1. The addition of a catalyst during a chemical reaction alters which of the following quantities?

    (1) Internal energy

    (2) Enthalpy

    (3) Activation energy

    (4) Entropy

Answer (3)

Sol. Catalyst decreases the activation energy and thus increases the rate of reaction.

2. Predict the **correct** order among the following

    (1) lone pair - lone pair > bond pair - bond pair > lone pair - bond pair

    (2) bond pair - bond pair > lone pair - bond pair > lone pair - lone pair

    (3) lone pair - bond pair > bond pair - bond pair > lone pair - lone pair

   (4) lone pair - lone pair > lone pair - bond pair > bond pair - bond pair

Answer (4)

Sol. Fact.

3. The **correct** statement regarding the basicity of arylamines is

    (1) Arylamines are generally more basic than alkylamines because the nitrogen lone-pair electrons are not delocalized by interaction with the aromatic ring π electron system

    (2) Arylamines are generally more basic than alkylamines because of aryl group

    (3) Arylamines are generally more basic than alkylamines, because the nitrogen atom in arylamines is *sp*-hybridized

    (4) Arylamines are generally less basic than alkylamines because the nitrogen lone-pair electrons are delocalized by interaction with the aromatic ring π electron system
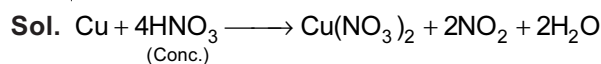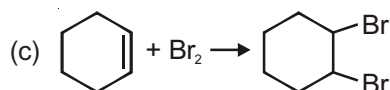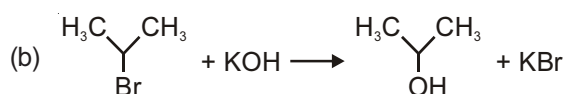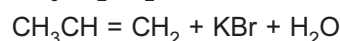
Answer (4)

Sol.

Arylamine (less basic)   Alkyl amine (more basic)
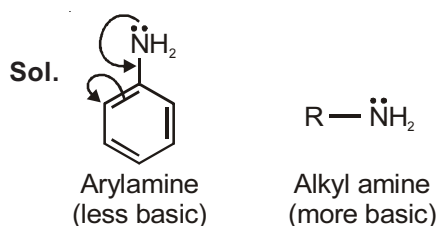
4. When copper is heated with conc. HNO_3, it produces

    (1) $Cu(NO_3)_2$ and NO

    (2) $Cu(NO_3)_2$, NO and NO_2

    (3) $Cu(NO_3)_2$ and N_2O

    (4) $Cu(NO_3)_2$ and NO_2

Answer (4)

Sol. $Cu + 4HNO_3 \xrightarrow{\text{(Conc.)}} Cu(NO_3)_2 + 2NO_2 + 2H_2O$

5. For the following reactions :

    (a) $CH_3CH_2CH_2Br + KOH \rightarrow$
        $CH_3CH = CH_2 + KBr + H_2O$

    (b)

    (c)
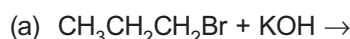
    Which of the following statements is correct?

    (1) (a) is elimination, (b) is substitution and (c) is addition reaction

    (2) (a) is elimination, (b) and (c) are substitution reactions

    (3) (a) is substitution, (b) and (c) are addition reactions

    (4) (a) and (b) are elimination reactions and (c) is addition reaction

Answer (1)

Sol. (a) $CH_3CH_2CH_2Br + KOH \rightarrow CH_3CH = CH_2 + KBr + H_2O$: Elimination reaction

    (b) : Substitution reaction

    (c) : Addition reaction
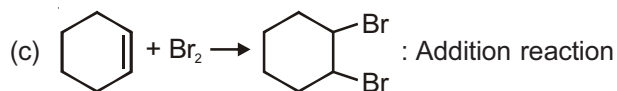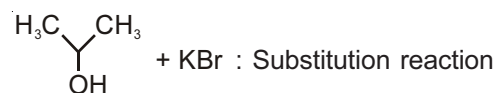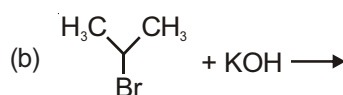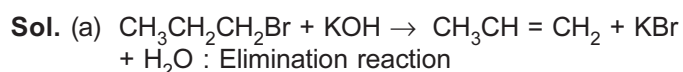
6. Two electrons occupying the same orbital are distinguished by

    (1) Magnetic quantum number

    (2) Azimuthal quantum number

    (3) Spin quantum number

    (4) Principal quantum number

Answer (3)

Sol. Fact.

7. The reaction

can be classified as

(1) Alcohol formation reaction

(2) Dehydration reaction

(3) Williamson alcohol synthesis reaction

(4) Williamson ether synthesis reaction

Answer (4)

Sol. Fact

8. The electronic configurations of Eu (Atomic no. 63), Gd (Atomic No. 64) and Tb (Atomic No 65) are :

(1) $[Xe]4f^6 5d^1 6s^2$, $[Xe]4f^7 5f^1$ and $[Xe]4f^9 6s^2$

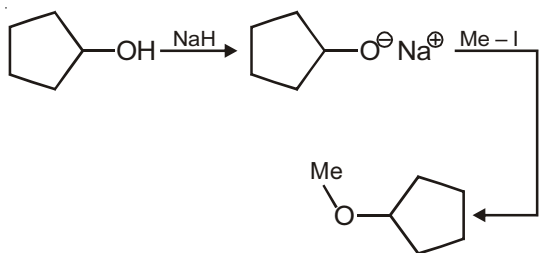(2) $[Xe]4f^6 5d^1 6s^2$, $[Xe]4f^7 5d^1 6s^2$ and $[Xe]4f^8 5d^1 6s^2$

(3) $[Xe]4f^7 6s^2$, $[Xe]4f^7 5d^1 6s^2$ and $[Xe]4f^9 6s^2$

(4) $[Xe]4f^7 6s^2$, $[Xe]4f^8 6s^2$ and $[Xe]4f^8 5d^1 6s^2$

Answer (3)

Sol. Fact

9. At 100°C the vapour pressure of a solution of 6.5 g of a solute in 100 g water is 732 mm. If K_b = 0.52, the boiling point of this solution will be

(1) 100°C   (2) 102°C

(3) 103°C   (4) 101°C

Answer (4)

Sol. $\because \quad \dfrac{P_A^0 - P_S}{P_S} = \dfrac{n_B}{n_A}$

$\Rightarrow \quad \dfrac{760 - 732}{732} = \dfrac{W_B \times M_A}{M_B \times W_A}$

$\Rightarrow \quad \dfrac{28}{732} = \dfrac{6.5 \times 18}{M_B \times 100}$

$\therefore \quad M_B = 30.6$

$\therefore \quad \Delta T_b = 0.52 \times \dfrac{6.5 \times 1000}{30.6 \times 100}$

$\quad = 1.10$

$\therefore \quad$ Boiling point = 100 + 1.1

$\quad = 101.1°C$

$\quad \approx 101°C$

10. The **correct** statement regarding the comparison of staggered and eclipsed conformations of ethane is

(1) The eclipsed conformation of ethane is more stable than staggered conformation, because eclipsed conformation has no torsional strain

(2) The eclipsed conformation of ethane is more stable than staggered conformation even though the eclipsed conformation has torsional strain

(3) The staggered conformation of ethane is more stable than eclipsed conformation, because staggered conformation has no torsional strain

(4) The staggered conformation of ethane is less stable than eclipsed conformation, because staggered conformation has torsional strain

Answer (3)

Sol. Fact.

11. Which one of the following characteristics is associated with adsorption?

(1) ΔG, ΔH and ΔS all are negative

(2) ΔG and ΔH are negative but ΔS is positive

(3) ΔG and ΔS are negative but ΔH is positive

(4) ΔG is negative but ΔH and ΔS are positive

Answer (1)

Sol. Adsorption is a spontaneous process with release in energy and decreases the randomness of adsorbed substance

$\therefore \Delta G$, ΔH & ΔS all are negative.

12. Match the compounds given in Column-I with the hybridisation and shape given in Column-II and mark the corect option.

Column-I	Column-II
(a) X_3F_6	(i) Distorted octahedral
(b) XeO_3	(ii) Square planar
(c) $XeOF_4$	(iii) Pyramidal
(d) XeF_4	(iv) Square pyramidal

	(a)	(b)	(c)	(d)
(1)	(i)	(ii)	(iv)	(iii)
(2)	(iv)	(iii)	(i)	(ii)
(3)	(iv)	(i)	(ii)	(iii)
(4)	(i)	(iii)	(iv)	(ii)

Answer (4)

Sol. Fact.

13. The correct statement regarding a carbonyl compound with a hydrogen atom on its alpha-carbon, is

   (1) A carbonyl compound with a hydrogen atom on its alpha-carbon rapidly equilibrates with its corresponding enol and this process is known as aldehyde-ketone equilibration

   (2) A carbonyl compound with a hydrogen atom on its alpha-carbon rapidly equilibrates with its corresponding enol and this process is known as carbonylation

   (3) A carbonyl compound with a hydrogen atom on its alpha-carbon rapidly equilibrates with its corresponding enol and this process is known as keto-enol tautomerism

   (4) A carbonyl compound with a hydrogen atom on its alpha-carbon never equilibrates with its corresponding enol

Answer (3)

Sol. Fact

14. In a protein molecule, various amino acids are linked together by

   (1) β-glycosidic bond

   (2) Peptide bond

   (3) Dative bond

   (4) α-glycosidic bond

Answer (2)

Sol. Fact.

15. Match items of **Column I** with the items of **Column II** and assign the correct code :

	Column I		Column II
(a)	Cyanide process	(i)	Ultrapure Ge
(b)	Froth floatation process	(ii)	Dressing of ZnS
(c)	Electrolytic reduction	(iii)	Extraction of Al
(d)	Zone refining	(iv)	Extraction of Au
		(v)	Purification of Ni

Code :

	(a)	(b)	(c)	(d)
(1)	(ii)	(iii)	(i)	(v)
(2)	(i)	(ii)	(iii)	(iv)
(3)	(iii)	(iv)	(v)	(i)
(4)	(iv)	(ii)	(iii)	(i)

Answer (4)

Sol. Fact.

16. Which of the following is an analgesic?

   (1) Penicillin

   (2) Streptomycin

   (3) Chloromycetin

   (4) Novalgin

Answer (4)

Sol. Fact.

17. Which is the **correct** statement for the given acids?

   (1) Phosphinic acid is a monoprotic acid while phosphonic acid is a diprotic acid

   (2) Phosphinic acid is a diprotic acid while phosphonic acid is a monoprotic acid

   (3) Both are triprotic acids

   (4) Both are diprotic acids

Answer (1)

Sol.

