

Botany - Section A

1. What is incorrect regarding the tRNA molecule?

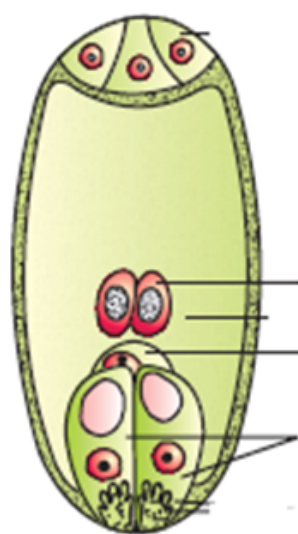
1. There are no tRNAs for stop codons
2. It is the smallest of the major cellular RNAs
3. The actual structure of tRNA looks like a clover leaf
4. Its 3' end is the amino acid acceptor end

2. In pea seeds, starch synthesis is controlled by one gene with two alleles [B/b]. A pea seed with genotype Bb will be:

1. Round and Large
2. Wrinkled and large
3. Round and intermediate in size
4. Round and small in size

3. In the given diagram, the correctly labelled parts are:

A: Micropylar end



D: Polar cells

E: Egg

B: Antipodals

C: Chalazal end

1. Only E
2. Only D and E
3. Only A and C
4. Only B

4. Which RNA molecule plays structural and catalytic role during translation?

1. miRNA
2. rRNA
3. tRNA
4. mRNA

5. What is incorrect about the Double helix structure of DNA molecule?

1. The two strands are antiparallel
2. The two strands are complementary
3. The pitch is 34 nm
4. The two strands are coiled in a right-handed fashion

6. A heterozygous tall pea plant is allowed to self-pollinate. What proportion of tall progeny will be heterozygous tall?

1. $\frac{1}{4}$
2. $\frac{2}{3}$
3. $\frac{1}{2}$
4. $\frac{3}{4}$

7. Match each item in Column I with one in Column II and select the correct match from the codes given:

	COLUMN I		COLUMN II
A	Asexual reproductive structure in <i>Penicillium</i>	P	Conidia
B	Vegetative propagule in <i>Agave</i>	Q	<i>Marchantia</i>
C	Monoecious plant	R	<i>Chara</i>
D	Dioecious plant	S	Bulbil

Codes:

	A	B	C	D
1.	P	S	Q	R
2.	S	P	Q	R
3.	P	S	R	Q
4.	S	P	R	Q

8. In sexually reproducing organisms which of the following events can normally be regarded as most 'critical'?

1. Gametogenesis
2. Gamete transfer
3. Fertilization
4. Embryogenesis

9. There are six mRNA codons for all the following amino acids except:

1. Leucine
2. Serine
3. Arginine
4. Glycine

10. A crop gets infected with a certain virus and the farmers of the area suffer immense financial loss. You have been asked to help the farmers and you decide to improve the crop by raising virus free plants through plant tissue culture. The explant you will choose must be:

1. Meristem
2. Anther
3. Embryo
4. Internode

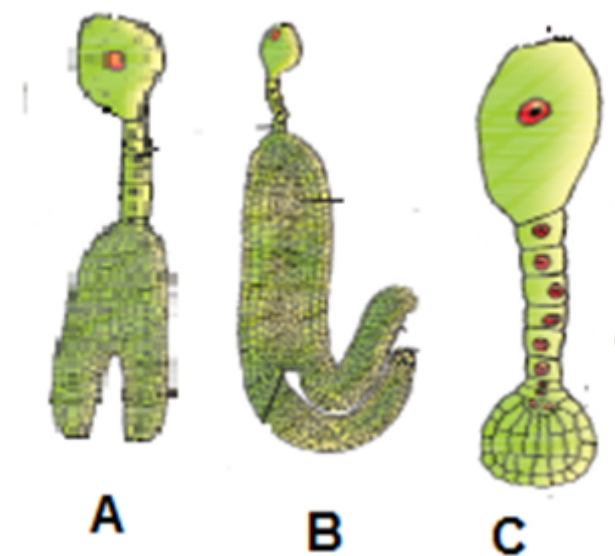
11. During decomposition of detritus, the correct chronological sequence of steps involved is:

1. Fragmentation → Leaching → Catabolism
2. Catabolism → Leaching → Fragmentation
3. Leaching → Fragmentation → Catabolism
4. There is no sequence as all steps occur simultaneously

12. In a test cross $AaBb \times aabb$ [assuming independent assortment], the ratio of progeny with genotypes $AaBb$ and $aabb$ will be:

1. 1 : 1
2. 3 : 1
3. 1 : 1 : 1 : 1
4. 9 : 1

13. Identify the correct chronological sequence in the stages of embryonic development in a dicot:



1. $A \rightarrow B \rightarrow C$
2. $C \rightarrow A \rightarrow B$
3. $B \rightarrow A \rightarrow C$
4. $C \rightarrow B \rightarrow A$

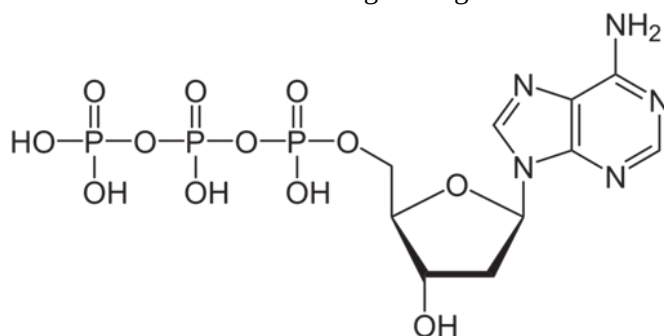
14. The genus *Citrus* has a number of species that undergo polyembryony, where alongside sexually-derived embryos:

1. multiple nucellar-cell-derived embryos exist
2. multiple integument derived embryos exist
3. only one nucellar-cell-derived embryo exists
4. multiple antipodal-cell-derived embryos exist

15. Fredrick Griffith:

1. proved that DNA is the genetic material
2. discovered the process of bacterial transformation
3. identified *Diplococcus pneumoniae* as the causative agent of pneumonia
4. was the first to isolate DNA in pure form

16. The molecule shown in the given figure:



- I. serve as substrate for DNA replication
- II. provide energy for polymerisation reaction

1. Only I
2. Only II
3. Both I and II
4. Neither I nor II

17. After germinating from the seed, which of the following plants takes the longest time to flower?

1. Neela kuranji
2. Bamboo
3. Marigold
4. Mango

18. Match each item in Column I with one in Column II and select the correct match from the codes given:

	COLUMN I		COLUMN II
A	Golden rice	P	High protein wheat
B	Atlas 66	Q	Vitamin A enriched
C	<i>Pusa Komal</i>	R	Resistant to Bacterial Blight
D	<i>Pusa Gaurav</i>	S	Resistant to <i>Aphids</i>

Codes:

	A	B	C	D
1.	Q	P	S	R
2.	Q	P	R	S
3.	P	Q	R	S
4.	P	Q	S	R

19. Organisms exhibiting external fertilization do not:

- show synchrony between the sexes
- release a large number of gametes in the surrounding medium
- depend on water for fertilization
- show a significant reduction in the number of eggs produced

20. In Hershey and Chase experiment:

- Radioactive sulfur-35 was used to label the DNA contained in the T2 phage
 - Radioactive phosphorus-32 was used to label the protein sections of the T2 phage
- Only I is correct
 - Only II is correct
 - Both I and II are correct
 - Both I and II are incorrect

21. Identify the correct statements:

- Cleistogamous flowers are invariably autogamous.
 - Geitonogamy is genetically similar to autogamy.
- Only I
 - Only II
 - Both I and II
 - Neither I nor II

22. Match each item in Column I with one in Column II and select the correct match from the codes given:

	COLUMN I [Flower]		COLUMN II [Pollination by]
A	<i>Brassica</i>	P	Water
B	<i>Zostera</i>	Q	Moth
C	Grasses	R	Wind
D	<i>Yucca</i>	S	Honey bees

Codes:

	A	B	C	D
1.	S	P	R	Q
2.	Q	R	P	S
3.	S	P	Q	R
4.	Q	R	S	P

23. Currently what is the most important cause that is driving animals and plants to extinction?

- Habitat loss and fragmentation
- Alien species invasion
- Over-exploitation
- Co-extinction

24. The basic structural unit of DNA packaging in eukaryotes [the basic repeating unit of eukaryotic chromatin] is called as:

- Nucleosome
- Solenoid
- Euchromatin
- Heterochromatin

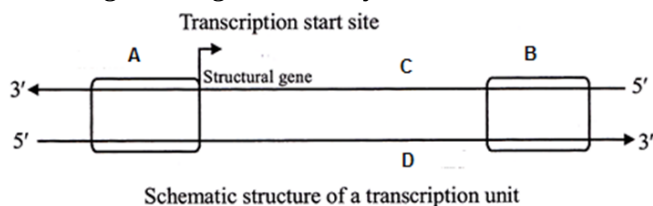
25. Identify the incorrectly matched pair:

1.	Brown rust of wheat	Fungus
2.	Black rot of crucifers	Bacterium
3.	Tobacco mosaic	Virus
4.	Root knot of tobacco	Annelid

26. A very low level of expression of lac operon is present in E.coli:

- Only when lactose is present
- Only when glucose is absent
- Only when allolactose is present
- all the time

27. In the given diagram, identify A,B,C and D:

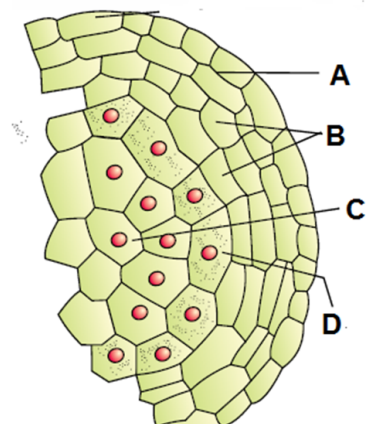


	A	B	C	D
1.	Terminator	Promoter	Template Strand	Coding Strand
2.	Promoter	Terminator	Template Strand	Coding Strand
3.	Promoter	Terminator	Coding Strand	Template Strand
4.	Terminator	Promoter	Coding Strand	Template Strand

28. The prime contaminants of water bodies responsible for cultural or Accelerated Eutrophication are:

1. Calcium and Magnesium
2. Zinc and Cobalt
3. Nitrates and phosphates
4. Sulphates and carbonates

29. In the given diagram showing the TS of wall of an anther, identify the layer where cells can be binucleate:



1. A
2. B
3. C
4. D

30. Match each item in Column I with one in Column II and select the correct match from the codes given:

	COLUMN I		COLUMN II
A	Khasi hills	P	Waste water management
B	Western ghats	Q	Chipko movement
C	Arcata	R	Sacred groves
D	Garhwal himalayas	S	Hotspot of biodiversity

