correct?
   (a) (B), (C) and (D) (b) (C) and (D) only
   (c) (B) and (C) only (d) (A) and (B) only
17. *Bacillus thuringiensis* forms protein crystals which contain insecticidal protein that **[2011M]**
   (a) binds with epithelial cells of midgut of the insect pest ultimately killing it
   (b) is coded by several genes including the gene cry
   (c) is activated by acid pH of the foregut of the insect pest.
   (d) does not kill the carrier bacterium which is itself resistant to this toxin
18. The genetically-modified (GM) brinjal in India has been developed for: **[2010]**
   (a) insect-resistance
   (b) enhancing shelf life
   (c) enhancing mineral content
   (d) drought-resistance
19. Some of the characteristics of *Bt* cotton are: **[2010]**
   (a) long fibre and resistance to aphids
   (b) medium yield, long fibre and resistance to beetle pests
   (c) high yield and production of toxic protein crystals which kill dipteran pests
   (d) high yield and resistance to bollworms
20. What is **true** about *Bt* toxin? **[2009]**
   (a) *Bt* protein exists as active toxin in the *Bacillus*
   (b) The activated toxin enters the ovaries of the pest to sterilise it and thus prevent its multiplication.
   (c) The concerned *Bacillus* has antitoxins.
   (d) The inactive protoxin gets converted into active form in the insect gut.
21. The bacterium *Bacillus thuringiensis* is widely used in contemporary biology as **[2009]**
   (a) insecticide
   (b) agent for production of dairy products
   (c) source of industrial enzyme
   (d) indicator of water pollution
22. Main objective of production/use of herbicide resistant GM crops is to **[2008]**
   (a) eliminate weeds from the field without the use of manual labour
   (b) eliminate weeds from the field without the use of herbicides
   (c) encourage eco-friendly herbicides
   (d) reduce herbicide accumulation in food articles for health safety
23. Cry endotoxins obtained from *Bacillus thuringiensis* are effective against **[2008]**
   (a) mosquitoes (b) flies
   (c) nematodes (d) boll worms

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24. The name of Norman Borlaug is associated with: *[2005]*
(a) white revolution (b) green revolution
(c) yellow revolution (d) blue revolution

25. *Bacillus thuringiensis* (*Bt*) strains have been used for designing novel : *[2005]*
(a) Biofertilizers
(b) Bio-metallurgical techniques
(c) Bio-mineralization processes
(d) Bioinsecticidal plants

26. One of the most important reasons why wild plants should thrive is that they are good sources of
(a) highly nutritive animal feed *[2000]*
(b) unsaturated edible oils
(c) genes for resistance to disease and pests
(d) very rare and highly sought after fruits of medical importance

Topic 2: Biotechnological Applications in Medicine

27. Match the following columns and select the correct option. *[2020]*

	Column-I		Column-II
(a)	Bt cotton	(i)	Gene therapy
(b)	Adenosine deaminase deficiency	(ii)	Cellular defence
(c)	RNAi	(iii)	Detection of HIV infection
(d)	PCR	(iv)	*Bacillus thuringiensis*

	(A)	(B)	(C)	(D)
(a)	(iii)	(ii)	(i)	(iv)
(b)	(ii)	(iii)	(iv)	(i)
(c)	(i)	(ii)	(iii)	(iv)
(d)	(iv)	(i)	(ii)	(iii)

28. Which of the following statements is not correct? *[2020]*
(a) The proinsulin has an extra peptide called C-peptide.
(b) The functional insulin has A and B chains linked together by hydrogen bonds.
(c) Genetically engineered insulin is produced in *E.Coli.*
(d) In man insulin is synthesised as a proinsulin

29. Which of the following features of genetic code does allow bacteria to produce human insulin by recombinant DNA technology? *[2019]*
(a) Genetic code is not ambiguous
(b) Genetic code is redundant
(c) Genetic code is nearly universal
(d) Genetic code is specific

30. The first human hormone produced by recombinant DNA technology is: *[2014]*
(a) Insulin (b) Estrogen
(c) Thyroxin (d) Progesterone

31. Which one of the following vectors is used to replace the defective gene in gene therapy? *[NEET Kar. 2013]*
(a) Ti plasmid (b) Adenovirus
(c) Cosmid (d) Ri plasmid

32. The first clinical gene therapy was given for treating *[2012M]*
(a) chicken pox
(b) diabetes mellitus
(c) rheumatoid arthritis
(d) adenosine deaminase deficiency

33. Continuous addition of sugars in 'fed batch' fermentation is done to: *[2011]*
(a) produce methane (b) obtain antibiotics
(c) purify enzymes (d) degrade sewage

34. Consider the following statements about biomedical technologies? *[2008]*
1. During open heart surgery blood is circulated in the heart-lung machine
2. Blockage in coronary arteries is removed by angiography
3. Computerised axial tomography (CAT) shows detailed internal structure as seen in a section of body
4. X-ray provides clear and detailed images of organs like prostate glands and lungs

Which two of the above statements are correct?
(a) 2 and 4 (b) 3 and 4
(c) 1 and 3 (d) 1 and 2

35. Ultrasound of how much frequency is beamed into human body for sonography ? *[2007]*
(a) 15 - 30 MHZ (b) 1 - 15 MHZ
(b) 45 - 70 MHZ (d) 30 - 45 MHZ.

36. Maximum application of animal cell culture technology today is in the production of *[2003]*
(a) edible proteins (b) insulin
(c) interferons (d) vaccines

37. What is true for monoclonal antibodies? *[2001]*
(a) These antibodies obtained from one parent and for one antigen
(b) These antibodies obtained from parent and for two antigen
(c) These antibodies obtained from one parent and for many antigen
(d) These antibodies obtained from many parents and for many antigens

38. Genetically engineered bacteria have been successfully used in the commercial production of *[1996]*
(a) human insulin (b) testosterone
(c) thyroxine (d) melatonin

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Topic 3: Transgenic Animals/Ethical Issues

39. Exploration of molecular, genetic and species level diversity for novel products of economic importance is known as : *[2019, Odisa]*
(a) Bioprospecting (b) Biopiracy
(c) Bioenergetics (d) Bioremediation

40. Exploitation of bioresources of a nation by multinational companies without authorisation from the concerned country is referred to as *[2019, Odisa]*
(a) Biowar (b) Bioweapon
(c) Biopiracy (d) Bioethics

41. Use of bioresources by multinational companies and organisations without authorisation from the concerned country and its people is called *[2018]*
(a) Bio-infringement (b) Biopiracy
(c) Bioexploitation (d) Biodegradation

42. In India, the organisation responsible for assessing the safety of introducing genetically modified organisms for public use is *[2018]*
(a) Indian Council of Medical Research (ICMR)
(b) Council for Scientific and Industrial Research (CSIR)
(c) Genetic Engineering Appraisal Committee (GEAC)
(d) Research Committee on Genetic Manipulation (RCGM)

43. A 'new' variety of rice was patented by a foreign company, though such varieties have been present in India for a long time. This is related to *[2018]*
(a) Co-667 (b) Sharbati Sonora
(c) Basmati (d) Lerma Rojo

44. Which body of the Government of India regulates GM research and safety of introducing GM organisms for public services? *[2015 RS]*
(a) Indian Council of Agricultural Research
(b) Genetic Engineering Approval Committee
(c) Research Committee on Genetic Manipulation
(d) Bio-safety committee

45. Maximum number of existing transgenic animals is of : *[2011]*
(a) fish (b) mice
(c) cow (d) pig

46. Read the following four statements (A-D) about certain mistakes in two of them *[2011M]*
(A) The first transgenic buffalo, Rosie produced milk which was human alpha-lactal albumin enriched.
(B) Restriction enzymes are used in isolation of DNA from other macro-molecules.
(C) Downstream processing is one of the steps of r-DNA technology.
(D) Disarmed pathogen vectors are also used in transfer of r-DNA into the host.
Which are the two statements having mistakes?
(a) Statement (B) and (C)
(b) Statement (C) and (D)
(c) Statement (A) and (C)
(d) Statement (A) and (B)

47. Genetic engineering has been successfully used for producing: *[2010]*
(a) transgenic mice for testing safety of polio vaccine before use in humans
(b) transgenic models for studying new treatments for certain cardiac diseases
(c) transgenic cow – rosie which produces high fat milk for making ghee
(d) animals like bulls for farm work as they have super power

48. Transgenic plants are the ones: *[2009]*
(a) generated by introducing foreign DNA into a cell and regenerating a plant from that cell.
(b) produced after protoplast fusion in artificial medium.
(c) grown in artificial medium after hybridization in the field.
(d) produced by a somatic embryo in artificial medium.

49. A transgenic food crop which may help in solving the problem of night blindness in developing countries is *[2008]*
(a) Flavr Savr tomatoes (b) Starlink maize
(c) Bt Soybean (d) Golden rice

50. Golden rice is a transgenic crop of the future with the following improved trait : *[2006]*
(a) insect resistance
(b) high lysine (essential amino acid) content
(c) high protein content
(d) high vitamin-A content

51. Two microbes found to be very useful in genetic engineering are *[2006]*
(a) *Vibrio cholerae* and a tailed bacteriophage
(b) *Diplococcus* sp. and *Pseudomonas* sp.
(c) Crown gall bacterium and *Caenorhabditis elegans*
(d) *Escherichia coli* and *Agrobacterium tumefaciens*

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ANSWER KEY

1	(b)	6	(d)	11	(c)	16	(c)	21	(a)	26	(c)	31	(b)	36	(a)	41	(b)	46	(d)	51	(d)
2	(a)	7	(c)	12	(a)	17	(a)	22	(a)	27	(d)	32	(d)	37	(a)	42	(c)	47	(a)		
3	(c)	8	(c)	13	(d)	18	(a)	23	(d)	28	(b)	33	(c)	38	(a)	43	(c)	48	(a)		
4	(d)	9	(a)	14	(a)	19	(d)	24	(b)	29	(c)	34	(c)	39	(a)	44	(b)	49	(d)		
5	(c)	10	(c)	15	(b)	20	(d)	25	(d)	30	(a)	35	(b)	40	(c)	45	(b)	50	(d)		

Hints & Solutions

1. (b) RNAi (RNA interference) is triggered by double stranded RNA in a wide variety of organisms including animals, plants and fungi. It involves silencing of a specific mRNA and therefore the expression of a gene by formation of a dsRNA molecule. The dsRNA is formed by binding of a complementary RNA (anti-sense RNA) molecule to original mRNA thereby preventing translation of the original mRNA.

NOTES In 1998, the American scientists Andrew Fire and Craig Mello published their discovery of a mechanism that can degrade mRNA from a specific gene. This mechanism, RNA interference, is activated when RNA molecules occur as double-stranded pairs in the cell. Historically, RNAi was known by other names, including co-suppression, post-transcriptional gene silencing (PTGS), and quelling.

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2. (a) Golden rice is a form of rice with biosynthesis of beta-carotene (a form of vitamin A) which gives its golden or yellow colouring. It is considered a type of genetically modified rice (GMO) and a fortified food that is produced to combat a vitamin A deficiency in areas where this vitamin is scarce.

NOTES It was in the late 1990s that two European scientists developed Golden Rice after inserting beta carotene-enriched rice gene from daffodil to rice.

3. (c) *Bacillus thuringiensis* (Bt) is a Gram positive, spore-forming bacterium that synthesises parasporal crystalline inclusions containing CryIA and CryIIAb proteins, some of which are toxic against a wide range of insect orders (for example, moth larva that attacks the fruiting bodies of certain crop), nematodes and human-cancer cells.
These toxins are produced in inactive protoxins form but become activated when dissolve in the high alkaline pH of insect gut. Once ingested by insects, these crystals are solubilised in the midgut, the toxins are then proteolytically activated by midgut proteases and bind to specific receptors located in the insect cell membrane, leading to cell disruption and insect death.

4. (d) *Meloidogyne incognita* is a nematode (roundworm) in the family Heteroderidae. It is commonly called the "southern root-knot nematode" or the "cotton root-knot nematode".

5. (c) Today plants having the broad leaves are made resistant to a powerful bio-degradable herbicide glyphosate. It is an active ingredient of Round Up ready plants. It disturbs the working of EPSP synthetase enzyme. If it is taken up by crop plants they will die. So, the bioengineers have transferred gene for synthesis of EPSP synthetase enzyme to crop plants.

NOTES EPSP is 5-enolpyruvylshikimate-3-phosphate synthase a key enzyme for the biosynthesis of aromatic amino acids in plants and many microbes. EPSP synthase catalyzes the addition of phosphoenol pyruvate (PEP) to shikimate-3-phosphate (S3P), generating 5-enolpyruvylshikimate-3-phosphate, which is a precursor for phenylalanine and tyrosine.

6. (d) *Bt* toxin are solubilised in alkaline pH of the insect gut causing death.

NOTES

The Bt toxin protein exist as inactive protoxins but once an insect ingest the inactive toxin, it is converted into an active form of toxin due to the alkaline pH of the gut which solubilise the crystals. The activated toxin binds to the surface of midgut epithelial cells and creates pores that cause cell swelling and lysis and eventually cause death of the insect.

7. (c) Golden rice (*Oryza sativa*) is a genetically modified crop. It biosynthesizes β-carotene which is the precursor of vitamin-A.

NOTES

Golden Rice was engineered from normal rice by Ingo Potrykus and Peter Beyer in the 1990s to help improve human health. Golden Rice has an engineered multi-gene biochemical pathway in its genome. This pathway produces beta-carotene, a molecule that becomes vitamin A when metabolized by humans.

8. (c) Pollen grains are rich in nutrients therefore used as food supplements. Athletes and race horses use these tablets to enhance performance.

NOTES

Pollen contains 22.7% of protein on average, including 10.4% of essential amino acids such as methionine, lysine, threonine, histidine, leucine, isoleucine, valine, phenylalanine, and tryptophan. Along with this, it also contains sugars, lipids and sterols.

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9. (a) *Bt* cotton is being grown in India by the farmers. *Bt* cotton is pest resistant plant which could decreased the pesticides used. *Bt* toxin is produced by a bacterium *Bacillus thuringiensis* (*Bt* for short). *Bt* toxin gene has been cloned from the bacteria and been expressed in plants to provide resistance to insects without the need for insecticides.
10. (c) RNAi is a method of cellular defense in all eukaryotes. It is a system within living cells that helps to control the activity of specific genes. This method involves silencing of mRNA due to complementary double stranded RNA that prevents translation of target gene or mRNA (silencing). Source of dsRNA is **retrovirus** (having RNA genome) or **transposons** (mobile genetic material).
11. (c) Golden rice is vitamin A rich variety developed by rDNA technology and used in the treatment of vitamin A deficiency.
12. (a) In RNA interference technique, sense and antisense RNA are complimentary to each other which form dsRNA that silent the expression of mRNA of nematode. RNA interference is a novel strategy adopted to prevent infestation of nematode, *Meloidogyne incognita* in roots of tobacco plants.
13. (d) Molasses are commonly used in distillaries for the production of ethanol. The molasses is diluted to a mash containing 10-20 wt % of sugar. By the fermentation system of molasses ethanol can be produced.
14. (a) RNA interference has been used to develop plants, resistant to nematodes. RNA interference is a double stranded RNA (dsRNA) induced for gene silencing phenomenon.

NOTES

Gene silencing is the regulation of gene expression in a cell to prevent the expression of a certain gene. Gene silencing can occur during either transcription or translation and is often used in research.

15. (b) In this technique, nematode specific genes are introduced in the host plant in such a way that it produces both sense and antisense RNA. The two RNA's being complementary to each other from a double stranded RNA (dsRNA) which is also called interfering RNA responsible for initiating RNA interference (RNAi). This (dsRNA) bind to and prevent translation of specific mRNA of nematode (gene silencing). Thus, transgenic plants based on RNAi technology are resistant to nematode.
16. (c) Organic farming is the form of agriculture that relies on the techniques like crop rotation, green manure, compost and biological pest control.
17. (a) *Bacillus thuringiensis* produces a large amount of crystalline protein during sporulation. In the cell, toxins are formed along with the spore and are referred to as parasporal body. The bacteria are capable of entering the insect's blood and using the host insect to reproduce. The proteins from ingested spores are activated by gut high pH and the polypeptide toxins destroy gut epithelial cells and kill the pest.

18. (a) The genetically modified brinjal in India has been developed for insect resistance. *Bt* brinjal is a transgenic brinjal that is developed by inserting a crystal gene from the *Bacillus thuringiensis* into the brinjal's genome. This process of insertion is accomplished using *Agrobacterium* mediated recombination.
19. (d) *Bt* toxin genes were isolated from *Bacillus thuringiensis* which incorporated into cotton plant to form a genetically modified crop called *Bt* cotton. *Bt* cotton has high yield and resistance to bollworms.
20. (d) About *Bt* toxin, it is true, that the inactive protoxin gets converted into active form in the insect gut. There are several advantages in expressing *Bt* toxins in transgenic *Bt* crops. The level of toxin expression can be very high, thus delivering sufficient dosage to the pest.
    The toxin expression is contained within the plant system and hence only those insects that feed on the crop perish. The toxin expression can be modulated by using tissue-specific promoters and replaces the use of synthetic pesticides in the environment.
21. (a) The bacterium *Bacillus thuringiensis* is widely used in contemporary biology as insecticide. *Bacillus thuringiensis* (also known as *Bt*) is a Gram-positive, soil dwelling bacterium of the genus *Bacillus*. *Bacillus thuringiensis* produces a parasporal insecticidal crystal protein.

> **NOTES** Gram positive bacteria have a thick peptidoglycan layer and no outer lipid membrane whilst Gram negative bacteria have a thin peptidoglycan layer and have an outer lipid membrane.

22. (a) & (d) Main objective of production/use of herbicide resistant GM crops is to reduce herbicide accumulation in food articles for health safety. Fields of herbicide-resistant crops can be sprayed with herbicide such as glyphosate, weeds are killed by the herbicide while the crop is unaffected. So this reduces the herbicide accumulation in food articles for health safety. GM plants has been useful in many ways.

> **NOTES** Genetic modifications has made crops more tolerant to abiotic stresses, reduced reliance on chemical pesticides, enhanced nutritional value of food.

23. (d) *Cry* endotoxin obtained from *Bacillus thuringiensis* are effective against bollworms. A bollworm is a common term for any larva of a moth that attacks the fruiting bodies of certain crops, especially cotton.
24. (b) The term Green revolution refers to the very substantial increase in yield obtained by breeding high yielding varieties of crops, under intensive application of fertilizers, irrigation and pesticides. The world wide increase, in productivity has come to be known as the 'Green Revolution' for which Dr. Borlaug won the Noble Peace Prize in 1970.
25. (d) *Bt* cotton, a transgenic crop variety has been introduced in India. The *Bt* cotton variety contains a foreign gene obtained from *Bacillus thuringiensis*. This bacterial gene protects cotton from the boll worm, a major pest of cotton.
26. (c) Wild varieties have the genes for the resistance to disease and pests.
27. (d) The correct option is (d) because in Bt cotton the specific Bt toxin gene was isolated from *Bacillus thuringiensis*. The first clinical gene therapy was given in 1990 to a 4-year old girl with adenosine deaminase (ADA) deficiency. RNAi (RNA interference) takes place in all eukaryotic organisms as a method of cellular defense. PCR is now routinely used to detect HIV in suspected AIDS patients.

> **NOTES** The PCR helps to detect the low amount of DNA by amplifying that piece of DNA to form many copies. The amplified DNA can be then easily detected by using other testing procedures. This technique is used to detect infection at the early stage by amplifying the DNA of microbe.

28. (b) The correct option is (b) because functional insulin has A and B chains linked together by disulphide bridges.

> **NOTES** Insulin molecules have a tendency to form dimers in solution due to hydrogen-bonding between the C-termini of B chains.

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29. (c) In recombinant DNA technology bacteria are able to produce human insulin, used to treat diabetes because genetic code is nearly universal.

30. (a) Mammalian hormones were among the first products prepared in bacteria by r-DNA technology. Human insulin and human growth hormone are earliest examples.

31. (b) Adenovirus is non-enveloped dsDNA virus which cause respiratory diseases. Specific modifications on fibre proteins are used to target adenovirus to certain cell types, a major effort is made to limit hepatotoxicity and prevent multiple organ failure.

NOTES

Adenovirus is used as a vehicle to administer targeted therapy in the form of recombinant DNA or protein.

32. (d) Gene therapy is an experimental technique that uses genes to treat or prevent disease. Adenosine deaminase deficiency, also called ADA deficiency or ADA-SCID is an autosomal recessive metabolic disorder that causes immunodeficiency. ADA deficiency is due to a lack of the enzyme adenosine deaminase.

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NOTES

The first clinical gene therapy was given for treating adenosine deaminase deficiency. A four-year old girl became the first gene therapy patient on September 14, 1990 at the NIH Clinical Center.

33. (c) A fed batch is a biotechnological batch process which is based on feeding of a growth limiting nutrient substrate to culture. It is done for purifying enzymes.

34. (c) A modern hospital can make use of variety of sophisticated instruments and equipment of accurate diagnosis and treatment of diseases. Three main categories of instruments and equipments used are diagnostic, imaging and therapeutic.

From the above given statements, statement 1 & 3 are correct.

- During open heart surgery blood is circulated in the heart lung machine.
- Computerised Axial Tomography (CAT) shows detailed internal structure as seen in a section of body.

35. (b) Ultrasound imaging has frequency range 1 - 15 MHz which has become part of our lives in the last decade. We are now all familiar with the blurry black and white sonograms (ultrasound pictures) that show the unborn baby inside the mother's uterus. Although it may take a little imagination on our part to understand that a round circle is the baby's head, that does not prevent a proud mother-to-be from showing off her first baby picture.

36. (a) Monoclonal antibodies are formed by Hybridoma technology. They are formed by fusion of myeloma cells (antigen) and B-cells.

Note: Monoclonal antibodies are also used in immunotherapy for treatment of cancer because they help turn the immune system against cancer.

37. (a) Monoclonal antibodies are identical molecules specific for one type of antigen. These are obtained by injecting the target antigen into a rat or mouse. Sometimes later, the spleen cells producing antibodies are isolated and fused with myeloma cells to produce monoclonal antibodies.

38. (a) Human insulin has 53 amino acids in two polypeptides (A and B), connected by two S-S (disulphide) linkages. In 1983, American company Eli Lilly prepared two DNA sequences corresponding to A and B insulin chains. When introduced in plamids of *E.coli*, insulin chains were formed. They were extracted and fused to produce humulin (human insulin).

39. (a) Bioprospecting refers to exploring molecular, genetic and species level diversity for process of discovery and commercialisation of new products of economic importance.

NOTES

Bioprospection can be said to have two different sides. On one hand, the many bioprospecting activities provide opportunities to make human life better, e.g. the opium poppy gave us a pain reliever called morphine, the white willow tree helped us develop aspirin, our knowledge about spoiled sweet clover gave rise to a powerful anticoagulant called warfarin.While on the other hand, this activity poses a threat to biodiversity because it provides opportunities for biopiracy.

40. (c) Biopiracy refer to the use of bio-resources by multinational companies and other organisations without proper authorisation from the countries and people concerned without compensatory payment.

Biowar/warfare in which disease-producing microorganism, toxins, or organic biocides (*e.g*. Bacillus anthracis or *Yersinia pestis)* used to destroy, injure or immobilise livestock, vegetation, or human life.

Bioweapon are harmful biological agents (such as a pathogenic microorganisms or a neurotoxin) used as a weapon to cause death or disease usually on a large scale.

Bioethics is the study of the ethical issues emerging from advances in biology and medicine.

41. (b) Biopiracy refers to the use of bioresources by multinational companies and other organisation without proper authorisation from the countries and people concerned with compensatory payment.

42. (c) Indian Government has setup organisation such as GEAC (Genetic Engineering Appraisal Committee) which will make decisions regarding the validity of GM research and safety of introducing GM-organism for public services.

NOTES

The Genetic Engineering Appraisal Committee (GEAC) functions in the Ministry of Environment, Forest and Climate Change (MoEF&CC). As per Rules, 1989, it is responsible for appraisal of activities involving large scale use of hazardous microorganisms and recombinants in research and industrial production from the environmental angle. The committee is also responsible for appraisal of proposals relating to release of genetically engineered (GE) organisms and products into the environment including experimental field trials. GEAC is chaired by the Special Secretary/ Additional Secretary of MoEF&CC and co-chaired by a representative from the Department of Biotechnology (DBT). Presently, it has 24 members and meets every month to review the applications in the areas indicated above.

43. (c) In 1997, an American company got patent rights on Basmati rice through the US patent and trademark office that was actually been derived from Indian farmer's varieties. The diversity of rice in India is one of the richest in the world, 27 documented varieties of Basmati are grown in India.

NOTES

Indian basmati was crossed with semi-dwarf varieties and claimed as an invention or a novelty. Sharbati sonora and Lerma Rojo are varieties of wheat.

44. (b) Genetic Engineering Approval Committee is the body of Government of India. It regulates GM research and safety of introducing GM organisms for public service in the country.

45. (b) In the world maximum number of existing transgenic animals is mice.

46. (d) Transgenic Rosie is actually cow. Restriction enzymes cut the DNA at specific sites.

47. (a) Genetic engineering has been successfully used for producing transgenic mice. Many transgenic mice are designed to increase our understanding of how genes contribute to development of diseases.

For example transgenic mice are being used to test the safety of polio vaccine.

NOTES

Transgenic mice are being developed for use in testing the safety of vaccine before they are used in human beings.