(Phosphinic acid) Monoprotic   (Phosphonic acid) Diprotic
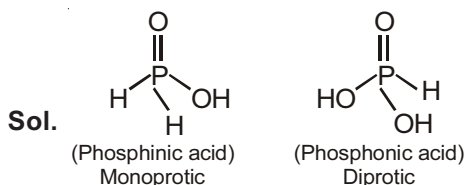
18. The pair of electron in the given carbanion, $CH_3C \equiv C^{\ominus}$ is present in which of the following orbitals?

   (1) sp^3

   (2) sp^2

   (3) sp

   (4) $2p$

Answer (3)

Sol. Fact

19. Consider the molecules CH_4, NH_3 and H_2O. Which of the given statements is false?

   (1) The H – O – H bond angle in H_2O is larger than the H – C – H bond angle in CH_4

   (2) The H – O – H bond angle in H_2O is smaller than the H – N – H bond angle in NH_3

   (3) The H – C – H bond angle in CH_4 is larger than the H – N – H bond angle in NH_3

   (4) The H – C – H bond angle in CH_4, the H – N – H bond angle in NH_3, and the H – O – H bond angle in H_2O are all greater than 90°

Answer (1)

Sol. Molecules   Bond angle

CH_4 $\longrightarrow$ 109.5°

NH_3 $\longrightarrow$ 107.5°

H_2O $\longrightarrow$ 104.45°

20. Which one of the following statements is correcdted when SO_2 is passed through acidified $K_2Cr_2O_7$ solution?

   (1) The solution is decolourized

   (2) SO_2 is reduced

   (3) Green $Cr_2(SO_4)$, is formed

   (4) The solution turns blue

Answer (3)

Sol. Fact.

21. The correct thermodynamic conditions for the spontaneous reaction at all temperatures is

   (1) $\Delta H > 0$ and $\Delta S < 0$

   (2) $\Delta H < 0$ and $\Delta S > 0$

   (3) $\Delta H < 0$ and $\Delta S < 0$

   (4) $\Delta H < 0$ and $\Delta S = 0$

Answer (2 & 4)

Sol. $\because$ $\Delta G = \Delta H - T\Delta S$

For reaction to be spontaneous, ΔG should be negative.

Note : ΔG can be negative in option (4) also.

22. Natural rubber has

   (1) All trans-configuration

   (2) Alternate cis - and trans-configuration

   (3) Random cis - and trans-configuration

   (4) All cis-configuration

Answer (4)

Sol. Fact

23. In which of the following options, the order of arrangement does **not** agree with the variation of property indicated against it?

   (1) B < C < N < O (increasing first ionisation enthalpy)

   (2) I < Br < Cl < F (increasing electron gain enthalpy)

   (3) Li < Na < K < Rb (increasing metallic radius)

   (4) $Al^{3+} < Mg^{2+} < Na^+ < F^-$ (increasing ionic size)

Answer (1 & 2)

Sol. For option (1) :

The correct order for 1st ionisation energy is B < C < O < N.

For option (2) :

The correct order for magnitude of electron gain enthalpy is I < Br < F < Cl

24. Which of the following reagents would distinguish cis-cyclopenta-1, 2-diol from the trans-isomer?

   (1) Ozone

   (2) MnO_2

   (3) Aluminium isopropoxide

   (4) Acetone

Answer (4)

Sol. cis-cylopenta-1, 2-diol can form cyclic ketal whereas tran-cyclopenta-1, 2-diol can't form cyclic ketal.
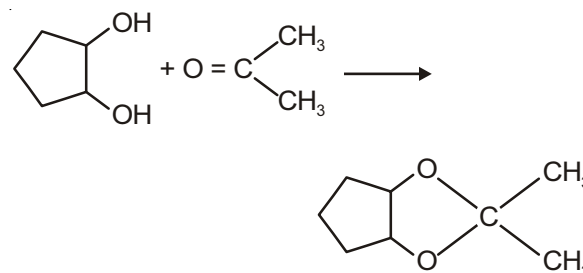
25. The product obtained as a result of a reaction of nitrogen with CaC_2 is

   (1) CaCN

   (2) $CaCN_3$

   (3) Ca_2CN

   (4) $Ca(CN)_2$

Answer (4)

Sol. Option (4) should be $CaCN_2$ instead of $Ca(CN)_2$

$$N_2 + CaC_2 \xrightarrow{\Delta} CaCN_2 + C$$
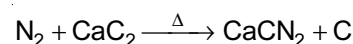
26. Fog is a colloidal solution of

   (1) Gas in liquid

   (2) Solid in gas

   (3) Gas in gas

   (4) Liquid in gas

Answer (4)

Sol. Fact.

27. Which one of the following orders is **correct** for the bond dissociation enthalpy of halogen molecules?

    (1) $Cl_2 > Br_2 > F_2 > I_2$

    (2) $Br_2 > I_2 > F_2 > Cl_2$

    (3) $F_2 > Cl_2 > Br_2 > I_2$

    (4) $I_2 > Br_2 > Cl_2 > F_2$

Answer (1)

Sol. Fact

28. Equal moles of hydrogen and oxygen gases are placed in a container with a pin-hole through which both can escape. What fraction of the oxygen escapes in the time required for one-half of the hydrogen to escape?

    (1) $\dfrac{1}{4}$

    (2) $\dfrac{3}{8}$

    (3) $\dfrac{1}{2}$

    (4) $\dfrac{1}{8}$

Answer (4)

Sol. $\dfrac{n_{O_2}}{n_{H_2}} = \sqrt{\dfrac{M_{H_2}}{M_{O_2}}}$

$\Rightarrow \dfrac{n_{O_2}}{0.5} = \sqrt{\dfrac{2}{32}}$

$\therefore n_{O_2} = \dfrac{1}{8}$

29. Lithium has a bcc structure. Its density is 530 kg m^{-3} and its atomic mass is 6.94 g mol^{-1}. Calculate the edge length of a unit cell of Lithium metal ($N_A = 6.02 \times 10^{23}$ mol^{-1})

    (1) 352 pm

    (2) 527 pm

    (3) 264 pm

    (4) 154 pm

Answer (1)

Sol. $0.53 \text{ g/cm}^3 \dfrac{2 \times 6.94 \text{ (g/mol)}}{a^3 \times 6.02 \times 10^{23} \text{ mol}^{-1}}$

On solving, a = 352 pm

30. Which of the following statements about the composition of the vapour over an ideal 1 : 1 molar mixture of benzene and toluene is correct? Assume that the temperature is constant at 25°C. (Given, Vapour Pressure Data at 25°C, benzene = 12.8 kPa, toluene = 3.85 kPa)

    (1) The vapour will contain a higher percentage of toluene

    (2) The vapour will contain equal amounts of benzene and toluene

    (3) Not enough information is given to make a prediction

    (4) The vapour will contain a higher percentage of benzene

Answer (4)

Sol. The component having higher vapour pressure will have higher percentage in vapour phase.

31. Which of the following has longest C – O bond length? (Free C – O bond length CO is 1.128 Å)

    (1) $[Co(CO)_4]^{\ominus}$

    (2) $[Fe(CO)_4]^{2-}$

    (3) $[Mn(CO)_6]^{+}$

    (4) $Ni(CO)_4$

Answer (2)

Sol. Due to increase in –ve charge on metal atom bond length of C – O bond increases.

32. Among the following, the correct order of acidity is

    (1) $HClO < HClO_2 < HClO_3 < HClO_4$

    (2) $HClO_2 < HClO < HClO_3 < HClO_4$

    (3) $HClO_4 < HClO_2 < HClO < HClO_3$

    (4) $HClO_3 < HClO_4 < HClO_2 < HClO$

Answer (1)

Sol. $\underset{\text{Acidic} - \text{strength}}{\overset{+1}{HClO} < \overset{+3}{HClO_2} < \overset{+5}{HClO_3} < \overset{+7}{HClO_4}} \longrightarrow$

33. In the reaction

    $H-C \equiv CH \xrightarrow[\text{(2) }CH_3CH_2Br]{\text{(1) }NaNH_2/\text{liq. }NH_3} X \xrightarrow[\text{(2) }CH_3CH_2Br]{\text{(1) }NaNH_2/\text{liq. }NH_3} Y$
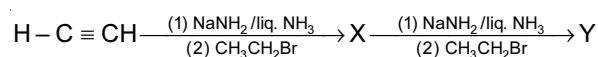
    X and Y are

    (1) X = 2-Butyne; Y = 3-Hexyne

    (2) X = 2-Butyne; Y = 2-Hexyne

    (3) X = 1-Butyne; Y = 2-Hexyne

    (4) X = 1-Butyne; Y = 3-Hexyne

Answer (4)

Sol. $H-C \equiv CH \xrightarrow[\text{(2) CH}_3\text{CH}_2\text{Br}]{\text{(1) NaNH}_2/\text{liq. NH}_3} H-C \equiv C-CH_2-CH_3$

(1–Butyne (X))

$\xrightarrow[\text{(2) CH}_3\text{CH}_2\text{Br}]{\text{(1) NaNH}_2/\text{liq. NH}_3} CH_3-CH_2-C \equiv C-CH_2-CH_3$

(3-Hexyne (Y))

34. MY and NY_3, two nearly insoluble salts, have the same K_{SP} values of 6.2×10^{-13} at room temperature. Which statement would be true in regard to MY and NY_3?

(1) The molar solubility of MY in water is less than that of NY_3

(2) The salts MY and NY_3 are more soluble in 0.5 M KY than in pure water

(3) The addition of the salt of KY to solution of MY and NY_3 will have no effect on their solubilities

(4) The molar sulubilities of MY and NY_3 in water are identical

Answer (1)

Sol. For MY,

$K_{SP} = S^2$

$\therefore$ $S = (6.2 \times 10^{-13})^{1/2}$
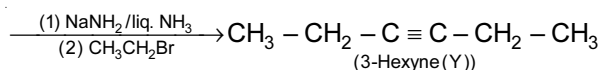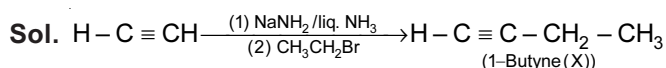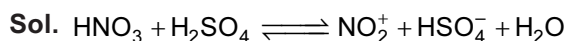
For, NY_3,

$K_{SP} = 27 S^4$

$\therefore$ $S = \left(\dfrac{6.2 \times 10^{-13}}{27}\right)^{1/4}$

35. Consider the nitration of benzene using mixed conc. H_2SO_4 and HNO_3. If a large amount of $KHSO_4$ is added to the mixture, the rate of nitration will be

(1) Slower

(2) Unchanged

(3) Doubled

(4) Faster

Answer (1)

Sol. $HNO_3 + H_2SO_4 \rightleftharpoons NO_2^+ + HSO_4^- + H_2O$

$\therefore$ Addition of $KHSO_4$ will decrease the NO_2^+ concentration.