Codes:

	A	B	C	D
1.	S	R	P	Q
2.	R	S	P	Q
3.	S	Q	P	R
4.	R	S	Q	P

31. During RNA splicing 200-300 adenine residues are added:

1. at the 3'-end of RNA in a template independent manner
2. at the 5'-end of RNA in a template independent manner
3. at the 3'-end of RNA in a template dependent manner
4. at the 5'-end of RNA in a template dependent manner

32. Identify the option that includes all dominant traits seen in *Pisum sativum*?

1. Tall stem height, Violet flower, Green pod colour, Axial flower position, Inflated pod shape, Round seed shape and Yellow seed colour
2. Tall stem height, Violet flower, Yellow pod colour, Axial flower position, Inflated pod shape, Round seed shape and Green seed colour
3. Dwarf stem height, Violet flower, Green pod colour, Axial flower position, Inflated pod shape, Round seed shape and Yellow seed colour
4. Tall stem height, Violet flower, Green pod colour, Terminal flower position, Inflated pod shape, Round seed shape and Yellow seed colour

33. Pure-breeding red-flowering snapdragons [*Antirrhinum* sp.] are crossed with pure-breeding white-flowering snapdragons. The proportion of progeny with pink flowers from this cross is expected to be:

1. 25 %
2. 50 %
3. 75 %
4. 100 %

34. Identify the correct statements:

- I. Pioneers in primary xerarch succession are lichens
 - II. Pioneers in primary hydrarch succession are phytoplanktons
 - III. Secondary succession is slower than primary succession
1. Only I and II
 2. Only I and III
 3. Only II and III
 4. I, II and III

35. "Chromosomes, which are seen in all dividing cells and pass from one generation to the next, are the basis for all genetic inheritance" – this statement can correctly be attributed to:

1. de Vries, Correns and Tschermak
2. Sutton and Boveri
3. Knight and Goss
4. Beadle and Tatum

Botany - Section B

36. Assertion: In order to link the alien DNA, the vector needs to have very few, preferably single, recognition sites for the commonly used restriction enzymes.

Reason: Presence of more than one recognition sites within the vector will generate several fragments, which will complicate the gene cloning.

1. Both assertion and reason are true and the reason is the correct explanation of the assertion
2. Both assertion and reason are true but the reason is not the correct explanation of the assertion
3. Assertion is true but reason is false
4. Both assertion and reason are false

37. Assertion: Thermostable DNA dependent DNA polymerase is used in Polymerase Chain Reaction

Reason: Such enzymes do not require primers and can initiate DNA synthesis

1. Both assertion and reason are true and the reason is the correct explanation of the assertion
2. Both assertion and reason are true but the reason is not the correct explanation of the assertion
3. Assertion is true but reason is false
4. Both assertion and reason are false

38. Assertion: Cyclosporin A has been commercialized as a blood-cholesterol lowering agent

Reason: Cyclosporin A is a competitive inhibitor of an enzyme responsible for the biosynthesis of cholesterol

1. Both assertion and reason are true and the reason is the correct explanation of the assertion
2. Both assertion and reason are true but the reason is not the correct explanation of the assertion
3. Assertion is true but reason is false
4. Both assertion and reason are false

39. Assertion: When constructing rDNA, the vector DNA should never be cut by the same restriction endonuclease that was used to cut the donor DNA

Reason: Use of same restriction endonuclease will generate same kind of sticky ends retarding the function of DNA ligase.

1. Both assertion and reason are true and the reason is the correct explanation of the assertion
2. Both assertion and reason are true but the reason is not the correct explanation of the assertion
3. Assertion is true but reason is false
4. Both assertion and reason are false

40. Assertion: It makes sense to make concentrated efforts to conserve hotspots of biodiversity.

Reason: They cover majority of the area of the planet earth.

1. Both assertion and reason are true and the reason is the correct explanation of the assertion
2. Both assertion and reason are true but the reason is not the correct explanation of the assertion
3. Assertion is true but reason is false
4. Both assertion and reason are false

41. Assertion: Apiculture has been an age-old cottage industry

Reason: It is an activity that can be carried on in people's homes

1. Both assertion and reason are true and the reason is the correct explanation of the assertion
2. Both assertion and reason are true but the reason is not the correct explanation of the assertion
3. Assertion is true but reason is false
4. Both assertion and reason are false

42. Assertion: The organic farmer holds the view that eradication of pest is undesirable

Reason: Biocontrol is not a good strategy to control pest

1. Both assertion and reason are true and the reason is the correct explanation of the assertion
2. Both assertion and reason are true but the reason is not the correct explanation of the assertion
3. Assertion is true but reason is false
4. Both assertion and reason are false

43. Assertion: Ecosystems with higher species diversity are less subject to invasive species.

Reason: Fewer niches are available in ecosystems with higher species diversity

1. Both assertion and reason are true and the reason is the correct explanation of the assertion
2. Both assertion and reason are true but the reason is not the correct explanation of the assertion
3. Assertion is true but reason is false
4. Both assertion and reason are false

44. Assertion: Whole plants can be regenerated from any part of a plant taken out and grown in a test tube, under sterile conditions in special nutrient media

Reason: Every living plant cell is totipotent

1. Both assertion and reason are true and the reason is the correct explanation of the assertion
2. Both assertion and reason are true but the reason is not the correct explanation of the assertion
3. Assertion is true but reason is false
4. Both assertion and reason are false

45. Assertion: Temperature is usually not an important factor limiting primary production in the ocean.

Reason: Due to high specific heat of water the temperature variations in water are not as significant as on the land.

1. Both assertion and reason are true and the reason is the correct explanation of the assertion
2. Both assertion and reason are true but the reason is not the correct explanation of the assertion
3. Assertion is true but reason is false
4. Both assertion and reason are false

46. Assertion: The reduction of combustion of fossil fuels can reduce air pollution drastically.

Reason: A very effective means to reduce air pollution is the transition to renewable energy.

1. Both assertion and reason are true and the reason is the correct explanation of the assertion
2. Both assertion and reason are true but the reason is not the correct explanation of the assertion
3. Assertion is true but reason is false
4. Both assertion and reason are false

47. Assertion: Ex-situ conservation is advisable if the organism is facing a high threat of extinction.

Reason: Ex-situ conservation is an on-site conservation where we conserve and protect the whole ecosystem.

1. Both assertion and reason are true and the reason is the correct explanation of the assertion
2. Both assertion and reason are true but the reason is not the correct explanation of the assertion
3. Assertion is true but reason is false
4. Both assertion and reason are false

48. Assertion: The thinning of ozone [ozone hole] is especially significant over Antarctica.

Reason: CFCs get accumulated over Antarctica in maximum concentration.

1. Both assertion and reason are true and the reason is the correct explanation of the assertion
2. Both assertion and reason are true but the reason is not the correct explanation of the assertion
3. Assertion is true but reason is false
4. Both assertion and reason are false

49. Assertion: The current sixth mass extinction is happening at a lower pace than the previous mass extinctions.

Reason: Human beings have been highly successful in conserving biodiversity across the globe.

1. Both assertion and reason are true and the reason is the correct explanation of the assertion
2. Both assertion and reason are true but the reason is not the correct explanation of the assertion
3. Assertion is true but reason is false
4. Both assertion and reason are false

50. Assertion: Traditional hybridization for crop improvement very often leads to inclusion and multiplication of undesirable genes along with the desirable gene

Reason: Genetic engineering allows isolation and introduction one or a set of desirable genes without introducing undesirable genes into the target organism

1. Both assertion and reason are true and the reason is the correct explanation of the assertion
2. Both assertion and reason are true but the reason is not the correct explanation of the assertion
3. Assertion is true but reason is false
4. Both assertion and reason are false

56. When a retrovirus infects an animal cell:

1. c DNA is introduced into cell
2. Viral RNA is produced by reverse transcription
3. Viral RNA incorporates into host genomes
4. Infected cell can survive while viruses are being replicated and released

57. What is true about HBB [gene for production of beta chain of haemoglobin]:

1. It is a single gene located on chromosome 11
2. It is a single gene located on chromosome 16
3. There are two genes closely linked on chromosome 11
4. There are two genes closely linked on chromosome 16

Zoology - Section A

51. Identify the incorrectly matched pair:

1.	Length of Testis	4 to 5 cm
2.	Width of testis	2 to 3 cm
3.	Length of ovary	5 to 6 cm
4.	Length of fallopian tube	10 to 12 cm

52. In the absence of fertilization:

1. the zona pellucid gets hardened
2. the secondary oocyte completes meiosis II
3. the corpus luteum degenerates
4. menstruation does not occur

53. What is true regarding the experiment carried out by S. L. Miller?

1. The flask contained methane, ammonia and oxygen
2. The temperature was kept at 4⁰C
3. Electric discharge was used as a source of energy
4. He did not observe formation of any amino acids

54. The total number of centrioles present in a normal human sperm is:

1. 2
2. 3
3. 4
4. 8

55. The ultimate source of all genetic [allelic] variation is:

1. Natural selection
2. Genetic drift
3. Mutation
4. Recombination

58. Match each item in Column I with one in Column II and select the correct match from the codes given:

	COLUMN I [Organism]		COLUMN II [Mechanism of sex determination]
A	Honey bees	P	Genic balance
B	Grasshopper	Q	ZZ-ZW, female heterogamety
C	Birds	R	XX-XO male heterogamety
D	Fruit fly	S	Haplo-diploidy

Codes:

	A	B	C	D
1.	Q	P	S	R
2.	R	P	Q	S
3.	P	Q	R	S
4.	S	R	Q	P

59. Which of the following human diseases is not transmitted by faecal-oral route ?

1. Ascariasis
2. Viral Diarrhoea
3. Filariasis
4. Typhoid

60. Match each item in Column I with one in Column II and select the correct match from the codes given:

	COLUMN I		COLUMN II
A	Number of genes on chromosome 1	P	2968
B	Number of genes on Y chromosome	Q	Less than 2
C	Percent of genome that codes for proteins	R	Over 50
D	Percent of discovered genes without known functions	S	231

Codes:

	A	B	C	D
1.	P	S	Q	R
2.	S	P	Q	R
3.	P	S	R	Q
4.	S	P	R	Q

61. What can be correctly inferred from species richness model?

1. The extinction rate and the rate at which new species arrive will tend toward an equilibrium number of species
2. Offspring can inherit characteristics acquired by their parents
3. More new species will arrive in an area than go extinct in a given amount of time
4. The number of species in an area will always increase

62. The drug, amongst the following, that is least likely to produce hallucinations as side effect, is :

1. LSD
2. Cocaine
3. Atropine
4. Benzodiazepines

63. Darwin did not believe that Earth was only few thousand years old. According to him, the species found on earth today:

1. Were created in their current forms about 6000 years ago
2. Evolved from a few common ancestors
3. Are no longer evolving
4. Originated on another planet

64. Consider the two statements

I : The thorn and tendrils of Bougainvillea and cucurbita represent homology

II : Sweet potato and potato represent analogy

1. Only I is correct
2. Only II is correct
3. Both I and II are correct
4. Both I and II are incorrect

65. Study the given diagram and select the correct option:



1. The karyotype is of an individual suffering from Down's syndrome
2. The number of autosomes seen is 43
3. The genetic sex of this individual must be female
4. The fertility will be maintained in this individual

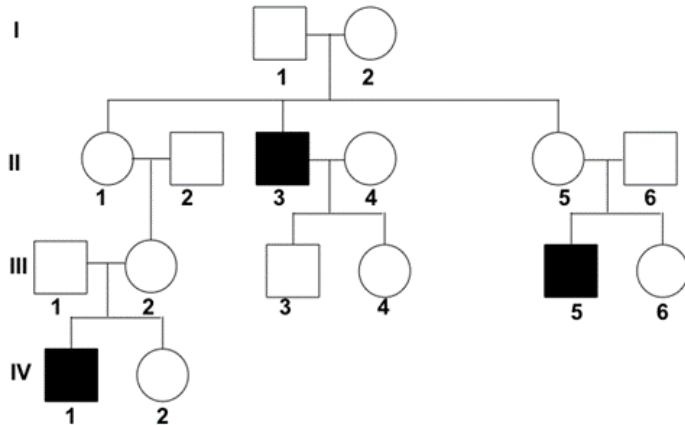
66. Beginning from the mammary alveolus which of the following would be the first structure amongst the following?

1. Mammary duct
2. Ampulla
3. Lactiferous duct
4. mammary tubule

67. Which of the following may or may not undergo cell division during oogenesis?

1. Oogonia
2. First polar body
3. Second polar body
4. Primary oocyte

68. The trait shown in the given pedigree [symbols have usual meaning] is most likely:



1. Autosomal recessive
2. X-linked recessive
3. Autosomal dominant
4. X-linked dominant

69. Match each item in Column I with one in Column II and select the correct match from the codes given:

	COLUMN I		COLUMN II
A	Jersey	P	Exotic cattle breed
B	Leghorn	Q	Chicken breed
C	Catla	R	Freshwater edible fish
D	Hilsa	S	Marine water edible fish

Codes:

	A	B	C	D
1.	Q	P	S	R
2.	R	P	Q	S
3.	P	Q	R	S
4.	S	R	Q	P

70. A small group of individuals leaves a population and establishes a new one in a geographically isolated region. This is called as:

1. gene flow
2. genetic drift
3. natural selection
4. saltation

71. Match each item in Column I with one in Column II and select the correct match from the codes given:

	COLUMN I [month of pregnancy]		COLUMN II [Feature of embryonic development]
A	End of one month	P	Limbs and digits develop
B	End of second month	Q	Heart is formed
C	During the fifth month	R	First movements of foetus observed
D	End of sixth month	S	Eyelashes are formed

Codes:

	A	B	C	D
1.	Q	P	S	R
2.	Q	P	R	S
3.	P	Q	R	S
4.	P	Q	S	R

72. What would be true regarding chromosomes?

1. There are more chromosomes in animal cells than plant cells.
2. The more complex the organism, the more chromosomes it has.
3. A greater number of chromosomes does not mean an organism will be more sophisticated.
4. Larger organisms have more chromosomes than smaller organisms.

73. Consider the two statements

- I. Multiload -375 is a Cu releasing IUD
 - II. Levonorgesterel is an oestrogen
1. Only I is correct
 2. Only II is correct
 3. Both I and II are correct
 4. Both I and II are incorrect

74. Identify the incorrect statement:

1. The survival of a species relies on some individuals producing offspring.
2. Fitness in evolutionary terms is reproductive fitness.
3. All organisms of a particular species are identical; otherwise they would not be able to breed.
4. The organisms best adapted to their environment are the most likely to produce offspring.

75. An environment eliminates individuals at the extremes of a population. This type of natural selection will be called as:

1. Stabilizing
2. Directional
3. Disruptive
4. Dispersive

76. According to the MTP [Amendment] Act 2017, the gestational age till which MTP can be performed is a maximum of:

1. 12 weeks
2. 16 weeks
3. 20 weeks
4. 24 weeks

77. Consider the two statements

- I. Sertoli cells divide meiotically to produce sperms
- II. Leydic cells secrete androgens when stimulated by FSH

1. Only I is correct
2. Only II is correct
3. Both I and II are correct
4. Both I and II are incorrect

78. Consider the two statements

- I. Phenylketonuria is caused by mutation in a pleiotropic gene
- II. Sickle cell anemia is inherited as an autosomal-recessive condition

1. Only I is correct
2. Only II is correct
3. Both I and II are correct
4. Both I and II are incorrect

79. Evolution can be best defined as:

1. changes in a population of organisms over a period of time
2. passage of acquired traits to progeny
3. differential reproduction
4. organisms coming into existence at a defined moment in time and not changing

80. Sickle cell anaemia allele is deleterious and frequently causes death in homozygous condition. Yet the disease persists because:

1. It is caused by a dominant allele
2. The allele is located on the X chromosome
3. Presence of one allele confers protection against severe malaria
4. The allele arises by a recurring mutation in the wild allele

81. In a population at genetic equilibrium the frequency of dominant allele is 0.8. What is the frequency of heterozygotes in this population?

1. 0.04
2. 0.16
3. 0.32
4. 0.64

82. Match each item in Column I with one in Column II and select the correct match from the codes given:

	COLUMN I [Ancestors of <i>Homo sapiens</i>]		COLUMN II [Cranial capacity]
A	<i>Homo erectus</i>	P	1400 cc
B	<i>Homo habilis</i>	Q	450 cc
C	<i>Australopithecus</i>	R	650-800 cc
D	Neanderthal man	S	900 cc

Codes:

	A	B	C	D
1.	Q	P	S	R
2.	R	P	Q	S
3.	P	Q	R	S
4.	S	R	Q	P

83. The economist whose book 'Essay on the Principle of Populations' influenced Darwin was:

1. Georges Cuvier
2. Alfred Lyell
3. T. R. Malthus
4. A. R. Wallace

84. The term transformation can be used for :

- I. Specific process where exogenous genetic material is directly taken up and incorporated by a cell through its cell membrane.
- II. The process by which an animal cell acquires the properties of cancer.

1. Only I
2. Only II
3. Both I and II
4. Neither I nor II

85. Australian marsupials and placental mammals of other continents have many similarities. This is due to:

1. Divergent evolution
2. Reproductive isolation
3. Adaptive radiation
4. Convergent evolution

Zoology - Section B

86. Assertion: Anabolic steroids are frequently abused by athletes

Reason: They decrease aggressiveness helping athletes to maintain calm during competitive athletic events

1. Both assertion and reason are true and the reason is the correct explanation of the assertion
2. Both assertion and reason are true but the reason is not the correct explanation of the assertion
3. Assertion is true but reason is false
4. Both assertion and reason are false

87. Assertion: Particulate size $2.5 \mu m$ or less in diameter [PM 2.5] are responsible for causing the greatest harm to human health

Reason: Electrostatic precipitators are not effective in removing particulate matter from polluted air.

1. Both assertion and reason are true and the reason is the correct explanation of the assertion
2. Both assertion and reason are true but the reason is not the correct explanation of the assertion
3. Assertion is true but reason is false
4. Both assertion and reason are false

88. Assertion: Most cancers are treated by combination of surgery, radiotherapy and chemotherapy

Reason: A combination therapy is curative for all types of cancers

1. Both assertion and reason are true and the reason is the correct explanation of the assertion
2. Both assertion and reason are true but the reason is not the correct explanation of the assertion
3. Assertion is true but reason is false
4. Both assertion and reason are false

89. Assertion: Mammals from colder climates generally have small body size and long appendages (ears and limbs)

Reason: This promotes increased heat production and minimises heat loss

1. Both assertion and reason are true and the reason is the correct explanation of the assertion
2. Both assertion and reason are true but the reason is not the correct explanation of the assertion
3. Assertion is true but reason is false
4. Both assertion and reason are false

90. Assertion: VNTR are the basis of DNA finger printing by RFLP

Reason: VNTR are polymorphic and are inherited

1. Both assertion and reason are true and the reason is the correct explanation of the assertion
2. Both assertion and reason are true but the reason is not the correct explanation of the assertion
3. Assertion is true but reason is false
4. Both assertion and reason are false

91. Assertion: Transgenic animals can be specifically designed to allow the study of how genes are regulated, and how they affect the normal functions of the body and its development, e.g., study of complex factors involved in growth such as insulin-like growth factor.

Reason: By introducing genes from other species that alter the formation of this factor and studying the biological effects that result, information is obtained about the biological role of the factor in the body.

1. Both assertion and reason are true and the reason is the correct explanation of the assertion
2. Both assertion and reason are true but the reason is not the correct explanation of the assertion
3. Assertion is true but reason is false
4. Both assertion and reason are false

92. Assertion: The genetic sex of an individual with Klinefelter's syndrome is female

Reason: Only X-chromosome is present in their genotype

1. Both assertion and reason are true and the reason is the correct explanation of the assertion
2. Both assertion and reason are true but the reason is not the correct explanation of the assertion
3. Assertion is true but reason is false
4. Both assertion and reason are false

93. Assertion: Spleen can help in survival in cases of haemorrhagic shock

Reason: Spleen has a large reservoir of erythrocytes

1. Both assertion and reason are true and the reason is the correct explanation of the assertion
2. Both assertion and reason are true but the reason is not the correct explanation of the assertion
3. Assertion is true but reason is false
4. Both assertion and reason are false

94. Assertion: Natural selection is differential reproduction

Reason: The unit of natural selection is individual

1. Both assertion and reason are true and the reason is the correct explanation of the assertion
2. Both assertion and reason are true but the reason is not the correct explanation of the assertion
3. Assertion is true but reason is false
4. Both assertion and reason are false

95. Assertion: The female anopheles mosquito is not considered a parasite

Reason: The bite of the female anopheles mosquito injects infective stage of malarial parasite into human blood

1. Both assertion and reason are true and the reason is the correct explanation of the assertion
2. Both assertion and reason are true but the reason is not the correct explanation of the assertion
3. Assertion is true but reason is false
4. Both assertion and reason are false

96. Assertion: Delivery of ADA cDNA into lymphocytes is not a permanent cure for ADA deficiency

Reason: Lymphocytes do not express ADA gene.