48. (a) Transgenic plants are the ones generated by introducing foreign DNA into a cell and regenerating a plant from that cell.

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49. (d) Golden rice is a transgenic food crop which may help in solving the problem of night blindness in developing countries. Golden rice or miracle rice is rich in vitamin A or β-carotene and iron.

NOTES

Decaffeinated coffee are also valuable achievements of gene transfer technology.

50. (d) Golden rice is a transgenic crop of the future with high Vit. A content. Millions of people suffer from Vit. A deficiency which leads to vision impairment. Transgenic rice has been developed which is capable of synthesizing beta carotene, the precursor of Vitamin A. The transgenic rice variety is now being crossed with adapted varieties through field tests to make them grow in an year or two.

51. (d) *Escherichia coli* is a bacterium found in human colon. On this bacterium scientists have made extensive genetic experiments to make some vital chemicals like insulin. Another bacterium is *Agrobacterium tumefaciens* which causes crown gall in plants is extensively used for genetic experiments.

35 Organisms and Populations

Trend Analysis with Important Topics & Sub-Topics

Topic	Sub-Topics	2020		2019		2018		2017		2016	
		Qns.	LOD	Qns.	LOD	Qns.	LOD	Qns.	LOD	Qns.	LOD
Organism & Its Environment	Major Biomes							1	A		
Population Attributes/ Population Growth/ Population Interactions	Logistic Growth Curve							1	A	1	A
	Mutualism							1	A		
	Population Interaction	1	A	1	D	2	A			1	A
	Population density	1	A			1	A				
	Growth Curve	1	A								
	Age Pyramids					1	A				

LOD - Level of Difficulty | E - Easy | A - Average | D - Difficult | Qns - No. of Questions

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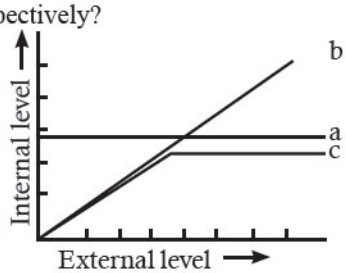
Topic 1 : Organism & Its Environment

1. The process of growth is maximum during *[2020]*
   (a) Lag phase
   (b) Senescence
   (c) Dormancy
   (d) Log phase
2. Which one of these animals is not a homeotherm? *[2018]*
   (a) *Macropus* (b) *Chelone*
   (c) *Psittacula* (d) *Camelus*
3. Presence of plants arranged into well defined vertical layers depending on their height can be seen best in: *[2017]*
   (a) Tropical Rain Forest
   (b) Grassland
   (c) Temperate Forest
   (d) Tropical Savannah
4. Most animals are tree dwellers in a: *[2015 RS]*
   (a) Thorn woodland
   (b) Temperate deciduous forest
   (c) Tropical rain forest
   (d) Coniferous forest
5. Benthic organisms are affected most by *[NEET Kar. 2013]*
   (a) Water-holding capacity of soil
   (b) Light reaching the forest floor
   (c) Surface turbulence of water
   (d) Sediment characteristics of aquatic ecosystems
6. Which one of the following is **not** a parasitic adaptation? *[NEET Kar. 2013]*
   (a) Loss of unnecessary sense organs
   (b) Development of adhesive organs
   (c) Loss of digestive organs
   (d) Loss of reproductive capacity
7. Large woody vines are more commonly found in : *[2011]*
   (a) temperate forest
   (b) mangroves
   (c) tropical rainforests
   (d) alpine forests

8. Consider the following four conditions (i) - (iv) and select the correct pair of them as adaptation to environment in desert lizards. The conditions : ***[2011]***
   (i) Burrowing in soil to escape high temperature
   (ii) Losing heat rapidly from the body during high temperature
   (iii) Bask in sun when temperature is low
   (iv) Insulating body due to thick fatty dermis
   Options :
   (a) (iii), (iv) (b) (i) and (iii)
   (c) (ii), (iv) (d) (i), (ii)
9. Which one of the following statements is correct for secondary succession ? ***[2011]***
   (a) It begins on a bare rock.
   (b) It occurs on a deforested site.
   (c) It follows primary succession.
   (d) It is similar to primary succession except that it has a relatively fast pace.
10. The logistic population growth is expressed by the equation: ***[2011M]***
   (a) $dt/dN = Nr\left(\frac{K-N}{K}\right)$
   (b) $dN/dt = rN\left(\frac{K-N}{K}\right)$
   (c) $dN/dt = rN$
   (d) $dN/dt = rN\left(\frac{N-K}{N}\right)$
11. The figure given below is a diagrammatic representation of response of organisms to abiotic factors. What do a, b and c represent respectively? ***[2010]***



	(i)	(ii)	(iii)
(a)	conformer	regulator	partial regulator
(b)	regulator	partial regulator	conformer
(c)	partial regulator	regulator	conformer
(d)	regulator	conformer	partial regulator

12. Consider the following four statements (a-d) about certain desert animals such as kangaroo rat. ***[2008]***
   (1) They have dark colour and high rate of reproduction and excrete solid urine
   (2) They do not drink water, breathe at a slow rate to conserve water and have their body covered with thick hairs
   (3) They feed on dry seeds and do not require drinking water
   (4) They excrete very concentrated urine and do not use water to regulate body temperature
   Which two of the above statements for such animals are true? ***[2008]***
   (a) 3 and 4 (b) 2 and 3
   (c) 3 and 1 (d) 1 and 2
13. Which one of the following pairs is **mismatched**? ***[2005]***
   (a) Tundra - Permafrost
   (b) Savanna - *Acacia* trees
   (c) Prairie - Epiphytes
   (d) Coniferous forest - Evergreen trees
14. All of the following statements concerning the Actinomycetes filamentous soil bacterium *Frankia* are correct except that *Frankia* : ***[2005]***
   (a) Can induce root nodules on many plant species
   (b) Cannot fix nitrogen in the free-living state.
   (c) Forms specialized vesicles in which the nitrogenase is protected from oxygen by a chemical barrier involving triterpene hopanoids
   (d) Like *Rhizobium*, it usually infects its host plant through root hair deformation and stimulates cell proliferation in the host's cortex
15. What is a keystone species ? ***[2004]***
   (a) A species which makes up only a small proportion of the total biomass of a community, yet has a huge impact on the community's organization and survival

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(b) A common species that has plenty of biomass, yet has a fairly low impact on the community's organization
(c) A rare species that has minimal impact on the biomass and on other species in the community
(d) A dominant species that constitutes a large proportion of the biomass and which affects many other species.

16. In which one of the following habitats does the diurnal temperature of soil surface vary most? *[2004]*
(a) Shrub land (b) Forest
(c) Desert (d) Grassland

17. Diffuse porous woods are characteristic of plants growing in *[2003]*
(a) tropics (b) alpine region
(c) cold winter regions (d) temperate climate

18. In which one of the following is nitrogen not a constituent ? *[2003]*
(a) Pepsin (b) Idioblast
(c) Bacteriochlorophyll (d) Invertase

19. Cause of mimicry is *[2002]*
(a) concealment (b) attack (offence)
(c) protection (defence) (d) both (b) and (c)

20. Which part of the world has a high density of organisms? *[1999]*
(a) Grasslands
(b) Savannahs
(c) Deciduous forests
(d) Tropical rain forests

21. Plants such as *Prosopis, Acacia* and *Capparis* represent examples of tropical *[1998]*
(a) thorn forests (b) deciduous forests
(c) evergreen forests (d) grasslands

22. Which of the following communities is more vulnerable to invasion by outside animals and plants ? *[1998]*
(a) Tropical evergreen forests
(b) Oceanic island communities
(c) Mangroves
(d) Temperate forests.

23. Species occurring in different geographical areas are called as *[1998]*
(a) sibling (b) sympatric
(c) allopatric (d) neopatric

24. Keystone species in an ecosystem are those *[1997]*
(a) present in maximum number
(b) that are most frequent
(c) attaining a large biomass
(d) contributing to ecosystem properties

25. The high boiling point of water is advantageous to living organisms because *[1997]*
(a) the environment seldom reaches the boiling point of water
(b) organisms can easily boil off enough water to keep themselves cool
(c) it allows organisms to spread heat evenly throughout their bodies
(d) organisms can absorb a great deal of heat before they reach the boiling point from organisms and population

26. Which of the following pairs is correctly matched? *[1995]*
(a) uricotelism - aquatic habitat
(b) parasitism - intra-specific relationship
(c) excessive perspiration - xeric adaptation
(d) stream lined body - aquatic adaptation

27. Desert plants are generally *[1995]*
(a) viviparous (b) succulent
(c) herbaceous (d) heterophyllus

28. Xeric environment is characterised by *[1994]*
(a) precipitation
(b) low atmospheric humidity
(c) extremes of temperature
(d) high rate of vapourisation

29. Animals that can tolerate a narrow range of salinity are *[1994]*
(a) stenohaline (b) euryhaline
(c) anadromous (d) catadromous

30. Tropical forests occur in India *[1994]*
(a) Jammu and Kashmir
(b) Rajasthan
(c) Kerala and Assam
(d) The forests do not occur in India

31. Soil best suited for plant growth is *[1993]*
(a) clay (b) loam
(c) sandy (d) gravel

32. A fertile agricultural soil appears deep coloured at the surface as compared to soil one metre down. The reason for colour of top soil is
(a) more moisture *[1992]*
(b) rich in organic matter
(c) rich in iron, calcium and magnesium
(d) recent formation

33. Soil particles determine its *[1992]*
(a) texture
(b) field capacity
(c) water holding capacity
(d) soil flora

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34. Homeostasis is *[1991]*
    (a) tendency of biological systems to change with change in environment
    (b) tendency of biological systems to resist change
    (c) disturbance of self regulatory system and natural controls
    (d) biotic materials used in homeopathic medicines.
35. Deep black soil is productive due to high proportion of *[1991]*
    (a) sand and zinc
    (b) gravel and calcium
    (c) clay and humus
    (d) silt and earthworm

Topic 2 : Population Attributes/Population Growth/Population Interactions

36. Secondary metabolites such as nicotine, strychnine and caffeine are produced by plants for their *[2020]*
    (a) Growth response
    (b) Defence action
    (c) Effect on reproduction
    (d) Nutritive value
37. Which of the following is not an attribute of a population? *[2020]*
    (a) Natality (b) Mortality
    (c) Species interaction (d) Sex ratio
38. Between which among the following, the relationship is *not* an example of commensalism? *[2019, Odisha]*
    (a) Female wasp and fig species
    (b) Orchid and the tree on which it grows
    (c) Cattle egret and grazing cattle
    (d) Sea anemone and clown fish
39. Which of the following shows whorled phyllotaxy? *[2019, Odisha]*
    (a) *Calotropis* (b) Mustard
    (c) China rose (d) *Alstonia*
40. Carnivorous animals - lions and leopards, occupy the same niche but lions predate mostly larger animals and leopards take smaller ones. This mechanism of competition is referred to as– *[2019, Odisha]*
    (a) Competitive exclusion
    (b) Character displacement
    (c) Altruism
    (d) Resource partitioning
41. Match Column-I with Column-II. *[2018]*

Column-I	Column-II
(A) Saprophyte	(i) Symbiotic association of fungi with plant roots
(B) Parasite	(ii) Decomposition of dead organic materials
(C) Lichens	(iii) Living on living plants or animals
(D) Mycorrhiza	(iv) Symbiotic association of algae and fungi

Choose the correct answer from the options given below:

	(A)	(B)	(C)	(D)
(a)	(i)	(ii)	(iii)	(iv)
(b)	(iii)	(ii)	(i)	(iv)
(c)	(ii)	(i)	(iii)	(iv)
(d)	(ii)	(iii)	(iv)	(i)

42. In a growing population of a country, *[2018]*
    (a) pre-reproductive individuals are more than the reproductive individuals.
    (b) reproductive individuals are less than the post-reproductive individuals.
    (c) pre-reproductive individuals are less than the reproductive individuals.
    (d) reproductive and pre-reproductive individuals are equal in number.
43. Which one of the following population interactions is widely used in medical science for the production of antibiotics? *[2018]*
    (a) Commensalism (b) Mutualism
    (c) Amensalism (d) Parasitism
44. Which one of the following plants shows a very close relationship with a species of moth, where none of the two can complete its life cycle without the other? *[2018]*
    (a) *Hydrilla* (b) *Yucca*
    (c) *Viola* (d) Banana
45. World Ozone Day is celebrated on *[2018]*
    (a) 5th June (b) 21st April
    (c) 22nd April (d) 16th September
46. Asymptote in a logistic growth curve is obtained when : *[2017]*
    (a) K = N
    (b) K > N
    (c) K < N
    (d) The value of 'r' approaches zero

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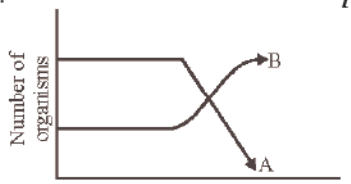
47. Mycorrhizae are the example of: *[2017]*
(a) Amensalism (b) Antibiosis
(c) Mutualism (d) Fungistasis

48. Gause's principle of competitive exclusion states that : *[2016]*
(a) more abundant species will exclude the less abundant species through competition.
(b) competition for the same resources excludes species having different food preferences.
(c) no two species can occupy the same niche indefinitely for the same limiting resources.
(d) larger organisms exclude smaller ones through competition.

49. When does the growth rate of a population following the logistic model equal zero ? The logistic model is given as $dN/dt = rN(1-N/K)$
(a) when N/K is exactly one. *[2016]*
(b) when N nears the carrying capacity of the habitat.
(c) when N/K equals zero.
(d) when death rate is greater than birth rate.

50. In which of the following interactions both partners are adversely affected ? *[2015 RS]*
(a) Predation (b) Parasitism
(c) Mutualism (d) Competition

51. The following graph depicts changes in two populations (A and B) of herbivores in a grassy field. A possible reason for these changes is that: *[2015 RS]*



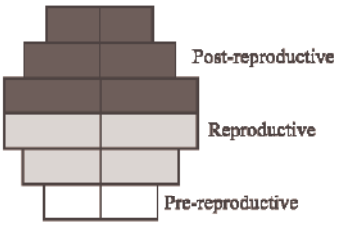
(a) Population B competed more successfully for food than population A
(b) Population A produced more offspring than population B
(c) Population A consumed the members of population B
(d) Both plant populations in this habitat decreased

52. A sedentary sea anemone gets attached to the shell lining of hermit crab. The association is : *[NEET 2013]*
(a) Symbiosis (b) Commensalism
(c) Amensalism (d) Ectoparasitism

53. A biologist studied the population of rats in a barn. He found that the average natality was 250, average mortality 240, immigration 20 and emigration 30. The net increase in population is : *[NEET 2013]*
(a) 15 (b) 05
(c) Zero (d) 10

54. *Cuscuta* is an example of *[2012M]*
(a) ectoparasitism (b) brood parasitism
(c) predation (d) endoparasitism

55. What type of human population is represented by the following age pyramid? *[2011]*



(a) Vanishing population
(b) Stable population
(c) Declining population
(d) Expanding population

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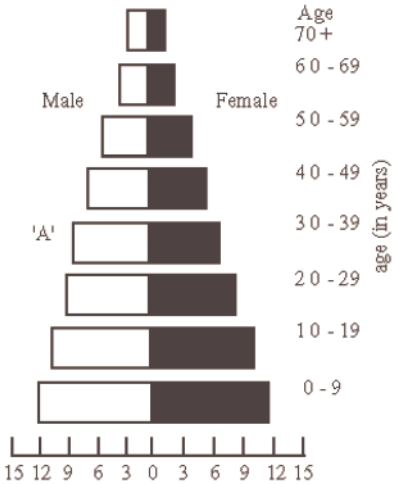
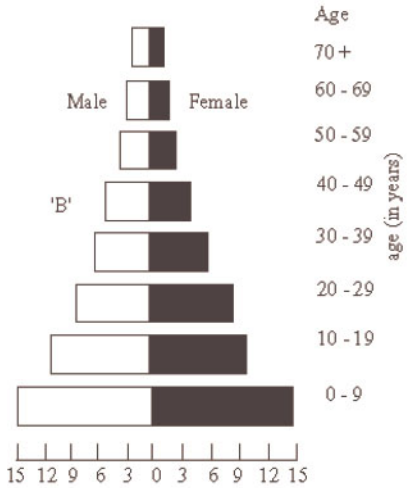
56. Which one of the following is one of the characteristics of a biological community? *[2010]*
(a) Stratification (b) Natality
(c) Mortality (d) Sex ratio

57. A country with a high rate of population growth took measures to reduce it. The Figure below shows age-sex pyramids of populations A and B twenty years apart. *[2009]*





Select the **correct** interpretation about them: Interpretations:

(a) "B" is earlier pyramid and shows stabilised growth rate.
(b) "B" is more recent showing that population is very young
(c) "A" is the earlier pyramid and no change has occurred in the growth rate.
(d) "A" is more recent and shows slight reduction in the growth rate.

58. What is true about the isolated small tribal populations? *[2008]*
(a) There is a decline in population as boys marry girls only from their own tribe.
(b) Hereditary diseases like colour blindness do not spread in the isolated population.
(c) Wrestlers who develop strong body muscles in their life time pass this character on to their progeny.
(d) There is no change in population size as they have a large gene pool.

59. Geometric representation of age structure is a characteristic of *[2007]*
(a) population (b) landscape
(c) ecosystem (d) biotic community.

60. The population of an insect species shows an explosive increase in numbers during rainy season followed by its disappearance at the end of the season. What does this show? *[2007]*
(a) The food plants mature and die at the end of the rainy season
(b) Its population growth curve is of J-type
(c) The population of its predators increases enormously
(d) S-shaped or sigmoid growth of this insect.

61. Two plants can be conclusively said to belong to the same species if they *[2007]*
(a) have more than 90 per cent similar genes
(b) look similar and possess identical secondary metabolites
(c) have same number of chromosomes
(d) can reproduce freely with each other and form seeds.

62. A high density of elephant population in an area can result in *[2007]*
(a) intra specific competition
(b) inter specific competition
(c) predation on one another
(d) mutualism.

63. Niche overlap indicates *[2006]*
(a) two different parasites on the same host
(b) sharing of one or more resources between the two species
(c) mutualism between two species
(d) active cooperation between two species

64. The formula for exponential population growth is *[2006]*
(a) dN/rN = dt (b) rN / dN = dt
(c) dN / dt = rN (d) dt / dN = rN

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65. Praying mantis is a good example of *[2006]*
(a) warning colouration (b) social insects
(c) camouflage (d) mullerian mimicry

66. People living at sea level have around 5 million RBC per cubic millimeter of their blood whereas those living at an altitude of 5400 metres have around 8 million. This is because at high altitude *[1995, 2006]*
(a) atmospheric O_2 level is less and hence more RBCs are needed to absorb the required amount of O_2 to survive
(b) there is more UV radiation which enhances RBC production
(c) people eat more nutritive food, therefore more RBCs are formed
(d) people get pollution - free air to breathe and more oxygen is available

67. Which of the following is not true for a species? *[2005]*
(a) Members of a species can interbreed.
(b) Gene flow does not occur between the populations of a species.
(c) Each species is reproductively isolated from every other species.
(d) Variations occur among members of a species.

68. The maximum growth rate occurs in *[2004]*
(a) stationary phase
(b) senescent phase
(c) lag phase
(d) exponential phase

69. Certain characteristic demographic features of developing countries are *[2004]*
(a) high fertility, low or rapidly falling mortality rate, rapid population growth and a very young age distribution
(b) high fertility, high density, rapidly rising mortality rate and a very young age distribution
(c) high infant mortality, low fertility, uneven population growth and a very young age distribution
(d) high mortality, high density, uneven population growth and a very old age distribution

70. Two opposite forces operate in the growth and development of every population. One of them relates to the ability to reproduce at a given rate. The force opposing it is called *[2003]*
(a) environmental resistance
(b) morbidity
(c) fecundity
(d) biotic potential

71. In a population unrestricted reproductive capacity is called as *[2002]*
(a) biotic potential
(b) fertility
(c) carrying capacity
(d) birth rate

72. Choose the correct sequence of stages of growth curve for bacteria *[2002]*
(a) Lag, log, stationary, decline phase
(b) Lag, log, stationary phase
(c) Stationary, lag, log, decline phase
(d) Decline, lag, log phase

73. The semilog of per minute growing bacteria is plotted against time. What will be the shape of graph? *[2002]*
(a) Sigmoid
(b) Hyperbolic
(c) Ascending straight line
(d) Descending straight line

74. Which of the following is a correct pair? *[2002]*
(a) *Cuscuta* – parasite
(b) *Dischidia* – insectivorous
(c) *Opuntia* – predator
(d) *Capsella* – hydrophyte

75. Choose the correct match. *[2002]*
(a) *Trapa, Dionaea, Drosera*
(b) *Nepenthes ,Utricularia, Vanda*
(c) *Utricularia, Drosera , Dionaea*
(d) *Dionaea, Trapa, Vanda*

76. Which type of association is found in between entomophilous flower and pollinating agent? *[2002]*
(a) mutualism (b) commensalism
(c) cooperation (d) co-evolution

77. Exponential growth of cells is a characteristic feature of *[1999]*
(a) tissue culture cells
(b) multicellular organisms
(c) unicellular organisms
(d) embryo

78. A pair of insectivorous plants is *[1999]*
(a) *Drosera* and *Rafflesia*
(b) *Nepenthes* and Bladderwort
(c) *Dionaea* and *Viscum*
(d) Venus fly trap and *Rafflesia*

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79. An interesting modification of flower shape for insect pollination occurs in some orchids in which a male insect mistakes the pattern on the orchid flower for the female of his species and tries to copulate with it, thereby pollinating the flower. This phenomenon is called *[1998]*
(a) mimicry
(b) pseudopollination
(c) pseudocopulation
(d) pseudoparthenocarpy

80. In increasing order of organizational complexity, which one of the following is the correct sequence? *[1997]*
(a) Population, species, community, ecosystem
(b) Population, variety, species, ecosystem
(c) Population, ecosystem, species, community
(d) Species, variety, ecosystem, community

81. What is the most important factor for the success of animal population? *[1997]*
(a) Natality
(b) Unlimited food
(c) Adaptability
(d) Inter-species activity

82. The present population of the world is about *[1997]*
(a) 500 million (b) 100 billion
(c) 6 billion (d) 15 billion

83. Human population growth in India *[1996]*
(a) tends to follow a sigmoid curve as in case of many other animal species
(b) tends to reach a zero population growth as in case of some animal species
(c) can be reduced by permitting natural calamities and enforcing birth control measures
(d) can be regulated by following the National programme of family planning

84. The concept that population tends to increase geometrically while food supply increases arithmetically was put forward by *[1995]*
(a) Stuart Mill (b) Adam Smith
(c) Charles Darwin (d) Thomas Malthus

85. In India, human population is heavily weighed towards the younger age groups as a result of *[1995]*
(a) short life span of many individuals and low birth rate
(b) long life span of many individuals and low birth rate
(c) short life span of many individuals and high birth rate
(d) long life span of many individuals and high birth rate

86. The sum total of the populations of the same kind of organisms constitute *[1993]*
(a) colony (b) genus
(c) community (d) species

87. Association of animals when both partners are benefitted *[1993]*
(a) colony (b) mutualism
(c) commensalism (d) amensalism

88. Which one is true? *[1991]*
(a) Commensalism when none of the interacting populations affect each other
(b) Symbiosis when the interaction is useful to both the populations
(c) Symbiosis when neither populations affects each other
(d) Commensalism when the interaction is useful to both the populations

89. Vivipary is characteristic of *[1990]*
(a) mesophytes
(b) xerophytes
(c) hygrophytes
(d) halophytes

90. Competition for light, nutrients and space is most severe between *[1988]*
(a) closely related organism growing in different niches.
(b) closely related organisms growing in the same area/niche.
(c) distantly related organisms growing in the same habitat.
(d) distantly related organisms growing in different niches.

91. A mutually beneficial association necessary for survival of both partners is *[1988]*
(a) mutualism/symbiosis
(b) commensalism
(c) amensalism
(d) both (A) and (B)

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ANSWER KEY

1	(d)	11	(d)	21	(a)	31	(b)	41	(d)	51	(a)	61	(d)	71	(a)	81	(c)	91	(a)
2	(b)	12	(a)	22	(b)	32	(b)	42	(a)	52	(b)	62	(a)	72	(a)	82	(c)		
3	(a)	13	(c)	23	(c)	33	(a)	43	(c)	53	(c)	63	(b)	73	(c)	83	(d)		
4	(c)	14	(b)	24	(d)	34	(b)	44	(b)	54	(a)	64	(c)	74	(a)	84	(d)		
5	(d)	15	(a)	25	(b)	35	(c)	45	(d)	55	(c)	65	(c)	75	(c)	85	(c)		
6	(d)	16	(c)	26	(d)	36	(b)	46	(a)	56	(a)	66	(a)	76	(a)	86	(d)		
7	(c)	17	(a)	27	(b)	37	(c)	47	(c)	57	(d)	67	(b)	77	(a)	87	(b)		
8	(b)	18	(b)	28	(b)	38	(a)	48	(c)	58	(a)	68	(d)	78	(b)	88	(b)		
9	(b)	19	(a)	29	(a)	39	(d)	49	(a)	59	(a)	69	(a)	79	(a)	89	(d)		
10	(b)	20	(d)	30	(c)	40	(d)	50	(d)	60	(b)	70	(a)	80	(a)	90	(b)		

Hints & Solutions

1. (d) In exponential growth, the initial growth is slow (lag phase) and it increases rapidly thereafter at an exponential rate in log or exponential phase.
2. (b) The two extremes in the animal kingdom are endothermic homeotherms and ectothermic poikilotherms. Most mammals, including humans, as well as most birds are endothermic homeotherms, while most fish, invertebrates, reptiles, and amphibians are ectothermic poikilotherms. *Chelone* (Turtle) belongs to class reptilia which is poikilotherm or cold blooded.
3. (a) The tropical rain forest have five vertical strata on the basis of plants height i.e., ground vegetation, shrubs, short canopy trees, tall canopy trees and tall emergent trees.