36. The product formed by the reaction of an aldehyde with a primary amine is

(1) Ketone

(2) Carboxylic acid

(3) Aromatic acid

(4) Schiff base

Answer (4)

Sol. $R-\overset{\displaystyle O}{\overset{\|}{C}}-H + R'NH_2 \longrightarrow R-\overset{\displaystyle H}{\overset{|}{C}}=N-R' + H_2O$

schiff base
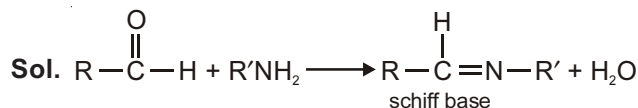
37. The pressure of H_2 required to make the potential of H_2 – electrode zero in pure water at 298 K is

(1) 10^{-12} atm

(2) 10^{-10} atm

(3) 10^{-4} atm

(4) 10^{-14} atm

Answer (4)

Sol. $2H^+ + 2e^- \rightarrow H_2(g)$
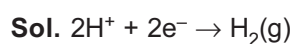
$E = E° - \dfrac{0.0591}{2} \times \log\dfrac{P_{H_2}}{[H^+]^2}$

$= 0 - \dfrac{0.0591}{2} \times \log\dfrac{P_{H_2}}{(10^{-7})^2}$

$\therefore$ For potential of H_2 electrode to be zero, P_{H_2} should be 10^{-14} i.e., $\log\dfrac{10^{-14}}{10^{-14}} = 0$

38. The **correct** statement regarding RNA and DNA, respectively is

(1) The sugar component in RNA is ribose and the sugar component in DNA is 2′-deoxyribose

(2) The sugar component in RNA is arabinose and the sugar component in DNA is ribose

(3) The sugar component in RNA is 2′-deoxyribose and the sugar component in DNA is arabinose

(4) The sugar component in RNA is arabinose and the sugar component in DNA is 2′-deoxyribose

Answer (1)

Sol. Fact.

39. Which one given below is a non-reducing sugar?

(1) Lactose

(2) Glucose

(3) Sucrose

(4) Maltose

Answer (3)

Sol. Sucrose is non-reducing sugar because reducing parts of glucose and fructose are involved in glycosidic linkage.

40. Which of the following statements about hydrogen is **incorrect?**

    (1) Hydrogen never acts as cation in ionic salts

    (2) Hydronium ion, H_3O^+ exists freely in solution

    (3) Dihydrogen does not act as a reducing agent

    (4) Hydrogen has three isotopes of which tritium is the most common

Answer (3 & 4)

Sol. Fact.

41. Consider the following liquid-vapour equilibrium.

    Liquid $\rightleftharpoons$ Vapour

    Which of the following relations is correct?

    (1) $\dfrac{d\ln P}{dT} = \dfrac{-\Delta H_v}{RT}$

    (2) $\dfrac{d\ln P}{dT^2} = \dfrac{-\Delta H_v}{T^2}$

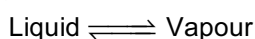   (3) $\dfrac{d\ln P}{dT} = \dfrac{\Delta H_v}{RT^2}$

    (4) $\dfrac{d\ln G}{dT^2} = \dfrac{\Delta H_v}{RT^2}$

Answer (3)

Sol. Fact.

42. Which of the following biphenyl is optically active?

    (1)

    (2)

    (3)

    (4)
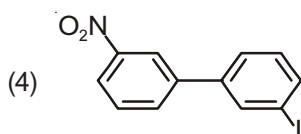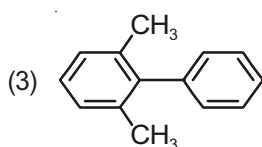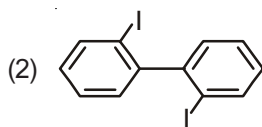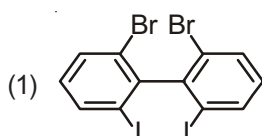
Answer (1)

Sol. Due to steric hindrance, arising due to presence of bulkier groups at ortho-positions of benzene rings, the biphenyl system becomes non-planar *i.e.*, optically active.

43. Which of the following statements is false?

    (1) Ca^{2+} ions are important in blood clotting

    (2) Ca^{2+} ions are not important in maintaining the regular beating of the heart

    (3) Mg^{2+} ions are important in the green parts of plants

    (4) Mg^{2+} ions form a complex with ATP

Answer (2)

Sol. Fact.

44. The ionic radii of A^+ and B^- ions are 0.98×10^{-10} m and 1.81×10^{-10} m. The coordination number of each ion in AB is

    (1) 4

    (2) 8

    (3) 2

    (4) 6

Answer (4)

Sol. $\dfrac{r_{(+)}}{r_{(-)}} = \dfrac{0.98 \times 10^{-10}}{1.81 \times 10^{-10}} = 0.54$

i.e., Ionic solid has octahedral geometry, thus co-ordination number of each ion in AB is 6.

45. The rate of a first-order reaction is 0.04 mol l^{-1} s^{-1} at 10 seconds and 0.03 mol l^{-1} s^{-1} at 20 seconds after initiation of the reaction. The half-life period of the reaction is

    (1) 34.1 s

    (2) 44.1 s

    (3) 54.1 s

    (4) 24.1 s

Answer (4)

Sol. $K = \dfrac{2.303}{10} \times \log \dfrac{0.04}{0.03}$

$= \dfrac{2.303 \times 0.124}{10}$

$\therefore\ t_{1/2} = \dfrac{2.303 \times 0.301 \times 10}{2.303 \times 0.124}$

$= 24.27$ s

$\therefore\ t_{1/2} \approx 24.1$ s

46. The two polypeptides of human insulin are linked together by

    (1) Phosphodiester bond

    (2) Covalent bond

    (3) Disulphide bridges

    (4) Hydrogen bonds

Answer (3)

Sol. Mature insulin has two polypeptide chains (A and B) which are linked together by disulphide linkages (bridges).

47. The coconut water from tender coconut represents

    (1) Fleshy mesocarp

    (2) Free nuclear proembryo

    (3) Free nuclear endosperm

    (4) Endocarp

Answer (3)

Sol. Coconut milk represents free nuclear endosperm where the division of PEN is not followed by cytokinesis.

48. Which of the following is **not** a feature of the plasmids?

    (1) Circular structure

    (2) Transferable

    (3) Single-stranded

    (4) Independent replication

Answer (3)

Sol. Plasmid is extrachromosomal, double stranded circular DNA.

49. Which is the National Aquatic Animal of India?

    (1) River dolphin   (2) Blue whale

    (3) Sea-horse   (4) Gangetic shark

Answer (1)

Sol. River Dolphin is the national aquatic animal of India. This mammal can only survive in pure and fresh water.

50. The avena curvature is used for bioassay of

    (1) GA_3 (2) IAA

    (3) Ethylene   (4) ABA

Answer (2)

Sol. Bioassay - It is a quantitative and qualitative test used to determine the nature and function of a biochemical by using living material e.g., *Avena* curvature test used as bioassay for auxins.

51. Which of the following is the most important cause of animals and plants being driven to extinction?

    (1) Alien species invasion

    (2) Habitat loss and fragmentation

    (3) Co-extinctions

    (4) Over-exploitation

Answer (2)

Sol. There are four major causes of biodiversity loss in which most important cause driving animals and plants to extinction is "habitat loss and fragmentation".

52. Which of the following approaches does **not** give the defined action of contraceptive?

(1)	Intra uterine devices	Increase phagocytosis of sperms, suppress sperm motility and fertilizing capacity of sperms
(2)	Hormonal contraceptives	Prevent/retard entry of sperms, prevent ovulation and fertilization
(3)	Vasectomy	Prevents spermatogenesis
(4)	Barrier methods	Prevent fertilization

Answer (3)

Sol. Vasectomy blocks the gamete transport and does not affect spermatogenesis.

53. In a testcross involving F_1 dihybrid flies, more parental-type offspring were produced than the recombinant-type offspring. This indicates

    (1) Chromosomes failed to separate during meiosis

    (2) The two genes are linked and present on the same chromosome

    (3) Both of the characters are controlled by more than one gene

    (4) The two genes are located on two different chromosomes

Answer (2)

Sol. When two genes in a dihybrid cross are situated on the same chromosome, the proportion of parental gene combinations are much higher than the non-parental or recombinant type.

54. A typical fat molecule is made up of

    (1) One glycerol and three fatty acid molecules

    (2) One glycerol and one fatty acid molecule

    (3) Three glycerol and three fatty acid molecules

    (4) Three glycerol molecules and one fatty acid molecule

Answer (1)

Sol. A typical fat molecule is triglyceride formed by esterification of one glycerol and three fatty acid molecules.

55. Match the terms in **Column I** with their description in **Column II** and choose the correct option

	Column I		Column II
(a)	Dominance	(i)	Many genes govern a single character
(b)	Codominance	(ii)	In a heterozygous organism only one allele expresses itself
(c)	Pleiotropy	(iii)	In a heterozygous organism both alleles express themselves fully
(d)	Polygenic inheritance	(iv)	A single gene influences many characters

(1) a(ii), b(iii), c(iv), d(i)   (2) a(iv), b(i), c(ii), d(iii)

(3) a(iv), b(iii), c(i), d(ii)   (4) a(ii), b(i), c(iv), d(iii)

Answer (1)

Sol.
Dominance – Expression of only one allele in heterozygous organism.

Codominance – Side by side full expression of both alleles. F_1 resembles both parents.

Pleiotropy – Single gene can exhibit multiple phenotypic expression e.g., Phenyl ketonuria.

Polygenic inheritance – Many genes govern a single character e.g., Human skin colour.

56. Which of the following statements is **not correct**?

(1) Insects that consume pollen or nectar without bringing about pollination are called pollen/nectar robbers

(2) Pollen germination and pollen tube growth are regulated by chemical components of pollen interacting with those of the pistil

(3) Some reptiles have also been reported as pollinators in some plant species

(4) Pollen grains of many species can germinate on the stigma of a flower, but only one pollen tube of the same species grows into the style

Answer (4)

Sol. Pollen grains of different species are incompatible, so they fail to germinate.