1. Both assertion and reason are true and the reason is the correct explanation of the assertion
2. Both assertion and reason are true but the reason is not the correct explanation of the assertion
3. Assertion is true but reason is false
4. Both assertion and reason are false

97. Assertion: IgG antibodies are important for humoral immunity in the new born before its own immune system develops

Reason: IgG antibodies can cross placenta

1. Both assertion and reason are true and the reason is the correct explanation of the assertion
2. Both assertion and reason are true but the reason is not the correct explanation of the assertion
3. Assertion is true but reason is false
4. Both assertion and reason are false

98. Assertion: Selection of good breeds is the most important task when setting up a dairy farm for cattle

Reason: Milk yield is primarily dependent on the quality of breeds in the farm.

1. Both assertion and reason are true and the reason is the correct explanation of the assertion
2. Both assertion and reason are true but the reason is not the correct explanation of the assertion
3. Assertion is true but reason is false
4. Both assertion and reason are false

99. Assertion: Competition can be avoided even if two species compete for the same resource

Reason: The competition species can partition their resources to avoid competition

1. Both assertion and reason are true and the reason is the correct explanation of the assertion
2. Both assertion and reason are true but the reason is not the correct explanation of the assertion
3. Assertion is false but reason is true
4. Assertion is true but reason is false

100. Assertion: Predatory fish such as swordfish and sharks or birds like osprey and eagles have higher concentrations of mercury in their tissue than could be accounted for by direct exposure alone.

Reason: Mercury undergoes biomagnifications in aquatic ecosystems.

1. Both assertion and reason are true and the reason is the correct explanation of the assertion
2. Both assertion and reason are true but the reason is not the correct explanation of the assertion
3. Assertion is true but reason is false
4. Both assertion and reason are false

Chemistry - Section A

101. In $[\text{Cr}(\text{NH}_3)_6]\text{Cl}_3$, the spin only magnetic moment of central atom will be

1. 1.732 BM
2. 2.45 BM
3. 3.87 BM
4. 4.9 BM

102. The boiling point of 1M Urea solution is 101°C. At the same conditions of temperature and pressure, the boiling point of 1M KCl solution will be (Assume that KCl is 100% dissociated)

1. 102°C
2. 202°C
3. 104°C
4. Data insufficient

103. When salicylic acid is reacted with acetic anhydride then an analgesic as well as an antipyretic drug is formed. The name of this drug is-

1. Acetyl salicylic acid
2. 2-Acetoxybenzoic acid
3. Aspirin
4. All of the above

104. The molarity of 28% KOH solution ($d = 1.2 \text{ g/ml}$) is-

1. 3 M
2. 6 M
3. 9 M
4. 12 M

105. The radioactive lanthanoid is-

1. Ce(58)
2. Nd(60)
3. Pm(61)
4. Eu(63)

106. Nylon 2-Nylon-6 is a biodegradable polymer. The monomer units of Nylon 2-Nylon 6 is-

1. Glycine and caproic acid
2. Glycine and Amino caproic acid
3. Glycine and Hexamethylene diammine
4. Amino caproic acid and ethanoic acid

107. In the metallurgy of iron, the reduction in the upper zone of the blast furnace is

1. C
2. CO
3. Both 1 and 2
4. None of the above

108. Step-growth polymer, amongst the following, is

1. Polythene
2. PVC
3. Teflon
4. Nylon-6,6

109. $\text{Al}_2(\text{SO}_4)_3$ is 40% dissociated. The value of Van't Hoff Factor (i) is

1. 2
2. 2.6
3. 3.6
4. 5

110. $(\text{CH}_3)_3\text{C}-\text{O}-\text{CH}_3 + \text{HI} \rightarrow \text{A} + \text{B}$,
(1mole)

The compounds A and B will be

1. $(\text{CH}_3)_3\text{C}-\text{OH} + \text{CH}_3\text{I}$
2. $(\text{CH}_3)_3\text{C}-\text{I} + \text{CH}_3\text{I}$
3. $(\text{CH}_3)_3\text{C}-\text{OH} + \text{CH}_3\text{OH}$
4. $(\text{CH}_3)_3\text{C}-\text{I} + \text{CH}_3\text{OH}$

111. $\text{Fe}(\text{OH})_3$ is a positive sol. Which electrolyte has the minimum flocculation value for the precipitation of $\text{Fe}(\text{OH})_3$ sol?

1. Na_3PO_4
2. $\text{K}_4[\text{Fe}(\text{CN})_6]$
3. MgSO_4
4. NaCl

112. When aniline is reacted with concentrated HNO_3 , then which, of the following, nitro derivative of aniline has the highest percentage?

1. o-nitroaniline
2. m-nitroaniline
3. p-nitroaniline
4. All have equal percentages

113.
 $\text{CH}_3 - \text{CH} - \text{CH}_2 - \text{NH}_2 + \text{HNO}_2 \rightarrow \text{A}(\text{Major}),$

|
 CH_3

The compound 'A' is

1.
 $\text{CH}_3 - \text{CH} - \text{CH}_2 - \text{OH}$

|
 CH_3

2. $(\text{CH}_3)_3\text{C}-\text{OH}$

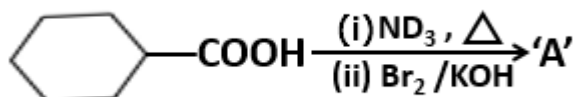
3.
 $\text{CH}_3 - \text{CH} - \text{CH}_2 - \text{CH}_3$

|
 OH

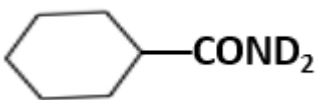
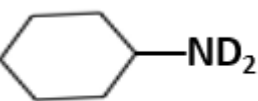
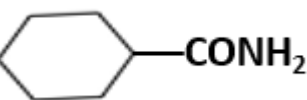
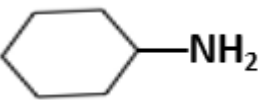
4.
 $\text{CH}_3 - \text{CH} - \text{CH}_2 - \text{NO}_2$

|
 CH_3

114.



The compound "A" is

1. 
2. 
3. 
4. 

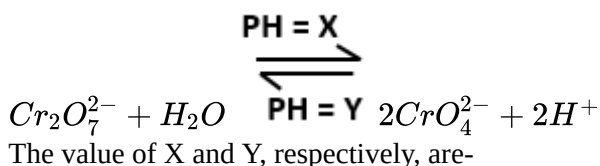
115. When one mole ethyl methyl ketone is oxidised with acidic $\text{K}_2\text{Cr}_2\text{O}_7$ then the product formed is

1. Two moles of CH_3COOH
2. One mole of $\text{C}_2\text{H}_5\text{COOH}$ and one mole of HCOOH
3. One mole of $\text{C}_2\text{H}_5\text{COOH}$ and one mole of CO_2
4. One mole of CH_3COOH and 2 mole of HCOOH

116. Consider the reaction, $\text{A} \rightarrow \text{Products}$. When the concentration of A increases 4 times then its rate increases 2 times. The order with respect to A will be

1. $1/2$
2. 1
3. 2
4. 3

117. Dichromate ion shows the following equilibrium in an aqueous solution



1. 4 and 8
2. 8 and 4
3. 7 and 7
4. 4 and 4

118. $[\text{Cu}(\text{NH}_3)_4]\text{SO}_4$ is a blue soluble complex. The blue colour of this complex is due to the presence of

1. $[\text{Cu}(\text{NH}_3)_4]^{2+}$
2. Cu^{2+}
3. SO_4^{2-}
4. $[\text{Cu}(\text{NH}_3)_6]^{2+}$

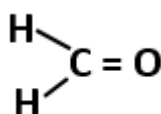
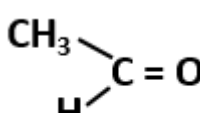
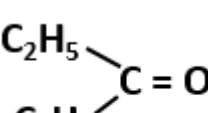
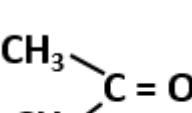
119. In which complex, central atom is dsp^2 hybridised and paramagnetic?

1. $[\text{NiCl}_4]^{2-}$
2. $[\text{Ni}(\text{CN})_4]^{2-}$
3. $[\text{Cu}(\text{NH}_3)_4]^{2+}$
4. $[\text{PtCl}_4]^{2-}$

120. Eu^{2+} and Ce^{4+} behave, respectively, as

1. Reducing agent and Reducing agent
2. Oxidising agent and Reducing agent
3. Reducing agent and oxidising agent
4. Oxidising agent and oxidising agent

121. Which carbonyl compound does not react with NaHSO_3 ?

1. 
2. 
3. 
4. 

122. Which crystal system has all the four types of unit cell i.e., Simple, Body-centered, Face-centered, and End-centered?

1. Cubic
2. Hexagonal
3. Orthorhombic
4. Tetragonal

123. Phosphinic acid and Phosphonic acid, respectively, are

1. H_3PO_2 and H_3PO_3
2. H_3PO_3 and H_3PO_2
3. H_3PO_2 and H_3PO_4
4. H_3PO_3 and H_3PO_4

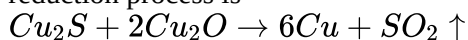
124. In the metallurgy of copper matte contains

1. Mixture of Cu_2S and Cu_2O
2. Cu_2S with a small amount of FeS
3. FeS with a small amount of Cu_2S
4. Cu_2S with a small amount of FeO

125. $[Pt(en)_2Cl_2]$ can show optical as well as geometrical isomerism. The total number of isomers for $[Pt(en)_2Cl_2]$ are-

1. 2
2. 3
3. 4
4. 6

126. In the metallurgy of copper, reaction for auto-reduction process is



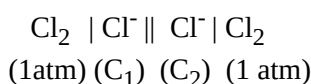
In this process, correct statement, amongst the following, is-

1. Both Cu_2S and Cu_2O are reduced
2. Cu_2S is oxidised while Cu_2O is reduced
3. Cu_2S is reduced while Cu_2O is oxidised
4. Both Cu_2S and Cu_2O are oxidised

127. The correct order of acidity is-

1. $CH_3OH > C_2H_5OH > H_2O$
2. $H_2O > CH_3OH > C_2H_5OH$
3. $CH_3OH > H_2O > C_2H_5OH$
4. $C_2H_5OH > CH_3OH > H_2O$

128. Consider the following:



For spontaneous cell, which of the following condition, is correct?