NOTES

The tropical rainforest have hot and wet climate because it is on the equator the sun's rays will always be directly shining on them. Rainforests are wet because the air pressure at the equator is low. Air is sucked in from the oceans which contains moisture.

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4. (c) In tropical rain forest zone, most of the animals prefer to live on trees. The reason is that the floor of forest is full of humidity, decomposing leaves and other organic matters and is the habitat of insects etc.
5. (d) The sediment characteristics often determine the type of benthic animals that can thrive there.

NOTES

The benthic zone is one of the ecological regions of a body of water. It comprises the bottom—such as the ocean floor or the bottom of a lake—the sediment surface, and some sub-surface layers. Organisms living in this zone—that is, on or in the bottom of the body of water—are called benthos.

6. (d) In parasitism, one species (parasite) is benefitted and the other (host) is harmed. Parasites have very high reproduction capacity. The life cycles of parasites are often complex, involving one or two intermediate hosts or vectors to facilitate parasitisation of its primary host.
7. (c) Large woody vines are more commonly found in tropical rain forests. This is a common concern in the high humidity climatic condition.
8. (b) Some species make permanent burrows deep into the soil to escape high temperature or sunlight and some cold blooded animals often like to bask in the sun to warm up their body.
9. (b) Secondary succession refers to the regrowth of a habitat in the area where disruptive event has occurred and eliminated the existing, above ground plant life of the natural habitat. So, it occurs on a deforested site.
10. (b) The logistic population growth is expressed by the equation $\frac{dN}{dt} = rN\left[\frac{(K-N)}{K}\right]$

    where N is population density at time t, r is the Malthusian parameter (rate of maximum population growth) and K is the so called carrying capacity (*i.e.* maximum sustainable population). It is a type of population growth when resources are limiting.
11. (d) In the graph, the line 'a' represents regulator, line 'b' represents conformer and line 'c' represents partial regulator. Organism that are able to maintain homeostasis by physiological means that ensures constant body temperature are called regulators. Organism that are not able to maintain a constant internal temperature are called conformers.

    Partial regulators are organisms that have the ability to regulate, but only over a limited range of environmental conditions, beyond which they simply conform.
12. (a) Characteristics of certain desert animals such as kangaroo, rat are -
    - They feed on dry seeds and do not require drinking water.
    - They excrete very concentrated urine and do not use water to regulate body temperature.
13. (c) Prairie is a grass land, and epiphytes and ephemerals are found in desert. In Tundra,

much of the ground stays frozen round the year, this condition is called permafrost. The *Acacia* trees are common in African savannas. In coniferous forest, all plants do not shed their leaves at the same time hence forest remain evergreen.

14. (b) *Frankia*, is a nitrogen fixing mycelial bacterium which is not free living and associated symbiotically with the root nodules of several non legume plants.

15. (a) A keystone species is the one which makes up only a small proportion of the total biomass of a community, yet has a huge impact on the community's organization and survival.

NOTES

Some examples of keystone species are as follows:

- Shark is an avid predator that feeds on fishes of all kinds making it the keystone species in deep waters.
- Sea otter a mammal in the North Pacific Ocean, which feeds on sea urchins thus maintaining the coastal marine ecosystem.
- Snowshoe haresare prey for a lot of predators in the Canadian Boreal forests.
- The African elephant is the biggest mammal on land is also a keystone species. It is found in Africa. Its role is in its destructive force on trees and consumption of young saplings of the savannah grasslands.

16. (c) Desert show maximum difference between day and night temperature. Due to the bare plant cover, the soil of desert is much more exposed to these fluctuations as compared to that of other areas. During day time, the soil becomes hot and in night, it frequently becomes cool.

17. (a) Diffused porous wood have vessels irregularly arranged within the wood. In tropics, there is no sharp distinction between the seasons; hence, there is not much difference in the activity of cambium.

18. (b) Raphides are needle-shaped crystals of calcium carbonate or calcium oxalate found in specialized plant cells called idioblasts. It is believed that the raphides are a defense mechanism against plant predators, as they are likely to tear the soft tissues of the throat or esophagus of a plant predator chewing on the plant's leaves. They are non-nitrogenous substances.

19. (a) Mimicry is resemblance of an organism to its natural surroundings, a non living object or another organism for concealing itself from its natural predators or preys.

20. (d) Tropical rain forests occur in equatorial and subequatorial regions. The forests receive all the external inputs for optimum plant growth. Due to abundant plant growth, a large number of animals live in tropical rain forests. In grasslands, fire occur periodically which prevent tree growth. In savannahs, periods of drought are common. In deciduous, forests are found predominantly broad leaved hard wood deciduous trees.

21. (a) Deciduous forests are present in both northern and southern hemisphere contain broad leaved and hardwood. Deciduous trees – oak, maple, chestnut etc. evergreen forests occur in equatorial and subequatorial regions, important plants are Rosewood Ebony, Mahogany, fig, etc. Grass lands are large plains covered by grasses. *Prosopis, Acacia* and *Capparis* are non succulent, thorny hot desert plants.

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22. (b) This is so because oceanic islands are normally cut off from other habitats.

23. (c) Two or more species which are reproductively isolated from each other but are morphologically quite similar are known as sibling species. Sympatric species are developed due to reproductive isolation and occur in overlapping or same area of geographical distribution. Parapatric species are developed in adjacent geographical areas meeting in very narrow regions of overlap.

24. (d) The keystone species in an ecosystem are those who are the main contributors to the ecosystem.

25. (b) This is one of the reasons for organisms being homeostatic (constant body temperature).

26. (d) The correctly matched pair is streamlined body for aquatic adaptation.
Parasitism-inter specific relationship in which one species (parasite) benefits for growth and reproduction and other species (host) harmed. Parasite live on or inside the body of host.

27. (b) Succulent plants are fleshy xerophytes, which can grow in low water level area (desert). That is why, they are called as desert plants.

28. (b) Xeric environment is found in deserts where temperature remains high in the day and low during the night and air humidity is very low.
29. (a) **Stenohaline:** 'Steno' means narrow and 'haline' means salt. A fish cannot handle a wide fluctuation in salt content in water. Many fresh water fish tend to be stenohaline and die in environment of high salinity such as the ocean. Fish living in coastal estuaries and tide pools are often euryhaline (tolerant to changes in salinity) as are many species which have life cycle requiring tolerance to both fresh water and sea water environments such as *Salmon*.
30. (c) In Kerala and Assam tropical forests are highly productive terrestrial ecosystem.
31. (b) Loam soil is best suited for plant growth because it possesses good aeration, nutritive salts and good water retaining capacity.
32. (b) High organic matter darkens the colour of soil. The organic matter is present in the soil is contributed by death and decay of living organisms.
33. (a) Soil particles size defines its texture. The mineral particles present in soil, vary enormously in size, the fine fragments (consisting of sand, silt and clay particles) and coarse fragments (gravel, copples and stones). The relative proportion's of sand, silt and clay in a soil is referred as **soil texture**. Fine textured soil have more of clay particles.
    Water holding capacity-Larger soil particles like sand, gravel have large pores. These have less water holding capacity and higher percolotion rate. Field capacity is the amount of soil moisture or water content held in soil after excess water has drained away.
34. (b) Homeostasis is the property of an open system, especially living organisms, to regulate its internal environment to maintain a stable, constant condition, by means of multiple dynamic equilibrium adjustments, controlled by interrelated regulation mechanisms.
35. (c) Deep black soil has high content of clay and humus, which makes it more fertile and productive. Humus is amorphous and colloidal mixture of complex organic substances. It provides fertility to the soil.
36. (b) A wide variety of chemical substances that we extract from plants on a commercial scale (nicotine, caffeine, quinine, strychnine, opium, etc) are produced by them (plants) as defences against grazers and browsers.

NOTES

Strychnine is a highly toxic, colorless, bitter, crystalline alkaloid used as a pesticide, particularly for killing small vertebrates such as birds and rodents.

37. (c) Natality refers to the number of births during a given period in the population that are added to the initial density. Mortality is the number of deaths in the population during a given period. Population interaction is the interaction between different populations. It refers to the effects that the organisms in a community have on one another. The sex ratio is the ratio of males to females in a population.
38. (a) Female wasp and fig species is not an example of commensalism. It show mutualism in which each organism benefits from the interaction in some way. While orchid on trees on which it grows, cattle egret and grazing cattle, and sea anemone and clown fish show commensalism. Commensalism is an association between two organisms in which one benefits and the other derives neither benefit nor harm.
39. (d) *Alstonia* shows whorled phyllotaxy. In whorled phyllotaxy, more than two leaves arise at each node and form a whorl or a circle.
    China rose and mustard shows alternate phyllotaxy in which a single leaf arises at each node in alternate manner. Whereas *Calotropis* shows opposite type of phyllotaxy in which a pair of leaves arise at each node and lie opposite to each other.
40. (d) If two species compete for the same resource, they could avoid competition by choosing, for instance different times for feeding or different foraging patterns. Such mechanism is called resource partitioning.
41. (d) Saprophytes are organisms which live on dead organic matter and help in their decomposition.
    Parasites is an organisms that live in or on other living plants and animals and dependent on them for their food.

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Lichens represent a type of symbiotic association of algae and fungi, in which, both of them dependent on each other for their food and shelter.
Mycorrhiza is also a type of symbiotic association of fungi and plant roots, e.g., *Cycas* coralloid root.

42. (a) Whenever the pre-reproductive individuals or the younger population size is larger than the reproductive group, the population will be an increasing population.

43. (c) Amensalism/antibiosis, association between organisms of two different species in which one is inhibited or destroyed and the other is unaffected. These are chemicals secreted by one microbial group (eg : *Penicillium*) which harm other microbes (*eg : Staphylococcus*). It has no effect on *Penicillium* or the organism which produces it.

44. (b) In obligate mutualism, one organism cannot survive without the other. *Yucca* have an obligate mutualism with a species of moth i.e. *Pronuba*.

45. (d) World Ozone day is celebrated on 16th September. 5th June is World Environment Day. 21st April is National Yellow Bat Day. 22nd April is National Earth Day.

NOTES

September 16 was designated by the United Nations General Assembly as the International Day for the Preservation of the Ozone Layer. This designation had been made on December 19, 2000, in commemoration of the date, in 1987, on which nations signed the Montreal Protocol on Substances that Deplete the Ozone Layer.

46. (a) In logistic growth curve, the curve has an upper a symptote known as carrying capacity (K) is obtained when the maximum population size is at $\frac{dN}{dt} = 0$. A population growing in a habitat with limited resources shows logistic growth curve.
For logistic growth,

$$\frac{dN}{dt} = rN\left(\frac{K-N}{K}\right)$$

If K = N then $\frac{K-N}{K} = 0$

$$\therefore \quad \frac{dN}{dt} = 0.$$

The population reaches asymptote.

NOTES

Carrying capacity is widely used as an indicator of environmental sustainability. It often serves as the basis for sustainable development policies that attempt to balance the needs of today against the resources that will be needed in the future.

47. (c) Mycorrhizae is a symbiotic association between fungi and roots of higher plants.

NOTES

The population interaction is a very important one as it ensures that there is stability in the ecosystem. The two main populations interacting in predation are the predators and the prey. The species diversity in a community is also maintained by the predators. They reduce the intensity of the competition between prey species.

48. (c) Gause's principle of competitive exclusion can be restated to say that no two species can occupy the same niche indefinitely when resources are limiting. Certainly species can and do coexist while competing for some of the same resources. Nevertheless, Gause's theory predicts that when two species coexist on a long-term basis, either resources must not be limited or their niches will always differ in one or more features; otherwise, one species will outcompete the other and the extinction of the second species will inevitably result, a process referred to as competitive exclusion.

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NOTES

The Abingdon tortoise in Galapagos Islands became extinct within a decade after goats were introduced on the island, apparently due to the greater browsing efficiency of the goats.

49. (a) In logistic growth model population growth equation is described as

$$\frac{dN}{dt} = rN\left(1-\frac{N}{K}\right)$$

N = population density at time t;
r = Intrinsic rate of natural increase;
K = carrying capacity

When N/K = 1; $1 - \frac{N}{K} = 0$

Therefore, $\frac{dN}{dt} = 0$

NOTES

Studying population growth also helps scientists understand what causes changes in population sizes and growth rates. Studying population growth gives scientists insight into how organisms interact with each other and with their environments.

50. (d) Competition occurs for light, food and space among organisms in which all partners are adversely affected in an ecosystem.
51. (a) Both the populations are herbivorous. If the food sources for these populations A and B have decreased, then both the populations A and B would have declined. If population A have produced more offsprings then the graph A should have increased. Based on the graph, population B is more successful for competing with population A, that is why number of organisms in population B increased while that in population A decreased, as they get access to limited resources.
52. (b) Commensalism is a interaction where one species is benefitted and other is neither benefitted nor harmed.
53. (c) Net increase in population :
(Natality + Immigration) – (Mortality + Emigration)
(250 + 20) – (240 + 30) = 270 – 270 = 0
54. (a) *Cuscuta*, or Dodder plant, is a parasitic plant that wraps around other plants for nourishment. *Cuscuta* is found on outer side of the host and is total stem parasite. Cuscuta a parasite of *Acacia*.
55. (c) This age pyramid represents the declining population of any organism. Population decline is the reduction over time in region's census. It can be caused for several reasons that includes heavy immigration disease, famine or sub-replacement fertility.
56. (a) Stratification is one of the characteristics of biological community. Natality, mortality, age, structure and sex ratio are basic characteristics of a population.
57. (d) 'A' is more recent and shows slight reduction in growth rate.
58. (a) There is a decline in population as boys marry girls only from their own tribe in the isolated small tribal populations. This is because at some stage marriage will stop due to isolation (neither immigration nor emigration will occur) and on the other hand, marriages within same tribe will lead to homozygosity of disease and ultimately death. Thus, leading to decline in population.
59. (a) Geometric representation of age structure a characteristic of population.
60. (b) If a population (*e.g* reindeer population) is allowed to grow in a predator free environment, the population grows beyond carrying capacity and there occurs population crash due to sudden shortage of food. Such growth curves also occur in insect populations during rainy season and in algal blooms.
61. (d) When the members of a species are inter - fertile and produce fertile offsprings.
62. (a) It is competition between individuals of same species. The intraspecific competition may be very severe because all the members of a species have similar requirements of food, habitat mate, etc. and they also have similar adaptations to get their needs.
63. (b) Niche indicate the habitat of a particular species and the interaction of that species with the resources present in the habitat. Niche overlap means that two or more species share the resources present in a particular niche.
64. (c) The formula of exponential growth is $\frac{dN}{dt} = rN$ where $\frac{dN}{dt}$ is the rate of change in population size, r is the biotic potential and N is the population size.
65. (c) Praying mantis is a good example of camouflage. Camouflage is the natural colouring of an animal which enables it to blend in with its surroundings.

A praying mantis from **India**

NOTES

A **praying mantis,** or **praying mantid,** is the common name for an insect of the order Mantodea. Often mistakenly spelled **praying mantis** (a tempting mistake, as they are notoriously predatory) they are in fact named for the typical "prayer-like" stance. The word *mantis* derives from the Greek word mantis for prophet or fortune teller.

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66. (a) At an altitude of 5400 meters the low atmospheric pressure of O2 will be very low, so the solubility of oxygen in the blood will be very less hence the oxygen carried by each RBC will be too less. But to fulfill the oxygen requirement of the body, blood has to carry more oxygen to the body tissue and this is done by the increased numbered of RBCs.
67. (b) Gene flow is the spread of genes through populations as effected by movements of individual and their propagules, e.g. seeds spores etc. Gene flow ensures that all populations of a given species share a common gene pool. i.e. it reduces difference between populations. The interruption of gene flow between populations is a pre-requisite for the formation of new species.
68. (d) In the sigmoid growth curve, growth is slow in the lag phase. Growth rate remains stable during the stationary phase and it declines during the senescent phase. Growth increases logarithmically during the exponential phase.
69. (a) Demography is the study of population in all aspects. Fertility refers to the number of children per couple. Mortality rate is the average number of natural deaths per unit population per unit time. Age distribution refers to the proportionate occurrence of individuals of the three age groups. Developing countries usually have high rate of population growth, because of increasing fertility and declining mortality.

NOTES John Graunt is known as the father of demography.

70. (a) Biotic potential is the inherent ability of an organism to reproduce. Resistance refers to the sum total of all the limiting factors that inhibit further growth of population.
71. (a) Carrying capacity refers to the maximum number of individuals that can be sustained by the environment. Birth rate refers to number of births per unit population.
72. (a) The growth curve for bacteria is sigmoid. First phase is the phase of slow growth- Lag phase. Second phase is the period of accelerated growth - Log phase. Third phase is the phase when growth rate becomes stable - Stationary phase. Finally growth rate declines.
73. (c) Semilog of per minute growing bacterium when plotted against time, would yield ascending straight line.
74. (a) *Opuntia* is a xerophyte. *Cuscuta* is a parasite. *Capsella* is not a hydrophyte.
75. (c) These are all insectivorous plants.
76. (a) Commensalism is an interaction between two individuals in which one is benefitted while the other is unaffected. In mutualism both individuals are beneficial for each other. The pollinating insect gets nectar from flower and in turn helps in pollination of flowers.
77. (a) Tissue culture cells graph is 'J' shaped.
78. (b) Insectivorous plants supplement the supply of nitrogenous food by capturing and digesting insects. Pitcher plant (*Nepenthes*) and bladderwort (*Utricularia*) are both insectivorous plants.
79. (a) Mimicry is resemblance of an organism to its natural surrounding, a non-living object or another organism for concealing itself from its enemies. Flowers of *Ophrys muscifera* resemble the female wasps of *Colpa* aurea so that the male wasp tries to copulate with the flowers and pollinate them.
80. (a) Population is an aggregation or grouping of individuals of the same species at the same time in a particular area. Species is a grouping of individuals of one or more populations resembling each other in important morphological, anatomical and biochemical characters and can potentially interbreed. Biotic community is an assemblage of interdependent, and ecosystem is a self sufficient and self regulating segment of nature comprising of a biotic community and its physical environment, both interacting and exchanging materials. The basic level of ecological organisation starts with the individual, the next more complex levels are populations, species, community and then ecosystem.
81. (c) Adaptability refers to the capacity of the organisms to adapt themselves to their environment.
82. (c) Human population in world is estimated to have crossed 6 billion in the year 1999.
83. (d) Human population growth in India can be regulated by following the national programme of family planning.

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84. (d) Thomas R. Malthus put forward a theory of human population growth in 1778. He told that population grows in geometrical progression, whereas the means which support it, grow only in arithmatical progression.
85. (c) In India, there is short life span of individuals and high birth rate as compared to other countries. That is why, the human population is heavily weighed towards the younger age groups.
86. (d) A species is a group of individuals of same kind of phenotypic characters and can interbreed easily.
87. (b) Mutualism type of interactions are shown in plant roots in mycorrhizal region.
88. (b) Symbiosis when the interaction is useful for both the populations.
89. (d) Special type of seed germination, characteristic of halophytes growing in saline conditions is vivipary. The seed germination occurs inside the fruit while it is attached to the parent plant.
90. (b) Competition is most severe between the members of a population belonging to same niches.
91. (a) Symbiosis or mutualism is a mutually beneficial association necessary for the survival of both the partners.

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36 Ecosystem

Trend Analysis with Important Topics & Sub-Topics

Topic	Sub-Topics	2020 Qns.	2020 LOD	2019 Qns.	2019 LOD	2018 Qns.	2018 LOD	2017 Qns.	2017 LOD	2016 Qns.	2016 LOD
Ecosystem- Structure & Function/ Productivity Decomposition	Ecosystem services							1	E	1	E
	Productivity	1	D							1	E
Energy Flow/ Ecological Pyramids/ Ecological Sucession	Ecological Sucession					1	E				
	Ecological pyramid			1	E	1	D				
	Trophic level	1									
Nutrient Cycling/ Ecosystem Services											

LOD - Level of Difficulty | E - Easy | A - Average | D - Difficult | Qns - No. of Questions

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Topic 1: Ecosystem-Structure & Function/ Productivity Decomposition

1. In relation to Gross primary productivity and Net primary productivity of an ecosystem, which one of the following statements is correct? *[2020]*
   (a) Gross primary productivity is always more than net primary productivity
   (b) Gross primary productivity and Net primary productivity are one and same
   (c) There is no relationship between Gross primary productivity and Net primary productivity
   (d) Gross primary productivity is always less than net primary productivity
2. Niche is *[2018]*
   (a) all the biological factors in the organism's environment
   (b) the physical space where an organism lives
   (c) the functional role played by the organism where it lives
   (d) the range of temperature that the organism needs to live
3. The term ecosystem was coined by *[2016]*
   (a) E.P. Odum (b) A.G. Tansley
   (c) E.Haeckel (d) E. Warming
4. Most animals that live in deep oceanic waters are: *[2015 RS]*
   (a) secondary consumers
   (b) tertiary consumers
   (c) detritivores
   (d) primary consumers
5. Vertical distribution of different species occupying different levels in a biotic community is known as: *[2015 RS]*
   (a) Stratification (b) Zonation
   (c) Pyramid (d) Divergence
6. The mass of living material at a trophic level at a particular time is called : *[2015 RS]*
   (a) Standing state
   (b) Net primary productivity
   (c) Standing crop
   (d) Gross primary productivity
7. In an ecosystem the rate of production of organic matter during photosynthesis is termed as: *[2015 RS]*
   (a) Gross primary productivity
   (b) Secondary productivity
   (c) Net productivity
   (d) Net primary productivity

8. Which one of the following processes during decomposition is correctly described? *[NEET 2013]*
   (a) Humification-Leads to the accumulation of a dark coloured substance humus which undergoes microbial action at every fast rate
   (b) Catabolism-Last step decomposition under fully anaerobic condition
   (c) Leaching-Water soluble inorganic nutrients rise to the top layers of soil
   (d) Fragmentation-Carried out by organisms such as earthworm
9. Secondary productivity is rate of formation of new organic matter by *[NEET 2013]*
   (a) Parasite (b) Consumer
   (c) Decomposer (d) Producer
10. The rate of formation of new organic matter by rabbit in a grassland, is called *[2012M]*
   (a) net productivity
   (b) secondary productivity
   (c) net primary productivity
   (d) gross primary productivity
11. The breakdown of detritus into smaller particles by earthworm is a process called *[2011M]*
   (a) humification (b) fragmentation
   (c) mineralisation (d) catabolism
12. Of the total incident solar radiation the proportion of PAR is : *[2011]*
   (a) about 70% (b) about 60%
   (c) less than 50% (d) more than 80%
13. The biomass available for consumption by the herbivores and the decomposers is called: *[2010]*
   (a) net primary productivity
   (b) secondary productivity
   (c) standing crop
   (d) gross primary productivity
14. About 70% of total global carbon is found in *[2008]*
   (a) grasslands (b) agroecosystems
   (c) oceans (d) forests
15. The slow rate of decomposition of fallen logs in nature is due to their *[2008]*
   (a) low moisture content
   (b) poor nitrogen content
   (c) anaerobic environment around them
   (d) low cellulose content
16. Which one of the following ecosystem types has the highest annual net primary productivity? *[2007]*
   (a) tropical deciduous forest
   (b) temperate evergreen forest
   (c) temperate deciduous forest
   (d) tropical rain forest.
17. Which of the following is expected to have the highest value ($gm/m^2/yr$) in a grassland ecosystem? *[2004]*
   (a) Secondary Production
   (b) Tertiary Production
   (c) Gross Production (GP)
   (d) Net Production (NP)
18. Pneumatophores are characteristic of plants growing in *[2000]*
   (a) saline soils
   (b) sandy soils
   (c) marshy places and salt lakes
   (d) dryland regions
19. The greatest biomass of autotrophs in the oceans is that of *[2000]*
   (a) sea grasses and slime moulds
   (b) free floating microalgae, cyanobacteria and nanoplankton
   (c) benthic brown algae,coastal red algae and daphnids
   (d) benthic diatoms and marine viruses
20. The rate at which light energy is converted to the chemical energy of organic molecules is the ecosystem's *[1998]*
   (a) net primary productivity
   (b) gross primary productivity
   (c) net secondary productivity
   (d) gross secondary productivity
21. Which of the following ecosystems has highest rate of gross primary production? *[1997]*
   (a) Grasslands
   (b) Mangroves
   (c) Coral reefs
   (d) Equatorial rain forest
22. Niche of a species in an ecosystem refers to its *[1996]*
   (a) function at its place of occurrence
   (b) place of its occurrence
   (c) competitive ability
   (d) centre of origin
23. Which of the following does not have stomata? *[1995]*
   (a) hydrophytes
   (b) mesophytes
   (c) xerophytes
   (d) submerged hydrophytes

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24. If we completely remove the decomposers from an ecosystem, its functioning will be adversely affected, because *[1995]*
(a) energy flow will be blocked
(b) herbivores will not receive solar energy
(c) mineral movement will be blocked
(d) rate of decomposition will be very high

25. Which of the following is the most stable ecosystem? *[1995]*
(a) Forest (b) Desert
(c) Mountain (d) Ocean

26. In a biotic community, the most important factor for survival of an animal is *[1994]*
(a) day length (b) soil moisture
(c) green food (d) predators

27. Bulk CO_2 fixation occurs in *[1994]*
(a) Crop plants
(b) Oceans
(c) Tropical rain forests
(d) Temperature forests

28. Decomposers are organisms that *[1994]*
(a) elaborate chemical substances, causing death of tissues
(b) operate in living body and simplifying organic substances of cells step by step
(c) attack and kill plants as well as animals
(d) operate in relay terms, simplifying step by step the organic constituents of dead body

29. Study of inter-relationships between organisms and their environment is *[1993]*
(a) ecology (b) ecosystem
(c) phytogeography (d) ethology

30. Pedology is science of *[1991]*
(a) earth (b) soil
(c) diseases (d) pollution

31. Greatest producers of organic matter are
(a) crop plants *[1989]*
(b) forests
(c) plants of the land area
(d) phytoplankton of oceans

32. Upper part of sea/aquatic ecosystem contains
(a) plankton (b) nekton *[1988]*
(c) plankton and nekton (d) benthos

Topic 2: Energy Flow/Ecological Pyramids/ Ecological Sucession

33. Match the trophic levels with their correct species examples in grassland ecosystem. *[2020]*
(A) Fourth trophic level (i) Crow
(B) Second trophic level (ii) Vulture
(C) First trophic level (iii) Rabbit
(D) Third trophic level (iv) Grass
Select the correct option

	(A)	(B)	(C)	(D)
(a)	(iii)	(ii)	(i)	(iv)
(b)	(iv)	(iii)	(ii)	(i)
(c)	(i)	(ii)	(iii)	(iv)
(d)	(ii)	(iii)	(iv)	(i)

34. Which of the following ecological pyramids is generally inverted? *[2019]*
(a) Pyramid of numbers in grassland
(b) Pyramid of energy
(c) Pyramid of biomass in a forest
(d) Pyramid of biomass in a sea

35. What type of ecological pyramid would be obtained with the following data? *[2018]*
Secondary consumer : 120 g
Primary consumer : 60 g
Primary producer : 10 g
(a) Inverted pyramid of biomass
(b) Pyramid of energy
(c) Upright pyramid of biomass
(d) Upright pyramid of numbers

36. Which ecosystem has the maximum biomass?
(a) Grassland ecosystem *[2017]*
(b) Pond ecosystem
(c) Lake ecosystem
(d) Forest ecosystem

37. Which of the following is a characteristic feature of cropland ecosystem ? *[2016]*
(a) Absence of soil organisms
(b) Least genetic diversity
(c) Absence of weeds
(d) Ecological succession

38. Which of the following would appear as the pioneer organisms on bare rocks? *[2016]*
(a) Lichens (b) Liverworts
(c) Mosses (d) Green algae

39. Secondary Succession takes place on/in :
(a) Degraded forest *[2015 RS]*
(b) Newly created pond
(c) Newly cooled lava
(d) Bare rock

40. During ecological succession: *[2015 RS]*
(a) the establishment of a new biotic community is very fast in its primary phase.
(b) the numbers and types of animals remain constant.
(c) the changes lead to a community that is in near equilibrium with the environment and is called pioneer community.
(d) the gradual and predictable change in species composition occurs in a given area.