57. Which of the following features is not present in *Periplaneta americana*?

(1) Indeterminate and radial cleavage during embryonic development

(2) Exoskeleton composed of N-acetylglucosamine

(3) Metamerically segmented body

(4) Schizocoelom as body cavity

Answer (1)

Sol. Cockroach has determinate cleavage during embryonic development.

58. Water soluble pigments found in plant cell vacuoles are

(1) Chlorophylls   (2) Carotenoids

(3) Anthocyanins   (4) Xanthophylls

Answer (3)

Sol. Anthocyanin are water soluble vacuolar pigments that may appear red, purple or blue depending on pH.

59. A cell at telophase stage is observed by a student in a plant brought from the field. He tells his teacher that this cell is not like other cells at telophase stage. There is no formation of cell plate and thus the cell is containing more number of chromosomes as compared to other dividing cells. This would result in

(1) Polyploidy   (2) Somaclonal variation

(3) Polyteny   (4) Aneuploidy

Answer (1)

Sol. Polyploidy cells have a chromosome number that is more than double the haploid number.

60. A plant in your garden avoids photorespiratory losses, has improved water use efficiency, shows high rates of photosynthesis at high temperatures and has improved efficiency of nitrogen utilisation. In which of the following physiological groups would you assign this plant?

(1) C_4 (2) CAM

(3) Nitrogen fixer   (4) C_3

Answer (1)

Sol. C_4 plants are special, they tolerate higher temperatures, they lack photorespiration and have greater productivity of biomass.

61. In higher vertebrates, the immune system can distinguish self-cells and non-self. If this property is lost due to genetic abnormality and it attacks self-cells, then it leads to

    (1) Graft rejection
    (2) Auto-immune disease
    (3) Active immunity
    (4) Allergic response

Answer (2)

Sol. In autoimmune diseases, the immune cells are unable to distinguish between self cells and non-self cells and attack self cells.

62. Emerson's enhancement effect and Red drop have been instrumental in the discovery of

    (1) Two photosystems operating simultaneously
    (2) Photophosphorylation and cyclic electron transport
    (3) Oxidative phosphorylation
    (4) Photophosphorylation and non-cyclic electron transport

Answer (1)

Sol. Emerson performed photosynthetic experiment on *chlorella*. He provided monochromatic light of more than 680 nm and observed decrease in rate of photosynthesis known as red drop.

Later he provided synchronised light of 680 nm and 700 nm and observed increase in rate of photosynthesis, known as enhancement effect.

This experiment led to discovery of two photosystems. - PS II and PS I.

63. Select the correct statement

    (1) *Salvinia, Ginkgo* and *Pinus* all are gymnosperms
    (2) *Sequoia* is one of the tallest trees
    (3) The leaves of gymnosperms are not well adapted to extremes of climate
    (4) Gymnosperms are both homosporous and heterosporous

Answer (2)

Sol. *Sequoia* is one of the tallest tree species, known as red wood tree.

64. Which of the following is not a characteristic feature during mitosis in somatic cells?

    (1) Disappearance of nucleolus
    (2) Chromosome movement
    (3) Synapsis
    (4) Spindle fibres

Answer (3)

Sol. Synapsis is pairing of homologous chromosomes. It occurs during zygotene stage of meiosis.

65. Blood pressure in the pulmonary artery is

    (1) More than that in the carotid
    (2) More than that in the pulmonary vein
    (3) Less than that in the venae cavae
    (4) Same as that in the aorta

Answer (2)

Sol. Blood pressure in different blood vessels:

Artery > Arteriole > Capillary > Venule > Vein (Vena cava)

66. Which of the following structures is homologus to the wing of a bird?

    (1) Wing of a Moth
    (2) Hind limb of Rabbit
    (3) Flipper of Whale
    (4) Dorsal fin of a Shark

Answer (3)

Sol. Wings of bird and flipper of whale are modified fore limbs but wings help in flying and flippers help in swimming.

67. Seed formation without fertilization in flowering plants involves the process of

    (1) Budding
    (2) Somatic hybridization
    (3) Apomixis
    (4) Sporulation

Answer (3)

Sol. Apomixis is a special mechanism to produce seeds without fertilisation.

68. Name the chronic respiratory disorder caused mainly by cigarette smoking

    (1) Asthma
    (2) Respiratory acidosis
    (3) Respiratory alkalosis
    (4) Emphysema

Answer (4)

Sol. Emphysema is characterised by inflation of alveoli which is mainly due to chronic cigarette smoking.

69. Spindle fibres attach on to:

    (1) Kinetochore of the chromosome
    (2) Centromere of the chromosome
    (3) Kinetosome of the chromosome
    (4) Telomere of the chromosome

Answer (1)

Sol. Spindle fibres attach to kinetochores of chromosomes

70. In context of amniocentesis, which of the following statement is incorrect?

    (1) It is used for prenatal sex determination.

    (2) It can be used for detection of Down syndrome.

    (3) It can be used for detection of Cleft palate.

    (4) It is usually done when a woman is between 14 - 16 weeks pregnant.

Answer (3)

Sol. Cleft palate is a developmental abnormality and can be detected by sonography.

Amniocentesis is a foetal sex determination test and is banned in India for sex determination to legally check increasing female foeticides.

71. Stems modified into flat green organs performing the functions of leaves are known as

    (1) Phyllodes   (2) Phylloclades

    (3) Scales   (4) Cladodes

Answer (2)

Sol. Phylloclades are modified stem, *i.e.*, green flat structure as in Opuntia.

72. In a chloroplast the highest number of protons are found in

    (1) Lumen of thylakoids

    (2) Inter membrane space

    (3) Antennae complex

    (4) Stroma

Answer (1)

Sol. Proton concentration is higher in the lumen of thylakoid due to photolysis of water, H^+ pumping and NADP reductase activity in stroma.

73. Nomenclature is governed by certain universal rules. Which one of the following is contrary to the rules of nomenclature?

    (1) The first word in a biological name represents the genus name and the second is a specific epithet

    (2) The names are written in Latin and are italicised

    (3) When written by hand, the names are to be underlined

    (4) Biological names can be written in any language

Answer (4)

Sol. Biological names originate from latin language and printed in italics

74. In meiosis crossing over is initiated at

    (1) Leptotene   (2) Zygotene

    (3) Diplotene   (4) Pachytene

Answer (4)

Sol. Leptotene   - Condensation of chromatin

Zygotene   - Synapsis of homologous chromosomes

Pachytene - Crossing over

Diplotene   - Dissolution of synaptonemal complex and appearance of chiasmata

Diakinesis - Terminalisation of chiasmata

75. Antivenom injection contains preformed antibodies while polio drops that are administered into the body contain

    (1) Harvested antibodies

    (2) Gamma globulin

    (3) Attenuated pathogens

    (4) Activated pathogens

Answer (3)

Sol. Oral polio vaccine consists of attenuated pathogen.

76. The taq polymerase enzyme is obtained from

    (1) *Thiobacillus ferroxidans*

    (2) *Bacillus subtilis*

    (3) *Pseudomonas putida*

    (4) *Thermus aquaticus*

Answer (4)

Sol. Taq polymerase is thermostable DNA polymerase obtained from *Thermus aquaticus*

77. Which of the following most appropriately describes haemophilia?

    (1) X-linked recessive gene disorder

    (2) Chromosomal disorder

    (3) Dominant gene disorder

    (4) Recessive gene disorder

Answer (1)

Sol. Haemophilia is X-linked recessive gene disorder. It is a blood clotting disorder and shows criss-cross inheritance.
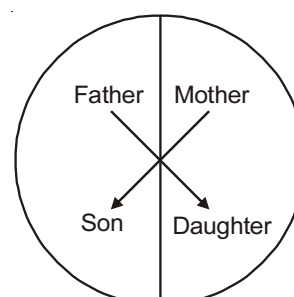
78. The standard petal of a papilionaceous corolla is also called
    (1) Pappus
    (2) Vexillum
    (3) Corona
    (4) Carina

Answer (2)

Sol. The standard petal of a papilionaceous corolla is also called vexillum.

79. Which part of the tobacco plant is infected by *Meloidogyne incognita?*
    (1) Leaf
    (2) Stem
    (3) Root
    (4) Flower

Answer (3)

Sol. *Meloidogyne incognita* cause root knot disease in tobacco plant.

80. Which of the following statements is **wrong** for viroids?
    (1) They are smaller than viruses
    (2) They causes infections
    (3) Their RNA is of high molecular weight
    (4) They lack a protein coat

Answer (3)

Sol. Viroids have RNA of low molecular weight.

81. Which of the following statements is not true for cancer cells in relation to mutations?
    (1) Mutations destroy telomerase inhibitor
    (2) Mutations inactivate the cell control
    (3) Mutations inhibit production of telomerase
    (4) Mutations in proto-oncogenes accelerate the cell cycle

Answer (3)

Sol. Cancerous cells have high telomerase activity. Telomerase inhibitors are used in cancer treatment.

82. Which type of tissue **correctly** matches with its location?

	Tissue	Location
(1)	Areolar tissue	Tendons
(2)	Transitional epithelium	Tip of nose
(3)	Cuboidal epithelium	Lining of stomach
(4)	Smooth muscle	Wall of intestine

Answer (4)

Sol. Columnar epithelium is present in the lining of stomach.
   ● Tendon is dense connective tissue and connects muscle to bone.
   ● Tip of nose consists of elastic cartilage.

83. Which of the following pairs of hormones are **not** antagonistic (having opposite effects) to each other?
    (1) Insulin   -   Glucagon
    (2) Aldosterone   -   Atrial Natriuretic Factor
    (3) Relaxin   -   Inhibin
    (4) Parathormone   -   Calcitonin

Answer (3)

Sol. Relaxin relaxes the pubic symphysis during parturition while inhibin decreases the secretion of FSH from anterior pituitary.

84. Specialised epidermal cells surrounding the guard cells are called
    (1) Subsidiary cells   (2) Bulliform cells
    (3) Lenticels   (4) Complementary cells

Answer (1)

Sol. Few epidermal cells, in the vicinity of the guard cells become specialised in their shape and size and are known as subsidiary cells.

The stomatal aperture, guard cells and the surrounding subsidiary cells are together called **stomatal apparatus**.

85. Fertilization in humans is practically feasible only if
    (1) The ovum and sperms are transported simultaneously to ampullary - isthmic junction of the fallopian tube
    (2) The ovum and sperms are transported simultaneously to ampullary - isthmic junction of the cervix
    (3) The sperms are transported into cervix within 48 hrs of release of ovum in uterus
    (4) The sperms are transported into vagina just after the release of ovum in fallopian tube

Answer (1)

Sol. Fertilization in human is practically feasible only if the sperms and ovum are transported simultaneously at ampullary-isthmic junction.