1. $C_1 > C_2$
2. $C_1 < C_2$
3. $C_1 = C_2$
4. All of the above

129. 0.2% solution of phenol and 1% solution of phenol act, respectively, as

1. Analgesic and Antiseptic
2. Antiseptic and Antiseptic
3. Antiseptic and Disinfectant
4. Disinfectant and Disinfectant

130. Which, of the following, is not a ferromagnetic substance?

1. CrO_2
2. Fe
3. Fe_3O_4
4. Ni

131. The most basic oxide is-

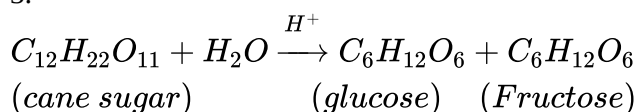
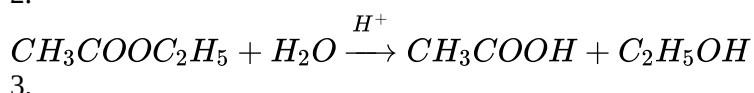
1. P_2O_3
2. Bi_2O_5
3. As_2O_3
4. Bi_2O_3

132. $[Cr(NH_3)_5Br]SO_4$ and $[Cr(NH_3)_5(SO_4)]Br$ are-

1. Geometrical isomers
2. Ionisation Isomers
3. Linkage isomers
4. Optical isomers

133. The example of pseudo-unimolecular reaction is

1. $CH_3COOC_2H_5 + NaOH \rightarrow CH_3COONa + C_2H_5OH$
- 2.



4. Both 2 and 3

134. In Freundlich adsorption isotherm, if we plot a graph between $\log \frac{x}{m}$ and $\log P$ then it is a straight line with a positive slope. The slope is equal to

1. $\log K$
2. n
3. $1/n$
4. $-\log K$

135. When glucose is reacted with methanol in presence of concentrated H_2SO_4 , then a mixture of α -methyl glucoside and β -methyl glucoside is formed. This reaction shows that glucose has

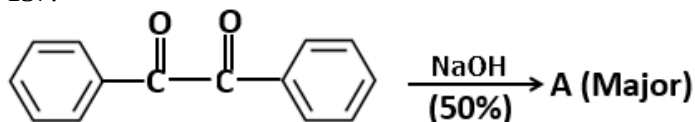
1. A linear chain of six carbon atoms
2. Ring structure
3. Free-CHO group
4. Five -OH groups

Chemistry - Section B

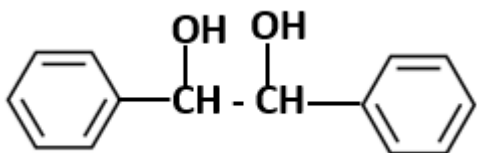
136. In the uppermost layer of cubic closed packed structure, the co-ordination number of an atom is

1. 4
2. 6
3. 9
4. 12

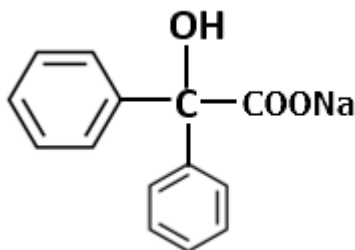
137.



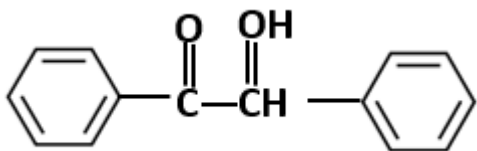
The compound 'A' is



1.



2.



3.

4. All of the above

138. The value of rate constant depends on

1. Temperature
2. Catalyst
3. Concentration
4. Both (1) and (2)

139. Which of the following is not a condensation method for the preparation of colloids?

1. Peptisation
2. Oxidation
3. Reduction
4. Hydrolysis

140. When a carbonyl compound reacts with hydroxyl amine then oximes are formed. Which carbonyl compound gives two different oximes instead of one?

1. HCHO
2. CH₃CHO
3. CH₃COCH₃
4. C₂H₅COC₂H₅

141. $\alpha - D$ glucose and galactose are

1. Anomers
2. Epimers
3. Conformers
4. Functional isomers

142. When benzaldehyde is reacted with acetic anhydride in presence of sodium acetate at 180°C, then the product formed is

1. Cinnamic acid
2. Cinnamaldehyde
3. Benzoin
4. Hydrazobenzene

143. The number of Faradays required for the evolution of 22.4 litres O₂ gas at NTP from the electrolysis of acidulated water are

1. 1F
2. 2F
3. 3F
4. 4F

144. Nessler's reagent is

1. K₂HgI₄
2. K₂HgI₄ + KOH
3. HgI₂ + KCl
4. HgO + HgI₂

145. When aqueous solution of CuSO₄ is electrolysed using platinum electrodes, then pH of the solution

1. Decreases
2. Increases
3. Remains unchanged
4. Firstly increases and then decreases

146. When nitrobenzene is reduced with As₂O₃ / NaOH then the product formed is

1. Azobenzene
2. Azoxybenzene
3. Hydrazobenzene
4. Phenyl Hydroxyl amine

147. When phthalic anhydride is reacted with phenol in presence of concentrated H_2SO_4 then the product formed is-

1. Resorcinol
2. Phenolphthalein
3. Fluorescein Dye
4. Methyl Orange

148. Case Study

A halogen is more electronegative than carbon. Consequently, the two atoms do not share their bonding electrons equally, because a partial negative charge is formed on halogen and a partial positive charge on the carbon to which it is bonded. It is the polar-carbon halogen bond that causes alkyl halides to undergo substitution reactions.

There are two important mechanisms for the substitution reaction:

1. $\text{S}_\text{N}1$: The carbon-halogen bond breaks heterolytically without any assistance from the nucleophile, forming a carbocation. The carbocation- an electrophile-then reacts with the nucleophile to form the substitution product
2. $\text{S}_\text{N}2$: A nucleophile is attracted to the partially positively charged carbon (an electrophile).As the nucleophile approaches the carbon and forms a new bond, the carbon-halogen bond breaks heterolytically (the halogen takes both of the bonding electrons)

The shape of the transition state formed in $\text{S}_\text{N}2$ mechanism is trigonal bipyramidal. The hybridized state of carbon in the transition state is-

1. sp
2. sp^2
3. sp^3
4. sp^3d

149. Case Study

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Which solvent,from the following, favors the $\text{S}_\text{N}2$ mechanism?

1. Non-polar solvent
2. Polar protic solvent
3. Polar aprotic solvent
4. All of the above

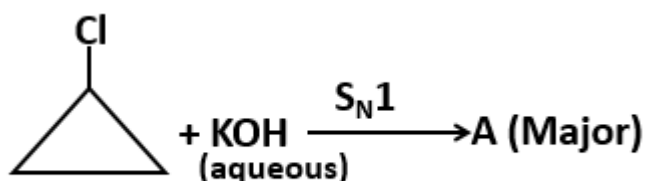
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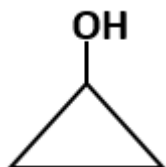
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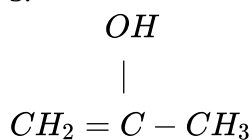
Based on the above, given the following reaction.



Compound 'A', in the above reaction, is



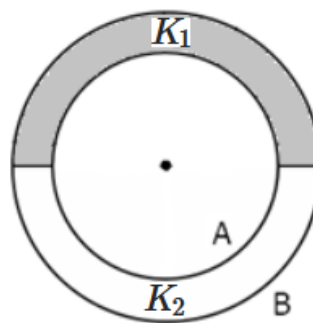
- 1.
2. $\text{CH}_2 = \text{CH} - \text{CH}_2 - \text{OH}$
- 3.



4. $\begin{array}{c} \text{O} \\ || \\ \text{CH}_3 = \text{C} - \text{CH}_3 \end{array}$

Physics - Section A

151. An arrangement consisting of two concentric spherical shells A, B has a capacitance C_0 between them. If the upper 'hemispherical' space between them is filled by a dielectric of relative permittivity K_1 and the lower by one of relative permittivity K_2 , the new capacitance will be:

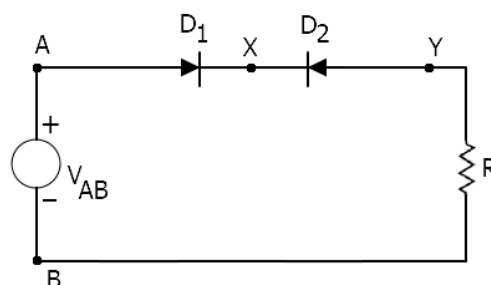


1. $(K_1 + K_2) C_0$
2. $\frac{K_1 + K_2}{2} C_0$
3. $\frac{1}{2} \left(\frac{1}{K_1} + \frac{1}{K_2} \right) C_0$
4. $\frac{2K_1 K_2}{K_1 + K_2} C_0$

152. The width of the central maximum of the diffraction pattern of a single slit of width 1 mm equals the width of the slit itself, when the screen is 1 m away from it. The wavelength of light used equals:

1. 250 nm
2. 500 nm
3. 1000 nm
4. 2000 nm

153. A voltage V_{AB} is applied to the left side input and the potential differences V_{AX} and V_{XY} are measured. Assume the diodes are ideal i.e., there is no potential difference across the diodes in forward bias. Which of the following is true?



1. If $V_{AB} > 0$, $V_{AX} > 0$
2. If $V_{AB} > 0$, $V_{XY} > 0$
3. If $V_{AB} < 0$, $V_{XY} > 0$
4. If $V_{AB} < 0$, $V_{AX} > 0$

Hint: Observe the diode which is reverse biased.

154. Two cells are balanced on a potentiometer and give balance lengths readings of 20 cm and 30 cm respectively. If the cells are connected in parallel (with their like terminals connected together), the balance length of the combination is found to be 28 cm. Their resistances are in the ratio:

1. $\frac{1}{3}$
2. $\frac{3}{1}$
3. $\frac{1}{4}$
4. $\frac{4}{1}$

155. Two small current-carrying loops carrying currents in the clockwise direction are placed in the same plane, separated by a distance d (which is much larger than the size of the loops). The two loops:

1. attract each other.
2. repel each other.
3. exert no force on each other, but exert a torque.
4. neither exert any force nor any torque on each other.

