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Senior School Certificate Examination

March 2019

**Marking Scheme – BIOLOGY (SUBJECT CODE 044)
(PAPER CODE 57/1-1,2,3)**

General Instructions: -

1. You are aware that evaluation is the most important process in the actual and correct assessment of the candidates. A small mistake in evaluation may lead to serious problems which may affect the future of the candidates, education system and teaching profession. To avoid mistakes, it is requested that before starting evaluation, you must read and understand the spot evaluation guidelines carefully. **Evaluation is a 10-12 days mission for all of us. Hence, it is necessary that you put in your best efforts in this process.**
2. Evaluation is to be done as per instructions provided in the Marking Scheme. It should not be done according to one's own interpretation or any other consideration. Marking Scheme should be strictly adhered to and religiously followed. **However, while evaluating, answers which are based on latest information or knowledge and/or are innovative, they may be assessed for their correctness otherwise and marks be awarded to them.**
3. The Head-Examiner must go through the first five answer books evaluated by each evaluator on the first day, to ensure that evaluation has been carried out as per the instructions given in the Marking Scheme. The remaining answer books meant for evaluation shall be given only after ensuring that there is no significant variation in the marking of individual evaluators.
4. If a question has parts, please award marks on the right-hand side for each part. Marks awarded for different parts of the question should then be totaled up and written in the left-hand margin and encircled.
5. If a question does not have any parts, marks must be awarded in the left hand margin and encircled.
6. If a student has attempted an extra question, answer of the question deserving more marks should be retained and the other answer scored out.
7. No marks to be deducted for the cumulative effect of an error. It should be penalized only once.
8. A full scale of marks 0-70 has to be used. Please do not hesitate to award full marks if the answer deserves it.
9. Every examiner has to necessarily do evaluation work for full working hours i.e. 8 hours every day and evaluate 25 answer books per day.
10. Ensure that you do not make the following common types of errors committed by the Examiner in the past:-
 - Leaving answer or part thereof unassessed in an answer book.
 - Giving more marks for an answer than assigned to it.
 - Wrong transfer of marks from the inside pages of the answer book to the title page.
 - Wrong question wise totaling on the title page.
 - Wrong totaling of marks of the two columns on the title page.
 - Wrong grand total.
 - Marks in words and figures not tallying.
 - Wrong transfer of marks from the answer book to online award list.
 - Answers marked as correct, but marks not awarded. (Ensure that the right tick mark is correctly and clearly indicated. It should merely be a line. Same is with the X for incorrect answer.)
 - Half or a part of answer marked correct and the rest as wrong, but no marks awarded.

11. While evaluating the answer books if the answer is found to be totally incorrect, it should be marked as (X) and awarded zero (0) Marks.
12. Any unassessed portion, non-carrying over of marks to the title page, or totaling error detected by the candidate shall damage the prestige of all the personnel engaged in the evaluation work as also of the Board. Hence, in order to uphold the prestige of all concerned, it is again reiterated that the instructions be followed meticulously and judiciously.
13. The Examiners should acquaint themselves with the guidelines given in the Guidelines for spot Evaluation before starting the actual evaluation.
14. Every Examiner shall also ensure that all the answers are evaluated, marks carried over to the title page, correctly totaled and written in figures and words.
15. The Board permits candidates to obtain photocopy of the Answer Book on request in an RTI application and also separately as a part of the re-evaluation process on payment of the processing charges.

Question Paper Code 57/1/1

SECTION – A

(Q. Nos. 1 - 5 are of one mark each)

1. **British geneticist R.C. Punnett developed a graphical representation of a genetic cross called “Punnett Square”. Mention the possible result this representation predicts of the genetic cross carried.**

Ans. (Probability of) all genotypes / genotypic ratio

[1 mark]

2. **State the two principal outcomes of the experiments conducted by Louis Pasteur on origin of life.**

Ans. Life comes from pre-existing life / biogenesis , dismissed the concept of spontaneous generation
= $\frac{1}{2} + \frac{1}{2}$

[1 mark]

3. **Name the layer of the atmosphere that is associated with ‘good ozone’.**

Ans. Stratosphere

[1 mark]

OR

Mention the term used to describe a population interaction between an orchid growing on a forest tree.

Ans. Commensalism

[1 mark]

4. **What are ‘flocs’, formed during secondary treatment of sewage ?**

Ans. Masses of bacteria associated with fungal filament (to form mesh like structure)

[1 mark]

OR

Write any two places where methanogens can be found.

Ans. Anaerobic sludge (digester) , rumen of cattle / ruminants / stomach of cattle / gut of cattle ,
marshy area , flooded rice fields , biogas plant (*Any two*) = $\frac{1}{2} + \frac{1}{2}$

[1 mark]

5. At what state does the meiosis occur in an organism exhibiting haploidic life cycle and mention the fate of the products thus produced.

Ans. After zygote formation = $\frac{1}{2}$

haploid organism / haploid spores / (haploid) gametophyte = $\frac{1}{2}$

[1 mark]

SECTION - B

(Q. Nos. 6 - 12 are of two marks each)

6. You are conducting artificial hybridization on papaya and potato. Which one of them would require the step of emasculation and why ? However for both you will use the process of bagging. Justify giving one reason.

Ans. Potato = 1

Flowers of potato have both male and female reproductive parts in same flower / bisexual flowers / monoecious plant = $\frac{1}{2}$

Bagging : To prevent unwanted pollens from coming on the stigma = $\frac{1}{2}$

[2 marks]

7. How would the gene flow or genetic drift affect the population in which either of them happen to take place ?

Ans. Results in changed frequency of genes (or alleles) in both populations , causing variation , leading to evolution / speciation / founder effect = 1 + 1

(Any two)

[2 marks]

8. Differentiate between the roles of B-lymphocytes and T-lymphocytes in generating immune responses.

Ans. B-lymphocytes : Produce antibodies = 1

T-lymphocytes : Help B-lymphocytes to produce antibodies / kills the pathogen directly (Killer T-cells)= 1

[2 marks]

OR

Principle of vaccination is based on the property of “memory” of the immune system. Taking one suitable example, justify the statement.

Ans. When a vaccine / heat killed pathogen / attenuated pathogen / weakened pathogen / a preparation of antigenic proteins of pathogen is introduced into the body to prevent chicken pox / measles / any other example it produces antibodies against antigen / pathogen , = 1

It generates B and T memory cells that recognize the pathogen quickly on subsequent exposure , to produce large amount of antibodies which inactivate the pathogen causing the disease = $\frac{1}{2} + \frac{1}{2}$ (*Any other correct example of a disease can also be substituted*)

[2 marks]

9. Explain the relevance of “Totipotency” and “Somaclones” in raising healthy banana plants from virus infected banana plants.

Ans. Totipotency : Capacity of (apical / axillary) meristematic tissue of banana plant , which are virus free , to generate whole plant through tissue culture (micropropagation) = $\frac{1}{2} \times 3$

Somaclones : Plants produced are genetically identical to the original plant = $\frac{1}{2}$

[2 marks]

10. How is a continuous culture system maintained in bioreactors and why ?

Ans. Used medium is drained out from one side of the bioreactor and fresh medium is added from the other side = 1

This type of culturing method produces a larger biomass leading to higher yields (of desired protein) = 1

[2 marks]

11. List any four ways by which GMO’s have been useful for enhanced crop output.

Ans. Make crops more tolerant to abiotic / cold / heat / drought / salt stresses /
Reduces reliance on chemical pesticides (pest-resistant crops) / Reduce post harvest losses /
Increased efficiency of mineral usage by plant (prevents early exhaustion of soil fertility) / Enhanced nutritional value of food (example vitamin A enriched rice / starch) / To create tailor-made plants for non food purposes (to supply alternative resources of fuels / pharmaceuticals to industries) = (*Any four*) = $\frac{1}{2} \times 4$

[2 marks]

12. Mention four significant services that a healthy forest ecosystem provide.

Ans. Purify air / Production of O_2 / Purify water / Mitigate droughts and floods / Nutrient cycling /
Generating fertile soils / Provide wildlife habitat / Maintain biodiversity / Pollinate crops / Provide site for carbon storage / Provide aesthetic - cultural - spiritual values / economic benefits / from nature food / industrial products / products of medicinal importance (*Any four*) = $\frac{1}{2} \times 4$

[2 marks]

OR

Substantiate with the help of one example that in an ecosystem mutualists (i) tend to co-evolve and (ii) are also one of the major causes of biodiversity loss.

Ans. Fig species is pollinated only by (its partner) wasp species where the female wasp uses the fruit of fig species as a site for egg laying and nourishing its larvae (mutualists tend to co-evolve / evolution of flower and its pollinated species are tightly linked) / Moth deposits its egg in the locule of the ovary of *Yucca* plant and the flower in turn gets pollinated by the moth (mutualists tend to co-evolve / evolution of flower and its pollinator species are tightly linked) (**Any other relevant example explained**) = 1

When any one of these two species become extinct - the other species associated with it in obligatory way also becomes extinct and leads to biodiversity loss = 1

[2 marks]

SECTION-C

(Q. Nos. 13 - 24 are of three marks each)

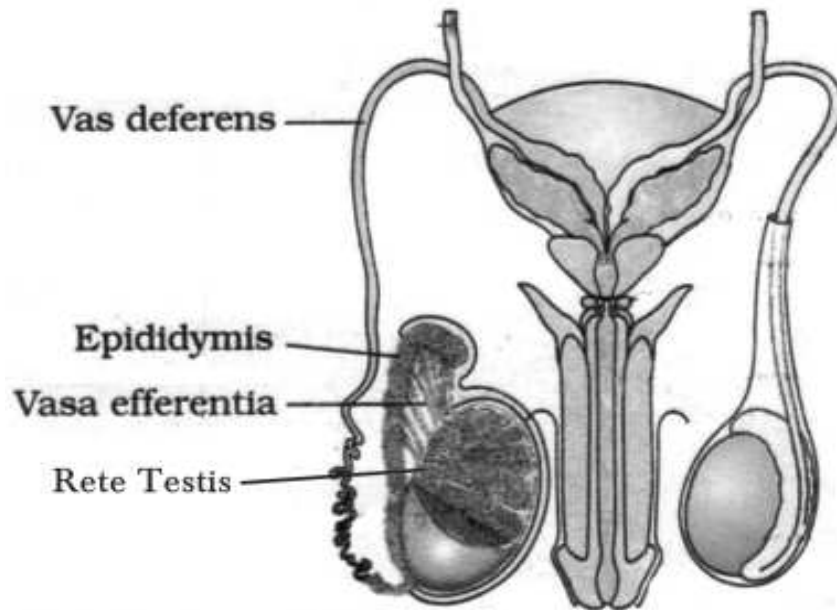
13. Pollen banks are playing a very important role in promoting plant breeding programme the world over. How are pollens preserved in the pollen banks ? Explain. How are such banks benefitting our farmer ? Write any two ways.