86. Which one of the following is the starter codon?

    (1) UGA   (2) UAA

    (3) UAG   (4) AUG

Answer (4)

Sol. AUG is the start codon.

UAA, UAG and UGA are stop codons.

87. A river with an inflow of domestic sewage rich in organic waste may result in

    (1) Increased population of aquatic food web organisms

    (2) An increased production of fish due to biodegradable nutrients

    (3) Death of fish due to lack of oxygen

    (4) Drying of the river very soon due to algal bloom

Answer (3)

Sol. A river with an inflow of domestic sewage rich in organic waste will reduce the dissolved oxygen (DO) and may result in death of fish due to lack of oxygen.

88. Following are the two statements regarding the origin of life

    (a) The earliest organisms that appeared on the earth were non-green and presumably anaerobes.

    (b) The first autotrophic organisms were the chemoautotrophs that never released oxygen.

    On the above statements which one of the following options is **correct**?

    (1) (b) is correct but (a) is false

    (2) Both (a) & (b) are correct

    (3) Both (a) & (b) are false

    (4) (a) is correct but (b) is false

Answer (2)

Sol. The earliest organisms that appeared on earth were anaerobic chemoheterotrophs.

Chemoautotrophs were the first autotrophic organisms unable to perform photolysis of water and never released oxygen.

89. A system of rotating crops with legume or grass pasture to imporve soil structure and fertility is called

    (1) Contour farming   (2) Strip farming

    (3) Shifting agriculture   (4) Ley farming

Answer (4)

Sol. The growing of granes or legumes in rotation with grain or tilled crops as a soil conservation measure.

90. Gause's principle of competitive exclusion states that

    (1) Competition for the same resources excludes species having different food preferences

    (2) No two species can occupy the same niche indefinitely for the same limiting resources

    (3) Larger organisms exclude smaller ones through competition

    (4) More abundant species will exclude the less abundant species through competition

Answer (2)

Sol. Gause's principle of competitive exclusion states that no two species can occupy the same niche indefinitely for the same limiting resources.

91. Which of the following characteristic features always holds true for the corresponding group of animals?

(1)	Viviparous	Mammalia
(2)	Possess a mouth with an upper and a lower jaw	Chordata
(3)	3-chambered heart with one incompletely divided ventricle	Reptilia
(4)	Cartilaginous endoskeleton	Chondrichthyes

Answer (4)

Sol. Reptiles have 3-chambered heart except crocodiles. Mammals are viviparous except prototherian mammals; chordates have jaws except protochordates and cyclostomes.

92. Changes in GnRH pulse frequency in females is controlled by circulating levels of

    (1) Estrogen and inhibin

    (2) Progesterone only

    (3) Progesterone and inhibin

    (4) Estrogen and progesterone

Answer (4)

Sol. High level of estrogen and progesterone gives negative feedback to hypothalamus for the release of GnRH.

93. Microtubules are the constituents of

    (1) Spindle fibres, Centrioles and Cilia

    (2) Centrioles, Spindle fibres and Chromatin

    (3) Centrosome, Nucleosome and Centrioles

    (4) Cilia, Flagella and Peroxisomes

Answer (1)

Sol. Microtubules are structures present in cilia, flagella, centrioles and spindle fibres.

94. Mitochondria and chloroplast are

    (a) semi-autonomous organelles

    (b) formed by division of pre-existing organelles and they contain DNA but lack protein synthesizing machinery

    Which one of the following options is **correct**?

    (1) (b) is true but (a) is false

    (2) (a) is true but (b) is false

    (3) Both (a) and (b) are false

    (4) Both (a) and (b) are correct

Answer (2)

Sol. Mitochondria and chloroplast are semi-autonomous organelles which contains DNA, RNA, ribosomes (70S) etc.

95. Photosensitive compound in human eye is made up of

    (1) Opsin and Retinal

    (2) Opsin and Retinol

    (3) Transducin and Retinene

    (4) Guanosine and Retinol

Answer (1)

Sol. Photosensitive pigment rhodopsin in human eye is made up of opsin protein and retinal [aldehyde form of vitamin A (Retinol)]

96. Chrysophytes, Euglenoids, Dinoflagellates and Slime moulds are included in the kingdom

    (1) Protista   (2) Fungi

    (3) Animalia   (4) Monera

Answer (1)

Sol. All single celled eukaryotes like chrysophytes [diatoms and desmids], Euglenoids [*Euglena*], Dinoflagellates and slime moulds are included in kingdom -Protista.

97. The primitive prokaryotes responsible for the production of biogas from the dung of ruminant animals, include the

    (1) Thermoacidophiles   (2) Methanogens

    (3) Eubacteria   (4) Halophiles

Answer (2)

Sol. Methanogens are obligate anaerobic ancient and primitive bacteria. They are involved in methanogenesis.

98. Identify the correct statement on inhibin

    (1) Is produced by granulose cells in ovary and inhibits the secretion of FSH

    (2) Is produced by granulose cells in ovary and inhibits the secretion of LH

    (3) Is produced by nurse cells in testes and inhibits the secretion of LH

    (4) Inhibits the secretion of LH, FSH and Prolactin

Answer (1)

Sol. Inhibin is produced by granulosa cells in ovary and has direct effect on the secretion of FSH.

99. It is much easier for a small animal to run uphill than for a large animal, because

    (1) Smaller animals have a higher metabolic rate

    (2) Small animals have a lower O_2 requirement

    (3) The efficiency of muscles in large animals is less than in the small animals

    (4) It is easier to carry a small body weight

Answer (1)

Sol. Basal metabolic rate is inversely proportional to body size. So smaller animals have a higher metabolic rate.

100. A tall true breeding garden pea plant is crossed with a dwarf true breeding garden pea plant. When the F_1 plants were selfed the resulting genotypes were in the ratio of

    (1) 1 : 2 : 1 : : Tall heterozygous : Tall homozygous : Dwarf

    (2) 3 : 1 : : Tall : Dwarf

    (3) 3 : 1 : : Dwarf : Tall

    (4) 1 : 2 : 1 : : Tall homozygous : Tall heterozygous : Dwarf

Answer (4)

Sol.

Parents - TT   ×   tt
        (Tall)   (Dwarf)

F_1 generation   →   Tt (Heterozygous tall)

On selfing

Pollen → egg	T	t
T	TT (Tall)	Tt (Tall)
t	Tt (Tall)	tt (dwarf)

F_2 generation

Phenotypic ratio = 3 : 1 [Tall : Dwarf]

Genotypic ratio ⇒

1 : 2 : 1 [Homozygous tall : Heterozygous tall : Dwarf]

101. Depletion of which gas in the atmosphere can lead to an increased incidence of skin cancers

    (1) Ozone
    (2) Ammonia
    (3) Methane
    (4) Nitrous oxide

Answer (1)

Sol. Ozone is found in the upper part of the atmosphere called stratosphere and it acts as a shield absorbing ultraviolet radiation from sun and so its depletion can lead to incidence of skin cancers.

102. Which one of the following is a characteristic feature of cropland ecosystem?

    (1) Least genetic diversity
    (2) Absence of weeds
    (3) Ecological succession
    (4) Absence of soil organisms

Answer (1)

Sol. Cropland ecosystem is largest anthropogenic ecosystem characterised by less diversity and high productivity.

103. Tricarpellary, syncarpous gynoecium is found in flowers of

    (1) Solanaceae
    (2) Fabaceae
    (3) Poaceae
    (4) Liliaceae

Answer (4)

Sol. Liliaceae represents $\underline{G}(3)$.

104. In which of the following all three are macronutrients?

    (1) Iron, copper, molybdenum
    (2) Molybdenum, magnesium, manganese
    (3) Nitrogen, nickel, phosphorus
    (4) Boron, zinc, manganese

Answer (3)

Sol. None of the option is correct w.r.t. question statement. The option (1) seems to be more appropriate.

105. Reduction in pH of blood will

    (1) Reduce the blood supply to the brain
    (2) Decrease the affinity of hemoglobin with oxygen
    (3) Release bicarbonate ions by the liver
    (4) Reduce the rate of heart beat

Answer (2)

Sol. Reduction in pH of blood favours the dissociation of oxyhemoglobin.

106. Lack of relaxation between successive stimuli in sustained muscle contraction is known as

    (1) Fatigue
    (2) Tetanus
    (3) Tonus
    (4) Spasm

Answer (2)

Sol. Sustained muscle contraction due to repeated stimulus is known as tetanus.

107. Which one of the following statements is **wrong**?

    (1) Golden algae are also called desmids
    (2) Eubacteria are also called false bacteria
    (3) Phycomycetes are also called algal fungi
    (4) Cyanobacteria are also called blue-green algae

Answer (2)

Sol. Eubacteria are true bacteria.

108. Which of the following is a restriction endonuclease?

    (1) Protease
    (2) DNase I
    (3) RNase
    (4) Hind II

Answer (4)

Sol. Hind II is a restriction endonuclease.

109. Which of the following would appear as the pioneer organisms on bare rocks?

    (1) Liverworts
    (2) Mosses
    (3) Green algae
    (4) Lichens

Answer (4)

Sol. Pioneer species are the species that invade a bare area.

In primary succession on rocks these are lichens which are able to secrete acids to dissolve rock, helping in weathering and soil formation.

110. Water vapour comes out from the plant leaf through the stomatal opening. Through the same stomatal opening carbon dioxide diffuses into the plant during photosynthesis. Reason out the above statements using one of following options :

    (1) Both processes can happen together because the diffusion coefficient of water and CO_2 is different
    (2) The above processes happen only during night time
    (3) One process occurs during day time, and the other at night
    (4) Both processes cannot happen simultaneously

Answer (1)

Sol. Diffusion of water vapour and CO_2 are independent process. Their diffusion depends on the difference in their partial pressure.

111. Cotyledon of maize gain is called

(1) Coleorhiza   (2) Coleoptile

(3) Scutellum   (4) Plumule

Answer (3)

Sol. Large, shield shaped cotyledon of grass family is called scutellum.

112. Which of the following guards the opening of hepatopancreatic duct into the duodenum?

(1) Ileocaecal valve

(2) Pyloric sphincter

(3) Sphincter of Oddi

(4) Semilunar valve

Answer (3)

Sol. Sphincter of Oddi guards the opening of hepatopancreatic duct into the duodenum.