156. A muon is approximately 200 times heavier than an electron, but it is negatively charged, just like the electron. If a 'muonic' H-like atom is formed by a proton and a negative muon, assuming everything else except the mass to be the same, what will be the radius of the orbit for the ground state? Assume the Bohr radius (H-atom) to be r_H .

1. r_H
2. $r_H \times 200$
3. $\frac{r_H}{200}$
4. $r_H(200)^2$

157. An electromagnetic waveform which has an electric field given by: $\vec{E} = E_0[\hat{i} \cos(\omega t - kz) + \hat{j} \cos(\omega t - kx)]$ and the waveform propagates. The maximum electric field has the magnitude:

1. $\frac{E_0}{\sqrt{2}}$
2. $\sqrt{2} E_0$
3. E_0
4. $2E_0$

158. Let I_E , I_B , I_C be the magnitudes of the emitter, base, and collector currents in a transistor. Further, let V_{BE} and V_{CE} be the base-emitter and collector-emitter voltages (in magnitude) respectively. Then, in the common-emitter (CE) mode:

1. V_{CE} - small, I_B - large, when the transistor is in saturation
2. V_{CE} - large, I_B - small, when the transistor is in saturation
3. V_{BE} - large, I_C - small, when the transistor is in cutoff
4. V_{BE} - large, I_E - small, when the transistor is in cutoff

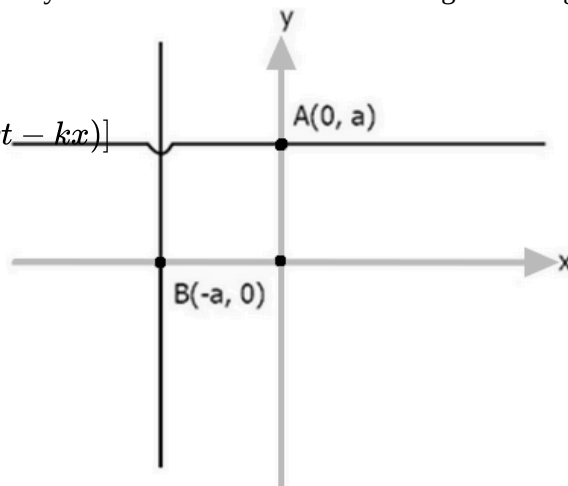
159. An electromagnetic waveform given by:

$$\vec{E} = E_0 \hat{j} \sin \omega t \cos kx$$

is set up in a certain region of space, where \vec{E} represents the electric field. The magnetic field associated with this waveform oscillates along the direction of:

1. \hat{i}
2. \hat{j}
3. \hat{k}
4. $\hat{j} + \hat{k}$

160. Two infinite positively charged wires lie in the x-y plane, both carrying the same quantity of charge per unit length. One wire passes through A (0, a) parallel to the x-axis, while the other wire passes through B (-a, 0) parallel to the y-axis. The electric field at the origin is along:



1. $\hat{i} - \hat{j}$
2. $-(\hat{i} + \hat{j})$
3. $-\hat{i}$
4. $-\hat{j}$

161. A parallel beam of light is incident onto a convex lens and after passing through the lens, it gets reflected from a plane mirror and passes through the lens again. The focal length of the lens is f . Where should the mirror be placed so that the final beam emerges parallel?

1. Just behind the lens
2. At the focus of the lens
3. At a distance of $2f$ from the lens
4. At a distance of $3f$ from the lens

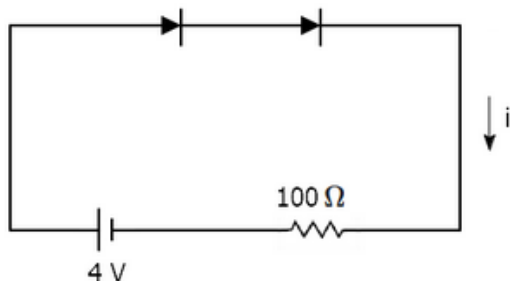
162. Photons of light of wavelength, $\lambda = 400$ nm are incident on a composite photocathode consisting of multiple regions with metals having work functions of 2.1 eV and 1.1 eV. The emitted photoelectrons are sent through a retarding potential difference, V_o . What is the minimum value of V_o required to stop all electrons? (Take: $hc = 1240$ eV-nm)

1. 1 V
2. 1.5 V
3. 2 V
4. 5.2 V

163. A thin prism of refractive index $\mu = 1.5$ introduces a deviation of $+1^\circ$ into the path of an incident beam. When this prism is immersed in a liquid of refractive index $\mu = 2$, the deviation introduced will be:

1. $\left(\frac{7}{6}\right)^\circ$
2. $\left(\frac{3}{2}\right)^\circ$
3. $-\left(\frac{1}{2}\right)^\circ$
4. $\left(\frac{1}{2}\right)^\circ$

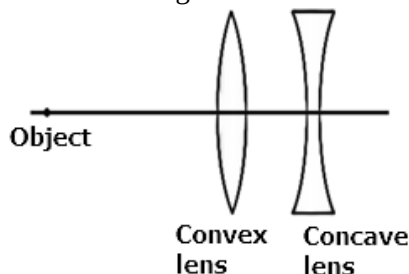
164. Assume that the threshold voltage of a diode is 0.7 V, and the forward resistance is negligible.



The current through the circuit is:

1. 40 mA
2. 54 mA
3. 33 mA
4. 26 mA

165. An equi-convex lens of focal length 50 cm and an equi-concave lens of the same magnitude of focal length are placed 50 cm apart, with a common principal axis. A point object is placed on the principal axis of the system, at a distance of 100 cm in front of the convex lens (see figure). The final image is formed at:



1. 100 cm in front of the concave lens.
2. 50 cm in front of the concave lens.
3. 50 cm behind the concave lens.
4. infinity.

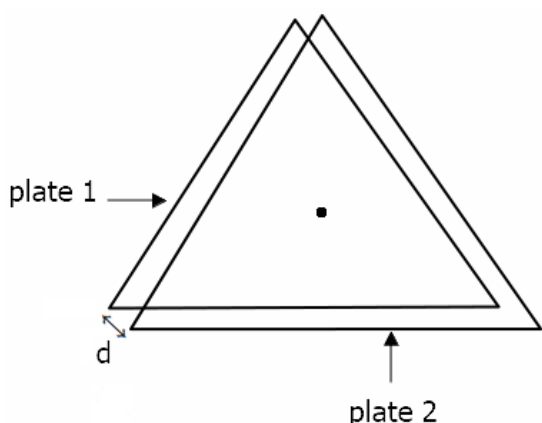
166. A long current-carrying solenoid produces a magnetic field B at its center, O. When a current-carrying wire is placed parallel to the axis of the solenoid, the field at O has the magnitude $2B$. The field due to wire has the magnitude (at O) of:

1. B
2. $3B$
3. $\frac{B}{\sqrt{3}}$
4. $\sqrt{3} B$

167. The capacitance of a parallel plate capacitor depends on the 'overlapping' or 'facing' area between the plates if the plates are very close together. A parallel plate capacitor is made by taking two metallic plates of the shape of equilateral triangles and placing them very close to each other at a uniform separation- facing each other. Their capacitance is now C_1 . The two plates are now rotated in their planes about an axis perpendicular to their planes- passing through their centers - until their 'overlap' is least.

The capacitance is now C_2 .

$\frac{C_1}{C_2}$ equals:

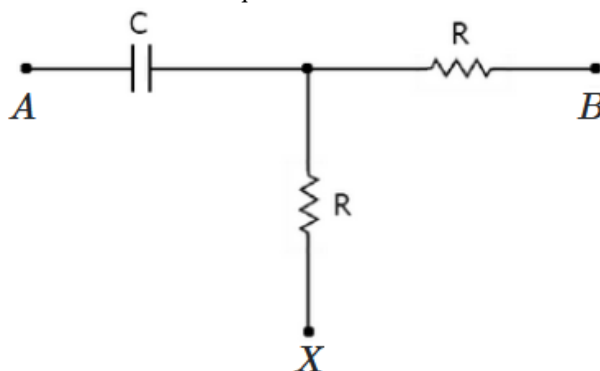


1. 3
2. 2
3. $\frac{3}{2}$
4. $\frac{4}{3}$

168. A monochromatic source of light emits 50 W at a wavelength of 400 nm. The number of photons emitted per second is approximately (Take $hc = 1240$ eV-nm):

1. 10^{20}
2. 10^{25}
3. 10^{30}
4. 10^{40}

169. The end 'B' of the circuit is earthed ($V_B = 0$) while a sinusoidal voltage is applied at 'A'; $V_A = V_0 \sin \omega t$. The rms voltage across the capacitor C equals that across the upper resistor R (as shown in the figure). What voltage should be applied at X (V_X) so that the current flowing into both the resistors is equal?

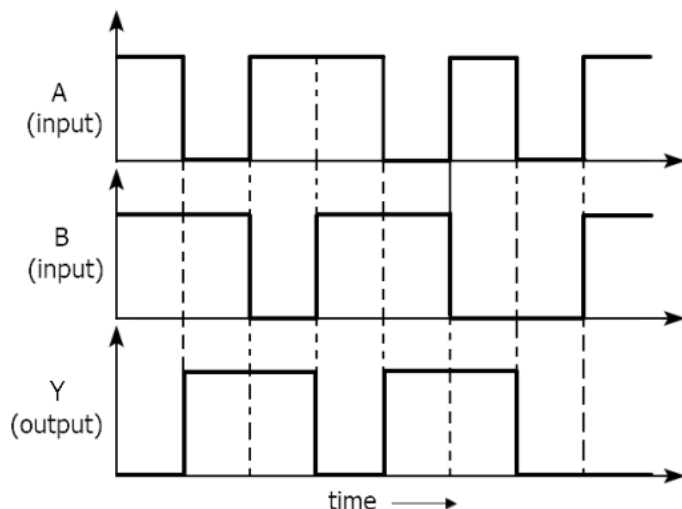


1. $V_X = \frac{V_0}{2} \sin \omega t$
2. $V_X = \frac{V_0}{2} \cos \omega t$
3. $V_X = V_0 (\sin \omega t + \cos \omega t)$
4. $V_X = 0$

170. Two small paramagnetic samples are placed in an (otherwise uniform) strong external magnetic field B. If the two samples are placed with a separation that is along the direction of the external field B, then, the force exerted by the two samples on each other is:

1. attractive.
2. repulsive.
3. zero.
4. any of the above depending on the external field B and the sample separation.