Ans. Cryopreservation / preserved in liquid nitrogen (-196°C) = 1

Availability of pollen of different genetic strains (for wider use) / Cryopreservation increases viability of pollens (which can be used in crop breeding programmes) / Can be preserved / stored for longer duration / Conserve large number of species / To prevent complete extinction of any species / Maintain biodiversity (**Any two**) = 1 + 1

[3 marks]

14. Draw a labelled diagram to show interrelationship of four accessory ducts in a human male reproductive system.



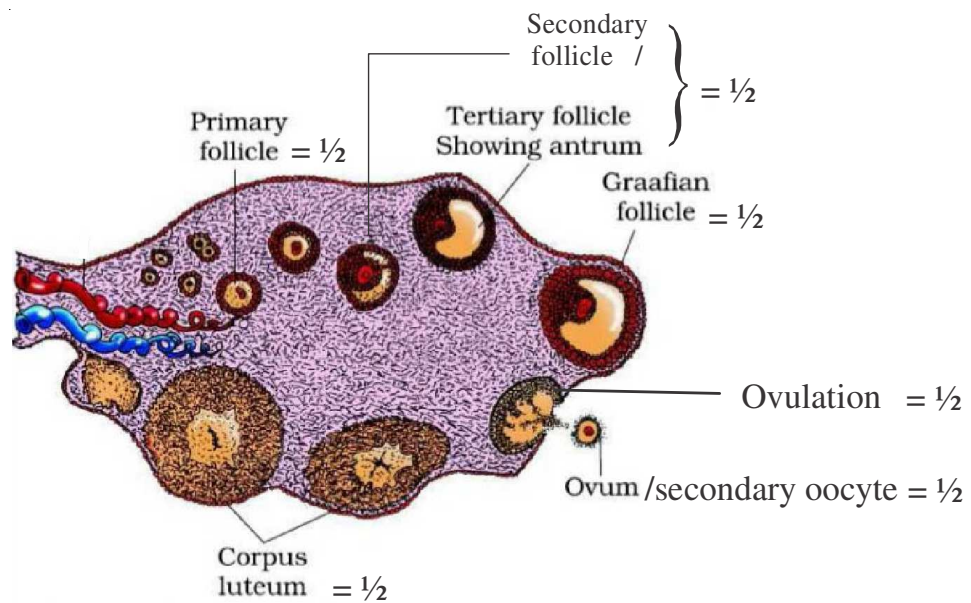
Correct diagram with : 1 labelling = $\frac{1}{2}$, 2 labellings = 1 , 3 labellings = 2 , 4 labellings = 3

[3 marks]

OR

Draw a sectional view of the human ovary showing the different stages of developing follicles, corpus luteum and ovulation.

Ans.



$$= \frac{1}{2} \times 6$$

[3 marks]

15. Compare in any three ways the chromosomal theory of inheritance as proposed by Sutton and Boveri with that of experimental results on pea plant presented by Mendel.

Sutton and Boveri	Mendel
1. Chromosomes occur in pairs	1. Factors occur in pairs
2. Chromosomes segregate at the time of gamete formation such that only one of each pair is transmitted to a gamete	2. Factors segregate at gamete formation stage and only one of each pair is transmitted to a gamete
3. Independent pairs of chromosomes segregate independently of each other	3. One pair of factors segregate independently of another pairs

= 1×3

[3 marks]

OR

- (a) Explain linkage and recombination as put forth by T.H. Morgan based on his observations with *Drosophila melanogaster* crossing experiment.
- (b) Write the basis on which Alfred Sturtevant explained gene mapping.

Ans. (a) Linkage :- Physical association of genes on a chromosome ,

- Two genes did not segregate independently of each other

- F_2 (phenotypic) ratio deviates (significantly) from 9:3:3:1 (**Any two**) = $\frac{1}{2} \times 2$

Recombination: -Tightly linked genes tend to show fewer recombinant frequency / $1.3\% = \frac{1}{2}$

- Loosely linked genes show higher percentage of recombinant frequency / $37.2\% = \frac{1}{2}$

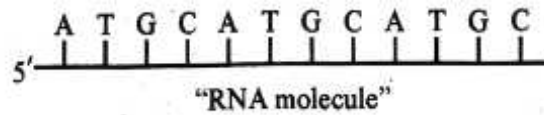
- (b) He used the frequency of recombination between gene pairs on the same chromosome as a measure of distance between genes and mapped their position on the chromosome = 1

[2 + 1 = 3 marks]

16. Explain the mechanism of DNA replication with the help of a replication fork. What role does the enzyme DNA-ligase play in a DNA replication fork ?

OR

Construct and label a transcription unit from which the RNA segment given below has been transcribed. Write the complete name of the enzyme that transcribed this RNA.



Ans. *Non evaluative , because the choice question is faulty , full marks to be awarded to all examinees who attempt either of the choice questions.*

17. (a) Write two differences between *Homo erectus* and *Homo habilis*.
- (b) Rearrange the following from early to late geologic periods: Carboniferous, Silurian, Jurassic.

Ans. (a) *Homo erectus* *Homo habilis*

(i) Brain capacity 900 cc Brain capacity 650 – 800 cc = 1

(ii) (Probably) ate meat (Probably) did not eat meat = 1

(b) Silurian → Carboniferous → Jurassic = 1

(No mark to be awarded if all the three are not in proper sequence)

[2 +1 = 3 marks]

18. Name the group of bacteria involved in setting milk into curd. Explain the process they carry in doing so. Write another beneficial role of such bacteria.

Ans. (group of) LAB / (group of) Lactic acid Bacteria / *Lactobacillus* species = 1

LAB produce acid that coagulate and partially digest the milk proteins = 1

Increases Vitamin B₁₂ / Checks disease causing microbes in the stomach = 1

[3 marks]

19. Bee keeping practice is a good income generating industry. Write the different points to be kept in mind for successful bee keeping. Write the scientific name of the most common Indian species used for the purpose.

Knowledge of the nature and habits of bees / selection of suitable location for keeping the beehive / catching and hiving of swarms (group of bees) / management of beehives during different seasons / handling and collection of honey and bee wax (*Any four*) = $\frac{1}{2} \times 4$

- *Apis indica* = 1

[3 marks]

20. (a) Match the microbes listed under Column-A with the products mentioned under Column-B.

Column - A	Column - B
(H) <i>Penicillium notatum</i>	(i) Statin
(I) <i>Trichoderma polysporum</i>	(ii) ethanol
(J) <i>Monascus purpurea</i>	(iii) antibiotic
(K) <i>Saccharomyces cerevisiae</i>	(iv) Cyclosporin-A

(b) Why does 'Swiss Cheese' develop large holes ?

- | | |
|-------------------------------------|--------------------|
| (a) (H) <i>Penicillium notatum</i> | (iii) antibiotic |
| (I) <i>Trichoderma polysporum</i> | (iv) Cyclosporin-A |
| (J) <i>Monascus purpureus</i> | (i) Statin |
| (K) <i>Saccharomyces cerevisiae</i> | (ii) ethanol |

$$= \frac{1}{2} \times 4$$

(b) Due to production of large amount of CO₂ (by *Propionibacterium sharmanii*) = 1

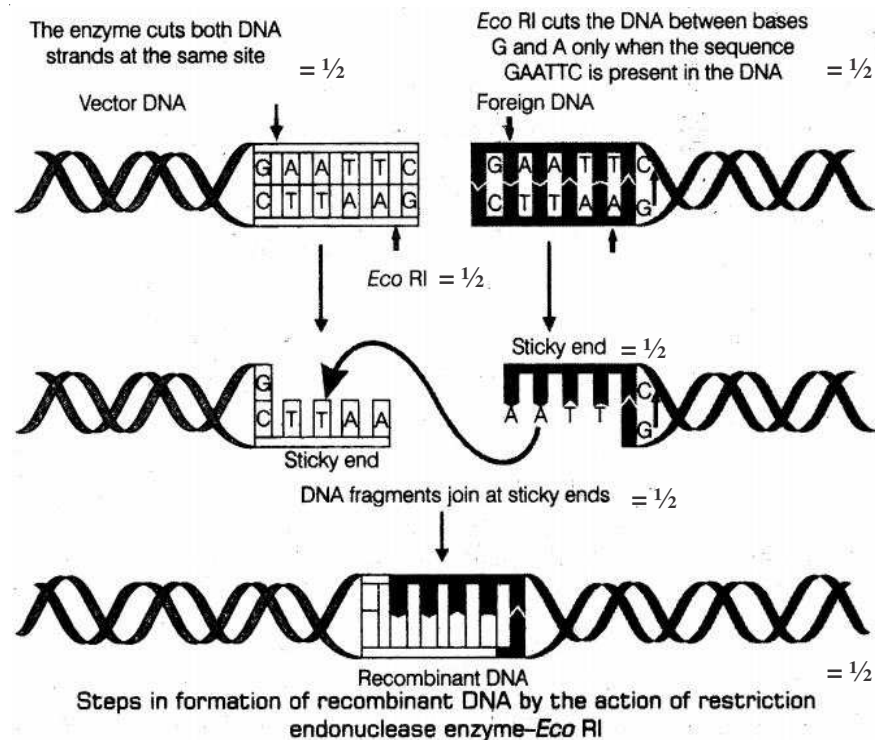
[3 marks]

21. Describe the formation of recombinant DNA by the action of EcoRI.

Ans. EcoRI identifies its palindromic sequence on both vector DNA and foreign DNA/ 5' GAATTC3', cuts strands of DNA little away from the centre of palindromic sites, but between same two bases (G and A), this leaves single stranded portion at the end (sticky ends) on each strand, for recombination both vector DNA and foreign DNA, with similar sticky ends are joined by the enzyme DNA ligase = $\frac{1}{2} \times 6$

The following diagram can be considered in lieu of the above explanation

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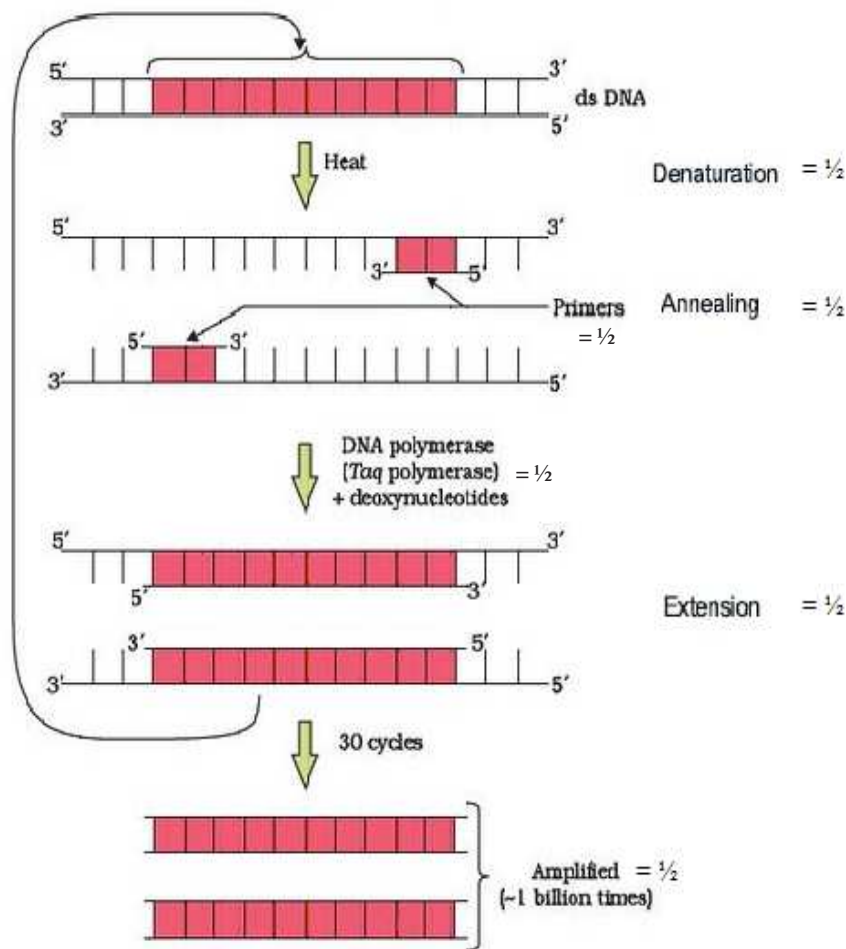
OR

Describe the process of amplification of “gene of interest” using PCR technique.