113. In the stomach, gastric acid is secreted by the

(1) Parietal cells   (2) Peptic cells

(3) Acidic cells   (4) Gastrin secreting cells

Answer (1)

Sol. In stomach, gastric acid (HCl) is secreted by parietal cells of gastric gland

114. In mammals, which blood vessel would normally carry largest amount of urea?

(1) Dorsal Aorta   (2) Hepatic Vein

(3) Hepatic Portal Vein   (4) Renal Vein

Answer (2)

Sol. Urea is synthesized in liver. So maximum amount of urea is present in hepatic vein and minimum in renal vein.

115. The term ecosystem was coined by

(1) A.G. Tansley   (2) E. Haeckel

(3) E. Warming   (4) E.P. Odum

Answer (1)

Sol. The term ecosystem was coined by A.G. Tansley.

116. Which of the following is required as inducer(s) for the expression of Lac operon?

(1) Galactose

(2) Lactose

(3) Lactose and Galactose

(4) Glucose

Answer (2)

Sol. *Lac* operon is an inducible operon. Lactose is the substrate for the enzyme beta-galactosidase and it also regulates switching on and off of the operon. Hence, it is termed as inducer.

117. Which of the following is wrongly matched in the given table?

	Microbe	Product	Application
(1)	*Monascus purpureus*	Statins	lowering of blood cholesterol
(2)	*Streptococcus*	Streptokinase	removal of clot from blood vessel
(3)	*Clostridium butylicum*	Lipase	removal of oil stains
(4)	*Trichoderma polysporum*	Cyclosporin A	immunosuppressive drug

Answer (3)

Sol. Butyric acid is produced by fermentive activity of *Clostridium butylicum*.

118. When does the growth rate of a population following the logistic model equal zero? The logistic model is given as dN/dt = rN(1-N/K)

(1) When N nears the carrying capacity of the habitat

(2) When N/K equals zero

(3) When death rate is greater than birth rate

(4) When N/K is exactly one

Answer (4)

Sol. In logistic growth model population growth equation is described as

$$\frac{dN}{dt} = rN\left(\frac{K-N}{K}\right)$$

where   N = population density at time t

r = Intrinsic rate of natural increase

K = carrying capacity

when $\frac{N}{K} = 1$ then $\frac{K-N}{K} = 0$

therefore $\frac{dN}{dt} = 0$

119. Which one of the following statements is **not** true?

    (1) Exine of pollen grains is made up of sporopollenin

    (2) Pollen grains of many species cause severe allergies

    (3) Stored pollen in liquid nitrogen can be used in the crop breeding programmes

    (4) Tapetum helps in the dehiscence of anther

Answer (4)

Sol. Tapetum provides nourishment to developing pollen grain.

120. In bryophytes and pteridophytes, transport of male gametes requires:

    (1) Insects   (2) Birds

    (3) Water   (4) Wind

Answer (3)

Sol. In several simple plants like algae, bryophytes and pteridophytes, water is the medium through which male gamete transfer takes place.

121. Which of the following is **not** a stem modification?

    (1) Thorns of citrus

    (2) Tendrils of cucumber

    (3) Flattened structures of *Opuntia*

    (4) Pitcher of *Nepenthes*

Answer (4)

Sol. Pitcher of *Nepenthes* is modified leaf.

122. Which one of the following cell organelles is enclosed by a single membrane?

    (1) Chloroplasts   (2) Lysosomes

    (3) Nuclei   (4) Mitochondria

Answer (2)

Sol. Nuclei, mitochondria and chloroplasts are double membrane bound organelles. Lysosomes are single membrane bound organelle.

123. Analogous structures are a result of

    (1) Convergent evolution

    (2) Shared ancestry

    (3) Stabilizing selection

    (4) Divergent evolution

Answer (1)

Sol. Analogous structures are a result of convergent evolution.

124. Which one of the following statements is wrong?

    (1) Cellulose is a polysaccharide

    (2) Uracil is a pyrimidine

    (3) Glycine is a sulphur containing amino acid

    (4) Sucrose is a disaccharide

Answer (3)

Sol. Glycine is simplest amino acid in which 'R' is replaced by H(Hydrogen).

125. Proximal end of the filament of stamen is attached to the

    (1) Connective

    (2) Placenta

    (3) Thalamus or petal

    (4) Anther

Answer (3)

Sol. A typical stamen consist of anther and filament.

    The proximal end of filament is attached to thalamus or petal of the flower where as distal and bears anther.

126. Which of the following is not required for any of the techniques of DNA fingerprinting available at present?

    (1) Zinc finger analysis

    (2) Restriction enzymes

    (3) DNA-DNA hybridization

    (4) Polymerase chain reaction

Answer (1)

Sol. A zinc finger is a small protein structural motif that characterised by the co-ordination of one or more Zn ions in order to stabilise the folds.

127. Which one of the following characteristics is **not** shared by birds and mammals?

    (1) Breathing using lungs

    (2) Viviparity

    (3) Warm blooded nature

    (4) Ossified endoskeleton

Answer (2)

Sol. Mammals are viviparous while birds are oviparous.

128. Select the **incorrect** statement :

    (1) LH triggers ovulation in ovary

    (2) LH and FSH decrease gradually during the follicular phase

    (3) LH triggers secretion of androgens from the Leydig cells

    (4) FSH stimulates the sertoli cells which help in spermiogenesis

Answer (2)

Sol. In follicular phase of menstrual cycle, LH and FSH increase gradually.

129. The amino acid Tryptophan is the precursor for the synthesis of

    (1) Thyroxine and Triiodothyronine

    (2) Estrogen and Progesterone

    (3) Cortisol and Cortisone

    (4) Melatonin and Serotonin

Answer (4)

Sol. Melatonin and serotonin are derivatives of tryptophan amino acid while thyroxine and tri-iodothyronine are tyrosine amino acid derivatives.

130. Joint Forest Management Concept was introduced in India during

    (1) 1970s   (2) 1980s

    (3) 1990s   (4) 1960s

Answer (2)

Sol. Joint Forest Management Concept was introduced in India during 1980s by the Government of India to work closely with the local communities for protecting and managing forests.

131. One of the major components of cell wall of most fungi is

    (1) Peptidoglycan   (2) Cellulose

    (3) Hemicellulose   (4) Chitin

Answer (4)

Sol. Cell wall of most fungi is made up of chitin.

132. A complex of ribosomes attached to a single strand of RNA is known

    (1) Polymer

    (2) Polypeptide

    (3) Okazaki fragment

    (4) Polysome

Answer (4)

Sol. In prokaryotes, several ribosomes may attach to single mRNA and form a chain called polyribosomes or polysomes.

133. Which of the following features is not present in the Phylum-Arthropoda?

    (1) Metameric segmentation

    (2) Parapodia

    (3) Jointed appendages

    (4) Chitinous exoskeleton

Answer (2)

Sol. Parapodia are present in aquatic annelids like *Nereis* and helps in swimming.

134. Asthma may be attributed to

    (1) Allergic reaction of the mast cells in the lungs

    (2) Inflammation of the trachea

    (3) Accumulation of fluid in the lungs

    (4) Bacterial infection of the lungs

Answer (1)

Sol. Asthma is an allergic reaction characterised by spasm of bronchi muscles because of effect of histamine released by mast cells.

135. Pick out the **correct** statements :

    (a) Haemophilia is a sex-linked recessive disease.

    (b) Down's syndrome is due to aneuploidy.

    (c) Phenylketonuria is an autosomal recessive gene disorder.

    (d) Sickle cell anaemia is an X-linked recessive gene disorder.

    (1) (b) and (d) are correct

    (2) (a), (c) and (d) are correct

    (3) (a), (b) and (c) are correct

    (4) (a) and (d) are correct

Answer (3)

Sol. Sickle cell anaemia is autosomal recessive gene disorder.

136. A capacitor of 2 μF is charged as shown in the diagram. When the switch S is turned to position 2, the percentage of its stored energy dissipated is
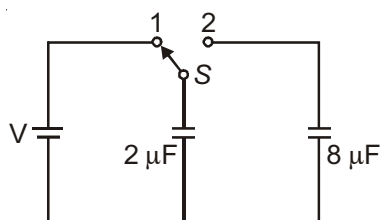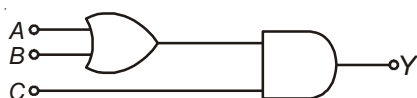

(1) 20% (2) 75%

(3) 80% (4) 0%

Answer (3)

Sol. Initial energy stored = $\dfrac{1}{2}(2\,\mu F)\times V^2$

Energy dissipated on connection across 8 μF

$$= \frac{1}{2}\frac{C_1C_2}{C_1+C_2}V^2$$

$$= \frac{1}{2}\times\frac{2\,\mu F\times 8\,\mu F}{10\,\mu F}\times V^2$$

$$= \frac{1}{2}\times(1.6\,\mu F)\,V^2$$

% loss of energy = $\dfrac{1.6}{2}\times 100 = 80\%$

137. To get output 1 for the following circuit, the correct choice for the input is

(1) $A = 1, B = 0, C = 0$

(2) $A = 1, B = 1, C = 0$

(3) $A = 1, B = 0, C = 1$

(4) $A = 0, B = 1, C = 0$

Answer (3)

Sol.

$Y = (A + B).C$

To get $Y = 1$, C should be 1.