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41. Increase in concentration of the toxicant at successive trophic levels is known as :*[2015 RS]*
(a) Biodeterioration (b) Biotransformation
(c) Biogeochemical (d) Biomagnification

42. An association of individuals of different species living in the same habitat and having functional interactions is: *[2015 RS]*
(a) Biotic community (b) Ecosystem
(c) Population (d) Ecological niche

43. Match the following and select the correct option: *[2014]*
(A) Earthworm (i) Pioneer species
(B) Succession (ii) Detritivore
(C) Ecosystem service (iii) Natality
(D) Population growth (iv) Pollination

	(A)	(B)	(C)	(D)
(a)	(i)	(ii)	(iii)	(iv)
(b)	(iv)	(i)	(iii)	(ii)
(c)	(iii)	(ii)	(iv)	(i)
(d)	(ii)	(i)	(iv)	(iii)

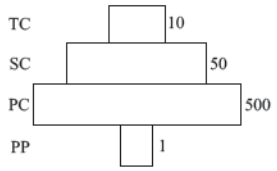
44. Which one of the following is a primary consumer in maize field ecosystem? *[NEET Kar. 2013]*
(a) Lion (b) Grasshopper
(c) Wolf (d) Phytoplankton

45. When man eats fish which feeds on zooplankton which have eaten small plants, the producer in the chain is *[NEET Kar. 2013]*
(a) Zooplankton (b) Small plants
(c) Fish (d) Man

46. *Pheretima* and its close relatives derive nourishment from : *[2012]*
(a) sugarcane roots
(b) decaying fallen leaves and soil organic matter.
(c) soil insects
(d) small pieces of fresh fallen leaves of maize, etc.

47. Identify the possible link "A" in the following food chain : *[2012]*
Plant → insect - frog → "A" → Eagle
(a) Rabbit (b) WoIf
(c) Cobra (d) Parrot

48. Given below is an imaginary pyramid of numbers. What could be one of the possibilities about certain organisms at some of the different levels ? *[2012]*



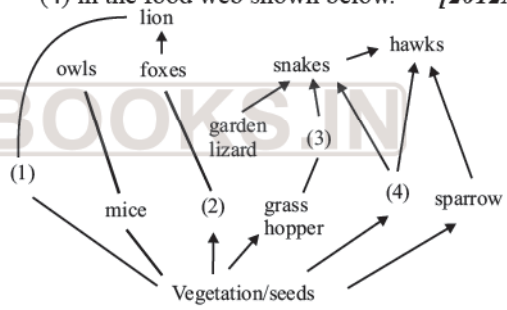
(a) Level PC is "insects" and level SC is "small insectivorous birds".
(b) Level PP is "phytoplanktons" in sea and "Whale" on top level TC
(c) Level one PP is "pipal trees" and the level SC is "sheep".
(d) Level PC is "rats" and level SC is "cats".

49. Which one of the following is not a function of an ecosystem? *[2012]*
(a) Energy flow (b) Decomposition
(c) Productivity (d) Stratification

50. The upright pyramid of number is absent in
(a) Pond (b) Forest *[2012]*
(c) Lake (d) Grassland

51. The second stage of hydrosere is occupied by plants like *[2012M]*
(a) Azolla (b) Typha
(c) Salix (d) Vallisneria

52. Identify the likely organisms (1), (2), (3) and (4) in the food web shown below. *[2012M]*



Options:

	(1)	(2)	(3)	(4)
(a)	Deer	Rabbit	Frog	Rat
(b)	Dog	Squirrel	Bat	Deer
(c)	Rat	Dog	Tortoise	Crow
(d)	Squirrel	Cat	Rat	Pigeon

53. Mass of living matter at a trophic level in an area at any time is called *[2011]*
(a) standing crop (b) deteritus
(c) humus (d) standing state

54. Which one of the following statements for pyramid of energy is incorrect, whereas the remaining three are correct ? *[2011]*
(a) Its base is broad
(b) It shows energy content of different trophic level organisms
(c) It is inverted in shape
(d) It is upright in shape

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55. Which one of the following animals may occupy more than one trophic levels in the same ecosystem at the same time? *[2011M]*
(a) Sparrow (b) Lion
(c) Goat (d) Frog

56. Both, hydrarch and xerarch successions lead to: *[2011M]*
(a) medium water conditions
(b) xeric conditions
(c) highly dry conditions
(d) excessive wet conditions

57. Study the four statements (a–d) given below and select the two correct ones out of them: *[2010]*
(i) A lion eating a deer and a sparrow feeding on grain are ecologically similar in being consumers
(ii) Predator star fish *Pisaster* helps in maintaining species diversity of some invertebrates
(iii) Predators ultimately lead to the extinction of prey species
(iv) Production of chemicals such as nicotine, strychnine by the plants are metabolic disorders
The two correct statements are:
(a) (ii) and (iii) (b) (iii) and (iv)
(c) (i) and (iv) (d) (i) and (ii)

58. The **correct** sequence of plants in a hydrosere is: *[2009]*
(a) *Volvox* → *Hydrilla* → *Pistia* →*Scirpus* *Lantana* → *Oak*
(b) *Pistia* →*Volvox* → *Scirpus* →*Hydrilla* → *Oak* →*Lantana*
(c) *Oak*→*Lantana* →*Volvox* →*Hydrilla* → *Pistia* →*Scirpus*
(d) *Oak* →*Lantana* →*Scirpus* →*Pistia* → *Hydrilla* →*Volvox*

59. Which one of the following types of organisms occupy more than one trophic level in a pond ecosystem? *[2009]*
(a) Fish (b) Zooplankton
(c) Frog (d) Phytoplankton

60. Consider the following statements concerning food chains *[2008]*
(1) removal of 80% tigers from an area resulted in greatly increased growth of vegetation
(2) removal of most of the carnivores resulted in an increased population of deers
(3) the length of food chains is generally limited to 3-4 trophic levels due to energy loss
(4) the length of food chains may vary from 2 to 8 trophic levels
Which two of the above statements are correct?
(a) (2) and (3) (b) (3) and (4)
(c) (1) and (4) (d) (1) and (2)

61. Which one of the following is not used for construction of ecological pyramids? *[2006]*
(a) Number of individuals
(b) Rate of energy flow
(c) Fresh weight
(d) Dry weight

62. An ecosystem which can be easily damaged but can recover after some time if damaging effect stops will be having *[2004]*
(a) low stability and high resilience
(b) high stability and low resilience
(c) low stability and low resilience
(d) high stability and high resilience

63. Bamboo plant is growing in a fir forest then what will be the trophic level of it? *[2002]*
(a) First trophic level (T_1)
(b) Second trophic level (T_2)
(c) Third trophic level (T_3)
(d) Fourth trophic level (T_4)

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64. The transfer of energy from one trophic level to another is governed by the 2nd law of thermodynamics. The average efficiency of energy transfer from herbivores to carnivores is
(a) 5% (b) 10% *[1996, 99]*
(c) 25% (d) 50%

65. In a food chain, the largest population is that of *[1996]*
(a) decomposers (b) producers
(c) primary consumers (d) tertiary consumers

66. The primary succession refers to the development of communities on a *[1995]*
(a) fleshly cleared crop field
(b) forest clearing after devastating fire
(c) pond, freshly filled with water after a dry phase
(d) newly-exposed habitat with no record of earlier vegetation

67. In a biotic community, the primary consumers are *[1995]*
(a) carnivores (b) omnivores
(c) detritivores (d) herbivores

68. The pyramid which cannot be inverted in a stable ecosystem is that of *[1994]*
(a) Biomass (b) Number
(c) Energy (d) All the above

69. In grass-deer-tiger food chain, grass biomass is one tonne. The tiger biomass shall be
(a) 100 kg (b) 10 kg *[1994]*
(c) 200 kg (d) 1 kg

70. Second most important trophic level in a lake is *[1994]*
(a) Zooplankton (b) Phytoplankton
(c) Benthos (d) Neuston

71. In a food chain, the largest population is that of *[1994]*
(a) producers
(b) decomposers
(c) secondary consumers
(d) primary consumers

72. Pyramid of numbers deals with number of
(a) species in an area *[1993]*
(b) individuals in a community
(c) individuals in a tropic-level
(d) subspecies in a community

73. Pyramid of numbers in a pond ecosystem is
(a) irregular (b) inverted *[1993]*
(c) upright (d) spindle shaped

74. Food chain in which micro-organisms breakdown the food formed by primary producers is *[1991]*
(a) parasitic food chain
(b) detritus food chain
(c) consumer food chain
(d) predator food chain

75. Pick up the correct food chain *[1991]*
(a) Grass → Chamelion → Insect → Bird
(b) Grass → Fox → Rabbit → Bird
(c) Phytoplankton → Zooplankton → Fish
(d) Fallen leaves → Bacteria → Insect larvae

76. Pyramid of numbers in a grassland/true ecosystem is *[1990, 91]*
(a) always inverted (b) always upright
(c) both A and B (d) spindle-shaped

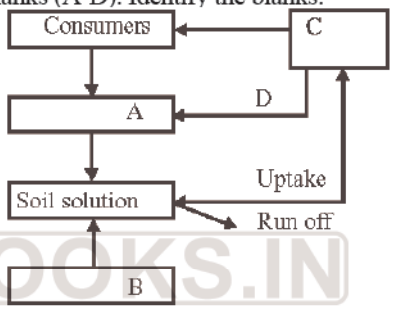
77. What is true of ecosystem? *[1988]*
(a) Primary consumers are least dependent upon producers
(b) Primary consumers out-number producers
(c) Producers are more than primary consumers
(d) Secondary consumers are the largest and most powerful

Topic 3: Nutrient Cycling/Ecosystem Services

78. In which of the following both pairs have correct combination ? *[2015 RS]*

(a)	Gaseous nutrient cycle	Carbon and sulphur
	Sedimentary nutrient cycle	Nitrogen and Phosphorus
(b)	Gaseous nutrient cycle	Nitrogen and sulphur
	Sedimentary nutrient cycle	Carbon and Phosphorus
(c)	Gaseous nutrient cycle	Sulphur and Phosphorus
	Sedimentary nutrient cycle	Carbon and Nitrogen
(d)	Gaseous nutrient cycle	Carbon and Nitrogen
	Sedimentary nutrient cycle	Sulphur and Phosphorus

79. Given below is a simplified model of phosphorus cycling in a terrestrial ecosystem with four blanks (A-D). Identify the blanks:- *[2014]*



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	A	B	C	D
(a)	Rock	Detritus minerals	Litter fall	Producers
(b)	Litter fall	Producers	Rock	Detritus minerals
(c)	Detritus minerals	Rock	Producer	Litter fall
(d)	Producers	Litter fall	Rock	Detritus minerals

80. Natural reservoir of phosphorus is : *[NEET 2013]*
(a) Animal bones (b) Rock
(c) Fossils (d) Sea water

81. Which one of the following is not a gaseous biogeochemical cycle in ecosystem ? *[2012]*
(a) Sulphur cycle (b) Phosphorus cycle
(c) Nitrogen cycle (d) Carbon cycle

82. Barophilic prokaryotes: *[2005]*
(a) grow and multiply in very deep marine sediments
(b) occur in water containing high concentrations of barium hydroxide
(c) readily grow and divide in sea water enriched in any soluble salt of barium
(d) grow slowly in highly alkaline frozen lakes at high altitudes

83. If by radiation all nitrogenase enzymes are inactivated, then there will be no *[2004]*
(a) fixation of nitrogen in legumes
(b) fixation of atmospheric nitrogen
(c) conversion from nitrate to nitrite in legumes
(d) conversion from ammonium to nitrate in soil

84. The main role of bacteria in the carbon cycle involves *[1998]*
(a) photosynthesis
(b) chemosynthesis
(c) digestion or breakdown of organic compounds
(d) assimilation of nitrogenous compounds

85. Which of the following pairs is a sedimentary type of biogeochemical cycle? *[1995]*
(a) oxygen and nitrogen
(b) phosphorus and sulphur
(c) phosphorus and nitrogen
(d) phosphorus and carbon dioxide

86. In an ecosystem, which one shows one-way passage *[1988]*
(a) free energy
(b) carbon
(c) nitrogen
(d) potassium

ANSWER KEY

1	(a)	10	(b)	19	(b)	28	(d)	37	(b)	46	(b)	55	(a)	64	(b)	73	(c)	82	(a)
2	(c)	11	(b)	20	(b)	29	(a)	38	(a)	47	(c)	56	(a)	65	(b)	74	(b)	83	(a)
3	(b)	12	(c)	21	(d)	30	(b)	39	(a)	48	(a)	57	(d)	66	(d)	75	(c)	84	(c)
4	(c)	13	(a)	22	(a)	31	(d)	40	(d)	49	(d)	58	(a)	67	(d)	76	(b)	85	(b)
5	(a)	14	(c)	23	(d)	32	(a)	41	(d)	50	(b)	59	(a)	68	(c)	77	(c)	86	(a)
6	(c)	15	(a)	24	(c)	33	(d)	42	(a)	51	(d)	60	(a)	69	(b)	78	(d)		
7	(a)	16	(d)	25	(d)	34	(d)	43	(d)	52	(a)	61	(c)	70	(a)	79	(c)		
8	(d)	17	(c)	26	(c)	35	(a)	44	(b)	53	(a)	62	(a)	71	(d)	80	(b)		
9	(b)	18	(c)	27	(b)	36	(d)	45	(b)	54	(c)	63	(a)	72	(c)	81	(b)		

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Hints & Solutions

1. (a) Gross primary productivity of an ecosystem is the rate of production of organic matter during photosynthesis. Net primary productivity is GPP-respiration. Hence, gross primary productivity is always more than NPP.

NOTES

The highest net primary productivity in terrestrial environments occurs in swamps and marshes and tropical rainforests; the lowest occurs in deserts.

2. (c) Joseph Grinnell in 1917 coined the term niche, which he used as largely equivalent to a species habitat. It refers the functional role played by the organism where it lives.

3. (b) Sir Arthur George Tansley was an English botanist and a pioneer in the science of ecology who coined the term ecosystem.

4. (c) Detritivores are the organisms which feed on dead plants and animal residues.

5. (a) Stratification is the occurrence of vertical zonation in the ecosystem and indicates the presence of favorable environmental conditions, for e.g., trees occupy top vertical strata or layer of a forest, shrubs the second. Herbs and grasses occupy the bottom layers. It is absent or poor where environmental conditions are unfavorable, e.g. desert ecosystems have very few trees and shrubs.

6. (c) Standing crop is the amount of living biomass in an ecosystem. It indicates the productivity and luxuriance of growth. It is expressed in the form of number or biomass of organisms per unit area.

7. (a) Gross Primary Productivity (GPP) is the rate of production of biomass or accumulation of energy by green plants per unit area per unit time. GPP depends on the chlorophyll content.
8. (d) Humification, catabolism, leaching and fragmentation are the steps of decomposition which operate simultaneously on the detritus. Fragmentation is breaking down detritus into smaller particles by detritivores like earthworm. By the process of leaching, water soluble inorganic nutrients go down into soil horizon and get precipitated as unavailable salts. Humification occurs at a very slow rate.
9. (b) The rate of resynthesis of organic matter by the consumers is known as secondary productivity . It depends upon the loss while transferring energy containing organic matter from the previous trophic level plus the consumption due to respiration and predation. Respiration loss is about 20% for autotrophs, 30% for herbivores and upto 60% in case of carnivores. Therefore net productivity decreases with each trophic level.
10. (b) At the trophic level of consumers the rate at which food energy is assimilated is called secondary productivity. Rabbit is a consumer.
11. (b) The break down of detritus into smaller particles by earthworm is known as fragmentation.
12. (c) Out of total incident solar radiation, about 50% of it forms Photosynthetically Active Radiation (PAR).
13. (a) The biomass available for consumption by the herbivores and the decomposers is called net primary productivity. It is equal to the rate of organic matter created by photosynthesis minus the rate of respiration and other losses.
14. (c) About 70% of total global carbon is found in oceans. This oceanic reservoir regulates the amount of carbon dioxide in the atmosphere. Atmosphere contains only about one percent of total global carbon.
15. (a) Low moisture content will lead to decrease in number of decomposers because decomposers need an optimum moisture for their growth and functioning.
16. (d) They are found in the equatorial regions rainfall exceeds 140 cm. The warm humid climate supports broad leaved evergreen plants. Productivity is very high (12000 kcal/m^2/year). The vegetation show stratification into two or more well defined layers.
17. (c) Grasslands will have highest value of gross production. Net production is obtained after subtracting the respiratory utilization from gross production. Secondary and tertiary production is related with secondary and tertiary consumers respectively.
18. (c) Some plants growing in salty marshes develop special roots for respiration, called pneumatophores. They are (–)vely geotropic.
19. (b) The greatest biomass of autotrophs in the oceans is that of free floating microalgae, cyanobacteria and nanoplankton.
20. (b) The rate at which organic molecules are formed in a green plant is called gross primary productivity.
21. (d) Equatorial forest has highest gross primary production i.e. productivity is maximum such as 12000 Kcal/m^2/yr. Coral reefs are often called "rainforest of the sea". It forms some of the most diverse ecosystem on earth.

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NOTES: Coral reef ecosystem have the highest gross primary productivity in the sea.

22. (a) Niche is a specific part of the habitat that is determined by the functioning of the population like shelter, type of food, season *etc.*
23. (d) In submerged hydrophytes whole plant body remains under water. *e.g. Ceratophyllum* and *Utricularia*. In these plants, stomata is absent and gaseous exchange takes place through general body surface.
24. (c) The decomposers act on the dead organic matter and break them down into simpler compounds and minerals.
25. (d) The oceans cover about 2/3rd of the whole surface of our earth. Thus it is the most stable ecosystem, because of buffering action by water.
26. (c) Food is necessary for life.

27. (b) Due to majority of phytoplanktons.

28. (d) Decomposers act on dead bodies converting complex organic constituents into simpler soluble form.
They obtain their energy from dead organisms. Decomposers themselves are organisms (often fungi, earthworms, or bacteria) that break down organic materials to gain nutrients and energy. Decomposers accelerate the natural process of decomposition. They supply the required nutrients for other trophic levels.
The fungi found on the tree are decomposers. When an organism dies, it leaves behind nutrients that are tightly bound together. A scavenger might eat the carcass, but its feces would still contain a considerable amount of unused energy and nutrients. Decomposers will later induce further breakdown. This last step releases raw nutrients (such as nitrogen, phosphorus and magnesium) in a form usable to plants, which quickly incorporates the chemicals into their own cells. This process greatly increases the nutrient-load of an ecosystem, in turn allowing for greater biodiversity.

29. (a) German biologist Ernst Haeckel coined the term 'ecology', the study of inter-relationship between organisms and their environment. Ecosystem, consist of different communities of organism and the physical environment with which they interact. Phytogeography is the study of geographic distribution of plants species on earth.

30. (b) Soil is the uppermost weathered layer or earth's crust and is composed of minerals and partly decomposed organic matter. Pedologist is a scientist who studies origin, composition and distribution of soil and the materials from which the soil is made.

31. (d) Phytoplanktons (algae) of oceans are the highest producers of organic matter.

32. (a) Plankton → Organisms passively floating in upper water.
Nekton → Actively swimming
Benthos → Lead sedentary life upon the sea bottom

33. (d) Grassland ecosystem is a terrestrial ecosystem. It includes various trophic levels. First trophic level (T_1) – Grass Second trophic level (T_2) – Rabbit Third trophic level (T_3) – Crow Fourth trophic level (T_4) – Vulture.

NOTES

If there is no producers (such as a plant), you cannot sea any primary consumers there. That is why trophic levels are important. They show availability of food/energy in a defined ecosystem, complexity of "who eats what", and dependency of any one to others.

34. (d) Ecological pyramid is a graphical representation that illustrates the flow of energy through different forms of life in an ecosystem. It is generally inverted in case of pyramid of biomass in a sea because the biomass of the fishes is more than the phytoplanktons (producers).
Features of pyramid of biomass in a sea:
- Food chain in ocean - Phytoplankton → zooplankton → predatory fish
- The biomass of consumers (zooplankton) is greater than phytoplankton (the producer) because of their small size and low weight. The predatory fish is much larger than zooplankton.
- The producers of ocean or aquatic ecosystem are phytoplankton and they have short life span and turn over and have lower mass than zooplankton.
- The biomass of tropic level is depends on the longevity of member.

35. (a) The given data depicts the inverted pyramid of biomass, usually present in aquatic ecosystem. Upright pyramid of biomass and numbers are not possible, as the data depicts primary producer is less than primary consumer and this is less than secondary consumers. Pyramid of energy is always upright.