Ans. Denaturation of desired DNA into two strands, each acting as templates, for each strands separate set of primer (two sets of primer) used, with the help of deoxy(ribo)nucleotides and Taq polymerase (DNA polymerase isolated from *Thermus aquaticus*), extension of DNA template occurs, resulting in replication of desired DNA (amplification) = $\frac{1}{2} \times 6$

The following diagram can be considered in lieu of the above explanation

//



[3 marks]

22. Two children, A and B aged 4 and 5 years respectively visited a hospital with a similar genetic disorder. The girl A was provided enzyme-replacement therapy and was advised to revisit periodically for further treatment. The girl, B was, however, given a therapy that did not require revisit for further treatment.

- Name the ailments the two girls were suffering from ?
- Why did the treatment provided to girl A required repeated visits ?
- How was the girl B cured permanently ?

Ans. (a) Adenosine deaminase (ADA) deficiency = 1

- (In Enzyme Replacement Therapy) functional ADA is introduced to the patient (by injection), this therapy is not completely curative / enzyme can act only for a limited time period = 1 + 1

- (c) [As there is no permanent cure at the age of five hence 1 mark of this answer allocated to part (b)]

[2 + 1 = 3 marks]

23. List six advantages of “ex-situ” approach to conservation of biodiversity.

An endangered / threatened species can be conserved / genetic strains of commercially important plants can be preserved for a long time (seed banks) / biodiversity loss is reduced / gametes of threatened species can be preserved in a viable and fertile condition for long periods (using cryopreservation) / eggs can be fertilized in -vitro / plants can be propagated using tissue culture / economically beneficial / conserve large number of species / aesthetic value = (**Any six points**)

[$\frac{1}{2} \times 6 = 3$ marks]

24. While on a visit to a pond in the city-neighbourhood, the visitors were delighted to find large expanse of water covered with colourful algal mass.

- (a) As a student of biology, do you agree with their delight ? Give reasons in support of your answer.
- (b) Explain the cause of such algal growth.

Ans. (a) No = $\frac{1}{2}$

These algal mass (algal bloom) causes deterioration of the water quality , increase fish mortality , are (extremely) toxic to humans and animals, imparts distinct colour to water bodies (**Any three**) = $\frac{1}{2} + \frac{1}{2} + \frac{1}{2}$

- (b) Presence of large amount of nutrients / nitrates and phosphates/ nitrogen and phosphorus in water body = 1

[2 + 1 = 3 marks]

SECTION-D

(Q. Nos. 25 - 27 are of five marks each)


25. (a) Explain one application of each one of the following :

- (A) Amniocentesis
- (B) Lactational amenorrhea
- (C) ZIFT

- (b) Prepare a poster for the school programme depicting the objectives of :

“Reproductive and Child Health Care Programme”.

Ans. (a) A. To detect chromosomal disorders / sex determination (legally banned) / detect genetic disorder / Karyotyping = 1

- B. To prevent pregnancy / means of natural contraception = 1
- C. To assist an infertile couple to have children by transferring the zygote / early embryo / embryo at eight blastomere stage into fallopian tube = 1
- (b) A poster made on RCH - **Any relevant slogan or sketch made should be awarded marks** e.g. Hum Do Hamare Do , Do Boond Zindagi Ke , Beti Bachao Beti Padhao , Stop STD , Gender selection and detection is punishable,  (Any other relevant theme) = 2

[3 + 2 = 5 marks]

OR

- (a) **Explain any two ways by which apomictic seed can develop.**
- (b) **List one advantage and one disadvantage of a apomictic crop.**
- (c) **Why do farmers find production of hybrid seeds costly ?**
- (a) (i) A diploid egg is formed without reduction division which develops into embryo without fertilization = 1
- (ii) Some cells of the nucellus (which are diploid in nature) start dividing and develop into embryo = 1
- (b) Advantage : No segregation of characters in hybrid progeny / Apomictic hybrid can be used to grow crop year after year / economical as ordinary hybrid seeds are costly = 1
- Disadvantage : Can not control deleterious genetic mutation / it reduces genetic diversity from parents to offspring plants due to lack of variations (in asexual reproduction) / lack ability to adapt to changing environment = 1
- (c) Hybrid seeds are costly as farmers have to purchase seeds year after year /production of hybrid seeds is a technical and expensive method to be done under controlled conditions = 1

[2 + 2+ 1 = 5 marks]

26. Differentiate between incomplete dominance and co-dominance. Substantiate you answer with one example of each.

Ans.	Incomplete Dominance	Co-dominance
	F1 generation does not resemble either of the parent but show an intermediate trait	Both dominant alleles express themselves F1 = $\frac{1}{2} + \frac{1}{2}$

Example AB blood group in human = 1

Incomplete dominance - When homozygous dominant and homozygous recessive parents are crossed all members of F1 progeny will show intermediate trait = 1

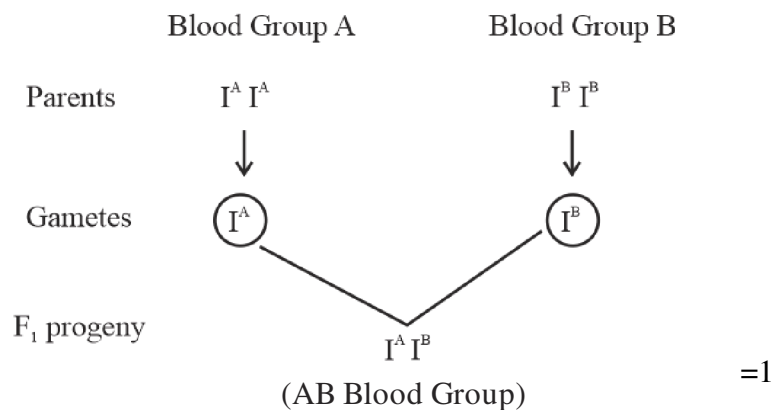
P generation Red (RR) White (rr)

Gametes R r

F₁ generation All pink (Rr)

= 1

//



With I^A_i & I^B_i / $I^A I^A$ & I^B_i / I^A_i & $I^B I^B$ / $I^A I^B$ & $I^A I^B$ / $I^A I^B$ & I^B_i / $I^A I^B$ & I^A_i

[5 marks]

OR

- (a) Write the contributions of the following scientists in deciphering the genetic code.
George Gamow; Hargobind Khorana ; Marshall Nirenberg ; Severo Ochoa
- (b) State the importance of a Genetic code in protein biosynthesis.

Ans. (a) George Gamow : Proposed that the Genetic code is constituted of 3 nucleotides / provided proof that the codon is a triplet = 1

Hargobind Khorana : Synthesized RNA molecule with a defined combination of bases (homopolymers and copolymers) = 1

Marshall Nirenberg : Cell free system for protein synthesis / helped the genetic code to be deciphered = 1

Severo Ochoa : Described enzyme (Polynucleotide phosphorylase) which polymerises RNA with defined sequence in a template independent manner (enzymatic synthesis of RNA) = 1

(b) Genetic code - Codes for a specific amino acid which is required for protein synthesis / provides information about the specific amino acid that form a particular protein / polypeptide = 1

[4 + 1 = 5 marks]

27. (a) What is “population” according to you as a biology student ?

(b) “The size of a population for any species is not a static parameter.” Justify the statement with specific reference to fluctuations in the population density of a region in a given period of time.

Ans. (a) Total number of organisms of a species in a particular area at a particular time = 1

(b) The size of a population for any species is not a static parameter because of the factors like :-

Birth rate/ Natality = $\frac{1}{2}$, number of births during a given period = $\frac{1}{2}$

Death rate/ Mortality = $\frac{1}{2}$, number of deaths during a given period = $\frac{1}{2}$

Immigration = $\frac{1}{2}$, number of individuals of the same species that have come into the habitat from elsewhere during the time period under consideration = $\frac{1}{2}$

Emigration = $\frac{1}{2}$, number of individuals of the population who left the habitat and gone elsewhere during the time period under consideration = $\frac{1}{2}$

[1 + 4 = 5 marks]

OR

- (a) What is hydrarch succession ?
- (b) Compare the pioneer species and climax communities of hydrarch and xerarch succession respectively.
- (c) List the factors upon which the type of invading pioneer species depend in secondary hydrarch succession. Why is the rate of this succession faster than that of primary succession ?

Ans. (a) The gradual and fairly predictable changes in the species composition in a water body / wetter areas = 1

(b) Hydrarch : Pioneer species – Phytoplanktons = $\frac{1}{2}$

Climax community – Forest / trees = $\frac{1}{2}$

Xerarch : Pioneer species – Lichens = $\frac{1}{2}$

Climax community – Forest / trees = $\frac{1}{2}$

(c) Condition of soil, availability of water, seeds or other propagules = 1

Because (some) soil / sediment is already there, the rate of secondary succession is much faster than primary succession = 1

[1 + 2 + 2 = 5 marks]

Question Paper Code 57/1/2

SECTION – A

(Q. Nos. 1 - 5 are of one mark each)

1. What are ‘flocs’, formed during secondary treatment of sewage ?

Ans. Masses of bacteria associated with fungal filament (to form mesh like structure)

[1 mark]

OR

Write any two places where methanogens can be found.

Ans. Anaerobic sludge (digester) , rumen of cattle / ruminants / stomach of cattle / gut of cattle , marshy area , flooded rice fields , biogas plant (*Any two*) = $\frac{1}{2} + \frac{1}{2}$

[1 mark]

2. How did Charles Darwin express ‘fitness’ ?

Ans. Reproductive fitness

[1 mark]

3. At what state does the meiosis occur in an organism exhibiting haploidic life cycle and mention the fate of the products thus produced.

Ans. After zygote formation = $\frac{1}{2}$

haploid organism / haploid spores / (haploid) gametophyte = $\frac{1}{2}$

[1 mark]

4. Name the layer of the atmosphere that is associated with ‘good ozone’.

Ans. Stratosphere

[1 mark]

OR

Mention the term used to describe a population interaction between an orchid growing on a forest tree.

Ans. Commensalism

[1 mark]

5. British geneticist R.C. Punnett developed a graphical representation of a genetic cross called “Punnett Square”. Mention the possible result this representation predicts of the genetic cross carried.

Ans. (Probability of) all genotypes / genotypic ratio

[1 mark]

SECTION - B

(Q. Nos. 6 - 12 are of two marks each)

6. Express the process of pollination in *Vallisneria*.

Ans. Long stalk of female flowers , Pollen released on the surface of water , Pollen grains are carried passively by water current , Pollen reach the stigma = $\frac{1}{2} \times 4$

[2 marks]

7. Differentiate between the roles of B-lymphocytes and T-lymphocytes in generating immune responses.

Ans. B-lymphocytes : Produce antibodies = 1

T-lymphocytes : Help B-lymphocytes to produce antibodies / kills the pathogen directly (Killer T-cells)= 1

[2 marks]

OR

Principle of vaccination is based on the property of “memory” of the immune system. Taking one suitable example, justify the statement.

Ans. When a vaccine / heat killed pathogen / attenuated pathogen / weakened pathogen / a preparation of antigenic proteins of pathogen is introduced into the body to prevent chicken pox / measles / any other example it produces antibodies against antigen / pathogen , = 1

It generates B and T memory cells that recognize the pathogen quickly on subsequent exposure , to produce large amount of antibodies which inactivate the pathogen causing the disease = $\frac{1}{2} + \frac{1}{2}$ (*Any other correct example of a disease can also be substituted*)

[2 marks]

8. How would the gene flow or genetic drift affect the population in which either of them happen to take place ?

Ans. Results in changed frequency of genes (or alleles) in both populations , causing variation , leading to evolution / speciation / founder effect (*Any two*) = 1 + 1

[2 marks]

9. Why is crossbreeding in animals practiced ? How is a breed Hisardale developed ?

Ans. Cross breeding allows the desirable qualities of two different breeds to combine = 1

By crossing of Bikaneri ewes with Marino rams = 1

[2 marks]

10. β galactosidase enzyme is considered a better selectable marker. Justify the statement.