138. A potentiometer wire is 100 cm long and a constant potential difference is maintained across it. Two cells are connected in series first to support one another and then in opposite direction. The balance points are obtained at 50 cm and 10 cm from the positive end of the wire in the two cases. The ratio of emf's is

(1) 5 : 4 (2) 3 : 4

(3) 3 : 2 (4) 5 : 1

Answer (3)

Sol. Potentiometer $E \propto I$

$$\Rightarrow \frac{E_1+E_2}{E_1-E_2} = \frac{50}{10} = \frac{5}{1}$$

$$\Rightarrow \frac{E_1}{E_2} = \frac{5+1}{5-1} = \frac{6}{4} = \frac{3}{2}$$

139. When a metallic surface is illuminated with radiation of wavelength λ, the stopping potential is V. If the same surface is illuminated with radiation of wavelength 2λ, the stopping potential is $\dfrac{V}{4}$. The threshold wavelength for the metallic surface is

(1) 5λ (2) $\dfrac{5}{2}\lambda$

(3) 3λ (4) 4λ

Answer (3)

Sol. Einstein P.E. equation

Case-I

$$eV = \frac{hc}{\lambda} - \frac{hc}{\lambda_0} \qquad \text{...(1)}$$

Case-II

$$e\frac{V}{4} = \frac{hc}{2\lambda} - \frac{hc}{\lambda_0}$$

$$\Rightarrow eV = \frac{4hc}{2\lambda} - \frac{4hc}{\lambda_0} \qquad \text{...(2)}$$

Equation (1) – (2)

$$\frac{hc}{\lambda} - \frac{2hc}{\lambda} = -\frac{4hc}{\lambda_0} + \frac{hc}{\lambda_0}$$

$$-\frac{hc}{\lambda} = -\frac{3hc}{\lambda_0}$$

$$\Rightarrow \lambda_0 = 3\lambda$$

140. Two non-mixing liquids of densities ρ and nρ ($n > 1$) are put in a container. The height of each liquid is h. A solid cylinder of length L and density d is put in this container. The cylinder floats with its axis vertical and length pL ($p < 1$) in the denser liquid. The density d is equal to

(1) $\{2 + (n + 1)p\}\rho$ (2) $\{2 + (n - 1)p\}\rho$

(3) $\{1 + (n - 1)p\}\rho$ (4) $\{1 + (n + 1)p\}\rho$

Answer (3)

Sol.
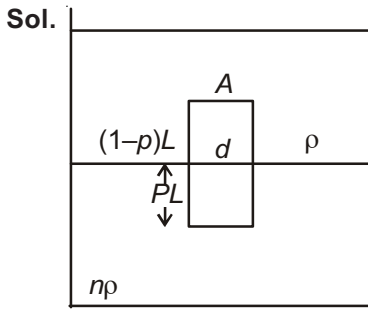
Weight of cylinder = $Th_1 + Th_2$

$ALdg = (1 - P) LA\rho g + (PLA) n\rho g$

$\Rightarrow \quad d = (1 - P) \rho + Pn\rho$

$\Rightarrow \qquad = \rho - P\rho + nP\rho$

$\qquad\qquad = \rho + (n - 1)P\rho$

$\qquad\qquad = \rho [1 + (n - 1)P]$

141. Out of the following options which one can be used to produce a propagating electromagnetic wave?

(1) A stationary charge

(2) A chargeless particle

(3) An accelerating charge

(4) A charge moving at constant velocity

Answer (3)

Sol. Accelerating charge produce electromagnetic wave.

142. The charge flowing through a resistance R varies with time t as $Q = at - bt^2$, where a and b are positive constants. The total heat produced in R is

(1) $\dfrac{a^3 R}{3b}$

(2) $\dfrac{a^3 R}{2b}$

(3) $\dfrac{a^3 R}{b}$

(4) $\dfrac{a^3 R}{6b}$

Answer (4)

Sol. $Q = at - bt^2$

$I = \dfrac{dQ}{dt} = a - 2bt$

Current will exist till $t = \dfrac{a}{2b}$

$P = \int\limits_0^t I^2 R\, dt = \int\limits_0^{\frac{a}{2b}} (a - 2bt)^2 R\, dt$

$= \int\limits_0^{\frac{a}{2b}} (a^2 + 4b^2 t^2 - 4abt) R\, dt$

$= \left[a^2 t + 4b^2 \dfrac{t^3}{3} - 4ab \dfrac{t^2}{2} \right]_0^{\frac{a}{2b}} R = \dfrac{a^3 R}{6b}$

143. At what height from the surface of earth the gravitation potential and the value of g are -5.4×10^7 J kg^{-2} and 6.0 ms^{-2} respectively? Take the radius of earth as 6400 km

(1) 1600 km

(2) 1400 km

(3) 2000 km

(4) 2600 km

Answer (4)

Sol. $V = -\dfrac{GM}{(R+h)}$ \qquad $g' = \dfrac{GM}{(R+h)^2}$

$\Rightarrow \dfrac{|V|}{g'} = R + h$

$\Rightarrow \dfrac{5.4 \times 10^7}{6.0} = R + h$

$\Rightarrow 9 \times 10^6 = R + h$

$\Rightarrow h = (9 - 6.4) \times 10^6 = 2.6 \times 10^6 = 2600$ km

144. Coefficient of linear expansion of brass and steel rods are α_1 and α_2. Lengths of brass and steel rods are l_1 and l_2 respectively. If $(l_2 - l_1)$ is maintained same at all temperatures, which one of the following relations holds good?

(1) $\alpha_1 l_2^2 = \alpha_2 l_1^2$

(2) $\alpha_1^2 l_2 = \alpha_2^2 l_1$

(3) $\alpha_1 l_1 = \alpha_2 l_2$

(4) $\alpha_1 l_2 = \alpha_2 l_1$

Answer (3)

Sol. $l_2' - l_1' = l_2 - l_1$

$\Rightarrow l_2(1 + \alpha_2 \Delta t) - l_1(1 + \alpha_1 \Delta t) = l_2 - l_1$

$l_2 \alpha_2 = l_1 \alpha_1$

145. The intensity at the maximum in a Young's double slit experiment is I_0. Distance between two slits is $d = 5\lambda$, where λ is the wavelength of light used in the experiment. What will be the intensity in front of one of the slits on the screen placed at a distance $D = 10\, d$?

(1) $\dfrac{I_0}{4}$

(2) $\dfrac{3}{4} I_0$

(3) $\dfrac{I_0}{2}$

(4) I_0

Answer (3)

Sol. $I_{max} = I_0$
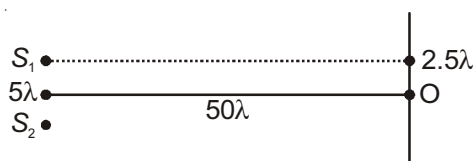
$$\text{Path diff} = \frac{dy_n}{D} = \frac{d \times \frac{d}{2}}{10d} = \frac{d}{20} = \frac{\lambda}{4}$$

Phase diff = 90°

$$I = I_0 \cos^2 \frac{\phi}{2} = \frac{I_0}{2}$$

146. Given the value of Rydberg constant is 10^7 m^{-1}, the wave number of the last line of the Balmer series in hydrogen spectrum will be

(1) 0.5×10^7 m^{-1} (2) 0.25×10^7 m^{-1}

(3) 2.5×10^7 m^{-1} (4) 0.025×10^4 m^{-1}

Answer (2)

Sol. $R_H = 10^7$ m^{-1}

Last line $n_2 = \infty$, $n_1 = 2$

$$\lambda = \frac{1}{R_H\left(\frac{1}{4} - 0\right)}$$

$$= \frac{4}{10^7} \text{ m} = 0.25 \times 10^7 \text{ m}^{-1}$$

147. The ratio of escape velocity at earth (v_e) to the escape velocity at a planet (v_p) whose radius and mean density are twice as that of earth is

(1) $1 : 2\sqrt{2}$ (2) $1 : 4$

(3) $1 : \sqrt{2}$ (4) $1 : 2$

Answer (1)

Sol. $v_e = \sqrt{2gR} = R\sqrt{\frac{8}{3}\pi G \rho}$

$$\Rightarrow \quad \frac{v_e}{v_p} = \frac{R\sqrt{\rho}}{R_p\sqrt{\rho}}$$

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

148. A long solenoid has 1000 turns. When a current of 4 A flows through it, the magnetic flux linked with each turn of the solenoid is 4×10^{-3} Wb. The self-inductance of the solenoid is

(1) 3 H   (2) 2 H

(3) 1 H   (4) 4 H

Answer (3)

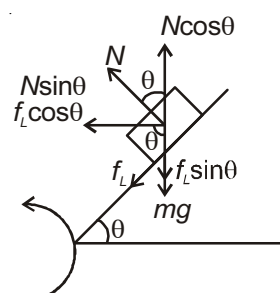**Sol.** $N = 1000$, $I = 4$ A, $\phi = 4 \times 10^{-3}$

$$L = \frac{\phi N}{I} = \frac{4 \times 10^{-3} \times 1000}{4} = 1 \text{ H}$$

149. A car is negotiating a curved road of radius R. The road is banked at an angle θ. The coefficient of friction between the tyres of the car and the road is μ_s. The maximum safe velocity on this road is

(1) $\sqrt{gR\dfrac{\mu_s + \tan\theta}{1 - \mu_s \tan\theta}}$ (2) $\sqrt{\dfrac{g}{R}\dfrac{\mu_s + \tan\theta}{1 - \mu_s \tan\theta}}$

(3) $\sqrt{\dfrac{g}{R^2}\dfrac{\mu_s + \tan\theta}{1 - \mu_s \tan\theta}}$ (4) $\sqrt{gR^2\dfrac{\mu_s + \tan\theta}{1 - \mu_s \tan\theta}}$

Answer (1)

Sol.

Vertical equilibrium

$N\cos\theta = mg + f_L \sin\theta$

$\Rightarrow \quad mg = N\cos\theta - f_L \sin\theta$ …(1)

Horizontal equilirbium

$N\sin\theta + f_L \cos\theta = \dfrac{mv^2}{R}$ …(2)

$$\frac{Eqn(2)}{Eqn(1)} \quad \frac{v^2}{Rg} = \frac{\sin\theta + \mu_s \cos\theta}{\cos\theta - \mu_s \sin\theta}$$

$$\Rightarrow \quad v = \sqrt{Rg\frac{\sin\theta + \mu_s \cos\theta}{\cos\theta - \mu_s \sin\theta}}$$

$$= \sqrt{Rg\frac{\tan\theta + \mu_s}{1 - \mu_s \tan\theta}}$$

150. The magnetic susceptibility is negative for

(1) Paramagnetic material only

(2) Ferromagnetic material only

(3) Paramagnetic and ferromagnetic materials

(4) Diamagnetic material only

Answer (4)

**Sol.** Susceptibility of diamagnetic substance is negative

Susceptibility of para and ferromagnetic substance is positive

151. A siren emitting a sound of frequency 800 Hz moves away from an observer towards a cliff at a speed of 15 ms^{-1}. Then, the frequency of sound that the observer hears in the echo reflected from the cliff is

(Take velocity of sound in air = 330 ms^{-1})

(1) 800 Hz   (2) 838 Hz

(3) 885 Hz   (4) 765 Hz

Answer (2)

Sol.

Cliff

Image (source)

15 m/s   15 m/s
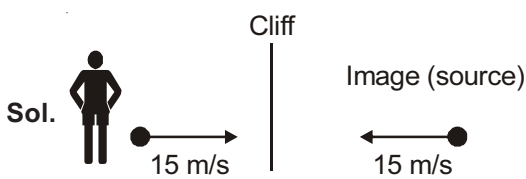
$$f' = \left(\frac{v}{v - v_s}\right) f = \left(\frac{330}{330 - 15}\right) 800$$
$$= 838 \text{ Hz}$$

152. A body of mass 1 kg begins to move under the action of a time dependent force $F = (2t\hat{i} + 3t^2\hat{j})\text{N}$, where $\hat{i}$ and $\hat{j}$ are unit vectors along x and y axis. What power will be developed by the force at the time t?