171. The two inputs (A) and (B) of a logic circuit are shown along with the output (Y) as functions of time. The 'highs' represent logic 1 and the 'lows' represent logic 0. The correct truth table for this circuit is:



A	B	Y	A	B	Y
0	0	0	0	0	0
0	1	0	0	1	1
1	0	1	1	0	0
1	1	0	1	1	0

1.

A	B	Y
0	0	1
0	1	0
1	0	0
1	1	1

2.

A	B	Y
0	0	0
0	1	1
1	0	1
1	1	0

3.

A	B	Y
0	0	1
0	1	0
1	0	0
1	1	1

4.

A	B	Y
0	0	0
0	1	1
1	0	1
1	1	0

172. Let the average nuclear force exerted by a proton on a proton be F_{pp} , by a proton on a neutron be F_{pn} and by a neutron on a neutron be F_{nn} . When their separations are nearly 1 fm, then,

1. $F_{pp} < F_{pn} < F_{nn}$
2. $F_{pn} > F_{pp} > F_{nn}$
3. $F_{pp} > F_{pn} > F_{nn}$
4. $F_{pp} = F_{pn} = F_{nn}$

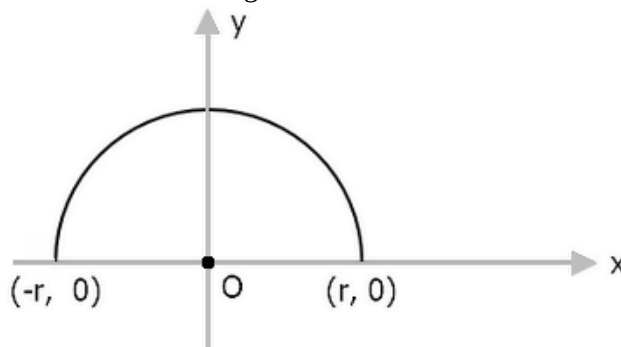
173. A metallic ball (work function: 2 eV) is irradiated with light consisting of photons of wavelength 200 nm. The ball has an initial charge, giving it a potential 1 V. Take the product of Planck's constant and velocity of light, hc as 1240 eV-nm. The final potential of the ball, when photoemission practically stops, is:

1. 2 V
2. 3.2 V
3. 4.2 V
4. 5.2 V

174. The nuclear radius of a ${}^8_3\text{Li}$ nucleus is 2.2 fm. The nuclear radius of ${}^{64}_{30}\text{Zn}$ is nearly:

1. 4.4 fm
2. 7 fm
3. 22 fm
4. 17.6 fm

175. A semi-circular wire carries a positive charge Q distributed uniformly over its circumference, and lies with its center at the origin and its ends on the x-axis, as shown in the figure. A single point charge is to be placed so that the net electric field due to the charge Q and the new charge (q_1) is zero at the origin. Let the distance of q_1 from O be r_1 . The potential at the origin is also zero. Which of the following is correct?



1. $r_1 < \frac{r}{2}$
2. $\frac{r}{2} < r_1 < r$
3. $r < r_1 < \frac{3r}{2}$
4. $\frac{3r}{2} < r_1$

176. In a certain region of space, equipotential surfaces of the electric field are drawn - corresponding to $V = 10$ volt and $V = 9.9$ volts. There is no field along the z-direction. At a certain point P, on the 10-volt surface, the distance PQ_1 , to the 9.9 volt surface is 2 mm

when \vec{PQ}_1 is along the x-axis. On the other hand, if \vec{PQ}_2 is taken parallel to the y-axis, the corresponding distance $PQ_2 = 1$ mm. The electric field at P is along:

1. $2\hat{i} + \hat{j}$
2. $2\hat{j} + \hat{i}$
3. $\frac{1}{4}\hat{i} + \hat{j}$
4. $\frac{1}{4}\hat{j} + \hat{i}$

177. The peak voltage in the output of a half-wave rectifier is 30 V . The rms voltage of the output wave is: (assuming no distortion in wave)

1. $\frac{30}{\sqrt{2}}\text{ V}$
2. 15 V
3. $\frac{15}{\sqrt{2}}\text{ V}$
4. 10 V

178. The energy of an atom with a K-shell vacancy is E_K , that with an L-shell vacancy is E_L , and that with an M-shell vacancy is E_M : all compared to an atom with no vacancy, then,

(I) $E_K < E_L$

(II) $E_L > E_M$

(III) $E_L - E_K = E_{K\alpha}$, the energy of K_α photon

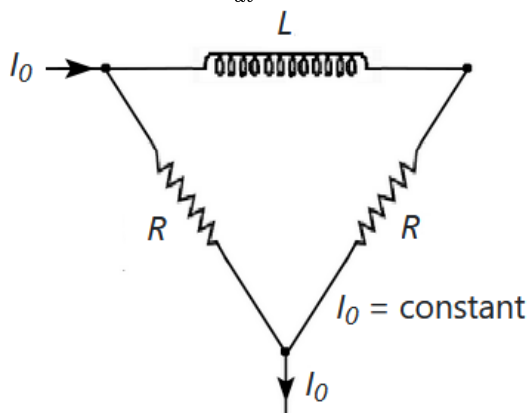
1. I is true
2. I, III are true
3. II is true
4. I, II are true

179. A $12\text{ }\mu\text{F}$ capacitor is charged by means of a 6 V battery and the charged capacitor and the battery are connected in series so that their combined potential difference is twice as much. When a second unknown capacitor (initially uncharged) is connected across this combination, the first capacitor is observed to lose half of its initial charge.

The capacitance of the unknown capacitor is:

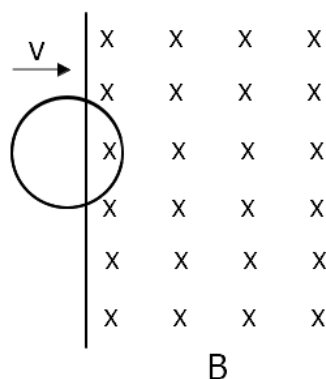
1. $4\text{ }\mu\text{F}$
2. $6\text{ }\mu\text{F}$
3. $24\text{ }\mu\text{F}$
4. $36\text{ }\mu\text{F}$

180. The current through the inductor in the figure, is initially zero. The initial rate of change of the current i through the inductor (i.e. $\frac{di}{dt}$) is:



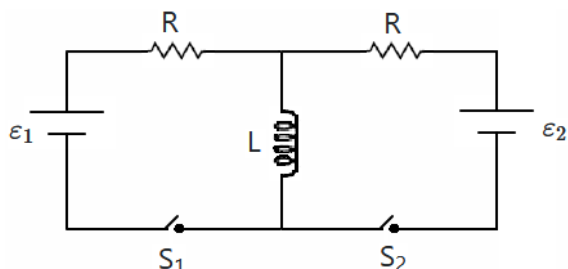
1. zero
2. $-\frac{I_0 R}{L}$
3. $\frac{I_0 R}{L}$
4. $\frac{I_0 R}{2L}$

181. A circular loop of radius R , enters a region of uniform magnetic field B as shown in the diagram. The field (B) is perpendicular to the plane of the loop while the velocity of the loop, v , is along its plane. The induced EMF:



1. increases continuously.
2. decreases continuously.
3. first increases and then decreases.
4. remains constant throughout.

182. The two switches S_1 , S_2 are switched on simultaneously. The current through the cell ε_1 is, initially,



1. $\frac{\varepsilon_1}{R}$
2. $\frac{\varepsilon_2}{R}$
3. $\frac{\varepsilon_1 - \varepsilon_2}{R}$
4. $\frac{\varepsilon_1 - \varepsilon_2}{2R}$

183. Calculate the dispersive power of a thin prism from the following data:

Colour	Deviation
Violet	2.04°
Yellow	2.00°
Red	1.96°

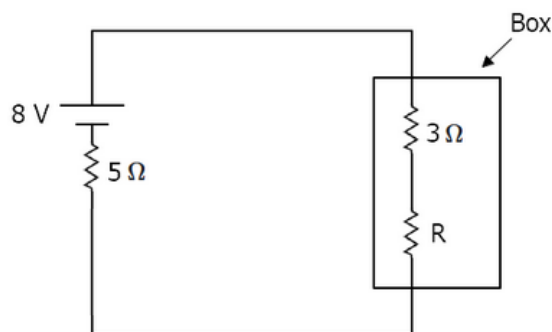
1. 0.04
2. 0.02
3. 25
4. 50

184. **Assertion (A):** When light consisting of wavelengths corresponding to the Balmer series is incident on a gas containing He^+ ions in the first three excited states - it can be absorbed by the He^+ ions.

Reason (R): All the energy levels of the He^+ ions are the same as those of the H atoms.

1. The (A) is true but the (R) is false.
2. The (A) is false but the (R) is true.
3. Both the (A) and the (R) are true and the (R) is a correct explanation of the (A).
4. Both the (A) and (R) are true but the (R) is not a correct explanation of the (A).

185. For what value of R will the power supplied by the battery (EMF = 8 V, internal resistance = $5\ \Omega$) to the resistance R will be a maximum?



1. $5\ \Omega$
2. $4\ \Omega$
3. $2\ \Omega$
4. $8\ \Omega$

Physics - Section B

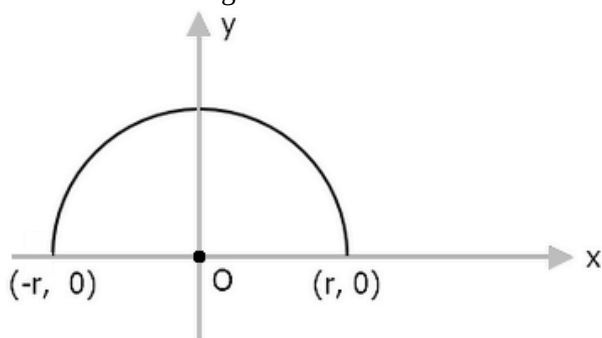
186. Two semi-circular current-carrying wires are placed in the same plane so that they share a common centre. The magnetic field due to any one of them at the common centre has the magnitude, B_0 . When one of them is tilted so that it is in a perpendicular plane, with the same centre, the magnetic field at the common centre is B . Then,

1. $B = 2B_0$
2. $B = \frac{B_0}{2}$
3. $B = \sqrt{2} B_0$
4. $B = \frac{B_0}{\sqrt{2}}$

187. A small permanent magnet is placed 'antiparallel' to a uniform magnetic field B . A null point is found at a distance r , on the axis of the magnet. Then, r is proportional to (nearly):

1. B^{-3}
2. B^{-2}
3. $B^{-1/2}$
4. $B^{-1/3}$

188. A semi-circular wire carries a positive charge Q distributed uniformly over its circumference, and lies with its center at the origin and its ends on the x-axis, as shown in the figure. A single point charge is to be placed so that the net electric field due to the charge Q and the new charge (q_1) is zero at the origin. Let the distance of q_1 from O be r_1 . The potential at the origin is also zero. Which of the following is correct?