Ans. Non-recombinant can be differentiated from recombinant on the basis of colour change (from colourless to blue), when grown on a chromogenic substrate, whereas the recombinant will not be able to show any colour change (due to insertional inactivation of the gene responsible for β galactosidase) = $\frac{1}{2} \times 3$

Non-cumbersome procedure / does not require simultaneous plating having different antibiotics / single step / easy process = $\frac{1}{2}$

[2 marks]

11. Mention four significant services that a healthy forest ecosystem provide.

Ans. Purify air / Production of O_2 / Purify water / Mitigate droughts and floods / Nutrient cycling / Generating fertile soils / Provide wildlife habitat / Maintain biodiversity / Pollinate crops / Provide site for carbon storage / Provide aesthetic - cultural - spiritual values / economic benefits / from nature food / industrial products / products of medicinal importance (**Any four**) = $\frac{1}{2} \times 4$

[2 marks]

OR

Substantiate with the help of one example that in an ecosystem mutualists (i) tend to co-evolve and (ii) are also one of the major causes of biodiversity loss.

Ans. Fig species is pollinated only by (its partner) wasp species where the female wasp uses the fruit of fig species as a site for egg laying and nourishing its larvae (mutualists tend to co-evolve / evolution of flower and its pollinated species are tightly linked) / Moth deposits its egg in the locule of the ovary of *Yucca* plant and the flower in turn gets pollinated by the moth (mutualists tend to co-evolve / evolution of flower and its pollinated species are tightly linked) (**Any other relevant example explained**) = 1

When any one of these two species become extinct - the other species associated with it in obligatory way also becomes extinct and leads to biodiversity loss = 1

[2 marks]

12. List any four ways by which GMO's have been useful for enhanced crop output.

Ans. Make crops more tolerant to abiotic / cold / heat / drought / salt stresses / Reduces reliance on chemical pesticides (pest-resistant crops) / Reduce post harvest losses / Increased efficiency of mineral usage by plant (prevents early exhaustion of soil fertility) / Enhanced nutritional value of food (example vitamin A enriched rice / starch) / To create tailor-made plants for non food purposes (to supply alternative resources of fuels / pharmaceuticals to industries) = (**Any four**) = $\frac{1}{2} \times 4$

[2 marks]

SECTION-C

(Q. Nos. 13 - 24 are of three marks each)

13. (a) Differentiate between geitonogamy and xenogamy.
(b) Write the difference in the characteristics of the progeny produced as a result of the two processes.

Ans.	Geitonogamy	Xenogamy
	<ul style="list-style-type: none">Transfer of pollen grains from anther to the stigma of another flower of the same plant	<ul style="list-style-type: none">Transfer of pollen grains from anther to stigma of a different plant of the same species = 1 + 1
	(b) Characters of progeny in geitonogamy are same as parents/no variation/ introduces homozygosity (pure lines)/low rate of variation can cause inbreeding depression = $\frac{1}{2}$	Characters of progeny in Xenogamy are different from parents/ variation is observed/ genetically different from parent/ no inbreeding depression = $\frac{1}{2}$

14. (a) Write two differences between *Homo erectus* and *Homo habilis*.
(b) Rearrange the following from early to late geologic periods: Carboniferous, Silurian, Jurassic.

Ans.	(a) <i>Homo erectus</i>	<i>Homo habilis</i>
	(i) Brain capacity 900 cc	Brain capacity 650 – 800 cc = 1
	(ii) (Probably) ate meat	(Probably) did not eat meat = 1
	(b) Silurian → Carboniferous → Jurassic = 1	

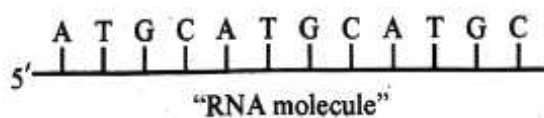
(No mark to be awarded if all the three are not in proper sequence)

[2 +1 = 3 marks]

15. Explain the mechanism of DNA replication with the help of a replication fork. What role does the enzyme DNA-ligase play in a DNA replication fork ?

OR

Construct and label a transcription unit from which the RNA segment given below has been transcribed. Write the complete name of the enzyme that transcribed this RNA.



Ans. *Non evaluative , because the choice question is faulty , full marks to be awarded to all examinees who attempt either of the choice questions.*

16. Compare in any three ways the chromosomal theory of inheritance as proposed by Sutton and Boveri with that of experimental results on pea plant presented by Mendel.

Sutton and Boveri	Mendel
1. Chromosomes occur in pairs	1. Factors occur in pairs
2. Chromosomes segregate at the time of gamete formation such that only one of each pair is transmitted to a gamete	2. Factors segregate at gamete formation stage and only one of each pair is transmitted to a gamete
3. Independent pairs of chromosomes segregate independently of each other	3. One pair of factors segregate independently of another pairs
	= 1×3

[3 marks]

OR

(a) Explain linkage and recombination as put forth by T.H. Morgan based on his observations with *Drosophila melanogaster* crossing experiment.

(b) Write the basis on which Alfred Sturtevant explained gene mapping.

Ans. (a) Linkage :- Physical association of genes on a chromosome ,

- Two genes did not segregate independently of each other

- F₂ (phenotypic) ratio deviates (significantly) from 9:3:3:1 (**Any two**) = $\frac{1}{2} \times 2$

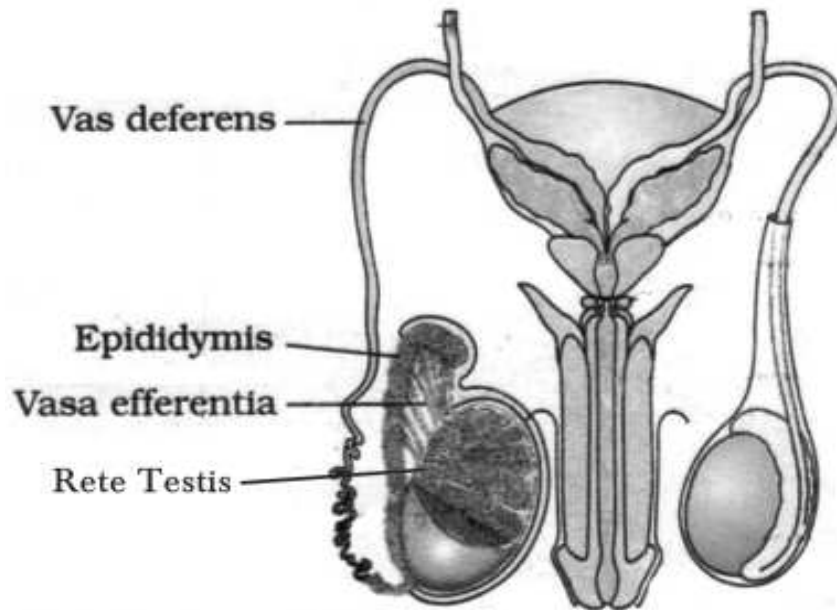
Recombination: -Tightly linked genes tend to show fewer recombinant frequency / 1.3% = $\frac{1}{2}$

-Loosely linked genes show higher percentage of recombinant frequency / 37.2% = $\frac{1}{2}$

(b) He used the frequency of recombination between gene pairs on the same chromosome as a measure of distance between genes and mapped their position on the chromosome = 1

[2 + 1 = 3 marks]

17. Draw a labelled diagram to show interrelationship of four accessory ducts in a human male reproductive system.

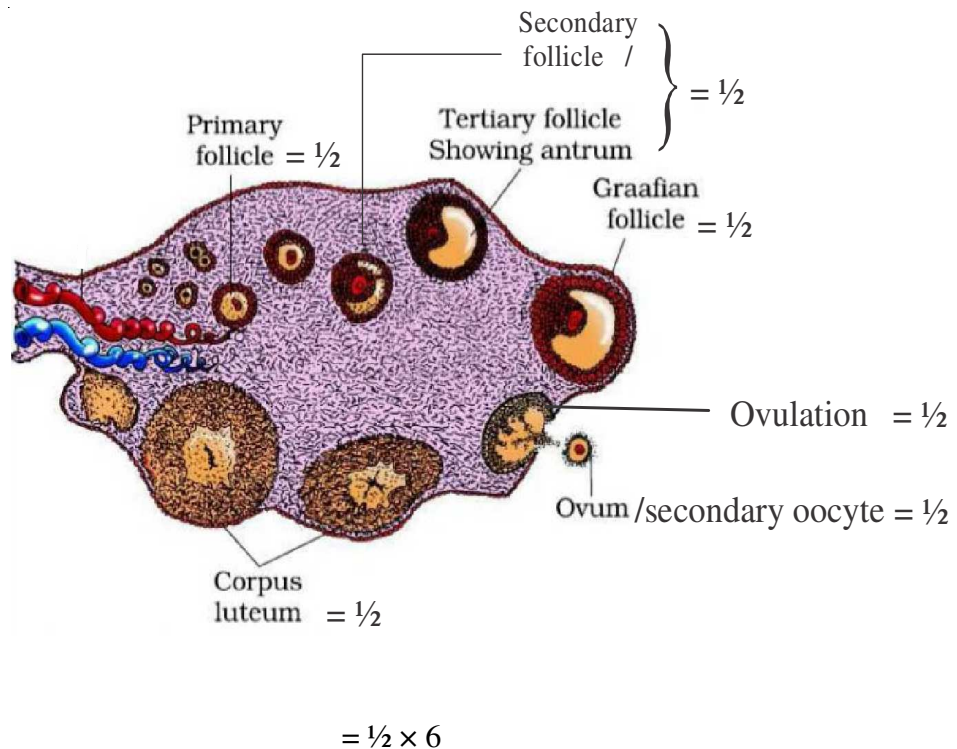


Correct diagram with : 1 labelling = $\frac{1}{2}$, 2 labellings = 1, 3 labellings = 2, 4 labellings = 3
[3 marks]

OR

Draw a sectional view of the human ovary showing the different stages of developing follicles, corpus luteum and ovulation.

Ans.



[3 marks]

18. How does the activity of each one of the following help in organic farming ?

- (a) *Mycorrhiza*
- (b) *Cyanobacteria*
- (c) *Rhizobium*

- Ans. (a) *Mycorrhiza* : The fungal symbionts in these association absorb phosphorous from soil and pass it to plant. Plants also show resistance to root borne pathogens , tolerance to salinity / drought , an overall increase in plant growth and development (**Any two**) = $\frac{1}{2} + \frac{1}{2}$
- (b) *Cyanobacteria* : Serve as an important biofertiliser by fixing atmospheric nitrogen , also add organic matter to the soil, and increase its fertility (**Any two**) = $\frac{1}{2} + \frac{1}{2}$
- (c) *Rhizobium* : Fix atmospheric nitrogen into organic forms , which is used by plant as nutrient/ increase soil fertility / symbiotic association in root nodules of leguminous plants (**Any two**) = $\frac{1}{2} + \frac{1}{2}$

[3 marks]

19. Two children, A and B aged 4 and 5 years respectively visited a hospital with a similar genetic disorder. The girl A was provided enzyme-replacement therapy and was advised to revisit periodically for further treatment. The girl, B was, however, given a therapy that did not require revisit for further treatment.

- (a) Name the ailments the two girls were suffering from ?
- (b) Why did the treatment provided to girl A required repeated visits ?
- (c) How was the girl B cured permanently ?