36. (d) Forest ecosystem has the maximum biomass.
Some very high productive ecosystem are
– Tropical rain forest
– Coral reef
– Estuaries
– Sugarcane fields

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37. (b) Cropland ecosystem is largest anthropogenic ecosystem characterized by less diversity and high productivity.
38. (a) Lichens produce small amounts of carbonic acids from their "roots" and these slowly dissolve the rock, releasing nutrients. Other nutrients are obtained from water-borne or air-borne particles of both organic and inorganic materials. The body of a lichen contains an alga; this is able to photosynthesise sugars, some of which are passed on to the fungal component of the lichen. In return the alga gets a tiny but significant amount of shelter within the tissues of the lichen.
39 (a) Secondary succession takes place in disturbed area having poor vegetation.
40. (d) The gradual and predictable change, in the composition of species takes place in a given area during ecological succession.
41. (d) Biomagnification means an increase in concentration of toxins through the trophic levels of a food chain.
42. (a) Biotic community is an association of individuals of different species living in the same habitat and showing functional interactions.
43. (d) Detrivores, (*e.g.* earthworm) break down detritus into smaller particles. The species that invade a bare area in succession is called pioneer species. The products of ecosystem processes are termed as ecosystem services, *e.g.*, healthy forest ecosystems purify air and water, mitigate droughts and floods etc. Natality refers to number of births during a given period in the population.
44. (b) In an ecosystem, producers (e.g., plants/phytoplankton) belong to first trophic level, herbivores or primary consumer (e.g., grasshopper) to the second and carnivores or secondary consumer (e.g., lion, wolf) to the third trophic level.
45. (b) Plants are producers which can prepare their food by the process of photosynthesis. Zooplanktons, fish and man are primary, secondary and tertiary carnivores respectively.
46. (b) Earthworm derives its nutrition from decaying fallen leaves and soil organic matter. Thus the type of feeding in earthworm is detritus.
47. (c)
48. (a)
49. (d) Four important functional aspects of the ecocystem are
(i) Productivity (ii) Decomposition,
(iii) Energy flow and
(iv) Nutrient cycling.
50. (b) In forest, a single tree can support a large of number of birds thus base showing producers in a pyramid of number will be narrower than the next slab showing primary consumers.
51. (d) A hydrosere is a plant succession which occurs in a freshwater lake. Second stage of hydrosere is submerged stage that is represented by *Vallisneria, Hydrilla, Elodea, Utricularia* etc.
52. (a) Food web is a network of food chains or feeding relationships by which energy and nutrients are passed on from one species of living organisms to another.
53. (a) A standing crop is the quantity or total weight or energy content of the organism, which are in a particular location at a particular time.
54. (c) An energy pyramid is the graphical representation of the tropic level (nutritionals) by which the incoming solar energy is transferred into an ecosystem. It can never be inverted in shape.
55. (a) It feeds upon grains hence called primary consumer and can also feed on insects hence called secondary consumer at the same time in the same ecosystem.
56. (a) Hydrarch succession takes place in wet areas and xerarch succession respectively, which takes place in dry areas. So, both hydrarch and xerarch successions leads to medium water conditions.
57. (d) The statement (i) and (ii) are correct. The statement (iii) is incorrect because predators cannot lead to the extinction of prey species. Predator and prey evolve together. The statement (iv) is incorrect because chemical such as nicotine and strychnine produced by the plants are not metabolic disorders but are metabolic wastes.

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58. (a) The correct sequence of plants in a hydrosere is *Volvox, Hydrilla, Pistia, Scirpus, Lanatana* and *Oak*. A hydrosere is a plant succession which occurs in a fresh water lake. In time, an area of open fresh water such as a lake will naturally dry out, ultimately becoming woodland. During this change, a range of different landtypes such as swamp and marsh will succeed each other. The succession from open water to climax woodland is likely to take at least two hundred years.
59. (a) A pond ecosystem is a delicate balance of fish, plants and other animals. Fish occupy more than one tropic level in pond ecosystem. Small fishes act as secondary consumer. They feed on primary consumer. Large fishes act as tertiary consumer. They feed on smaller fish.
60. (a) Food chain is the transfer of energy from green plants (Primary producers), through a sequence of organisms occupies in a food chain is known as its trophic level. Therefore, statements b and c are correct.
61. (c) Fresh weight is not used for the construction of ecological pyramids because the total fresh weight does not change into energy. Hence we can say that fresh weight is not continuous in the tropic levels.
62. (a) An ecosystem having low stability can be easily damaged. An ecosystem having high resilience will take less time to recover.
63. (a) First trophic level is occupied by producers. Second trophic level is occupied by primary consumers. Third trophic level is occupied by the secondary consumers.
64. (b) According to the 10% law, at each trophic level, only 10% of the energy received is transfered to the next trophic level.
65. (b) Producers are the direct and indirect source of food for all the trophic levels. They are always more in number.
66. (d) The primary succession means the development of communities only on a newly exposed habitat with no record of earlier vegetation.
67. (d) In a biotic community the herbivores (goat, deer) are those animals, which consume the primary producers (green plants). Hence they are primary consumers.
68. (c) Energy pyramid cannot be inverted because energy always flows in one direction only. According to 10% law of energy transfer given by Lindemann (1972), during transfer of energy from one trophic level to other there is always loss of energy in respiration and other activities. Only 10% of energy is transfered to net trophic level. So the amount of energy flow decreases with successive trophic levels.
69. (b) Only 10% of the mass is flown from one trophic level to another in the form of energy.
70. (a) First trophic level in a lake is phytoplankton, second is zooplankton.
71. (d) Decomposers include microorganisms such as bacteria and fungi. They form the largest population in a food chain.
72. (c) Pyramid of number represents the number of individuals on each tropic level.
73. (c) Pyramid of numbers of pond ecosystem is upright.
74. (b) Detritus food chain being with dead organic matter with dead plant parts, animals and their excretory product which is being acted upon by decomposers such as saprophytes to obtain energy needed for their survival.
75. (c) Phytoplankton $\rightarrow$ zooplankton $\rightarrow$ Fish. This is a type of food chain in aquatic ecosystem.
76. (b) Pyramid of numbers in a grassland ecosystem is always upright. For most ecosystem, like grass land ecosystem. Pyramids of numbers are upright because numbering of organisms decrease at successively higher trophic levels. Trophic level refers to the organisms, position in the food chain.
77. (c) In an ecosystem producers (green plants) are always more than consumers (herbivores, carnivores etc.)
78. (d) Carbon and Nitrogen are gaseous nutrient cycle. Sulphur and phosphorus are sedimentary nutrient cycle.

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79. (c) Phosphorus is an important element for living beings. Consumers obtain phosphorus directly or indirectly from plants. Phosphorus is also present in phosphatic rocks. It is released during the decomposition of plant and animal remains. The released phosphorus may reach the deeper layers of soil and gets deposited as phosphate rocks. All plants and animals eventually die and in due time, their organic remains or debris decay through the action of micro-organism and the phosphates are released into the water for recycling.

NOTES

Odum is the father of modern ecology. Clements proposed the theory of plant succession. The tern ecosystem was proposed by Tansley. Elton proposed the concept of ecological pyramids. Hence, it is also called as Eltonian pyramids.

80. (b) The natural reservoir of phosphate is rock which contains phosphorus in the form of phosphates when rocks are weathered, minute amounts of these phosphate dissolve in soil solution and are absorbed by the roots of the plants . Herbivores and other animals obtain this element from plants.

81. (b) Phosphorus is mostly used as phosphate. Its **reservoir pool** is phosphate rocks while cycling pool is soil for terrestrial ecosystems and water for aquatic ecosystems.

82. (a) **Barophiles** are bacteria which live in high pressure environments. They are generally found on ocean floors, where pressure generally exceeds 380 *atm* (38 *MPa*). Some have been found at the bottom of the Pacific Ocean where the maximum pressure is roughly 117 MPa.

83. (a) Nitrogenase is an enzyme involved in biological nitrogen fixation. Enzyme nitrate reductase is involved in conversion of nitrate to nitrite. Conversion of ammonia to nitrate is carried out by *Nitrosomonas* and *Nitrobacter.*

84. (c) Bacteria act as decomposers in the carbon cycle.

85. (b) Biogeochemical cycles : Two types :
(a) Gaseous : Biogenetic materials involved in circulation are gases eg. N_2, O_2, CO_2 *etc.*
(b) Sedimentary : Biogenetic materials involved in circulation are non-gaseous *eg.* P, Ca, S etc. forms rocks.

86. (a) Energy flow takes place only in one direction *i.e.*, producers $\rightarrow$ herbivores $\rightarrow$ carnivores whereas, nutrients use carbon, nitrogen and potassium shows cyclic flow.

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37 Biodiversity and its Conservation

Trend Analysis with Important Topics & Sub-Topics

Topic	Sub-Topics	2020 Qns.	2020 LOD	2019 Qns.	2019 LOD	2018 Qns.	2018 LOD	2017 Qns.	2017 LOD	2016 Qns.	2016 LOD
Biodiversity/ Patterns of Biodiversity/ Loss of Biodiversity	Biodiversity	2	E					1	E		
	Loss of Biodiversity			1	A					1	E
Biodiversity Conservation	Ex-situ conservation					1	E	2	E	1	E

LOD - Level of Difficulty | E - Easy | A - Average | D - Difficult | Qns - No. of Questions

Topic 1: Biodiversity/Patterns of Biodiversity/Loss of Biodiversity

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1. According to Robert May, the global species diversity is about *[2020]*
   (a) 20 million (b) 50 million
   (c) 7 million (d) 1.5 million
2. Decline in the population of Indian native fishes due to introduction of *Clarias gariepinus* in river Yamuna can be categorised as *[2019, Odisa]*
   (a) Alien species invasion
   (b) Co-extinction
   (c) Habitat fragmentation
   (d) Over exploitation
3. Alexander Von Humboldt described for the first time: *[2017]*
   (a) Laws of limiting factor
   (b) Species-Area relationships
   (c) Population Growth equation
   (d) Ecological Biodiversity
4. Which of the following is the most important cause of animals and plants being driven to extinction? *[2016]*
   (a) Over - exploitation
   (b) Alien species invasion
   (c) Habitat loss and fragmentation
   (d) Co-extinctions
5. The species confined to a particular region and not found elsewhere is termed as : *[2015 RS]*
   (a) Alien
   (b) Endemic
   (c) Rare
   (d) Keystone
6. A species facing extremely high risk of extinction in the immediate future is called: *[2014]*
   (a) Vulnerable
   (b) Endemic
   (c) Critically endangered
   (d) Extinct
7. The organization which publishes the Red List of species is: *[2014]*
   (a) ICFRE (b) IUCN
   (c) UNEP (d) WWF
8. Given below is the representation of the extent of global diversity of *invertebrates*. What groups the four portions (A-D) represent respectively? *[2014]*

	A	B	C	D
(a)	Insects	Crustaceans	Other animal groups	Molluscs
(b)	Crustaceans	Insects	Molluscs	Other animal groups
(c)	Molluscs	Other animal groups	Crustaceans	Insects
(d)	Insects	Molluscs	Crustaceans	Other animal groups

9. Which of the following represent maximum number of species among global biodiversity? *[NEET 2013]*
   (a) Lichens (b) Fungi
   (c) Mosses and Ferns (d) Algae
10. Which organization publishes the Red Data Book? *[NEET Kar. 2013]*
   (a) GEF (b) IUCN
   (c) UNEP (d) WWF
11. Maximum nutritional diversity is found in the group. *[2012]*
   (a) Fungi (b) Animalia
   (c) Monera (d) Plantae
12. The highest number of species in the world is represented by *[2012]*
   (a) Fungi (b) Mosses
   (c) Algae (d) Lichens
13. Which one of the following shows maximum genetic diversity in India? *[2011]*
   (a) Groundnut (b) Rice
   (c) Maize (d) Mango
14. Biodiversity of a geographical region represents *[2011M]*
   (a) endangered species found in the region.
   (b) the diversity in the organisms living in the region.
   (c) genetic diversity present in the dominant species of the region.
   (d) species endemic to the region.
15. Which one of the following has maximum genetic diversity in India? *[2009]*
   (a) Mango (b) Wheat
   (c) Tea (d) Teak
16. Tiger is **not** a resident in which one of the following national park? *[2009]*
   (a) Sunderbans (b) Gir
   (c) Jim Corbett (d) Ranthambhor
17. The table below gives the population (in thousands) of ten species (A-J in four areas (a-d) consisting of the number of habitats given within brackets against each. Study the table and answer the question which follows: *[2008]*

Area and Number of habitats	Species and their populations (in thousands) in the									
	A	B	C	D	E	F	G	H	I	J
a (11)	2.3	1.2	0.52	6.0	_	3.1	1.1	9.0	_	10.3
b (11)	10.2	_	0.62	_	1.5	3.0	_	8.2	1.1	11.2
c (13)	11.3	0.9	0.48	2.4	1.4	42	0.8	8.4	2.2	4.1
d (12)	3.2	10.2	11.1	4.8	0.4	33	0.8	7.3	113	2.1

   Which area out of a to d shows maximum species diversity?
   (a) b (b) c
   (c) d (d) a
18. *Quercus* species are the dominant component in *[2008]*
   (a) Temperate deciduous forests
   (b) Alpine forests
   (c) Scrub forests
   (d) Tropical rain forests
19. Which one of the following is the correct matched pair of an endangered animal and National Park ? *[2006]*
   (a) Rhinoceros - Kaziranga National Park
   (b) Wild ass - Dudhwa National Park
   (c) Great Indian bustard - Keoladeo National Park
   (d) Lion - Corbett National Park
20. At which latitude, heat gain through insolation approximately equals heat loss through terrestrial radiation? *[2005]*
   (a) $22\frac{1}{2}°$ North and South
   (b) 40° North and South
   (c) $42\frac{1}{2}°$ North and South
   (d) 66° North and South
21. Biodiversity Act of India was passed by the parliament in the year *[2005]*
   (a) 1992 (b) 1996
   (c) 2000 (d) 2002

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22. In which one of the following pairs is the specific characteristic of a soil *not* correctly matched? ***[2004]***
    (a) Laterite - Contains aluminium compound
    (b) Terra rossa - Most suitable for roses
    (c) Chernozems - Richest soil in the world
    (d) Black soil - Rich in calcium carbonate
23. Wildlife is destroyed most when ***[1994, 98, 2002]***
    (a) there is lack of proper care
    (b) mass scale hunting for foreign trade
    (c) its natural habitat is destroyed
    (d) natural calamity
24. Reason of diversity in living beings is due to
    (a) mutation ***[2001]***
    (b) long term evolutionary change
    (c) gradual change
    (d) short term evolutionary change
25. During adverse season, therophytes survive by ***[1997]***
    (a) bulbs (b) corms
    (c) rhizomes (d) seeds
26. Flamingoes breed in ***[1996]***
    (a) rann of Kutch (b) chilka lake
    (c) sambhar lake (d) mansarover Lake
27. If the forest cover is reduced to half, what is most likely to happen on a long term basis ? ***[1996]***
    (a) Tribals living in these areas will starve to death
    (b) Cattle in these and adjoining areas will die due to lack of fodder
    (c) Large areas will become deserts
    (d) Crop breeding programmes will suffer due to a reduced availability of variety of germplasm
28. Bulk fixation of carbon through photosynthesis takes place in ***[1994]***
    (a) tropical rain forests
    (b) tropical rain forest and crop plants
    (c) crop plants
    (d) oceans
29. Which animal has become extinct from India? ***[1994]***
    (a) Snow Leopard (b) *Hippopotamus*
    (c) Wolf (d) Cheetah
30. Species diversity increases as one proceeds from ***[1994]***
    (a) high altitude to low altitude and high latitude to low latitude
    (b) low altitude to high altitude and high latitude to low latitude
    (c) low altitude to high altitude and low latitude to high latitude
    (d) high altitude to low altitude and low latitude to high latitude.
31. American water plant that has become a troublesome water weed in India is ***[1993]***
    (a) *Cyperus rotundus*
    (b) *Eichhornia crassipes*
    (c) *Trapa latifolia*
    (d) *Trapa bispinosa*
32. A non-renewable resource is ***[1991, 92, 93]***
    (a) non-renewable non-conventional energy source
    (b) non-renewable conventional energy source
    (c) renewable non-conventional energy source
    (d) renewable conventional energy source
33. Fertility of soil is measured by its ability to
    (a) retain nutrients ***[1992]***
    (b) hold organic materials
    (c) hold water
    (d) support life
34. Petroleum is a ***[1992]***
    (a) synthetic product
    (b) renewable resource
    (c) non-renewable resource
    (d) inconvenient resource
35. Minerals and metals are ***[1992]***
    (a) biodegradable resources
    (b) renewable
    (c) non-renewable
    (d) renewable and non-renewable resources
36. Soil fertility is reduced by ***[1992]***
    (a) crop rotation
    (b) nitrogen fixing bacteria
    (c) decaying organic matter
    (d) intensive agriculture
37. Renewable source of energy is ***[1991]***
    (a) Biomass (b) Coal
    (c) Petroleum (d) Kerosene

Topic 2: Biodiversity Conservation

38. Which of the following regions of the globe exhibits highest species diversity? ***[2020]***
    (a) Madagascar
    (b) Himalayas
    (c) Amazon forests
    (d) Western Ghats of India

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39. Western Ghats have a large number of plant and animal species that are not found anywhere else. Which of the following terms will you use to notify such species? *[2019, Odisa]*
(a) Keystone (b) Endemic
(c) Vulnerable (d) Threatened

40. In mung bean, resistance to yellow mosaic, virus and powdery mildew were brought about by : *[2019, Odisa]*
(a) Hybridisation and selection
(b) Mutation breeding
(c) Biofortification
(d) Tissue culture

41. Which of the following is the most important cause for animals and plants being driven to extinction? *[2019]*
(a) Habitat loss and fragmentation
(b) Drought and floods
(c) Economic exploitation
(d) Alien species invasion

42. The Earth Summit held in Rio de Janeiro in 1992 was called: *[2019]*
(a) to reduce CO_2 emissions and global warming.
(b) for conservation of biodiversity and sustainable utilisation of its benefits.
(c) to assess threat posed to native species by invasive weed species.
(d) for immediate steps to discontinue use of CFCs that were damaging the ozone layer.

43. Which one of the following is not a method of in situ conservation of biodiversity? *[2019]*
(a) Biosphere Reserve (b) Wildlife Sanctuary
(c) Botanical Garden (d) Sacred Grove

44. All of the following are included in 'ex-situ conservation' except *[2018]*
(a) Wildlife safari parks (b) Sacred groves
(c) Seed banks (d) Botanical gardens

45. Which one of the following is related to Ex-situ conservation of threatened animals and plants ? *[2017]*
(a) Biodiversity hot spots
(b) Amazon rainforest
(c) Himalayan region
(d) Wildlife safari parks

46. The region of Biosphere Reserve which is legally protected and where no human activity is allowed is known as: *[2017]*
(a) Buffer zone (b) Transition zone
(c) Restoration zone (d) Core zone

47. Which is the National Aquatic Animal of India? *[2016]*
(a) Gangetic shark (b) River dolphin
(c) Blue whale (d) Sea-horse

48. Cryopreservation of gametes of threatened species in viable and fertile condition can be referred to as:- *[2015 RS]*
(a) Advanced *ex-situ* conservation of biodiversity
(b) *In situ* conservation by sacred groves
(c) *In situ* cryo-conservation of biodiversity
(d) *In situ* conservation of biodiversity

49. In which of the following both pairs have correct combination: *[2015 RS]*
(a) *In situ* conservation : Cryopreservation
Ex situ conservation : Wildlife Sanctuary
(b) *In situ* conservation : Seed Bank
Ex situ conservation : National Park
(c) *In situ* conservation : Tissue culture
Ex situ conservation : Sacred groves
(d) *In situ* conservation : National Park
Ex situ conservation : Botanical Garden

50. An example of *ex situ* conservation is: *[2014]*
(a) National Park (b) Seed Bank
(c) Wildlife Sanctuary (d) Sacred Grove

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51. Just as a person moving from Delhi to Shimla to escape the heat for the duration of hot summer, thousands of migratory birds from Siberia and other extremely cold northern regions move to: *[2014]*
(a) Western Ghat
(b) Meghalaya
(c) Corbett National Park
(d) Keoladeo National Park

52. The largest tiger reserve in India is *[NEET Kar. 2013]*
(a) Nagarhole
(b) Valmiki
(c) Nagarjunsagar-Srisailam
(d) Periyar

53. Which one of the following is not used for ex-situ plant conservation ? *[NEET 2013]*
(a) Seed banks (b) Shifting cultivation
(c) Botanical Gardens (d) Field gene banks

54. Which one of the following areas in India, is a hotspot of biodiversity? *[2012]*
(a) Eastern Ghats (b) Gangetic Plain
(c) Sunderbans (d) Western Ghats

55. Sacred groves are specially useful in *[2012M]*
(a) preventing soil erosion.
(b) year-round flow of water in rivers.
(c) generating environmental awareness.
(d) conserving rare and threatened species.

56. Select the correct statement about bio-diversity. ***[2012M]***
(a) Large scale planting of Bt cotton has no adverse effect on biodiversity.
(b) Western Ghats have a very high degree of species richness and endemism.
(c) Conservation of biodiversity is just a fad pursued by the developed countries.
(d) The desert areas of Rajasthan and Gujarat have a very high level of desert animal species as well as numerous rare animals.

A collection of plants and seeds having diverse alleles of all the genes of a crop is called ***[2011]***
(a) herbarium (b) germplasm
(c) gene library (d) genome

57. Consider the following statements (a)-(D) each with one or two blanks. ***[2011M]***
(a) Bears go into __(1)__ during winter to __(2)__ cold weather
(b) A conical age pyramid with a broad base represents __(3)__ human population
(c) A wasp pollinating a fig flower is an example of __(4)__
(d) An area with high levels of species richness is known as __(5)__

58. Which one of the following options give the correct fill ups for the respective blank numbers from (1) to (5) in the statements
(a) (2) - stable (4) commensalism, (5) marsh
(b) (1) - aestivation, (5) - escape, (3) - stable, (4) - mutualism
(c) (3) - expanding, (4) - commensalism, (5) biodiversity park
(d) (1)- hibernation, (2) - escape, (3) - expanding, (5) hot spot

59. Which one of the following is an example of *Exsitu* conservation? ***[2010]***
(a) Wildlife sanctuary (b) Seed bank
(c) Sacred groves (d) National park

60. Which one of the following is not observed in biodiversity hotspots? ***[2008]***
(a) Endemism
(b) Accelerated species loss
(c) Lesser inter-specific competition
(d) Species richness

61. World Summit on Sustainable Development (2002) was held in ***[2008]***
(a) Brazil (b) Sweden
(c) Argentina (d) South Africa

62. One of endangered species of Indian medicinal plants is that of ***[2007]***
(a) *Ocimum* (b) Garlic
(c) *Nepenthes* (d) *Podophyllum*

63. Identify the odd combination of the habitat and the particular animal concerned. ***[2007]***
(a) Sunderbans - Bengal Tiger
(b) Periyar - Elephant
(c) Rann of kutch - Wild Ass
(d) Dachigam National park - Snow Leopard.

64. Which one of the following pairs of organisms are exotic species introduced in India? ***[2007]***
(a) *Lantana camara*, water hyacinth
(b) Water hyacinth, *Prosopis cinereria*
(c) Nile perch, *Ficus* religiosa
(d) *Ficus religiosa*, *Lantana camara*

65. Which one of the following is not included under *in-situ* conservation ? ***[2006]***
(a) Botanical garden (b) Biosphere reserve
(c) National park (d) Sanctuary

66. Which of the following is considered a hot-spot of biodiversity in India ? ***[2006]***
(a) Indo-Gangetic Plain (b) Eastern Ghats
(c) Aravalli Hills (d) Western Ghats

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67. Which of the following pairs of an animal and a plant represents endangered organisms in India? ***[2006]***
(a) *Tamarind* and *Rhesus* monkey
(b) *Cinchona* and leopard
(c) Banyan and black buck
(d) *Bentinckia nicobarica* and Red Panda

68. According to IUCN Red List, what is the status of Red Panda (*Ailurus fulgens*)? ***[2005]***
(a) Critically endangered species
(b) Vulnerable species
(c) Extinct species
(d) Endangered species

69. One of the most important functions of botanical gardens is that ***[2005]***
(a) they provide a beautiful area for recreation
(b) one can observe tropical plants there
(c) they allow ex-situ conservation of germ plasm
(d) they provide the natural habitat for wildlife

70. In your opinion, which is the most effective way to conserve the plant diversity of an area? ***[2004]***
(a) By tissue culture method
(b) By creating biosphere reserve
(c) By creating botanical garden
(d) By developing seed bank

71. Which group of vertebrates comprises the highest number of endangered species ?*[2003]*
(a) Birds (b) Mammals
(c) Fishes (d) Reptiles

72. The endangered largest living lemur *Idri idri* is found in *[2000]*
(a) Sri Lanka (b) Madagascar
(c) Mauritius (d) India

73. An institution where valuable plant material likely to become irretrievably lost in the wild or in cultivation is preserved in a viable condition is known as *[2000]*
(a) Genome (b) Herbarium
(c) Gene library (d) Gene bank

74. Which animal has gone extinct in recent times in India? *[1999]*
(a) *Panthera leo*
(b) *Acinonyx jubatus*
(c) *Antilope cervicapra*
(d) *Rhinoceros unicornis*

75. A high density of a protected animal in a National Park can result into *[1999]*
(a) mutualism
(b) intraspecific competition
(c) emigration
(d) predation

76. MAB stands for *[1997]*
(a) Man and Biology Programme
(b) Man and Biosphere Programme
(c) Mammals and Biosphere Programme
(d) Mammals and Biology Programme

77. A number of natural reserves have been created to conserve specific wild life species. Identify the correct combination from the following
(a) Gir forest - Tiger *[1996]*
(b) Kaziranga - Elephants
(c) Rann of Kutch - Wild Ass
(d) Manas wild life Sanctuary - Musk deer

78. Which of the following is the correct matching pair of a sanctuary and its main protected wild animal? *[1995]*
(a) Gir-Lion
(b) Sariska-Tiger
(c) Sunderban- Rhino
(d) Kaziranga-Musk deer

79. Ranthambore National Park is situated in *[1994]*
(a) Maharashtra (b) Rajasthan
(c) Gujarat (d) U.P.

80. National Park associated with Rhinoceros is *[1994]*
(a) Kaziranga (b) Ranthambore
(c) Corbett (d) Valley of Flowers

81. Soil conservation is *[1989]*
(a) conversion of sterile soil into fertile one
(b) aeration of soil
(c) erosion of soil
(d) protection against loss

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ANSWER KEY

1	(c)	10	(b)	19	(a)	28	(d)	37	(a)	46	(d)	55	(d)	64	(a)	73	(d)
2	(a)	11	(c)	20	(b)	29	(d)	38	(c)	47	(b)	56	(b)	65	(a)	74	(a)
3	(b)	12	(a)	21	(d)	30	(a)	39	(b)	48	(a)	57	(c)	66	(d)	75	(b)
4	(c)	13	(b)	22	(d)	31	(b)	40	(b)	49	(d)	58	(d)	67	(d)	76	(b)
5	(b)	14	(b)	23	(c)	32	(b)	41	(a)	50	(b)	59	(b)	68	(d)	77	(c)
6	(c)	15	(b)	24	(b)	33	(d)	42	(b)	51	(d)	60	(c)	69	(c)	78	(a)
7	(b)	16	(b)	25	(d)	34	(c)	43	(c)	52	(c)	61	(d)	70	(d)	79	(b)
8	(d)	17	(c)	26	(b)	35	(d)	44	(b)	53	(b)	62	(d)	71	(b)	80	(a)
9	(b)	18	(a)	27	(c)	36	(d)	45	(d)	54	(d)	63	(d)	72	(b)	81	(d)

Hints & Solutions

1. (c) Robert May estimated global species diversity at about 7 million. Although some extreme estimates range from 20 to 50 million.
2. (a) Introduction of the African catfish *Clarias gariepinus* for aquaculture purposes has become a threat to indigenous catfishes in our rivers. *Clarias gariepinus* is an alien species for the communities in Yamuna.