1. $q_1 > 0$ and $|q_1| > |Q|$
2. $q_1 < 0$ and $|q_1| < |Q|$
3. $q_1 > 0$ and $|q_1| < |Q|$
4. $q_1 < 0$ and $|q_1| > |Q|$

189. An n-p-n transistor is connected in a common-emitter configuration and it is "ON". If V_E , V_B , V_C are the average (dc) voltages at the emitter, base, and collector, then:

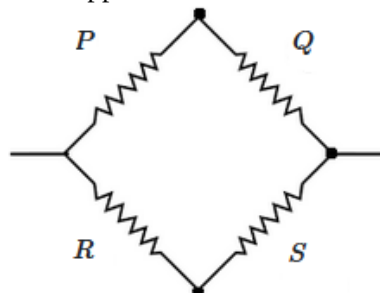
1. $V_E > V_B > V_C$
2. $V_E < V_B < V_C$
3. $V_B > V_E > V_C$
4. $V_B < V_E < V_C$

190. An equi-convex lens of focal length 20 cm (in the air) is split into two parts by a surface that has half the curvature of either of its outer surfaces. The ratio of the powers of the two lenses thus formed is:

1. 3 : 1
2. 2 : 1
3. 1 : 1
4. -2 : 1

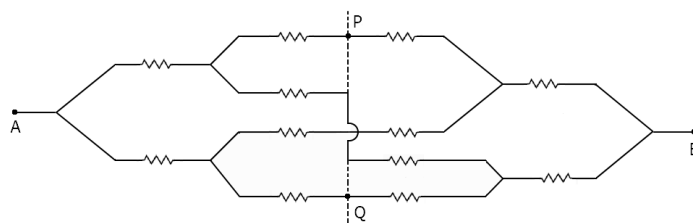
191. **Assertion (A):** In the Wheatstone Bridge shown in the figure, if the resistances in opposite arms are switched (i.e. Q, R are exchanged) then the bridge remains balanced if it was initially balanced.

Reason (R): The balance condition $\frac{P}{Q} = \frac{R}{S}$ is not affected if resistances in opposite arms are switched.



1. The (A) is true but the (R) is false.
2. The (A) is false but the (R) is true.
3. Both the (A) and the (R) are true and the (R) is a correct explanation of the (A).
4. Both the (A) and the (R) are true but the (R) is not a correct explanation of the (A).

192. All the resistances to the left of the vertical line PQ are $1\ \Omega$, while those on the right of line PQ are $2\ \Omega$ as shown in the figure above. The equivalent resistance between A and B is:



1. $18\ \Omega$
2. $9\ \Omega$
3. $4.5\ \Omega$
4. $2.25\ \Omega$

Hint: Are the points lying on the vertical line PQ equipotential?

193. Young's double-slit experiment is conducted with the light of wavelength 700 nm. A thin strip of a glass of refractive index $\mu = 1.7$ is placed in front of one of the slits and the fringe system is displaced by 10 fringes. The thickness of the glass strip is:

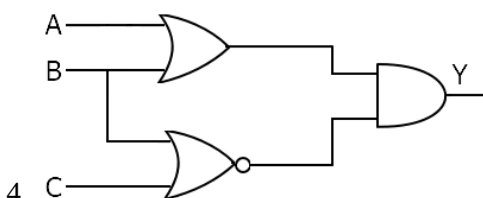
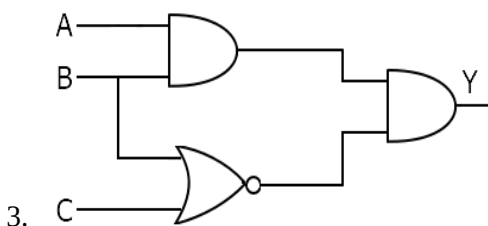
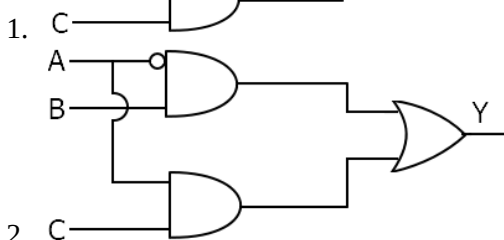
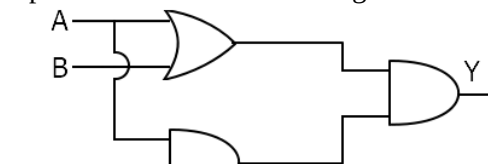
1. $10\ \mu m$
2. $1\ \mu m$
3. $17\ \mu m$
4. $1.7\ \mu m$

Hint: An optical path difference of λ corresponds to phase difference of 2π , and a shift by 1 fringe.

194. The truth table for a circuit is given by:

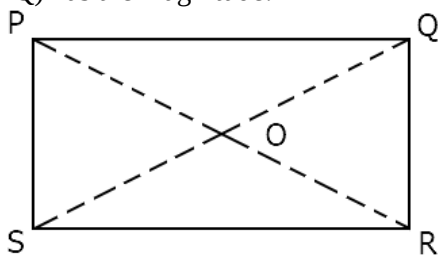
A	B	C	Y (Output)
1	X	1	1
0	1	X	1
All other cases			0

Here, X represents either 0 or 1. A, B, and C are the inputs. Which of the following is the correct circuit?

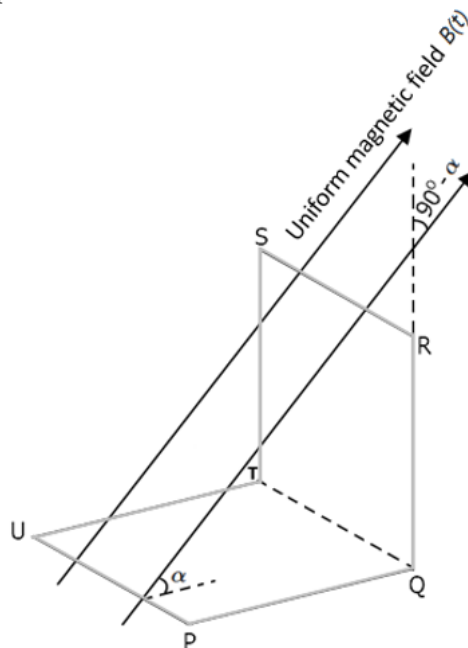


195. A straight current-carrying wire carrying current I passes perpendicular to the plane of an imaginary rectangular loop PQRS, passing through its center O (into the diagram). The diagonals intersect at 60° , and side PS is smaller than side PQ. The value of $\int \vec{B} \cdot d\vec{l}$ evaluated from P to Q (along PQ) has the magnitude:

- $\frac{\mu_0 I}{6}$
- $\frac{2\mu_0 I}{6}$
- $\frac{4\mu_0 I}{6}$
- $\frac{5\mu_0 I}{6}$

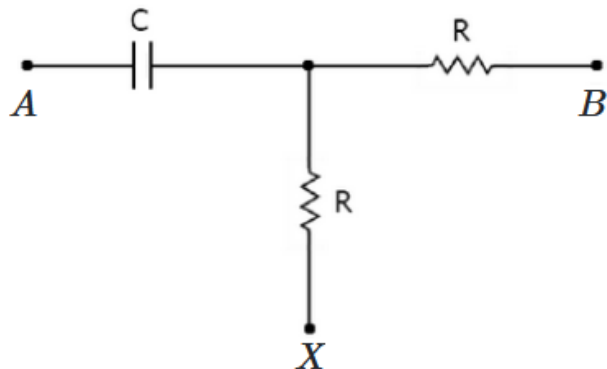


196. A rectangular loop of conducting wire is bent symmetrically so that its two plane halves are inclined at right angles w.r.t each other (i.e. $\angle PQR = \angle STU = 90^\circ$). Every segment has a length 'a' ($PQ = QR = RS = \dots = UP = a$). A uniform time-dependent magnetic field $B(t)$ acts on the loop, making an angle ' α ' with the lower half of the loop and ' $90^\circ - \alpha$ ' with the upper half. The EMF induced in the loop is proportional to:



- $(\cos \alpha + \sin \alpha) \frac{dB}{dt}$
- $(\cos \alpha - \sin \alpha) \frac{dB}{dt}$
- $(\tan \alpha + \cot \alpha) \frac{dB}{dt}$
- $(\tan \alpha - \cot \alpha) \frac{dB}{dt}$

197. The end 'B' of the circuit is earthed ($V_B = 0$) while a sinusoidal voltage is applied at 'A'; $V_A = V_0 \sin \omega t$. The rms voltage across the capacitor C equals that across the upper resistor R (as shown in the figure). What is the phase difference between the current through the capacitor and the voltage across the capacitor when no current flows out at X?



1. 0°
2. 45°
3. 90°
4. 180°

198. An electric field is given by:

$$\vec{E}(x, y) = 4x\hat{i} - 3y\hat{j};$$

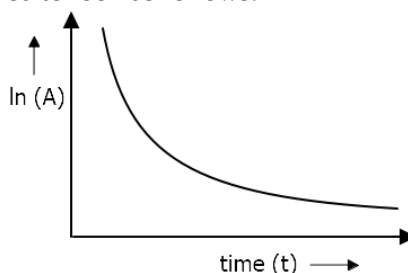
the field being measured in ' V/m ' and the distances in ' m '. The variation of the potential along the direction $(\hat{i} - \hat{j})$ at the point (2, 2) is given by:

1. $-14 V/m$
2. $14 V/m$
3. $-7\sqrt{2} V/m$
4. $7\sqrt{2} V/m$

199. A plano-convex lens made of glass ($\mu=1.5$) is placed with its convex surface in a liquid, and it is found that the focal length is doubled. The refractive index of the liquid is:

1. 3
2. 2
3. 1.25
4. 1.2

200. When the logarithm of the activity of a radioactive sample is plotted as a function of time, the graph is observed to look as follows:



The reason for this graph is, most likely the following:

1. Activity (A) decreases linearly with time (t).
2. Non-radioactive substances are mixed with radioactive substances.
3. A chemical reaction occurs interfering with the activity.
4. There are more than one radioactive isotopes present in the sample.

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