- Ans. (a) Adenosine deaminase (ADA) deficiency = 1
- (b) (In Enzyme Replacement Therapy) functional ADA is introduced to the patient (by injection), this therapy is not completely curative / enzyme can act only for a limited time period = 1 + 1
- (c) [As there is no permanent cure at the age of five hence 1 mark of this answer allocated to part (b)]

[2 + 1 = 3 marks]

20. While on a visit to a pond in the city-neighbourhood, the visitors were delighted to find large expanse of water covered with colourful algal mass.

- (a) As a student of biology, do you agree with their delight ? Give reasons in support of your answer.
- (b) Explain the cause of such algal growth.

Ans. (a) No = $\frac{1}{2}$

These algal mass (algal bloom) causes deterioration of the water quality, increase fish mortality, are (extremely) toxic to humans and animals, imparts distinct colour to water bodies (**Any three**) = $\frac{1}{2} + \frac{1}{2} + \frac{1}{2}$

(b) Presence of large amount of nutrients / nitrates and phosphates/ nitrogen and phosphorus in water body = 1

[2 + 1 = 3 marks]

21. (a) Match the microbes listed under Column-A with the products mentioned under Column-B.

Column - A	Column - B
(H) <i>Penicillium notatum</i>	(i) Statin
(I) <i>Trichoderma polysporum</i>	(ii) ethanol
(J) <i>Monascus purpurea</i>	(iii) antibiotic
(K) <i>Saccharomyces cerevisiae</i>	(iv) Cyclosporin-A

(b) Why does 'Swiss Cheese' develop large holes ?

(a) (H) <i>Penicillium notatum</i>	(iii) antibiotic
(I) <i>Trichoderma polysporum</i>	(iv) Cyclosporin-A
(J) <i>Monascus purpureus</i>	(i) Statin
(K) <i>Saccharomyces cerevisiae</i>	(ii) ethanol

= $\frac{1}{2} \times 4$

(b) Due to production of large amount of CO₂ (by *Propionibacterium sharmanii*) = 1

[3 marks]

22. Bee keeping practice is a good income generating industry. Write the different points to be kept in mind for successful bee keeping. Write the scientific name of the most common Indian species used for the purpose.

Knowledge of the nature and habits of bees / selection of suitable location for keeping the beehive / catching and hiving of swarms (group of bees) / management of beehives during different seasons / handling and collection of honey and bee wax (**Any four**) = $\frac{1}{2} \times 4$

- *Apis indica* = 1

[3 marks]

23. Mention the special adaptations evolved in parasites and why ?

- Ans. - Loss of unnecessary sense organs , since they do not interact with external environment (eg. lacks eyes as they are found in an environment that lacks light) = $\frac{1}{2} \times 2$
- Presence of adhesive organs / suckers / hooks , to cling to the host = $\frac{1}{2} \times 2$
- Loss of digestive system , to absorb (digested) food from the host body = $\frac{1}{2} \times 2$
- High reproductive capacity , to increase the chances the survival = $\frac{1}{2} \times 2$
- If the host evolves special mechanism for resisting or rejecting the parasite - the parasite also evolves mechanism to counteract and neutralise them , in order to be successful with the same host species = $\frac{1}{2} \times 2$
- Presence of more than one host , to facilitate parasitisation of its primary host = $\frac{1}{2} \times 2$
- Loss of chlrophyll & leaves (*cuscuta*) , to derive its nutrition from the host plant which it parasitises = $\frac{1}{2} \times 2$
- Eggs resembles the host egg (crow) in size and colour , to reduce the chances of host bird detecting / ejecting the foreign eggs (koel) = $\frac{1}{2} \times 2$

(Any three special adaptations with reasons) = 1×3

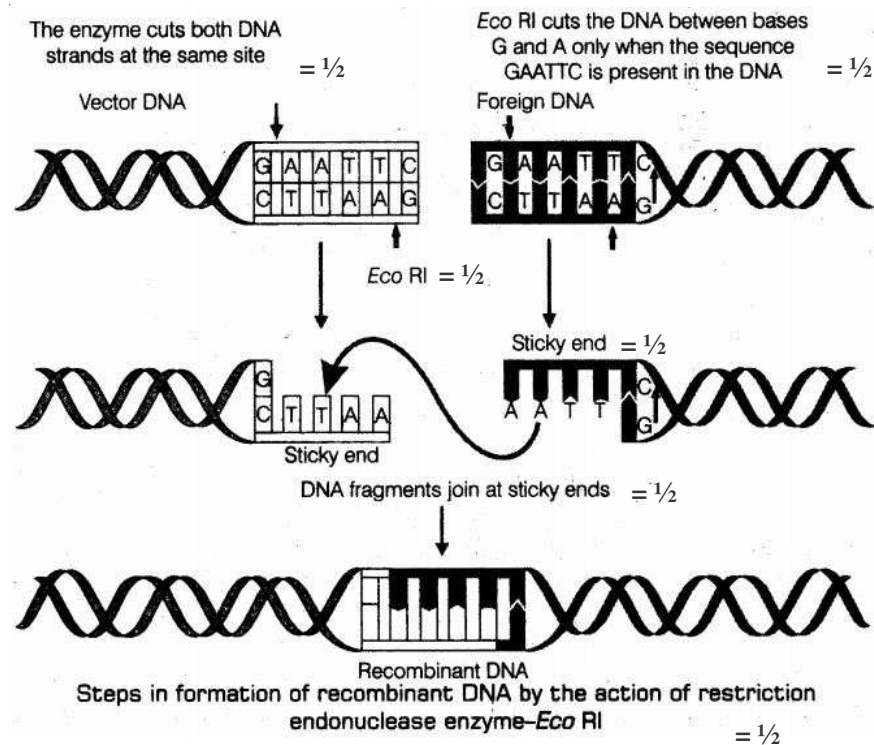
[3 marks]

24. Describe the formation of recombinant DNA by the action of EcoRI.

- Ans. EcoRI identifies its palindromic sequence on both vector DNA and foreign DNA/ 5' GAATTC3', cuts strands of DNA little away from the centre of palindromic sites , but between same two bases (G and A) , this leaves single stranded portion at the end (sticky ends) on each strand , for recombination both vector DNA and foreign DNA , with similar sticky ends are joined by the enzyme DNA ligase = $\frac{1}{2} \times 6$

The following diagram can be considered in lieu of the explanation

//



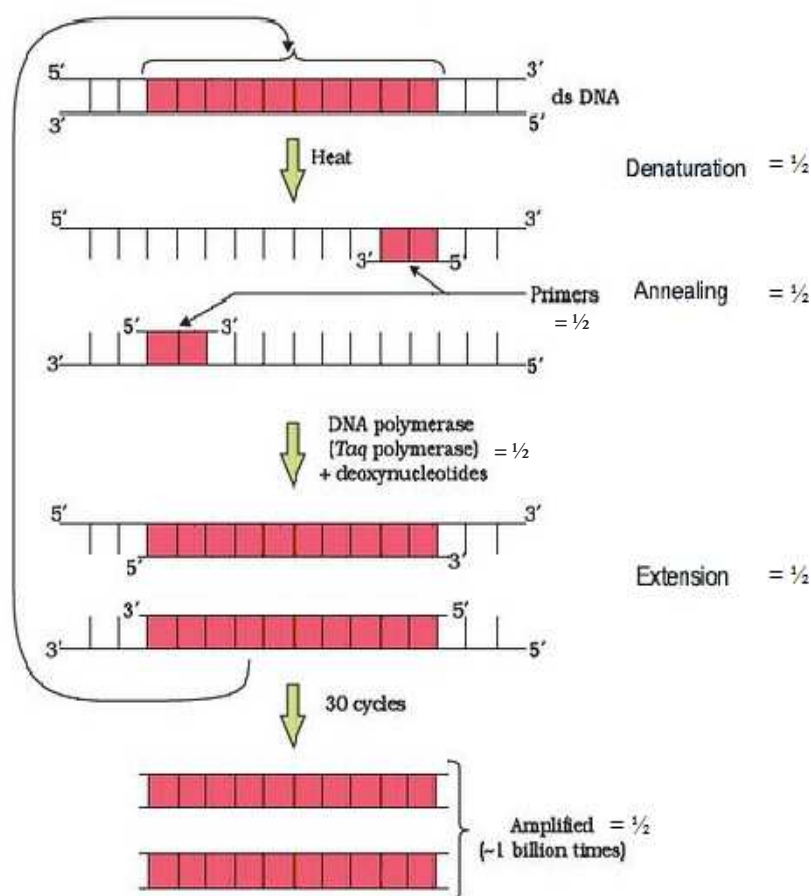
OR

Describe the process of amplification of “gene of interest” using PCR technique.

Ans. Denaturation of desired DNA into two strands, each acting as a template, for each strand separate set of primer (two sets of primer) used, with the help of deoxy(ribo)nucleotides and Taq polymerase (DNA polymerase isolated from *Thermus aquaticus*), extension of DNA template occurs, resulting in replication of desired DNA (amplification) = $\frac{1}{2} \times 6$

The following diagram can be considered in lieu of the explanation

//



[3 marks]

SECTION-D

(Q. Nos. 25 - 27 are of five marks each)

25. Where does the process of megasporogenesis start in an angiosperm ? Describe the process upto the formation of embryo sac.

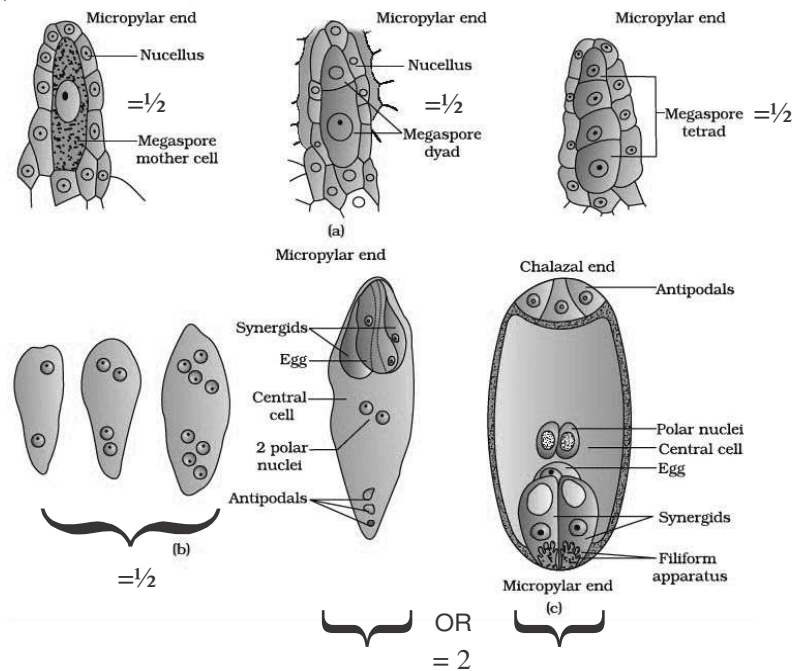
Ans. Nucellus / Ovules = 1

A single MMC / megaspore mother cell differentiates in the micropylar region of the nucellus , MMC undergoes meiosis , to produce four (haploid) megaspores , one of the megaspore functional, the nucleus of functional megaspore undergoes free nuclear division , to form 2 nucleate - 4 nucleate - 8 nucleate embryo sac , cell wall formation occurs in six of 8 nuclei , two polar nuclei occur in the large central cell to form 8 nucleated and 7 celled embryosac = $\frac{1}{2} \times 8$

//

The following diagram can be considered in lieu of the explanation

//



OR

- (a) Explain the process of fertilization in human.
- (b) Name the embryonic stage that gets implanted in human females. Explain the process of implantation.