> **NOTES** An invasive species is a non-native species that spreads from the point of introduction and becomes abundant. The invasive species label attaches only to populations of species whose impact upon introduction has altered their new environment.

3. (b) Alexander Von Humboldt noticed that within a region species richness increases with the increase in area.
4. (c) The primary cause of human-induced extinction events is simply human overpopulation of planet Earth. The most important causal anthropogenic activities are habitat destruction and fragmentation.
5. (b) Endemic species is confined to a particular area due to special type of adaptation according to that region.
6. (c) **Critically Endangered :** The taxon facing very high risk of extinction in the wild can become extinct any moment in the immediate future, e.g. *Sus salvinus* (Pigmy Hog), *Berberis nilghiriensis*.
7. (b) IUCN or WCN maintains a red data book which is a catalogue of threatened plants and animals facing risk of extinction. The IUCN red list (2004) documents the extinction of 784 species (including 338 vertebrates, 359 invertebrates and 87 plants) in the last 500 years.
8. (d) Arthropoda is the largest phylum of Animalia which includes insects. Over two-thirds of all named species on earth are arthropods. They have organ system level of organisation. Mollusca is the second largest animal phylum. They are terrestrial or aquatic (marine or fresh).
9. (b) The number of species of fungi is maximum in respect to other options. The number of fungus species in the world is more than the combined total of species of fishes, amphibians, reptiles and mammals.
10. (b) IUCN or WCN maintains a red data book which is a catalogue of threatened plants and animals facing risk of extinction. The IUCN red list (2004) documents the extinction of 784 species (including 338 vertebrates, 359 invertebrates and 87 plants) in the last 500 years.
11. (c)
12. (a) Recent estimate suggests that 5.1 million fungal species exists.
13. (b) In India maximum genetic diversity is seen in rice. Total of 23 variety of irrigated ecology and 8 varieties of rainfed ecology has been invented in India.
14. (b) Biodiversity is the number of variety of organism found within a specified geographic region.
15. (b) Wheat genetics is more complicated than that of most other domesticated species. Some wheat species are diploid, with two sets of chromosomes, but many are stable polyploids, with four sets of chromosomes (tetraploid) or six (hexaploid). India has more genetically diverse varieties of rice and than the varieties of mangoes.
16. (b) Tiger is not resident in Gir national park. Gir has a large population of marsh crocodile or mugger, which is among the 40 species of reptiles and amphibians recorded in the sanctuary. According to official census figures, Gir has about 300 lions and 300 leopards, making it one of the major big-cat concentrations in India. Sambar and spotted deer (chital), blue bull (nilgai), chousingha (the world's only four-horned antelope), chinkara (Indian gazelle) and wild boar thrive in Gir. Jackal, striped hyena, jungle cat, rusty-spotted cat, langur, porcupine, black-naped Indian hare are among the other mammals of Gir.

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17. (c) Species richness refers to the number of species per unit area. Species evenness is the relative abundance with which each species is represented in an area. Thus variation in the number of species, kinds of species as well as the number of individuals per species lead to greater diversity. Area(d) and number of habitats (12) shows the maximum species diversity.
18. (a) *Quercus* species is a dominant component in temperate deciduous forests. The common name of *Quercus* is cork oak belongs to family fabaceae. Cork used as a bottle stoppers, soles for shoes, insulating material and for manufacture of linoleum.
19. (a) Kaziranga National Park in Assam is famous as a protection environmental park for rhinoceros.
20. (b) At 40º North and South.
21. (d) Biodiversity Act of India was passed by the parliament in the year 2002.
22. (d) Option (d) is not the correct match as black soil is rich in metals such as Iron, Magnesium and Aluminium and not in calcium carbonate.
23. (c) If natural habitat is destroyed, wild life is affected worstly.
24. (b) Diversity is due to the long term evolutionary changes. Adaptability to continuous changes in environmental conditions is important for natural selection of variants and variations generation after generation leading to emergence of diverse descendants.
25. (d) Terophytes are those plants which survive the adverse season like winter as a seed and complete their life cycle between spring and autumn.
26. (b) Flamingoes breed in chilka lake.
27. (c) If the forest cover is reduced to half, large areas will become deserts.
28. (d) Bulk fixation of carbon through photosynthesis takes place in oceans, due to presence of majority of phytoplanktons.
29. (d) The 'Cheetah' has become extinct from India. The endangered subspecies *Acinonyx jubatus venaticus* lives in Asia (Iran). In 1990, there were reports in the Times of India of a cheetah sighting in eastern India. There is a chance some cheetahs remain in India, though it is doubtful. There have also been reports of Asiatic cheetahs in the Balochistan Province of Pakistan, though these continue to be unverified. The cheetah prefers to live in an open biotope, such as semi-desert, prairie, and thick bush.
30. (a) At low altitude and latitude more habitat is found and environment conditions are also more suitable i.e. more species and individuals occur at lower latitude and altitude places.
31. (b) *Eichhornia crassipes* is an American origin plant and now water weed in India.
32. (b) Non-renewable sources of energy are generally conventional (traditional) sources.
33. (d) The ability of soil to support life is called its fertility. It sustain agriculture plant growth.
34. (c) Petroleum is a non-renewable resource.
35. (d) Due to shorter recycling in case of biogenetic nutrients (minerals) they are renewable and due to very long recycling in case of metals and same minerals they are non-renewable.
36. (d) During intensive agriculture most of the nutrients and minerals are exhausted from the soil so fertility decreases.
37. (a) Coal, kerosene and petroleum are non-renewable while biomass is renewable source of energy.
The term "biomass" is especially useful for plants, where some internal structures may not always be considered living tissue, such as the wood (secondary xylem) of a tree. Biofuels include bioethanol, biobutanol, biodiesel & biogas.
Biomass is grown from several plants, including switchgrass, hemp, corn, poplar, willow and sugarcane. The particular plant used is usually not very important to the end products, but it does affect the processing of the raw material. Production of biomass is a growing industry as interest in sustainable fuel sources is growing.
38. (c) The largely tropical Amazon rain forest in South America has the greatest biodiversity on earth.
39. (b) Endemic species are those species that are confined to a particular region only and not found anywhere else.

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NOTES

The Western Ghats are a chain of hills that run along the western edge of peninsular India. These regions have moist deciduous forest and rain forest. The region shows high species diversity as well as high levels of endemism. Nearly 77% of the amphibians and 62% of the reptile species found here are found nowhere else.

40. (b) Mutation is the process by which genetic variations are created through changes in the base sequence within genes resulting in the creation of a new character or trait not found in the parental type. It is possible to induce mutations artificially through use of chemicals or radiations (like gamma radiations), and selecting and using the plants that have the desirable character as a source in breeding, this process is called mutation breeding. This procedure has helped mung bean production by providing resistance against yellow mosaic virus and powdery mildew (fungal disease).

NOTES

yellow mosaic virus symptoms: Initially small yellow patches or spots on the young leaves. Slowly yellow discoloration increases and the entire leaf may turn yellow. Infected leaves show alternating green and yellow patches. Yellow leaves turn slowly dry and wither.

Powdery mildew is a fungal disease that affects a wide range of plants. Powdery mildew diseases are caused by many different species of fungi in the order Erysiphales, with Podosphaera xanthii (a.k.a. Sphaerotheca fuliginea) being the most commonly reported cause.

41. (a) Habitat loss and fragmentation are the most important cause for animals and plants being driven to extinction. Habitats of various organisms are altered or destroyed by uncontrolled and unsustainable human activities (such as deforestation, slash and burn agriculture, mining, and urbanisation). This will lead to breaking up of the habitat into small pieces, which effect the movement of migratory animals and also, decrease the genetic exchange between populations leading to a declination of species.

42. (b) Earth Summit (Rio Summit)-1992, called upon all nations to take appropriate measures for conservation of biodiversity and sustainable utilisation of its benefits.

NOTES

The Earth Summit", its aim was to put the concept of sustainable development at the forefront of our concerns and to seek common action to protect the planet from environmental degradation that even threatens to change the global climate.

43. (c) Botanical garden is an *ex - situ* conservation (offsite conservation) method to conserve biodiversity.

44. (b) In-situ conservation is the on-site conservation or the conservation of genetic resources in natural populations of plant or animal species. E.g. Sacred groves.

45. (d) Ex-situ conservation is offsite strategy for conservation of biological diversity in zoological park and botanical gardens respectively.

46. (d) Biosphere reserve is a protected area for wildlife with multipurpose activities.

It has three zones

(a) Core zone – does not have any human interference

(b) Buffer zone – has limited human activity

(c) Transition zone – allows human settlement, grazing cultivation etc.

47. (b) River Dolphin is the National Aquatic Animal of India. This mammal is also said to represent the purity of the holy Ganga as it can only survive in pure and fresh water. *Platanista gangetica* has a long pointed snout and also have visible teeth in both the upper and lower jaws.

48. (a) In such type of conservation, the threatened animals and plants are taken out of their natural habitat and protected in special areas like zoological parks and wild life sanctuaries.

49. (d) *In-situ* (on site) conservation is within the natural habitat eg- sea, river and forest. *Ex-situ* (off site) conservation is outside the natural habitat e.g. zoological park.

50. (b) In *Ex-situ* conservation the threatened animals and plants are taken out of their natural habitat and are protected in special parks or

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areas like, Zoological parks, Wild life safari parks and Botanical gardens etc. The *ex-situ* conservation also includes cryopreservation, fertilization of eggs *in-vitro* and propagation of plants through 'Tissue culture methods', preservation of seeds through Seed banks.

51. (d) The Keoladeo National Park is a famous avifauna sanctuary in India that plays host to thousands of birds especially during the summer season. It is formerly known as the Bharatpur Bird Sanctuary in Bharatpur, Rajasthan. October to February is the best time, for the migratory birds are there as well as the residents. In August local birds start their nest building and rear their young for the next few months. October/November is when the migrants arrive. Most stay till March including the Siberian Crane.

52. (c) Nagarjunsagar-Srisailam Tiger Reserve is the largest Tiger reserve in India and the only Tiger Reserve in Andhra Pradesh state.

53. (b) Shifting or Jhum cultivation contributes to deforestation. *Ex-situ* conservation is a biodiversity conservation method in which threatened animals and plants are taken out of their natural habitat and placed in protected environments as zoological parks, botanical gardens, wildlife safari parks, seed banks and gene banks.

54. (d) Hots are the geographical area where biodiversity is maximum. Two hotspots in India are western ghats and north eastern himlayan region.

55. (d) An area with particular types of trees dedicated to local deities or ancestral spirits that are protected by local communities through social traditions and taboos incorporating spiritual and ecological values are called as sacred groves.

Sacred groves act as an ideal centre for biodiversity conservation. Several plants and animals that are threatened in the forest are still well conserved in some of the sacred groves. It has been observed that several medicinal plants that are not to be found in the forest are abundant in the sacred groves. Further, rare, endangered, threatened and endemic species are often concentrated in sacred groves.

56. (b) Western ghat is biodiversity rich zone along with endemism. The forests of the western ghats are some of the best representatives of non-equatorial tropical evergreen forests in the world. The Western Ghats have evolved into one of the richest centers of endemism owing to their isolation from other moist areas.

57. (c) Gene library contains DNA fragments representing the entire genome of an organism. So collection of alleles of the genes of a crop is called gene library.

58. (d)

59. (b) *Ex-situ* conservation is the conservation of selected organism in places outside their natural homes. They include off site collection and gene banks.

In-situ conservation, on the other hand, is the conservation of endangered species in their natural habitat. Biosphere reserves, national parks, wildlife sanctuaries and sacred groves all are examples of *in-situ* conservation.

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60. (c) Lesser inter-specific competition is not observe in biodiversity hotspots, levels of species richness and high degree of endemism. Initially 25 biodiversity hotspots were identified but subsequently nine more have of biodiversity hotspots in the world to 34. These hotspots are also regions of accelerated habitat loss.

61. (d) World Summit on sustainable development (2002) was held in Johannesburg, South Africa, 190 countries pledged their commitment to achieve by 2010, a significant in reduction the current rate of biodiversity loss at global, regional and local levels.

62. (d) *Podophyllum* is one of the endangered species of Indian medicinal plants. It is used to remove benign (not cancer) growths, such as certain kinds of warts. It works by destroying the tissue of the growth.

63. (d) Dachigam national park is for conservation of Hangul which is one of India's most scenically beautiful wildlife reserves. It is located only 22 kilometers from Srinagar, the capital city of the northern state of Jammu and Kashmir. It covers an area of 141 square kilometers.

64. (a) Exotic Species - a species that has been introduced from another geographic region to an area outside its natural range. Examples are water hyacinth, *Lantana camara*.

65. (a) *In-situ* means keeping endangered species of animals or plants into natural environment and not in the environment that looks like natural but man made, like zoological & botanical gardens. *In-situ* includes, national parks, sanctuaries and biosphere reserve.

66. (d) Hotspots are those areas which were rich in biodiversity but now under threat due to direct or indirect interference of human activites. These regions are on the edge to get some of their species extinct due to humans. Western Ghats in India are under threat due to continuous developmental activities and Doon valley is under threat due to continuous mining activities.

67. (d) Endangered plant is *Bentinckia nicobarica* and endangered animal is Red Panda (*Ailurus fulgens*).

68. (d) IUCN is International Union of Conservation of Nature and Natural resources which is now called World Conservation Union (WCU). It maintains a red databook or red list which is a catalogue of taxa facing risk of extinction.

Endangered Species are those facing a high risk of extinction in the wild in the near future due to decrease in its habitat, excessive predation or poaching. The percentage number of endangered species in the list of threatened ones is 19% mammals, 17% birds, 21% reptiles, 22% amphibians and 19% angiosperms. In India their number is 54 animals and 113 plants e.g Red Panda, *Bentinckia nicobarica*.

Critically Endangered: The taxon is facing very high risk of extinction in the wild and can become extinct any moment in the immediate future, e.g. *Sus salavinus* (Pigmy Hog), *Berberis nilghiriensis*.

Vulnerable: Presently the population is sufficient but is undergoing depletion due to some factors so that it is facing risk of extinction in medium term future e.g. *Antelope cervicapra*.

Extinct: The taxon has been completely eliminated or died out from earth e.g. Dodo.

69. (c) *Ex-situ* conservation means off site conservation. It is the process of protecting an endangered species of plant or animal by removing it from an unsafe or threatened habitat and placing it or part of it under the care of man. Botanical garden is one of the method of *ex-situ* conservation.

70. (d) Tissue culture method is used to propagate plant. Creating biosphere reserve conserves both flora and fauna. Botanical gardens can conserve only a few specific varieties of plants.

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71. (b) Mammals

72. (b) The Lemurs are the inhabitants of Madagascar and the Comoro Islands.

73. (d) An institution where valuable plant material likely to become irretrievably lost in the wild or in cultivation is preserved in a viable condition is known as Gene Bank.

74. (a) *Panthera leo* has gone extinct in recent times in India.

75. (b) Competition between organisms of the same species is called intraspecific competition. Mutualism is obligatory and mutually beneficial relationship occurring between two interacting organisms. Predation is the act of capturing, killing and eating. It is a negative interaction between two organisms. Migration is a permanent outward movement of individuals from a population for settling into a new area.

76. (b) MAB, Man and Biosphere Programme, was launched by UNESCO in 1971. There are 14 projects under this programme, which focus on research and training with emphasis on ecological approach to the study of inter-relationship between man and the environment.

77. (c) Gir forest – Lion

Kaziranga – Rhinoceros

Manas – Elephant, Rhinoceros

Manali – Musk deer

78. (a) Gir forest is important for protecting lion. The ecosystem of Gir, with its diverse flora and fauna, is a result of the efforts of the Government, forest department, wildlife activists and NGOs. The forest area of Gir and its lions were declared as "protected" in the early 1900's by the then Nawab of the princely state of Junagadh. This initiative assisted in the conservation of the lions whose population had plummeted to only 15 through slaughter for trophy hunting.

79. (b) Rajasthan

80. (a) Kaziranga National Park in Assam is associated with Rhinoceros.

81. (d) Soil conservation is to conserve fertile soil from the losses like, heavy rainfall, drainage, high wind, flood, draught etc.

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38 Environmental Issues

Trend Analysis with Important Topics & Sub-Topics

Topic	Sub-Topics	2020		2019		2018		2017		2016	
		Qns.	LOD	Qns.	LOD	Qns.	LOD	Qns.	LOD	Qns.	LOD
Air Pollution & its Control	Air Pollutants					1	E	1	E		
Water Pollution & its Control	Water Pollutants					1	A			1	E
Solid Wastes/ Agro-chemicals/ Radioactive wastes	Nuclear Waste			1	E						
Greenhouse Effect & Global Warming/ Ozone depletion/ Deforestation	Deforestation									1	E
	Ozone Depletion	2	E	1	E	2	E				
	Green house Gasses			1	E						

LOD - Level of Difficulty | E - Easy | A - Average | D - Difficult | Qns - No. of Questions

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Topic 1: Air Pollution & its Control

1. Which of the following is a secondary pollutant? *[2018]*
   (a) CO (b) CO_2
   (c) O_2 (d) SO_2
2. Which one of the following statements is not valid for aerosols? *[2017]*
   (a) They alter rainfall and monsoon patterns
   (b) They cause increased agricultural productivity
   (c) They have negative impact on agricultural land
   (d) They are harmful to human health
3. Acid rain is caused by increase in the atmospheric concentration of: *[2015 RS]*
   (a) SO_3 and CO (b) CO_2 and CO
   (c) O_3 and dust (d) SO_2 and NO_2
4. A location with luxuriant growth of lichens on the trees indicates that the: *[2014]*
   (a) Trees are very healthy
   (b) Trees are heavily infested
   (c) Location is highly polluted
   (d) Location is not polluted
5. A scrubber in the exhaust of a chemical industrial plant removes:- *[2014]*
   (a) gases like sulphur dioxide
   (b) particulate matter of the size 5 micrometer or above
   (c) gases like ozone and methane
   (d) particularte matter of the size 2.5 micrometer or less
6. The zone of atmosphere in which the ozone layer is present is called: *[2014]*
   (a) Ionosphere (b) Mesosphere
   (c) Stratosphere (d) Troposphere
7. The Air Prevention and Control of Pollution Act came into force in : *[NEET 2013]*
   (a) 1981 (b) 1985
   (c) 1990 (d) 1975
8. Which one of the following is **not correct** as regards to the harmful effects of particulate matter of the size 2.5 micro meters or less? *[NEET Kar. 2013]*
   (a) It can be inhaled into the lungs
   (b) It can cause respiratory problems
   (c) It can directly enter into our circulatory system
   (d) It can cause inflammation and damage to the lungs

9. dB is a standard abbreviation used for the quantitative expression of *[2010]*
   (a) the density of bacteria in a medium
   (b) a particular pollutant
   (c) the dominant *Bacillus* in a culture
   (d) a certain pesticide
10. Steps taken by the Government of India to control air pollution include *[2009]*
   (a) compulsory PUC (Pollution Under Control) certification of petrol driven vehicles which tests for carbon monoxide and hydrocarbons.
   (b) permission to use only pure diesel with a maximum of 500 ppm sulphur as fuel for vehicles.
   (c) use of non-polluting Compressed Natural Gas (CNG) only as fuel by all buses and trucks.
   (d) compulsory mixing of 20% ethyl alcohol with petrol and 20% biodiesel with diesel.
11. According to Central Pollution Control Board (CPCB), which particulate size in diameter (in micrometers) of the air pollutants is responsible for greatest harm to human health? *[2008]*
   (a) 2.5 or less (b) 1.5 or less
   (c) 1.0 or less (d) 5.2-2.5
12. In a coal fired power plant electrostatic precipitators are installed to control emission of
   (a) NO_x (b) SPM *[2007]*
   (c) CO (d) SO_2
13. Photochemical smog pollution does not contain
   (a) Nitrogen dioxide *[2006]*
   (b) Carbon dioxide
   (c) PAN (peroxy acyl nitrate)
   (d) Ozone
14. Which of the following is a secondary pollutant?
   (a) CO (b) CO_2 *[1999]*
   (c) PAN (d) Aerosol
15. If there was no CO_2 in the earth's atmosphere the temperature of earth's surface would be *[1998]*
   (a) higher than the present form environmental issues
   (b) less than the present
   (c) the same
   (d) dependent on the amount of oxygen in the atmosphere from environmental issues
16. How does carbon monoxide, a poisonous gas emitted by automobiles, prevent transport of oxygen into the body tissues? *[1998]*
   (a) By destroying the haemoglobin
   (b) By forming a stable compound with haemoglobin
   (c) By obstructing the reaction of oxygen with haemoglobin
   (d) By changing oxygen into carbon dioxide.
17. The CO_2 content in the atmospheric air is about
   (a) 0.034% (b) 0.34% *[1997]*
   (c) 3.34% (d) 6.5%
18. The Taj Mahal is threatened due to the effect o
   (a) oxygen (b) hydrogen *[1995]*
   (c) chlorine (d) sulphur dioxide
19. Atmosphere of big/metropolitan cities is polluted most by *[1994]*
   (a) automobile exhausts
   (b) pesticide residue
   (c) household waste
   (d) radio-active fall-out
20. Sound becomes hazardous noise pollution at level *[1994]*
   (a) Above 30 dB (b) Above 80 dB
   (c) Above 100 dB (d) Above 120 dB
21. Most hazardous metal pollutant of automobile exhausts is *[1992]*
   (a) Mercury (b) Cadmium
   (c) Lead (d) Copper
22. Which one is not a pollutant normally? *[1992]*
   (a) Hydrocarbons (b) Carbon dioxide
   (c) Carbon monoxide (d) Sulphur dioxide
23. Acid rains are produced by *[1991]*
   (a) excess emissions of NO_2 and SO_2 from burning fossil fuels
   (b) excess production of NH_3 by industry and coal gas
   (c) excess release of carbon monoxide by incomplete combustion
   (d) excess formation of CO_2 by combustion and animal respiration
24. Major aerosol pollutant in jet plane emission is *[1990]*
   (a) Sulphur dioxide (b) Carbon monoxide
   (c) Methane (d) Fluorocarbon

Topic 2: Water Pollution & its Control

25. In water hyacinth and water lily, pollination takes place by : *[2020]*
   (a) Water currents only (b) Wind and water
   (c) Insects and water (d) Insects or wind

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26. Polyblend, a fine powder of recycled modified plastic, has proved to be a good material for:
    (a) making plastic sacks *[2019]*
    (b) use as a fertiliser
    (c) construction of roads
    (d) making tubes and pipes
27. A river with an inflow of domestic sewage rich in organic waste may result in *[2016]*
    (a) drying of the river very soon due to algal bloom.
    (b) increased population of aquatic food web organisms.
    (c) an increased production of fish due to biodegradable nutrients.
    (d) death of fish due to lack of oxygen.
28. High value of BOD (Biochemical Oxygen Demand) indicates that : *[2015 RS]*
    (a) Water is highly polluted
    (b) Water is less polluted
    (c) Consumption of organic matter in the water is higher by the microbes
    (d) Water is pure
29. Eutrophication of water bodies leading to killing of fishes is mainly due to non-availability of : *[2015 RS]*
    (a) light (b) essential minerals
    (c) oxygen (d) food
30. In an area where DDT had been used extensively, the population of birds declined significantly because: *[2012]*
    (a) birds stopped laying eggs
    (b) earthworms in the area got eradicated
    (c) cobras were feeding exclusively on birds
    (d) many of the birds laid, did not hatch
31. Measuring Biochemical Oxygen Demand (BOD) is a method used for : *[2012]*
    (a) estimating the amount of organic matter in sewage water.
    (b) working out the efficiency of oil driven automobile engines.
    (c) measuring the activity of *Saccharomyces cerevisae* in producing curd on a commercial scale.
    (d) working out the efficiency of RBCs about their capacity to carry oxygen.
32. Secondary sewage treatment is mainly a
    (a) physical process *[2011]*
    (b) mechanical process
    (c) chemical process
    (d) biological process
33. Which of the following is mainly produced by the activity of anaerobic bacteria on sewage? *[2011]*
    (a) Laughing gas (b) Propane
    (c) Mustard gas (d) Marsh gas
34. Eutrophication is often seen in *[2011]*
    (a) deserts (b) fresh water lakes
    (c) ocean (d) mountains
35. Biochemical Oxygen Demand *(BOD)* in a river water *[2009]*
    (a) has no relationship with concentration of oxygen in the water.
    (b) gives a measure of *Salmonella* in the water.
    (c) increases when sewage gets mixed with river water.
    (d) remains unchanged when algal bloom occurs.
36. DDT residues are rapidly passed through food chain causing biomagnification because DDT is
    (a) moderately toxic *[2009]*
    (b) non-toxic to aquatic animals
    (c) water soluble
    (d) lipo soluble
37. A lake near a village suffered heavy mortality of fishes within a few days. Consider the following reasons for this? *[2008]*
    (1) Lots of urea and phosphate fertilizer were used in the crops in the vicinity
    (2) The area was sprayed with DDT by an aircraft
    (3) The lake water turned green and stinky
    (4) Phytoplankton populations in the lake declined initially thereby greatly reducing photosynthesis.