Ans. (a) When a sperm comes in contact with zona pellucida layer of ovum, induces the changes in membrane of ovum and blocks entry of other sperms, lytic enzymes / secretions from acrosome helps the entry of sperm head, completion of first meiotic division of secondary oocyte, formation of second polar body and ootid / ovum, fusion of nuclei of sperm and ovum forming zygote $=\frac{1}{2} \times 6$

- (b) Blastocyst stage = 1

Process : Cells of blastocyst are arranged into an outer layer trophoblast (and an inner cell mass) / Trophoblast gets attached to endometrium, blastocyst becomes embedded in the endometrium of the uterus (and this is) called implantation $=\frac{1}{2} \times 2$

[3+ 2 = 5 marks]

26. (a) What is "population" according to you as a biology student ?
- (b) "The size of a population for any species is not a static parameter." Justify the statement with specific reference to fluctuations in the population density of a region in a given period of time.

- Ans. (a) Total number of organisms of a species in a particular area at a particular time = 1
- (b) The size of a population for any species is not a static parameter because of the factors like :-
- Birth rate/ Natality = $\frac{1}{2}$, number of births during a given period = $\frac{1}{2}$
- Death rate/ Mortality = $\frac{1}{2}$, number of deaths during a given period = $\frac{1}{2}$
- Immigration = $\frac{1}{2}$, number of individuals of the same species that have come into the habitat from elsewhere during the time period under consideration = $\frac{1}{2}$
- Emigration = $\frac{1}{2}$, number of individuals of the population who left the habitat and gone elsewhere during the time period under consideration = $\frac{1}{2}$

[1 + 4 = 5 marks]

OR

- (a) **What is hydrarch succession ?**
- (b) **Compare the pioneer species and climax communities of hydrarch and xerarch succession respectively.**
- (c) **List the factors upon which the type of invading pioneer species depend in secondary hydrarch succession. Why is the rate of this succession faster than that of primary succession ?**

- Ans. (a) The gradual and fairly predictable changes in the species composition in a water body / wetter areas = 1
- (b) Hydrarch : Pioneer species – Phytoplanktons = $\frac{1}{2}$
- Climax community – Forest / trees = $\frac{1}{2}$
- Xerarch : Pioneer species – Lichens = $\frac{1}{2}$
- Climax community – Forest / trees = $\frac{1}{2}$
- (c) Condition of soil, availability of water, seeds or other propagules = 1
- Because (some) soil / sediment is already there, the rate of secondary succession is much faster than primary succession = 1

[1 + 2 + 1 + 1 = 5 marks]

27. Differentiate between incomplete dominance and co-dominance. Substantiate your answer with one example of each.

Ans. **Incomplete Dominance**

F1 generation does not resemble either of the parent but show an intermediate trait

Example : Snapdragon / *Antirrhinum* sp /
dog flower / *Mirabilis jalapa* /
Four O'clock plant = 1

Co-dominance

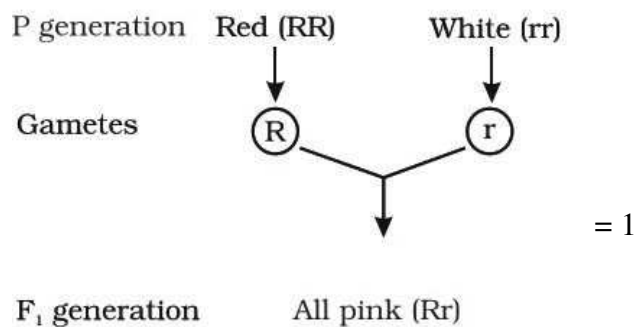
Both dominant alleles express themselves F1

$$= \frac{1}{2} + \frac{1}{2}$$

Example AB blood group in human = 1

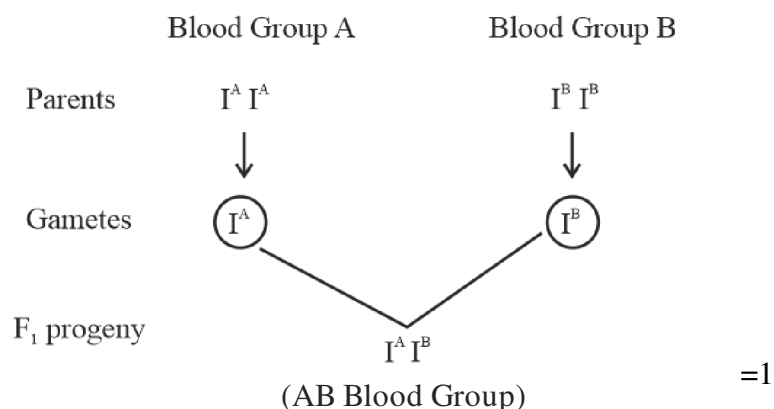
Incomplete dominance - When homozygous dominant and homozygous recessive parents are crossed all members of F1 progeny will show intermediate trait = 1

//



Co dominance - When I^A and I^B are present together they both produce their own sugar / antigen = 1

//



// (Any other suitable cross showing occurrence of I^A & I^B together in offsprings)

With $I^A i$ & $I^B i$ / $I^A I^A$ & $I^B i$ / $I^A i$ & $I^B I^B$ / $I^A I^B$ & $I^A I^B$ / $I^A I^B$ & $I^B i$ / $I^A I^B$ & $I^A i$

[5 marks]

OR

- (a) Write the contributions of the following scientists in deciphering the genetic code.

George Gamow; Hargobind Khorana ; Marshall Nirenberg ; Severo Ochoa

- (b) State the importance of a Genetic code in protein biosynthesis.

Ans. (a) George Gamow : Proposed that the Genetic code is constituted of 3 nucleotides / provided proof that the codon is a triplet = 1

Hargobind Khorana : Synthesized RNA molecule with a defined combination of bases (homopolymers and copolymers) = 1

Marshall Nirenberg : Cell free system for protein synthesis / helped the genetic code to be deciphered = 1

Severo Ochoa : Described enzyme (Polynucleotide phosphorylase) which polymerises RNA with defined sequence in a template independent manner (enzymatic synthesis of RNA) = 1

- (b) Genetic code - Codes for a specific amino acid which is required for protein synthesis / provides information about the specific amino acid that form a particular protein / polypeptide = 1

[4 + 1 = 5 marks]

Question Paper Code 57/1/3

SECTION – A

(Q. Nos. 1 - 5 are of one mark each)

1. At what state does the meiosis occur in an organism exhibiting haploidy life cycle and mention the fate of the products thus produced.

Ans. After zygote formation = $\frac{1}{2}$

haploid organism / haploid spores / (haploid) gametophyte = $\frac{1}{2}$

[1 mark]

2. Write the number of chromosomes body cells of honey bee workers and drone have.

Ans. Honey bee workers : 32 = $\frac{1}{2}$

Drones : 16 = $\frac{1}{2}$

[1 mark]

3. What are 'flocs', formed during secondary treatment of sewage ?

Ans. Masses of bacteria associated with fungal filament (to form mesh like structure)

[1 mark]

OR

Write any two places where methanogens can be found.

Ans. Anaerobic sludge (digester) , rumen of cattle / ruminants / stomach of cattle / gut of cattle , marshy area , flooded rice fields , biogas plant (*Any two*) = $\frac{1}{2} + \frac{1}{2}$

[1 mark]

4. Name the layer of the atmosphere that is associated with 'good ozone'.

Ans. Stratosphere

[1 mark]

OR

Mention the term used to describe a population interaction between an orchid growing on a forest tree.

Ans. Commensalism

[1 mark]

5. **British geneticist R.C. Punnett developed a graphical representation of a genetic cross called “Punnett Square”. Mention the possible result this representation predicts of the genetic cross carried.**

Ans. (Probability of) all genotypes / genotypic ratio

[1 mark]

SECTION-B

(Q. Nos. 6 - 12 are of two marks each)

6. **It is said apomixes is a type of asexual reproduction. Justify.**

Ans. Apomixis is the formation of seeds or embryo without fusion of gametes / fertilization / Diploid egg cell is formed without reductional division and develops into the embryo without fertilization / Some cells of the nucellus start dividing and develop into embryo (*Any two*) = 1 + 1

[2 marks]

7. **Mention four significant services that a healthy forest ecosystem provide.**

Ans. Purify air / Production of O₂ / Purify water / Mitigate droughts and floods / Nutrient cycling / Generating fertile soils / Provide wildlife habitat / Maintain biodiversity / Pollinate crops / Provide site for carbon storage / Provide aesthetic - cultural - spiritual values / economic benefits / from nature food / industrial products / products of medicinal importance (*Any four*) = $\frac{1}{2} \times 4$

[2 marks]

OR

Substantiate with the help of one example that in an ecosystem mutualists (i) tend to co-evolve and (ii) are also one of the major causes of biodiversity loss.

Ans. Fig species is pollinated only by (its partner) wasp species where the female wasp uses the fruit of fig species as a site for egg laying and nourishing its larvae (mutualists tend to co-evolve / evolution of flower and its pollinated species are tightly linked) / Moth deposits its egg in the locule of the ovary of *Yucca* plant and the flower in turn gets pollinated by the moth (mutualists tend to co-evolve / evolution of flower and its pollinator species are tightly linked) (*Any other relevant example explained*) = 1

When any one of these two species become extinct - the other species associated with it in obligatory way also becomes extinct and leads to biodiversity loss = 1

[2 marks]

8. **Write the steps in sequence as carried in multiple ovulation embryo transfer technology.**

Ans. Cow is administered with FSH like hormone, to induce follicular maturation and super ovulation / produce 6 – 8 eggs instead of one egg, animal is mated with an elite bull or artificially inseminated, fertilized eggs at 8 – 32 cells stages recovered non-surgically and transferred to surrogate mothers = $\frac{1}{2} \times 4$

[2 marks]

9. What is an origin of replication in a chromosome ? State its function.

Ans. This is the point on DNA where replication originates / starts = 1

It controls the copy number of linked DNA = 1

[2 marks]

10. List any four ways by which GMO's have been useful for enhanced crop output.

Ans. Make crops more tolerant to abiotic / cold / heat / drought / salt stresses /

Reduces reliance on chemical pesticides (pest-resistant crops) / Reduce post harvest losses / Increased efficiency of mineral usage by plant (prevents early exhaustion of soil fertility) / Enhanced nutritional value of food (example vitamin A enriched rice / starch) / To create tailor-made plants for non food purposes (to supply alternative resources of fuels / pharmaceuticals to industries) = *(Any four)* = $\frac{1}{2} \times 4$

[2 marks]

11. How is a continuous culture system maintained in bioreactors and why ?

Ans. Used medium is drained out from one side of the bioreactor and fresh medium is added from the other side = 1

This type of culturing method produces a larger biomass leading to higher yields (of desired protein)=1

[2 marks]

12. How would the gene flow or genetic drift affect the population in which either of them happen to take place ?

Ans. Results in changed frequency of genes (or alleles) in both populations , causing variation , leading to evolution / speciation / founder effect = 1 + 1

(Any two)

[2 marks]

SECTION-C

(Q. Nos. 13 - 24 are of three marks each)

13. How does a bisexual flowering plant ensures cross pollination ? Explain.

Ans. - Pollen release and stigma receptivity are non synchronized , either the pollen is released before the stigma becomes receptive / stigma becomes receptive before the release of pollen = $\frac{1}{2} \times 2$

- Anther and stigma are placed at different positions , pollen cannot come in contact with stigma of the same flower = $\frac{1}{2} \times 2$

- Self incompatibility , prevents self pollen from fertilising the ovules = $\frac{1}{2} \times 2$

[3 marks]

14. Bee keeping practice is a good income generating industry. Write the different points to be kept in mind for successful bee keeping. Write the scientific name of the most common Indian species used for the purpose.

Knowledge of the nature and habits of bees / Selection of suitable location for keeping the beehive / Catching and hiving of swarms (group of bees) / Management of beehives during different seasons / handling and collection of honey and bee wax (*Any four*) = $\frac{1}{2} \times 4$

- *Apis indica* = 1

[3 marks]

15. Explain the mechanism of DNA replication with the help of a replication fork. What role does the enzyme DNA-ligase play in a DNA replication fork ?

OR

Construct and label a transcription unit from which the RNA segment given below has been transcribed. Write the complete name of the enzyme that transcribed this RNA.



Ans. *Non evaluative , because the choice question is faulty , full marks to be awarded to all examinees who attempt either of the choice questions.*

16. (a) Write two differences between *Homo erectus* and *Homo habilis*.
(b) Rearrange the following from early to late geologic periods: Carboniferous, Silurian, Jurassic.

Ans. (a) *Homo erectus* *Homo habilis*
(i) Brain capacity 900 cc Brain capacity 650 – 800 cc = 1
(ii) (Probably) ate meat (Probably) did not eat meat = 1
(b) Silurian → Carboniferous → Jurassic = 1

(No mark to be awarded if all the three are not in proper sequence)

[2 +1 = 3 marks]

17. List six advantages of “ex-situ” approach to conservation of biodiversity.

An endangered / threatened species can be conserved / genetic strains of commercially important plants can be preserved for a long time (seed banks) / biodiversity loss is reduced / gametes of threatened species can be preserved in a viable and fertile condition for long periods (using

cryopreservation) / eggs can be fertilized in -vitro / plants can be propagated using tissue culture / economically beneficial / conserve large number of species / aesthetic value

(Any six points) = $\frac{1}{2} \times 6$

[3 marks]

- 18. Effluent from the primary treatment of sewage is passed for secondary treatment. Explain the process till the water is ready to be released into natural water bodies.**

Ans. During treatment (after adding small amount of inoculum) primary effluent is constantly agitated mechanically in (large) aeration tanks and air is pumped into it, this allows the vigorous growth of useful microbes into flocs, the microbes consume the major part of the organic matter in the effluent, it reduces the BOD of the effluent, the effluent is then passed into settling tank where the bacterial flocs are allowed to sediment, major part of the activated sludge is pumped into aerobic sludge digester (and remaining water is released into natural water bodies) = $\frac{1}{2} \times 6$

[3 marks]

- 19. Two children, A and B aged 4 and 5 years respectively visited a hospital with a similar genetic disorder. The girl A was provided enzyme-replacement therapy and was advised to revisit periodically for further treatment. The girl, B was, however, given a therapy that did not require revisit for further treatment.**

- (a) Name the ailments the two girls were suffering from ?
- (b) Why did the treatment provided to girl A required repeated visits ?
- (c) How was the girl B cured permanently ?

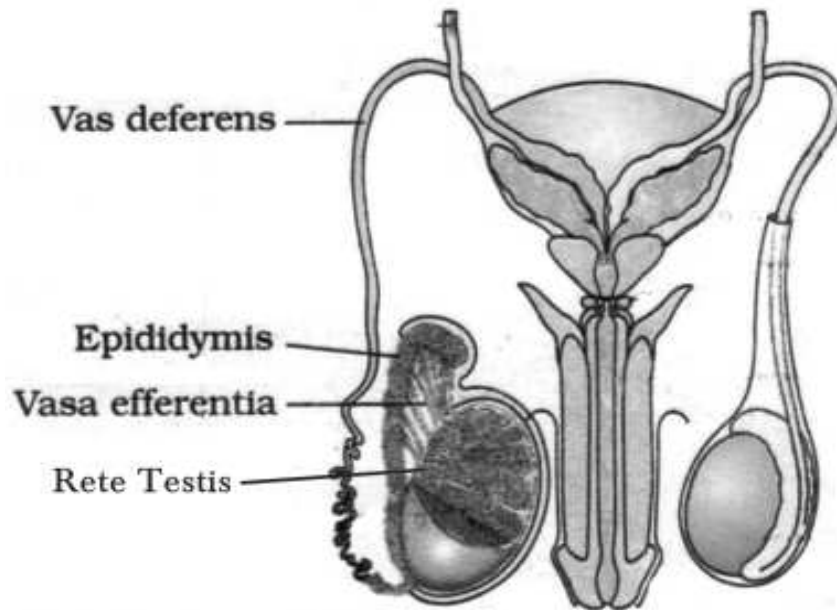
Ans. (a) Adenosine deaminase (ADA) deficiency = 1

(b) (In Enzyme Replacement Therapy) functional ADA is introduced to the patient (by injection), this therapy is not completely curative / enzyme can act only for a limited time period = 1 + 1

(c) [As there is no permanent cure at the age of five hence 1 mark of this answer allocated to part (b)]

[2 + 1 = 3 marks]

- 20. Draw a labelled diagram to show interrelationship of four accessory ducts in a human male reproductive system.**

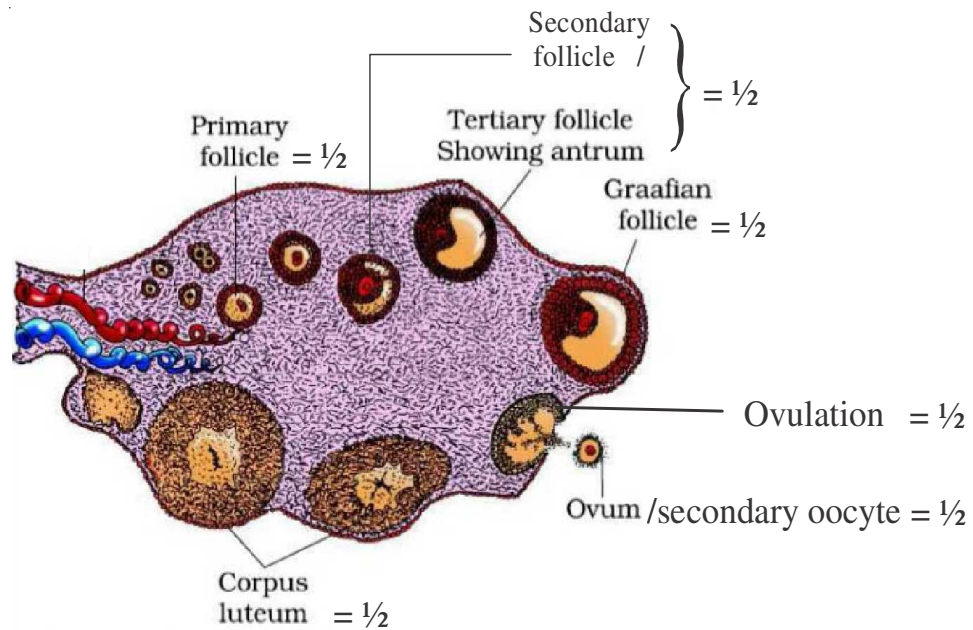


Correct diagram with : 1 labelling = $\frac{1}{2}$, 2 labellings = 1, 3 labellings = 2, 4 labellings = 3
[3 marks]

OR

Draw a sectional view of the human ovary showing the different stages of developing follicles, corpus luteum and ovulation.

Ans.



$$= \frac{1}{2} \times 6$$

[3 marks]

21. Compare in any three ways the chromosomal theory of inheritance as proposed by Sutton and Boveri with that of experimental results on pea plant presented by Mendel.

Sutton and Boveri	Mendel
1. Chromosomes occur in pairs	1. Factors occur in pairs
2. Chromosomes segregate at the time of gamete formation such that only one of each pair is transmitted to a gamete	2. Factors segregate at gamete formation stage and only one of each pair is transmitted to a gamete
3. Independent pairs of chromosomes segregate independently of each other	3. One pair of factors segregate independently of another pairs

= 1×3

[3 marks]

OR

- (a) Explain linkage and recombination as put forth by T.H. Morgan based on his observations with *Drosophila melanogaster* crossing experiment.
- (b) Write the basis on which Alfred Sturtevant explained gene mapping.

Ans. (a) Linkage :- Physical association of genes on a chromosome ,

- Two genes did not segregate independently of each other

- F_2 (phenotypic) ratio deviates (significantly) from 9:3:3:1 (**Any two**) = $\frac{1}{2} \times 2$

Recombination: -Tightly linked genes tend to show fewer recombinant frequency / $1.3\% = \frac{1}{2}$

-Loosely linked genes show higher percentage of recombinant frequency / $37.2\% = \frac{1}{2}$

- (b) He used the frequency of recombination between gene pairs on the same chromosome as a measure of distance between genes and mapped their position on the chromosome = 1

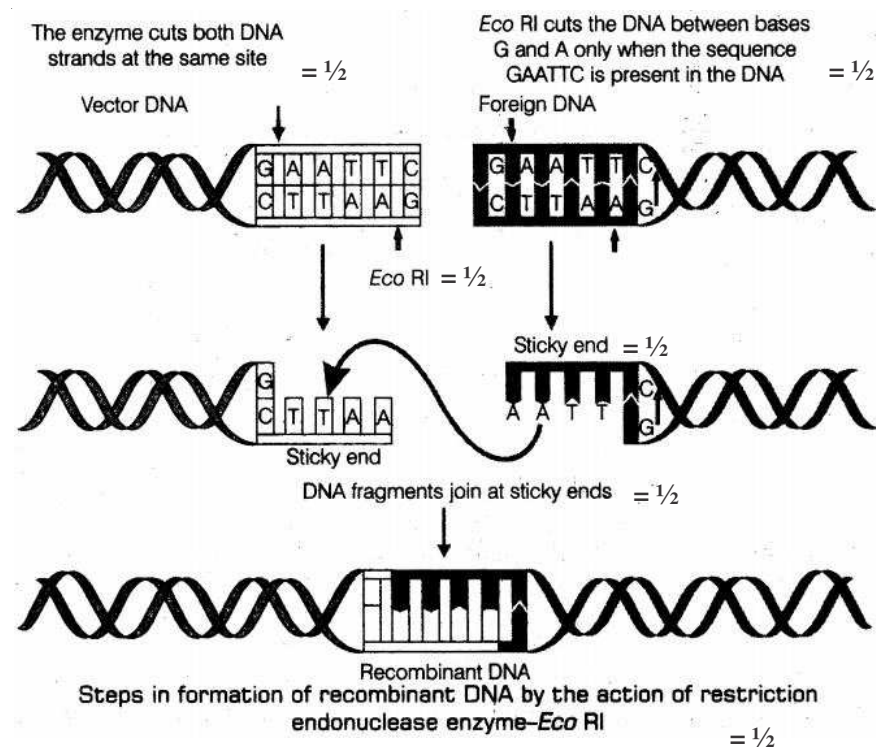
[2 + 1 = 3 marks]

22. Describe the formation of recombinant DNA by the action of EcoRI.

Ans. EcoRI identifies its palindromic sequence on both vector DNA and foreign DNA/ 5' GAATTC3', cuts strands of DNA little away from the centre of palindromic sites , but between same two bases (G and A) , this leaves single stranded portion at the end (sticky ends) on each strand , for recombination both vector DNA and foreign DNA , with similar sticky ends are joined by the enzyme DNA ligase = $\frac{1}{2} \times 6$