    Which two of the above were the main causes of fish mortality in the lake?
    (a) (2) and (3) (b) (3) and (4)
    (c) (1) and (3) (d) (1) and (2)
38. In which one of the following the BOD (Biochemical Oxygen Demand) of sewage (s), distillery effluent (DE), paper mill effluent (PE) and sugar mill effluent (SE) have been arranged in ascending order ? *[2007]*
    (a) SE < PE < S < DE (b) PE < S < SE < DE
    (c) S < DE < PE < SE (d) SE < S < PE < DE.
39. Which one of the following is not a bioindicator of water pollution? *[2007]*
    (a) Blood-worms (b) Stone flies
    (c) Sewage fungus (d) Sludge-worms.

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40. Limit of BOD prescribed by Central Pollution Control Board for the discharge of industrial and municipal waste waters into natural surface waters, is *[2006]*
(a) < 10 ppm (b) < 100 ppm
(c) < 30 ppm (d) < 3.0 ppm

41. Prolonged liberal irrigation of agricultural fields is likely to create the problem of *[2005]*
(a) Acidity (b) Aridity
(c) Salinity (d) Metal toxicity

42. Which of the following is not used for disinfection of drinking water? *[2005]*
(a) Chlorine (b) Ozone
(c) Chloramine (d) Phenyl

43. More than 70% of world's freshwater is contained in: *[2005]*
(a) polar ice
(b) glaciers and mountains
(c) antarctica
(d) greenland

44. In 1984, Bhopal gas tragedy took place because methyl isocyanate *[2004]*
(a) reacted with DDT
(b) reacted with ammonia
(c) reacted with CO_2
(d) reacted with water

45. The most common indicator organism that represents polluted water is *[2004]*
(a) *E. coli* (b) *P. typhi*
(c) *C. vibrio* (d) *Entamoeba*

46. *Escherichia coli* is used as an indicator organism to determine pollution of water with *[2003]*
(a) pollen of aquatic plants
(b) heavy metals
(c) faecal matter
(d) industrial effluents

47. Which of the following is absent in polluted water? *[2002]*
(a) *Hydrilla* (b) Water hyacinth
(c) Larva of stone fly (d) Blue green algae

48. DDT causes egg shell thinning in birds because it inhibits *[1999]*
(a) Calmodulin
(b) Calcium ATPase
(c) Magnesium ATPase
(d) Carbonic anhydrase

49. Maximum bioconcentration of pesticide residues is usually found in birds that exclusively feed on *[1999]*
(a) fish (b) seeds
(c) worms (d) meat

50. Which of the following organism is likely to have more concentration of D.D.T. in its body? *[1999]*
(a) Herbivores (b) Carnivores
(c) Top carnivores (d) Primary producers

51. D.D.T. is *[1999]*
(a) a non–degradable pollutant
(b) a bio-degradable pollutant
(c) not a pollutant
(d) an antibiotic

52. Gas released during Bhopal tragedy was *[1999]*
(a) Methyl isocyanate
(b) Potassium isothiocyanate
(c) Sodium isothiocyanate
(d) Ethyl isothiocyanate

53. Sudden mass killing of fishes is likely in *[1999]*
(a) mesotrophic lake (b) oligotrophic lake
(c) salt lake (d) eutrophic lake

54. Warm ocean surge of the Peru Current reoccurring every 5-8 years or so in the East Pacific of South America is widely known as *[1998]*
(a) Gulf Stream (b) *El Nino*
(c) Aye Aye (d) Magnox

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55. Which one of the following organisms is used as indicator of water quality? *[1998]*
(a) *Chlorella* (b) *Azospirillum*
(c) *Escherichia* (d) *Biggiatoa*

56. Phosphate pollution is caused by *[1997]*
(a) phosphate rocks only
(b) agricultural fertilizers only
(c) sewage and phosphate rocks
(d) sewage and agricultural fertilizers

57. Sewage drained into water bodies kill fishes because *[1996]*
(a) excessive carbon dioxide is added to water
(b) it gives off a bad smell
(c) it removes the food eaten by fish
(d) it increases competition with fishes for dissolved oxygen

58. When huge amount of sewage is dumped into a river, its B.O.D, will *[1995]*
(a) increase (b) decrease
(c) sharply decrease (d) remain unchanged

59. In Minamata Bay Japan, the animals which remained free from Minamata disease, are *[1995]*
(a) pigs (b) rabbits
(c) dogs (d) cats

60. Highest DDT deposition shall occur in *[1994]*
(a) Phytoplankton (b) Sea Gull/Birds
(c) Crab (d) Eel

61. Disease caused by eating fish found in water contaminated with industrial waste having mercury is *[1994]*
(a) Minamata disease
(b) Bright's disease
(c) Hashimoto's disease
(d) Osteosclerosis

62. Drawback of DDT as pesticide is *[1994]*
(a) It becomes ineffective after sometime
(b) It is less effective than others
(c) It is not easily/rapidly degraded in nature
(d) Its high cost

63. Fish die in water bodies polluted by sewage due to *[1994]*
(a) pathogens
(b) clogging of gills by silt
(c) reduction in oxygen
(d) foul smell

64. Largest amount of fresh water is found in *[1994]*
(a) lakes and streams
(b) underground
(c) polar ice and glaciers
(d) rivers

65. Water is a resource *[1992]*
(a) nondegradable nonmaintainable
(b) degradable maintainable
(c) renewable
(d) non-renewable

Topic 3: Solid Wastes/Agro-Chemicals/ Radioactive Wastes

66. Which of the following is an innovative remedy for plastic waste? *[2019, Odisa]*
(a) Electrostatic precipitator
(b) Burning in the absence of oxygen
(c) Burying 500 m deep below soil surface
(d) Polyblend

67. Which of these following methods is the most suitable for disposal of nuclear waste? *[2019]*
(a) Shoot the waste into space.
(b) Bury the waste under Antarctic ice-cover.
(c) Dump the waste within rocks under deep ocean.
(d) Bury the waste within rocks deep below the Earth's surface

68. Rachel Carson's famous book "Silent Spring" is related to : *[2015 RS]*
(a) Noise pollution
(b) Population explosion
(c) Ecosystem management
(d) Pesticide pollution

69. Which one of the following statements is wrong in case of Bhopal tragedy? *[2011]*
(a) Methyl lsocyanate gas leakage took place
(b) Thousands of human beings died
(c) Radioactive fall out engulfed Bhopal
(d) It took place in the night of December 2/3 1984.

70. A renewable exhaustible natural resource is:*[2010]*
(a) coal (b) petroleum
(c) minerals (d) forest

71. Which one of the following statements is correct? *[2007]*
(a) Both *Azotobacter* and *Rhizobium* fix atmospheric nitrogen in root nodules of plants.
(b) Cyanobacteria such as *Anabaena* and *Nostoc* are important mobilizers of phosphates and for plant nutrition in soil
(c) At present it is not possible to grow maize without chemical fertilizers
(d) Extensive use of chemical fertilizers may lead to eutrophication of nearby water bodies.

72. Lead concentration in blood is considered alarming if it is *[2004]*
(a) 20 mg/100 ml
(b) 30 mg/100 ml
(c) 4–6 mg/100 ml
(d) 10 mg/100 ml

73. Recently Govt. of India has allowed mixing of alcohol in petrol. What is the amount of alcohol permitted for mixing in petrol? *[2004]*
(a) 2.5% (b) 10 – 15%
(c) 10% (d) 5%

74. Which of these is a pollution related to occupational health hazard ? *[1999]*
(a) Pneumoconiosis (b) Asthma
(c) Flurosis (d) Silicosis

75. Which of the following is the use of lichens in case of pollution? *[1999]*
(a) They treat the polluted water
(b) They act as bioindicators of pollution
(c) They promote pollution
(d) Lichens are not related with pollution

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76. At present, the most significant cause of dwindling biodiversity is probably *[1999]*
(a) the deterioration of ozone layer
(b) the destruction of habitat
(c) biological magnification of DDT
(d) global warming

77. The worst environmental hazards were created by accidents in nuclear power plant and MIC gas tragedy respectively in *[1996]*
(a) Russia in 1990 & Bhopal in 1986
(b) Ukraine in 1988 & USA in 1984
(c) Bhopal in 1984 & Russia in 1990
(d) Ukraine in 1986 and Bhopal in 1984

78. River water deposits *[1992]*
(a) loamy soil (b) alluvial soil
(c) laterite soil (d) sandy soil

79. Domestic waste constitutes *[1991]*
(a) Nonbiodegradable pollution
(b) Biodegradable pollution
(c) Effluents
(d) Air pollution

Topic 4: Greenhouse Effect & Global Warming/Ozone Depletion/Deforestation

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80. Snow-blindness in Antarctic region is due to *[2020]*
(a) Inflammation of cornea due to high dose of UV-B radiation
(b) High reflection of light from snow
(c) Damage to retina caused by infra-red rays
(d) Freezing of fluids in the eye by low temperature

81. Montreal protocol was signed in 1987 for control of *[2020]*
(a) Emission of ozone depleting substances
(b) Release of Green House gases
(c) Disposal of e-wastes
(d) Transport of Genetically modified organisms from one country to another

82. Which of the following statements about ozone is correct? *[2019, Odisa]*
(a) Stratospheric ozone protects us from UV radiations.
(b) Tropospheric ozone protects us from UV radiations.
(c) Stratospheric ozone is 'bad'.
(d) Tropospheric ozone is 'good'.

83 . If an agricultural field is liberally irrigated for a prolonged period of time, it is likely to face a problem of : *[2019, Odisa]*
(a) Salinity (b) Metal toxicity
(c) Alkalinity (d) Acidity

84. Which of the following Protocols did aim for reducing emission of chlorofluorocarbons into the atmosphere? *[2019]*
(a) Montreal Protocol
(b) Kyoto Protocol
(c) Gothenburg Protocol
(d) Geneva Protocol

85. Which of the following pairs of gases is mainly responsible for green house effect? *[2019]*
(a) Ozone and Ammonia
(b) Oxygen and Nitrogen
(c) Nitrogen and Sulphur dioxide
(d) Carbon dioxide and Methane

86. Match the items given in Column I with those in Column II and select the correct option given below : *[2018]*

	Column-I		Column-II
A.	Eutrophication	i.	UV-B radiation
B.	Sanitary landfill	ii.	Deforestation
C.	Snow blindness	iii.	Nutrient enrichment
D.	Jhum cultivation	iv.	Waste disposal

	A	B	C	D
(a)	ii	i	iii	iv
(b)	i	iii	iv	ii
(c)	i	ii	iv	iii
(d)	iii	iv	i	ii

87. In stratosphere, which of the following elements acts as a catalyst in degradation of ozone and release of molecular oxygen? *[2018[*
(a) Carbon (b) Cl
(c) Oxygen (d) Fe

88. World Ozone Day is celebrated on *[2018]*
(a) 5th June (b) 21st April
(c) 22nd April (d) 16th September

89. Joint Forest Management Concept was introduced in India during *[2016]*
(a) 1960 s (b) 1970 s
(c) 1980 s (d) 1990 s

90. Depletion of which gas in the atmosphere can lead to an increased incidence of skin cancers
(a) Nitrous oxide (b) Ozone *[2016]*
(c) Ammonia (d) Methane

91. The UN Conference of Parties on climate change in the year 2011 was held in : *[2015 RS]*
(a) South Africa (b) Peru
(c) Qatar (d) Poland

92. Which of the following is not one of the prime health risks associated with greater UV radiation through the atmosphere due to depletion of stratospheric ozone? *[2015 RS]*
(a) Reduced Immune System
(b) Damage to eyes
(c) Increased liver cancer
(d) Increased skin cancer

93. The UN conference of Parties on climate change in the year 2012 was held at:*[2015 RS]*
(a) Doha (b) Lima
(c) Warsaw (d) Durban

94. Kyoto Protocol was endorsed at:*[NEET 2013]*
(a) CoP - 5 (b) CoP - 6
(c) CoP - 4 (d) CoP - 3

95. Global warming can be controlled by: *[NEET 2013]*
(a) Reducing reforestation, increasing the use of fossil fuel.
(b) Increasing deforestation, slowing down the growth of human population.
(c) Increasing deforestation, reducing efficiency of energy usage.
(d) Reducing deforestation, cutting down use of fossil fuel.

96. The second commitment period for Kyoto Protocol was decided at *[NEET Kar. 2013]*
(a) Cancun (b) Durban
(c) Bali (d) Doha

97. Climate of the world is threatened by *[NEET Kar. 2013]*
(a) Increasing concentration of atmospheric oxygen
(b) Decreasing amount of atmospheric oxygen
(c) Increasing amount of atmospheric carbon dioxide
(d) Decreasing amount of atmospheric carbon dioxide

98. Which one of the following is a wrong statement? *[2012]*
(a) Most of the forests have been lost in tropical areas.
(b) Ozone in upper part of atmosphere is harmful to animals.
(c) Greenhouse effect is a natural phenomenon.
(d) Eutrophication is a natural phenomenon in freshwater bodies.

99. Which one of the following expanded forms of the following acronyms is correct? *[2011]*
(a) IPCC = International Panel for Climate Change
(b) UNEP = United Nations Environment Policy
(c) EPA = Environmental Pollution Agency
(d) IUCN = International Union for Conservation of Nature and Natural Resources

100. Which one of following pairs of gases are the major cause of "Greenhouse effect"? *[2011]*
(a) CO_2 and O_3 (b) CO_2 and CO
(c) CFCs and SO_2 (d) CO_2 and N_2O

101. "Good ozone" is found in the *[2011M]*
(a) mesosphere (b) troposphere
(c) stratosphere (d) ionosphere

102. The two gases making highest relative contribution to the greenhouse gases are *[2010]*
(a) CO_2 and CH_4 (b) CH_4 and N_2O
(c) CFC_5 and N_2O (d) CO_2 and N_2O

103. Global agreement in specific control strategies to reduce the release of ozone depleting substances, was adopted by *[2009]*
(a) The Montreal Protocol
(b) The Kyoto Protocol
(c) The Vienna Convention
(d) Rio de Janeiro Conference

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104. Montreal protocol aims at *[2009]*
(a) Biodiversity conservation
(b) Control of water pollution
(c) Control of CO_2 emission
(d) Reduction of ozone depleting substances

105. Chipko movement was launched for the protection of *[2009]*
(a) forests (b) livestock
(c) wet lands (d) grasslands

106. Which one of the following is the correct percentage of the two (out of the total of 4) green house gases that contribute to the total global warming? *[2008]*
(a) CFCs 14%, Methane 20%
(b) CO_2, 40%, CFCs 30%
(c) N_2O 6%, CO_2 86%
(d) Methane 20%, N_2O 18%

107. Montreal protocol which calls for appropriate action to protect the ozone layer from human activities was passed in the year *[2006]*
(a) 1987 (b) 1988
(c) 1985 (d) 1986

108. Identify the correctly matched pair. *[2005]*
(a) Basal Convention - Biodiversity Conservation
(b) Kyoto Protocol - Climatic change
(c) Montreal Protocol - Global warming
(d) Ramsar Convention - Ground water pollution

109. Which one of the following pairs is mismatched? *[2005]*
(a) Fossil fuel burning - release of CO_2
(b) Nuclear power - radioactive wastes
(c) Solar energy - green house effect
(d) Biomass burning - release of CO_2

110. A major component of gobar gas is *[2004]*
(a) Ammonia (b) Methane
(c) Ethane (d) Butane

111. The major contributor of Green House gases to the atmosphere is *[2002]*
(a) Russia (b) U.S.A.
(c) Germany (d) Brazil.

112. Relative Biological Effectiveness (RBE) is usually referred to damages caused by *[2000]*
(a) Low temperature (b) High temperature
(c) Encephalitis (d) Radiation

113. Green house effect refers to *[1999]*
(a) cooling of earth
(b) trapping of UV rays
(c) production of cereals
(d) warming of earth

114. Which important green house gas other than methane is being produced from the agricultural fields? *[1998]*
(a) Sulphur dioxide (b) Ammonia
(c) Nitrous oxide (d) Arsine

115. In coming years, skin related disorders will be more common due to *[1997]*
(a) pollutants in air
(b) use of detergents
(c) water pollution
(d) depletion of ozone layer

116. Formation of ozone hole is maximum over
(a) India (b) Europe *[1997]*
(c) Antarctica (d) Africa

117. Which of the following is the main factor of desertification? *[1995]*
(a) Tourism
(b) Irrigated agriculture
(c) Over- grazing
(d) All of these

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118. Which gas contributes most to green house effect?
(a) CFC (b) Freon *[1994]*
(c) CO_2 (d) CH_4

119. Deforestation does not lead to *[1994]*
(a) quick nutrient cycling
(b) soil erosion
(c) alteration of local weather conditions
(d) destruction of natural habitat of wild animals

120. Ultraviolet radiations from sunlight causes a reaction that produces *[1993]*
(a) Fluorides (b) Carbon monoxide
(c) Sulphur dioxide (d) Ozone

121. Green house effect is warming due to *[1991]*
(a) Infra-red rays reaching earth
(b) Moisture layer in atmosphere
(c) Increase in temperature due to increase in carbon dioxide concentration of atmosphere
(d) Ozone layer of atmosphere

122. Deforestation will decrease *[1990]*
(a) soil erosion (b) land slides
(c) soil fertility (d) rainfall

ANSWER KEY																			
1	(c)	14	(c)	27	(d)	40	(a)	53	(d)	66	(d)	79	(b)	92	(c)	105	(a)	118	(c)
2	(b)	15	(b)	28	(a)	41	(c)	54	(b)	67	(d)	80	(a)	93	(a)	106	(a)	119	(a)
3	(d)	16	(b)	29	(c)	42	(d)	55	(c)	68	(d)	81	(a)	94	(d)	107	(a)	120	(d)
4	(d)	17	(a)	30	(d)	43	(a)	56	(d)	69	(c)	82	(a)	95	(d)	108	(b)	121	(c)
5	(a)	18	(d)	31	(a)	44	(d)	57	(d)	70	(d)	83	(a)	96	(d)	109	(c)	122	(c,d)
6	(c)	19	(a)	32	(d)	45	(a)	58	(a)	71	(d)	84	(a)	97	(c)	110	(b)		
7	(a)	20	(b)	33	(d)	46	(c)	59	(b)	72	(b)	85	(d)	98	(b)	111	(b)		
8	(c)	21	(c)	34	(b)	47	(c)	60	(b)	73	(d)	86	(d)	99	(d)	112	(d)		
9	(b)	22	(b)	35	(c)	48	(b)	61	(a)	74	(d)	87	(b)	100	(d)	113	(d)		
10	(a)	23	(a)	36	(d)	49	(a)	62	(c)	75	(b)	88	(d)	101	(c)	114	(c)		
11	(a)	24	(d)	37	(c)	50	(c)	63	(c)	76	(b)	89	(c)	102	(a)	115	(d)		
12	(b)	25	(d)	38	(NA)	51	(a)	64	(c)	77	(d)	90	(b)	103	(a)	116	(c)		
13	(b)	26	(c)	39	(b)	52	(a)	65	(c)	78	(b)	91	(a)	104	(d)	117	(c)		

Hints & Solutions

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1. (c) A primary pollutant is an air pollutant emitted directly from a source. A secondary pollutant is not directly emitted as such, but forms when other pollutants (primary pollutants) react in the atmosphere. O3 (ozone) is a secondary pollutant.
2. (b) Aerosols through its direct or indirect effects on plants can cause various problems in agriculture. However, continuous increase in air pollution may represent a threat to agriculture in the future that is persistent and largely irreversible.
3. (d) 60% – 70% SO_2 and 20% – 30% NO_2 contribute to the acid rain.
4. (d) Lichens are very good pollution indicators, they do not grow in pollutted areas. They are sensitive to sulphur dioxide pollution.
5. (a) Scrubbers are air pollution control devices that use liquid to remove particulate matter or gases from an industrial exhaust or flue gas stream. This atomized liquid (typically water) entrains particles and pollutant gases in order to effectively wash them out of the gas flow.

NOTES Scrubbers removes or scrubs SO_2 emissions from the exhaust of coal-fired power plants.

6. (c) The ozone (O_3) found in upper part of the atmosphere, *i.e.*, Stratosphere, is **Good ozone**, since, it acts as a shield for absorbing UV-radiations from sun.
7. (a) In India, the Air (Prevention and control of pollution) Act came into force in 1981 but was amended in 1987 to include noise as an air pollutant.
8. (c) According to Centrol Pollution Control Board (CPCB) particulate size 2.5 micrometers or less in diameter are responsible for causing various breathing and respiratory problems. They can also cause irritation, inflammations, damage to the lungs and premature deaths. It cannot directly enter circulatory system but indirectly through respiratory system.
9. (b) dB is a standard abbreviation for the quantitative expression of noise. Unwanted sound is called noise. Generally sound above 80 dB is noise.

10. (a) The step taken by Government of India to control air pollution include compulsory PUC (pollution under control) certification of petrol driven vehicles which tests for carbon monoxide and hydrocarbons.

11. (a) The central pollution control board (CPCB), statutory organisation, was constituted in September, 1974 under the water (Prevention and Control of Pollution) Act 1974. Further, CPCB was entrusted with the powers and functions under Air (prevention and control of pollution) Act, 1981. It serves as a field formation and also provides technical services to the Ministry of Environment and Forest, of the provisions of the Environments (protection) Act, 1986. Principal functions of the CPCB, as spelt out in the water (prevention and control of pollution) act, 1974, and the Air (prevention and control of pollution) Act, 1981.

(i) To promote cleanliness of streams and wells in different areas of the states by prevention, control and abatement of water pollution.

(ii) To improve the quality of air and to prevent, control or abate air pollution in the country.

NOTES

According to CPCB, 2.5 or less particulate size in diameter (in micrometers) of the air pollutants is responsible for greatest harm to human health.

12. (b) In recent years, the increases in toxic substances of NOx and/or SPM (Suspended Particulate Matter) from vehicles come to be serious problem. About the correlation between the traffic volume in our model and the real volume, we obtained the correlation coefficient of 0.74. Simultaneously, we got the result that the concentration of NOx was approximately 70 to 230 ppm. That of SPM was approximately 40 to 100 $\mu g/m^3$.

NOTES

Electrostatic precipitator, also called electrostatic air cleaner, a device that uses an electric charge to remove certain impurities—either solid particles or liquid droplets—from air or other gases in smokestacks and other flues. The precipitator functions by applying energy only to the particulate matter being collected, without significantly impeding the flow of gases.

13. (b) Photochemical smog is made by the deposition of dust and carbon particles on the pollutant gases and water vapours. The gases found in photochemical smog are NO_2, PAN, O_3 etc.

14. (c) Primary pollutant is that which persists in the form in which it is released in the environment eg. CO. A secondary pollutant is one which is formed from another pollutant due to change or reaction. e.g. PAN (Peroxy acytyl nitrate).

15. (b) CO_2 is a green house gas which traps the solar radiation i.e. heats up the earth's atmosphere.

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16. (b) Carbon monoxide, when inhaled, combines with blood haemoglobin to form carboxy-haemoglobin at a rate 210 times faster than the rate at which oxygen forms oxyhaemoglobin. Thus, respiration is impaired.

NOTES

Hyperbaric oxygen therapy (HBO) is used for treatment of high carboxyhaemoglobin in the blood which involves exposing patients to 100 percent oxygen under supra-atmospheric conditions. This results in a decrease in the half-life of carboxyhemoglobin (COHb), from approximately 90 minutes on 100 percent normobaric oxygen to approximately 30 minutes during HBO.

17. (a) The content of CO_2 in atmospheric air is 0.034%. The main contributors to air are N_2 and O_2.

18. (d) The Taj Mahal is threatened by environmental pollution, especially by acid rain due to sulphur dioxide emitted from Mathura refinery.

19. (a) Automobile exhaust is the main cause of air pollution in metro cities.

20. (b) Above 80 dB sound becomes hazardous.

21. (c) Lead (Pb) is the most hazardous metal pollutant present in automobile exhaust.

22. (b) CO_2 in its normal fraction in air (about 0.03%) is actually not a pollutant but above this it is considered as a pollutant. At the elevated level it becomes a cause for global warming.
23. (a) NO_2 and SO_2 after reacting with water in atmosphere produce HNO_3 and H_2SO_4 which falls down as acid rain.
24. (d) Fluorides of carbon is the major pollutant from jet plane emission.
25. (d) In majority of aquatic plants, the flowers emerge above the level of water. These may be pollinated by insects or wind *eg.*: Water hyacinth and water lily.