The following diagram can be considered in lieu of the explanation

//



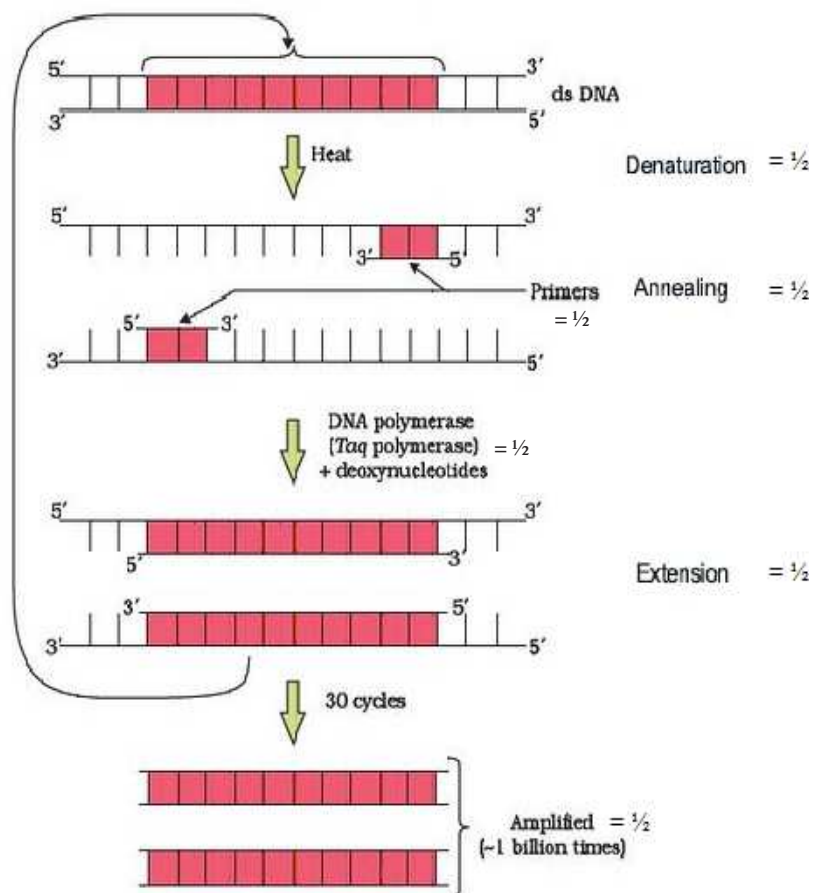
OR

Describe the process of amplification of “gene of interest” using PCR technique.

Ans. Denaturation of desired DNA into two strands, each acting as a template, for each strand separate set of primer (two sets of primer) used, with the help of deoxy(ribo)nucleotides and Taq polymerase (DNA polymerase isolated from *Thermus aquaticus*), extension of DNA template occurs, resulting in replication of desired DNA (amplification) = $\frac{1}{2} \times 6$

The following diagram can be considered in lieu of the explanation

//



[3 marks]

23. (a) Match the microbes listed under Column-A with the products mentioned under Column-B.

Column - A	Column - B
(H) <i>Penicillium notatum</i>	(i) Statin
(I) <i>Trichoderma polysporum</i>	(ii) ethanol
(J) <i>Monascus purpurea</i>	(iii) antibiotic
(K) <i>Saccharomyces cerevisiae</i>	(iv) Cyclosporin-A

- (b) Why does 'Swiss Cheese' develop large holes ?

- | | |
|------------------------------------|--------------------|
| (a) (H) <i>Penicillium notatum</i> | (iii) antibiotic |
| (I) <i>Trichoderma polysporum</i> | (iv) Cyclosporin-A |

(J) *Monascus purpureus*

(i) Statin

(K) *Saccharomyces cerevisiae*

(ii) ethanol

= $\frac{1}{2} \times 4$

(b) Due to production of large amount of CO₂ (by *Propionibacterium sharmanii*) = 1

[3 marks]

24. Explain any two most important levels of biological organisation showing biodiversity with the help of an example each.

Ans. (i) Genetic diversity : High diversity at the genetic level over its distributional range = 1

Example : *Rauwolfia vomitoria* growing in different himalayan ranges might be in terms of the potency and concentration of the active chemical that the plant produce / India has more than 50,000 genetically different strains of rice / 1,000 varieties of mango = $\frac{1}{2}$

(ii) Species diversity : Diversity at the species level = 1

Example : The Western Ghats have a greater amphibian species diversity than Eastern Ghats = $\frac{1}{2}$

(iii) Ecological diversity : At the ecosystem level = 1

Example : India for instance with its deserts / rain forests / mangroves / coral reefs / wetlands / estuaries / alpine meadows have a greater ecosystem diversity than a Scandinavian country like Norway (**Any two examples of ecological diversity**) = $\frac{1}{2}$

(**Any two levels of diversity**) = $1\frac{1}{2} + 1\frac{1}{2}$

[3 marks]

SECTION D

(Q. Nos. 25 - 27 are of five marks each)

25. Differentiate between spermatogenesis and Oogenesis on the basis of

(i) Time of initiation of the process

(ii) Site of completion of the process

(iii) Nature of meiotic division undergone by gamete mother cells

(b) Name the hormones and state their role involved in controlling spermatogenesis in humans.

Ans. (a)

	Spermatogenesis	Oogenesis
Time of initiation	At puberty	During foetal stage / embryonic stage
Site of completion	Seminiferous tubule	Fallopian tube / Ampullary - isthmic junction / Ampullary region
Nature of meiotic division	Equal cell division/	Unequal cell division /
	Continuous cell division/	Suspended/ arrested at early embryonic stage/
	Formation of four daughter cells / spermatids	Formation of one egg / Ovum

$$= \frac{1}{2} \times 6$$

- (b) GnRH acts on anterior pituitary to secrete LH and FSH, LH acts on Leydig cell and stimulates synthesis and secretion of androgens, androgen stimulates spermatogenesis, FSH acts on Sertoli cells which stimulate secretion of some factors which helps in the process of spermiogenesis = $\frac{1}{2} \times 4$

[3 + 2 = 5 marks]

OR

- (a) Explain the process of double fertilization in angiosperms.
- (b) Why does the development of endosperm precedes that of embryo?
- (c) List the parts of a typical dicot embryo.

- Ans.** (a) (i) One male gamete fuses with egg cell in the embryo sac to form zygote (2n), called syngamy = $\frac{1}{2} + \frac{1}{2}$
- (ii) Other male gamete fuses with two polar nuclei to form PEN (primary endosperm nucleus) (3n), triple fusion = $\frac{1}{2} + \frac{1}{2}$
- (iii) Both syngamy and triple fusion together called as double fertilisation = $\frac{1}{2}$
- (b) Endosperm contains the reserve food material which is used for the nutrition of developing embryo = 1
- (c) Radicle, Plumule, Cotyledons = $\frac{1}{2} \times 3$

[2½ + 1 + 1½ = 5 marks]

26. (a) What is “population” according to you as a biology student ?
- (b) “The size of a population for any species is not a static parameter.” Justify the statement with specific reference to fluctuations in the population density of a region in a given period of time.

- Ans. (a) Total number of organisms of a species in a particular area at a particular time = 1
- (b) The size of a population for any species is not a static parameter because of the factors like :-
- Birth rate/ Natality = $\frac{1}{2}$, number of births during a given period = $\frac{1}{2}$
- Death rate/ Mortality = $\frac{1}{2}$, number of deaths during a given period = $\frac{1}{2}$
- Immigration = $\frac{1}{2}$, number of individuals of the same species that have come into the habitat from elsewhere during the time period under consideration = $\frac{1}{2}$
- Emigration = $\frac{1}{2}$, number of individuals of the population who left the habitat and gone elsewhere during the time period under consideration = $\frac{1}{2}$

[1 + 4 = 5 marks]

OR

- (a) What is hydrarch succession ?
- (b) Compare the pioneer species and climax communities of hydrarch and xerarch succession respectively.
- (c) List the factors upon which the type of invading pioneer species depend in secondary hydrarch succession. Why is the rate of this succession faster than that of primary succession ?

- Ans. (a) The gradual and fairly predictable changes in the species composition in a water body / wetter areas = 1
- (b) Hydrarch : Pioneer species – Phytoplanktons = $\frac{1}{2}$
- Climax community – Forest / trees = $\frac{1}{2}$
- Xerarch : Pioneer species – Lichens = $\frac{1}{2}$
- Climax community – Forest / trees = $\frac{1}{2}$
- (c) Condition of soil, availability of water, seeds or other propagules = 1
- Because (some) soil / sediment is already there, the rate of secondary succession is much faster than primary succession = 1

[1 + 2 + 1 + 1 = 5 marks]

27. Differentiate between incomplete dominance and co-dominance. Substantiate your answer with one example of each.

Ans. **Incomplete Dominance**

F1 generation does not resemble either of the parent but show an intermediate trait

Example : Snapdragon / *Antirrhinum* sp /
 dog flower / *Mirabilis jalapa* /
 Four O'clock plant = 1

Co-dominance

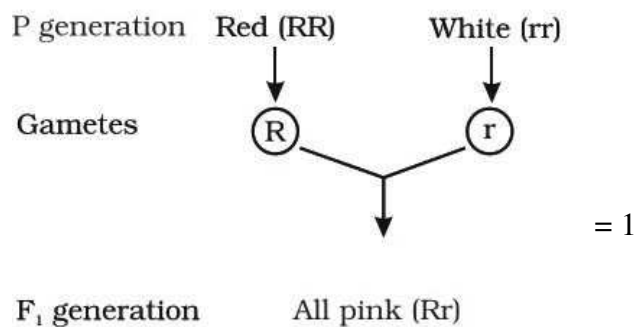
Both dominant alleles express themselves F1

$$= \frac{1}{2} + \frac{1}{2}$$

Example AB blood group in human = 1

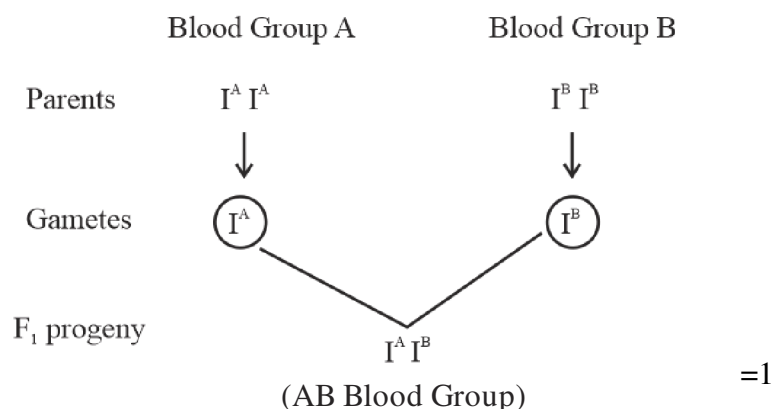
Incomplete dominance - When homozygous dominant and homozygous recessive parents are crossed all members of F1 progeny will show intermediate trait = 1

//



Co dominance - When I^A and I^B are present together they both produce their own sugar / antigen = 1

//



// (Any other suitable cross showing occurrence of I^A & I^B together in offsprings)

With $I^A i$ & $I^B i$ / $I^A I^A$ & $I^B i$ / $I^A i$ & $I^B I^B$ / $I^A I^B$ & $I^A I^B$ / $I^A I^B$ & $I^B i$ / $I^A I^B$ & $I^A i$

[5 marks]

OR

- (a) Write the contributions of the following scientists in deciphering the genetic code.

George Gamow; Hargobind Khorana ; Marshall Nirenberg ; Severo Ochoa

- (b) State the importance of a Genetic code in protein biosynthesis.

Ans. (a) George Gamow : Proposed that the Genetic code is constituted of 3 nucleotides / provided proof that the codon is a triplet = 1

Hargobind Khorana : Synthesized RNA molecule with a defined combination of bases (homopolymers and copolymers) = 1

Marshall Nirenberg : Cell free system for protein synthesis / helped the genetic code to be deciphered = 1

Severo Ochoa : Described enzyme (Polynucleotide phosphorylase) which polymerises RNA with defined sequence in a template independent manner (enzymatic synthesis of RNA) = 1

- (b) Genetic code - Codes for a specific amino acid which is required for protein synthesis / provides information about the specific amino acid that form a particular protein / polypeptide = 1

[4 + 1 = 5 marks]