NOTES

Wind pollinator flowers may be small, no petals, and no special colors, odors, or nectar. These plants produce enormous numbers of small pollen grains. For this reason, wind-pollinated plants may be allergens, but seldom are animals pollinated plants allergenic.

26. (c) Mr. Ahmed Khan, Managing Director of KK Plastic Waste Management has discovered a solution to utilise the waste plastic for the construction of roads. His company developed a technology which turns the plastic waste into a polyblend which can be used in laying of roads. Polyblend is developed and mixed with bitumen.

NOTES

When bitumen is mixed with Plastic/ Polymer coated aggregate a portion of bitumen diffuses through the polymer layer & binds with aggregate. During this process 3-D internal cross linked network structure are formed which results into stronger bonding.
Therefore this blend is much effctive for laying roads. The cost for construction of the road is slightly high but it would be compensated by the durability and echo friendly properties.

27. (d) Domestic sewage rich in organic waste leads to increase in Biological Oxygen Demand, which leads to decrease D.O. (dissolved oxygen) which leads to death of fishes.
28. (a) BOD (Biochemical Oxygen Demand) is a method which measures the level of water pollution. The polluted water has bacteria and many other microorganisms which consume the dissolved oxygen of water. Higher the BOD, the lower would be the dissolved oxygen in polluted water. High value of BOD indicates the highly polluted water.
29. (c) Due to eutrophication, water bodies lack oxygen causing death of aquatic life.
30. (d) High concentration of DDT disturbs calcium metabolism in birds which caused thinning of eggshell and their premature breaking.

NOTES

Biomagnification is a phenomenon through which certain pollutants such as pesticide and heavy metals get accumulated in tissues in increasing concentration along the food chains and produces fatal effect. This phenomenon is also called biological magnification.

31. (a) BOD is a measure of organic matter present in water. It refers to amount of O_2 consumed by microbes to decompose all the organic matter in 1 L of water at 20°C for 5 days. The greater the BOD of waste water, more is its polluting potential.
32. (d) In secondary treatment mainly settled sewage flows to an aerobic biological treatment stage where it comes into contact with micro-organisms which remove and oxidise most of the remaining organic pollutants.
33. (d) Marsh gas is another term for methane, produced by plants decomposing under water.

NOTES

Nitrous oxide is a colorless and odorless substance that's also known as "laughing gas." When inhaled, the gas slows down the body's reaction time. This results in a calm, euphoric feeling. This can be used for the treatment of pain. It also functions as a mild sedative. Because of this, it's sometimes used before dental procedures to promote relaxation and reduce anxiety.

34. (b) Eutrophication is often seen in fresh water lakes. The main causes of eutrophication in these water systems are sediments and thermal stratification, with agricultural run-off from fertilizers and manure, containing nitrates and phosphates and discharge of partially treated or untreated sewages or phosphate containing detergents.

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35. (c) Biochemical Oxygen Demand (BOD) in a river water increases when sewage gets mixed with river water. Biochemical oxygen demand or biological oxygen demand (BOD) is a chemical procedure for determining how fast biological organisms use up oxygen in a body of water. It is used in water quality management and assessment, ecology and environmental science.

NOTES BOD considered as an indication of the quality of a water source.

36. (d) DDT residues are rapidly passed through food chain causing biomagnification because DDT is lipo soluble. Biomagnification, also known as bioamplification or biological magnification, is the increase in concentration of a substance, such as the pesticide DDT, that occurs in a food chain as a consequence of:
- Persistence (slow to be broken down by environmental processes).
- Food chain energetics.
- Low (or non-existent) rate of internal degradation/excretion of the substance (often due to water-insolubility).

37. (c) Lots of urea and phosphate fertilizer were used in the crops in the vicinity and the lake water turned green and stinky. Due to this, lake near a village suffered heavy mortality of fishes within a few days.

38. (NA) No option is correct. The correct answer is: S < PE < SE < DE according to the given data. More value of BOD means the water sample is polluted by organic matter. BOD of distillary effluent is 40000 mg/L and that of paper mill effluent and sewage is 190 mg/L and 30 mg/L respectively.

39. (b) Stone flies are not bioindicators. Bio-indicators provide a range of techniques to assess the impacts of air pollution from reactive nitrogen (N) compounds on statutory nature conservation sites. They complement physical monitoring of atmospheric concentrations and deposition and risk assessment based on the critical loads approach by providing site-based information on atmospheric N concentrations, N deposition and/or ecological impacts.

NOTES Stone flies, mayflies and caddisflies are aquatic insects and a important biotic indicators of water quality.

40. (a) Biochemical Oxygen Demand (BOD) is the amount of oxygen required to destroy the organic waste by the bacteria. The more oxygen required for bacteria that means there is more organic waste. For pure drinking water it is decided less than 1 ppm and for industrial and municipal waste it is less than 10 ppm. In Yamuna water in Delhi it is about 1000 ppm.

41. (c) Since all surface and ground water contains salts to varying degrees. Therefore excessive irrigation followed by evaporation of the unabsorbed water leads to salinity. This also leads to waterlogging.

42. (d) Chlorine, ozone, chloramine are used for disinfection of drinking water.

43. (a) Three fourth surface of earth is covered by oceans which contain 97.5% of total water. It is marine water with about 3.5% salt content only 2.5% is fresh water which occurs on land. Most of this water (1.97%) occurs as frozen ice caps and glaciers, 0.5% fresh water occurs as ground water. Rivers and lakes contain 0.02%, soil 0.01% while atmosphere possesses 0.001% of water as vapours.

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44. (d) In Bhopal gas tragedy, methyl isocyanate (MIC) reacted with water to produce a large amount of heat, as it was an exothermic reaction. Due to this increase in pressure the safety valve of the tank bursted and the gas came out.

45. (a) *E. coli* lives in the human intestine. If they are present in water it indicates that the water is polluted.

46. (c) *E. coli* grows in water polluted by sewage and domestic waste.

47. (c) Stone fly larva requires well aerated, non-polluted water. It is absent in polluted water.

48. (b) DDT causes egg shell thinning in birds because it inhibits calcium ATPase.

49. (a) Biological magnification is the increase in concentration of persistent pollutant per unit weight of the organism with the rise in trophic level.

50. (c) Organisms found in the higher trophic level show greater accumulation of pesticides due to the phenomenon of biomagnification - which is defined as the gradual increase in concentration of harmful pesticides in the food chain, with increase in trophic level.
51. (a) DDT cannot be broken down or converted to harmless state by natural processes of oxidation or biological decomposition. Hence it is non biodegradable.
52. (a) MIC → (Methyl Isocyanate) was the deadly gas leaked from the fertilizer plant of Union Carbide company in Bhopal.
53. (d) Organic pollutants provide nutrients for stimulating growth of algae and other plants. Algal bloom reduces availability of light to submerged plants which get killed. The dead submerged plants consume more oxygen in decomposition. This reduces availability of oxygen to other life forms leading to death of organisms. This is known as eutrophication.
54. (b) *El. Nino* flows to the North from Antarctica along the west coast of South America to S. Ecuador, the west. It reoccurs after every 5 to 8 yrs. *El Nino* and *La Nina* are officially defined as sustained sea surface temperature anomalies of magnitude greater than 0.5°C across the central tropical Pacific Ocean. When the condition is met for a period of less than five months, it is classified as *El Nino* or *La Nina* conditions; if the anomaly persists for five months or longer, it is classified as an *El Nino* or *La Nina* episode.
55. (c) *E. coli* lives in the human intestine. If they are present in water it indicates that the water is polluted. *E.coli* coliform count test is done to test the quality of water.
56. (d) Part of fertilizers containing phosphates are passed down into water bodies as surface run off. Sewage contamination also results in algal bloom (eutrophication) due to increased availability of nitrate and phosphate.
57. (d) Organic pollutants brought in by the sewage drained into water bodies provides nutrients for stimulating growth of algae. Algal bloom reduces availability of light to the submerged plants which get killed. Dead algae and dead submerged plants consume oxygen during decomposition, causing oxygen depletion and increases competition for oxygen.
58. (a) By dumping of huge amount of sewage, the oxygen levels are depleted, which are reflected in terms of BOD values of water. The number of microbes also increases tremendously and these also consume most of the oxygen. Thus, BOD of the river water will increase.
59. (b) Release of mercury in water causes pollution. Mercury enters the food chain killing fishes. Human beings feeding on such fishes will suffer from minamata disease. Similarly all carnivores feeding on fishes will develop this disease except rabbit because it is herbivore.

NOTES

Minamata disease, is also called as Chisso-Minamata disease, and is a neurological syndrome which is caused by severe mercury poisoning. Its symptoms include ataxia, numbness in the hands and feet, general muscle weakness, narrowing of the field of vision and damage to hearing and speech.

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60. (b) DDT is not soluble in water but soluble in fats. Aquatic micro-organisms absorb them in fats where they accumulate to form concentration many times greater than in water. Zooplankton accumulate more concentrations, fishes feeding on zooplanktons also accumulate more concentration and finally birds feeding on fishes contain these compounds in more concentration. This increase in accumulation of toxic substances in the food pyramids is called "Biological magnification."
61. (a) Minamata disease is a type of neurological disorder which is caused by secure mercury poisoning.

NOTES

Hashimoto's disease, or Hashimoto's thyroiditis, is an autoimmune disease that damages the thyroid gland. Hashimoto's disease affects more women than men. It is the most common cause of hypothyroidism.

62. (c) In 1962, American biologist Rachel Carson published the book *Silent Spring*, which alleged that DDT caused cancer and harmed bird reproduction by thinning egg shells.

This followed the principles of biological magnification, killing higher level organisms like the birds.

DDT is a persistent organic pollutant with a reported half life of between 2-15 years, and is immobile in most soils.

63. (c) Sewage kills plant life and also use oxygen for degradation, so oxygen content of water is lowered and hence animal life in water body start decreasing.

64. (c) Polar ice and glaciers have the largest amount of pure and fresh water without any dissolved salt or impurity.

65. (c) Water is a renewable resource but can become non renewable if they are not used properly.

66. (d) Polyblend is fine powder of recycled plastic waste. It was produced by plastic manufacturers in order to recycle plastic waste. When blended with bitumen, polyblend can be used to lay roads which increases road life.

NOTES

POLYblend is a product family of PC/ABS blends. POLYblend is particularly useful for industrial materials. A unique combination of excellent mechanical and thermal properties allows application in a variety of industrial segments. POLYblend has superb processability and provides aesthetic surfaces.

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67. (d) It has been recommended that storage of nuclear waste after sufficient pre treatment, should be done in suitably shielded containers and buried within the rocks deep below the earth's surface (500 m deep).

68. (d) Rachel Carson's book 'Silent Spring' reveals the harmful effect of DDT, a fatal pesticide. The writer opposed to chemical industry in U.S.A. This book influenced the national policy over pesticide use in many countries all over the world.

69. (c) The Bhopal gas tragedy occured on the night of December 2-3, 1984 at the Union carbide India Limited pesticide plant in Bhopal, M.P. A leak of methyl isocyanate gas and other chemicals from the plant resulted in the exposure of thousands of people.

NOTES

Methyl isocyanate is a colourless highly flammable liquid that evaporates quickly when exposed to the air. It has a sharp, strong odour. This is used in the production of pesticides, polyurethane foam, and plastics.

70. (d) Exhaustible resources are those natural resources that are likely to be exhausted due to their continuous use. Forest is a renewable exhaustible resource that can be produced again and again. Coal, petroleum and minerals are non-renewable exhaustible natural resources that cannot be produced again.

71. (d) Extensive use of chemical fertilizers may lead to eutrophication of nearby water bodies.

72. (b) The concentration level of lead in blood is about 25 μg/100 ml. So any value above this is considered alarming.

73. (d) Alcohol to the tune of 5% is allowed to be mix in petrol as per the Govt. of India decision.

NOTES

Mixing of alcohol with gasoline produces gasohol. Advantages of fuel blends are that alcohol tends to increase the octane rating and reduce carbon monoxide (CO) and other tailpipe emissions from the engine.

74. (d) Silicosis is caused by exposure to dust containing silica.

75. (b) Lichens are sensitive to sulphur dioxide pollution, hence they serve as bioindicators of pollution.

76. (b) Habitat destruction affects the survival of populations and reduces biodiversity.

77. (d) The MIC gas tragedy occurred in Bhopal in 1984 and the Chernobyl tragedy (nuclear power plant) occurred in Ukraine in 1986.

78. (b) River water deposits alluvial soil. Alluvial soil- formed by the alluvium deposition by the rivers, when they slowly lose their carrying capacity due to decrease in velocity. These consists of diverse ratio of sand, silt and clay. These are the most widespread soil in India, the entire northern plains have loamy soil. It contains roughly equal amount of sand silt and clay. It is more fertile than sandy soil.

Laterite soil-formed in hot wet tropical areas which are formed by intensive and long lasting weathering of underlying rocks and are rich in iron and aluminium.

79. (b) Domestic waste includes peels of fruits, vegetables and food parts which comes under biodegradable pollution. These are decomposed chemically or by activity of microorganisms into harmless product and are recycled back into the atmosphere.

80. (a) UV-B radiations damage DNA and mutations may occur. In human eye, cornea absorbs UV-B radiations, and a high dose of UV-B causes inflammation of cornea called snow blindness, cataract, etc.

NOTES

Antarctica is covered with snow and ice; the ice surface is very reflective. Most of the sunlight hitting Antarctica is reflected right back out; very little radiation, or heat, is absorbed into the surface.

81. (a) Montreal protocol – Signed in 16 Sep, 1987 (Ozone day) came into force – 1 Jan, 1989. It was aimed at stopping the production and import of ODS and reduce their concentration in the atmosphere.

The main uses of ozone depleting substances include:

- CFCs and HCFCs in refrigerators and air conditioners,
- HCFCs and halons in fire extinguishers,
- CFCs and HCFCs in foam,
- CFCs and HCFCs as aerosol propellants, and
- Methyl bromide for fumigation of soil, structures and goods to be imported or exported.

NOTES

The Vienna Convention for the Protection of the Ozone Layer and its Montreal Protocol on Substances that Deplete the Ozone Layer are the most widely ratified treaties in United Nations history. In 2009, the Convention and the Montreal Protocol became the first treaties of any kind to achieve universal ratification.

82. (a) Ozone found in stratosphere are good ozone and protects us by absorbing solar ultraviolet radiation, which otherwise could cause severe damage to living organisms on the Earth's surface. Whereas ozone found in troposphere is a bad ozone and considered as a pollutant.

NOTES

Ozone is an irritating, pale blue gas that is explosive and toxic, even at low concentrations. It is mainly found in two regions of the Earth's atmosphere. About 90% ozone resides in a layer (called stratosphere) that begins between 6 and 10 miles (10 and 17 kilometres) above the Earth's surface and extends up to about 30 miles (50 kilometres). The ozone found in this region is commonly known as the ozone layer. The remaining ozone is in the lower region of the atmosphere, which is commonly called the troposphere.

83. (a) Irrigation of agricultural field for a prolonged time without proper drainage leads to waterlogging in the soil. Waterlogging draws salt to the surface of the soil and causes salinity.

NOTES

Over-irrigation leads to water loss, increases energy use for pumping, causes leaching of nitrogen and other micro nutrients, and wastes time. Crop nitrogen needs, fertilizer costs, and nitrogen losses to groundwater also result from over-irrigation

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84. (a) The Montreal Protocol on substances that deplete the Ozone Layer (the Montreal Protocol) is an international agreement made in 1987. It was designed to stop the production and import of ozone depleting substances (chlorofluorocarbons) and reduce their concentration in the atmosphere to help protect the earth's ozone layer.

85. (d) Gases, responsible for Green house effect are carbon dioxide and methane.

A green house gas is a gas that absorbs and emits radiant energy within the thermal infrared range. Greenhouse gases cause the greenhouse effect. The primary greenhouse gases in Earth's atmosphere are water vapour, carbon dioxide, methane, nitrous oxide and ozone. Without greenhouse gases, the average temperature of Earth's surface would be about −18 °C (0 °F), rather than the present average of 15 °C (59 °F).

86. (d)

NOTES

Snow blindness, also called arc eye or photokeratitis, is a painful eye condition caused by overexposure to ultraviolet (UV) light. When too much UV light hits the transparent outer layer of your eyes, called the cornea, it essentially gives your cornea a sunburn. Snow blindness symptoms can be disorienting.

87. (b) Chlorofluorocarbons (CFCs) and other halogenated ozone depleting substances (ODS) are mainly responsible for man-made chemical ozone depletion. CFCs rise into the stratosphere where they are eventually broken down by ultraviolet (UV) rays from the Sun. This causes them to release free chlorine which then reacts with oxygen leading to the chemical process of destroying ozone molecules.

88. (d) World Ozone day is celebrated on 16th September. 5th June is World Environment Day. 21st April is National Yellow Bat Day. 22nd April is National Earth Day.

NOTES

September 16 was designated by the United Nations General Assembly as the International Day for the Preservation of the Ozone Layer. This designation had been made on December 19, 2000, in commemoration of the date, in 1987, on which nations signed the Montreal Protocol on Substances that Deplete the Ozone Layer.

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89. (c) Joint Forest Management originated in West Bengal accidentally at the Arabari Forest Range in West Midnapore, near Midnapore town in 1971. After the initial successes in West Bengal and Haryana, the JFM schemes received national importance in the legislation of 1988.

90. (b) The ozone layer or ozone shield refers to a region of Earth's stratosphere that absorbs most of the Sun's ultraviolet (UV) radiation. It contains high concentrations of ozone (O_3) relative to other parts of the atmosphere.

NOTES

Skin cancer is the abnormal growth of skin cells which develops when skin is exposed to the harmful ultraviolet rays coming from the sun. There are three major types of skin cancer — basal cell carcinoma, squamous cell carcinoma and melanoma.

91. (a) The UN Conference of Parties on climate change in 2011, was held in Durban, South Africa. It aimed at decrease of pollutant emission.

92. (c) Liver cancer is caused due to aflatoxin released by *Aspergillus fungus* and Vinyl chloride. UV-rays are not related with liver cancer.

93. (a) This conference occured from 20 Nov to 8 December, 2012 to extend the life of the Kyoto Protocol at Doha in Qatar.

94. (d) In year 1997, at the conference of parties III (CoP - 3) , Kyoto, Japan the Kyoto conference on climate change took place. In that conference, developed countries agreed to specific targets for cutting their emissions of green house gases. A general framework has defined for this with specifics to be detailed in next few years. This become known as the kyoto protocol.

95. (d) In first three options CO_2 concentration increases but it decreases in option (d). Global warming is increase of earth's average temperature. Global warming is due to green house effect which is naturally occurring phenomenon that is responsible for heating of Earth's surface and atmosphere. The main green house gas is carbon-dioxide (contribute 60%).

96. (d) The Kyoto Protocol is an international agreement linked to the United Nations Framework Convention on climate change which commits its parties by setting internationally binding emissions reduction targets. In Doha, Qatar on 8 December 2012, the "Doha Amendment to the Kyoto Protocol" was adopted. The second commitment period was from 1st Jan. 2013 to 31st Dec. 2020.

97. (c) The increase in the level of green house gases (e.g., CO_2, CH_4, CFC, N_2O etc.) has led to the considerable heating of earth surface leading to **global warming.** The relative contributions of various green house gases to global warming is

CO_2 (60%) > CH_4 (20%) > CFC (14%) > N_2O (6%)

98. (b) Ozone present in upper part of the atmosphere *ie.* stratosphere is benefical for living beings. As, it functions as a shield against harmful UV-radiation.

NOTES

Pyrimidine dimers or thymidine dimers are formed by covalent linking between adjacent pyrimidine bases on the same strand of the DNA. Thymine dimers disort the shape of the DNA that prevents in the formation of accurate copy of DNA results in mutation.

99. (d) The correct acronym of IUCN is International Union for Conservation of Nature and Natural resources.
100. (d) CO_2 and N_2O are major green house gases.
101. (c) Good ozone occurs naturally in the earth's upper atmosphere 10 to 30 miles above earth's surface (stratosphere) where it forms a protective layer that shield us from the sun's harmful ultraviolet rays.
102. (a) The gases that makes highest relative contribution to the green house gases are carbon dioxide (CO_2) and methane (CH_4).
103. (a) Global agreement in specific control strategies to reduce the release of ozone depleting substances was adopted by the Montreal protocol. The treaty was originally signed in 1987 and substantially amended in 1990 and 1992. The Montreal protocol stipulates that the production and consumption of compounds that deplete ozone in the stratosphere, chlorofluoro carbons (CFCs), halogens, carbon tetrachloride, and methyl chloroform– are to be phased out by 2000 (2005 for methyl chloroform).
104. (d) The aim of Montreal protocol was to protect the ozone layer in the stratosphere by decreasing and eventually eliminating the use of ozone depleting substances like CFCs.
105. (a) Chipko movement was launched for the protection of forests. The Chipko movement refers to the unique form of protest adopted by the rural people in the himalayan region of India in the 1970s and 80s, against the indiscriminate logging and felling of trees that spelt the destruction of their environment. The first Chipko action occurred in April 1973. Over the next five years, the movement spread to several hill districts in Uttar Pradesh. In 1980, Chipko activists won a fifteen-year ban on green felling in the himalayan forests.
106. (a) CFC 14%, Methane 20% is the correct percentage of the two (out of the total 4) green house gases that contribute to the total global warming. A regular assessment of abundance of green house gases and their impact on global environment is being made by IPCC (Inter-Governmental Panel on Climate Change). The various green house gases are CO_2 (warming effect 60%), CH_4 (effect 20%), chlorofluorocarbons or CFCs (14%) and nitrous oxide (N_2O), 6%). Others of minor significance are water vapours and ozone.
107. (a) Montreal protocol which calls for appropriate action (like less production of ozone depleting substances called ODS such as CFCs) to protect the ozone layer was passed by a forum of 27 industralized countries on 16 September 1987. Till now 175 countries have joined this.
108. (b) Kyoto Protocol (1997) : International conference held in Kyoto, Japan obtained commitments from different countries for reducing overall greenhouse gas emissions at a level 9% below 1990 level by 2008-2012.
Montreal Protocol (1987) : Industrialized countries agreed to limit production of chloroflourocarbons to half the level of 1986.
109. (c) Solar energy coming to the earth is not responsible for green house effect. It is the increase in green house gases in atmosphere like CO_2 which is released by complete combustion of fossil fuels or biomass in industries or transportation vehicles that prevent the reradiation of infrared radiation from the earth and result in increase in temperature of the earth.
110. (b) Methane forms a major part of gobar-gas. Ammonia is toxic. Ethane and butane are not major components of gobar gas.
111. (b) The major contributor of Green House gases to the atmosphere is U.S.A., which itself releases around 37% of the chlorofluorocarbons (CFCs).
112. (d) RBE (Relative Biological Effectiveness) is a comparision of the dose of the radiation being studied with the dose of standard radiation producing the same effect.

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NOTES

RBE depends on the dose and biological endpoint. The formula of

$$RBE = \frac{\text{Dose of Standard Radiation}}{\text{Dose of Test Radiation}}$$ for a given effect

113. (d) Green house effect is the rise in atmospheric temperature due to increase in concentration of green house gases.
The **greenhouse effect**, discovered by Joseph Fourier in 1824 and first investigated quantitatively by Svante Arrhenius in 1896, is the process in which the emission of infrared radiation by an atmosphere warms a planet's surface. In the case of the Earth, without these greenhouse gases its surface would be up to 30°C cooler. The name comes from an incorrect analogy with the way in which greenhouses are heated by the sun in order to facilitate plant growth. In addition to the Earth, Mars and especially Venus have greenhouse effects. The maximum green house gases are emitted by USA.

114. (c) Some of the important green house gases are CO_2, CFCs, Nitrous oxide, Ozone, Methane etc. Nitrous oxide is produced by denitrifying bacteria acting on artificial fertilisers applied to poorly aerated soil.

115. (d) Increase in air pollution has resulted in gradual depletion of the ozone layer. This has exposed the earth's surface to the harmful ultraviolet radiations of the sun. Exposure to UV rays increases the risk of skin cancer and other skin related disorders.

116. (c) Ozone hole is an area with extreme reduction in the ozone concentration. It was discovered over Halley Bay in Antarctica by Farman *et. al* (1985), members of British Antarctic Survey Team.
Image of the largest Antarctic ozone hole ever recorded in September 2006.

117. (c) Desertification is the process leading to the formation of desert. The main factor of desertification of land is over-grazing by herbivorous animals.

118. (c) CO_2 is the major green house gas causing green house effect which is released in the atmosphere by burning fossil (combustion) or by activities like animal respiration. Deforestation adds to the increase in CO_2 in atmosphere because trees are cut down which are the big absorber of CO_2.

119. (a) Deforestation causes the depletion of wood and nutrients from an ecosystem and hence nutrient cycling gets slowed down.

120. (d) Ultraviolet radiations cause photochemical splitting of oxygen molecules in the stratosphere. The nascent oxygen combines with molecular oxygen to form ozone. In troposphere nascent oxygen comes from nitrogen dioxide.

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121. (c) Increase in the concentration of CO_2 do not allow the earth's radiations to go out of earth's atmosphere and contributes in increasing temperature of earth.

122. (c) & (d) Deforestation decreases soil fertility. Roots of trees bind the soil, due to soil erosion, soil fertility also affected.
It also reduces rainfall as plants absorb water from the soil and evaporates it to form clouds. Deforestation leads to cutting down of trees. As a result less water is absorbed from the soil which disturbs the water cycle.