(1) $(2t^2 + 4t^4)$ W   (2) $(2t^3 + 3t^4)$ W

(3) $(2t^3 + 3t^5)$ W   (4) $(2t^2 + 3t^3)$ W

Answer (3)

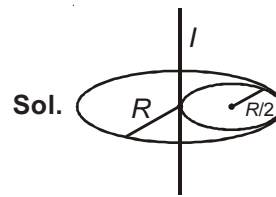**Sol.** $\vec{F} = \left(2t\hat{i} + 3t^2\hat{j}\right), \vec{a} = 2t\hat{i} + 3t^2\hat{j}$

$$v = \int_0^t a\, dt = t^2\hat{i} + t^3\hat{j}$$

$$P = \vec{F} \cdot \vec{v} = 2t \cdot t^2 + 3t^2 \cdot t^3$$
$$= 2t^3 + 3t^5$$

153. From a disc of radius R and mass M, a circular hole of diameter R, whose rim passes through the centre is cut. What is the moment of inertia of the remaining part of the disc about a perpendicular axis, passing through the centre?

(1) $13MR^2/32$ (2) $11MR^2/32$

(3) $9MR^2/32$ (4) $15MR^2/32$

Answer (1)

Sol.

$I = I_{\text{remain}} + I_{(R/2)}$

$\Rightarrow I_{\text{remain}} = I - I_{(R/2)}$

$$= \frac{MR^2}{2} - \left[\frac{\frac{M}{4}(R/2)^2}{2} + \frac{M}{4}\left(\frac{R}{2}\right)^2\right]$$

$$= \frac{MR^2}{2} - \left[\frac{MR^2}{32} + \frac{MR^2}{16}\right]$$

$$= \frac{MR^2}{2} - \left[\frac{MR^2 + 2MR^2}{32}\right]$$

$$= \frac{MR^2}{2} - \frac{3MR^2}{32} = \frac{16MR^2 - 3MR^2}{32} = \frac{13MR^2}{32}$$

154. In a diffraction pattern due to a single slit of width a, the first minimum is observed at an angle 30° when light of wavelength 5000 Å is incident on the slit. The first secondary maximum is observed at an angle of

(1) $\sin^{-1}\left(\frac{2}{3}\right)$ (2) $\sin^{-1}\left(\frac{1}{2}\right)$

(3) $\sin^{-1}\left(\frac{3}{4}\right)$ (4) $\sin^{-1}\left(\frac{1}{4}\right)$

Answer (3)

Sol. 1st minimum

$a \sin\theta = n\lambda$

$n = 1$, $a\sin 30° = \lambda$
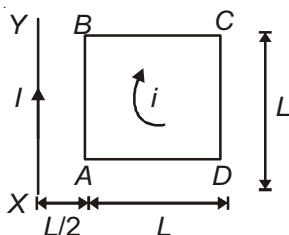
$\Rightarrow a = 2\lambda$

1st secondary maximum

$$a \sin\theta_1 = \frac{3\lambda}{2}$$

$$\Rightarrow \sin\theta_1 = \frac{3\lambda}{2a} = \frac{3}{4}$$

$$\Rightarrow \theta = \sin^{-1}\frac{3}{4}$$

155. A square loop *ABCD* carrying a current *i*, is placed near and coplanar with a long straight conductor *XY* carrying a current *I*, the net foce on the loop will be

(1) $\dfrac{\mu_0 Ii}{2\pi}$

(2) $\dfrac{2\mu_0 IiL}{3\pi}$

(3) $\dfrac{\mu_0 IiL}{2\pi}$

(4) $\dfrac{2\mu_0 Ii}{3\pi}$

Answer (4)

Sol. $F_{Loop} = F_{BA} - F_{CD}$

$$= \dfrac{\mu_0 iIL}{2\pi}\left[\dfrac{1}{\dfrac{L}{2}} - \dfrac{1}{\dfrac{3L}{2}}\right]$$

$$= \dfrac{2\mu_0 iI}{3\pi}$$

156. A black body is at a temperature of 5760 K. The energy of radiation emitted by the body at wavelength 250 nm is U_1, at wavelength 500 nm is U_2 and that at 1000 nm is U_3. Wien's constant, $b = 2.88 \times 10^6$ nmK. Which of the following is **correct**?

(1) $U_3 = 0$

(2) $U_1 > U_2$

(3) $U_2 > U_1$

(4) $U_1 = 0$

Answer (3)

Sol. $T_1 = 5760$ K , $\lambda_m T = 2.88 \times 10^6$ nmK
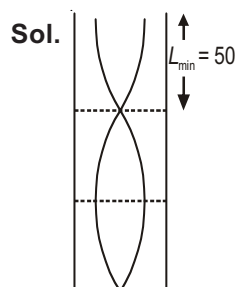
$$\lambda_m = \dfrac{2.88 \times 10^6 \text{ nmK}}{5760 \text{ K}} = 500 \text{ nm}$$

λ_m = Wavelength corresponding to maximum energy $U_2 > U_1$

157. An air column, closed at one end and open at the other, resonates with a tuning fork when the smallest length of the column is 50 cm. The next larger length of the column resonating with the same tuning fork is

(1) 100 cm

(2) 150 cm

(3) 200 cm

(4) 66.7 cm

Answer (2)

Sol.

L_{min} = 50 cm

So other lengths for resonance are $3L_{min}$, $5L_{min}$, $7L_{min}$, etc.

$\Rightarrow$ 150 cm, 250 cm, 350 cm, etc.

158. The molecules of a given mass of a gas have r.m.s. velocity of 200 ms^{-1} at 27°C and 1.0×10^5 Nm^{-2} pressure. When the temperature and pressure of the gas are respectively, 127°C and 0.05×10^5 Nm^{-2}, the r.m.s. velocity of its molecules in ms^{-1} is

(1) $\dfrac{400}{\sqrt{3}}$

(2) $\dfrac{100\sqrt{2}}{3}$

(3) $\dfrac{100}{3}$

(4) $100\sqrt{2}$

Answer (1)

Sol. v_{rms} = 200 ms^{-1}, T_1 = 300 K, $P_1 = 10^5$ Nm^{-2}

$$v_{rms} = \sqrt{\dfrac{3RT}{M}} \quad T_2 = 400 \text{ K}, \ P_2 = 0.05 \times 10^5 \text{ N/m}^2$$

$$\Rightarrow \quad \dfrac{V_2}{v_1} = \sqrt{\dfrac{T_2}{T_1}}$$

$$\Rightarrow \quad v_2 = \sqrt{\dfrac{400}{300}} \times 200 \text{ ms}^{-1} = \dfrac{400}{\sqrt{3}} \text{ ms}^{-1}$$

159. Consider the junction diode as ideal. The value of current flowing through *AB* is

(1) 10^{-2} A

(2) 10^{-1} A

(3) 10^{-3} A

(4) 0 A

Answer (1)

Sol. $V_A - V_B = IR$

$\Rightarrow 4 + 6 = 10^3 I$

$\Rightarrow I = \dfrac{10}{10^3} = 10^{-2} A$

160. If the magnitude of sum of two vectors is equal to the magnitude of difference of the two vectors, the angle between these vectors is

(1) 90° (2) 45°

(3) 180° (4) 0°

Answer (1)

Sol. $|\vec{A} + \vec{B}| = |\vec{A} - \vec{B}|$

$\Rightarrow \cos\theta = 0 \Rightarrow \theta = 90°$

161. A astronomical telescope has objective and eyepiece of focal length 40 cm and 4 cm respectively. To view an object 200 cm away from the objective, the lenses must be separated by a distance

(1) 46.0 cm (2) 50.0 cm

(3) 54.0 cm (4) 37.3 cm

Answer (3)

Sol.

Objective

$\dfrac{1}{v} - \dfrac{1}{u} = \dfrac{1}{f}$

$\Rightarrow \dfrac{1}{v} - \dfrac{1}{-200} = \dfrac{1}{40}$

$\dfrac{1}{v} = \dfrac{1}{40} - \dfrac{1}{200} = \dfrac{5-1}{200} = \dfrac{1}{50}$

$v = 50$

For normal adjustment = $L = v + f_e = 54$ cm.

162. A *npn* transistor is connected in common emitter configuration in a given amplifier. A load resistance of 800 Ω is connected in the collector circuit and the voltage drop across it is 0.8 V. If the current amplification factor is 0.96 and the input resistance of the circuit is 192 Ω, the voltage gain and the power gain of the amplifier will respectively be
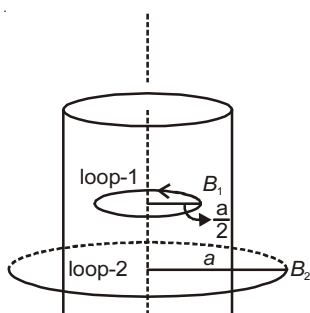
(1) 3.69, 3.84 (2) 4, 4

(3) 4, 3.69 (4) 4, 3.84

Answer (4)

Sol. $R_L = 800\ \Omega, V_L = 0.8\ V \Rightarrow I_C = \dfrac{V_L}{R_L} = 1mA$

$R_i = 192\ \Omega$

Current amplification = $\dfrac{\text{Output current}}{\text{Input current}} = \dfrac{I_C}{I_B} = 0.96$

$\Rightarrow I_B = \dfrac{1\ mA}{0.96}$

$A_v = \dfrac{V_L}{V_{in}} = \dfrac{V_L}{I_B R_i} = 4$

$A_p = \dfrac{I_C^2 R_L}{I_B^2 R_i} = 3.84$

163. A gas is compressed isothermally to half its initial volume. The same gas is compressed separately through an adiabatic process until its volume is again reduced to half. Then

(1) Compressing the gas through adiabatic process will require more work to be done

(2) Compressing the gas isothermally or adiabatically will require the same amount of work

(3) Which of the case (whether compression through isothermal or through adiabatic process) requires more work will depend upon the atomicity of the gas

(4) Compressing the gas isothermally will require more work to be done

Answer (1)

Sol.

164. A long straight wire of radius *a* carries a steady current *I*. The current is uniformly distributed over its cross-section. The ratio of the magnetic fields *B* and *B'* at radial distances $\dfrac{a}{2}$ and $2a$ respectively, from the axis of the wire is

(1) $\dfrac{1}{2}$ (2) 1

(3) 4 (4) $\dfrac{1}{4}$

Answer (2)

Sol.

Using Ampere circuital law

Loop-1

$$B_1 2\pi \frac{a}{2} = \mu_0 \frac{I}{\pi a^2} \times \frac{\pi a^2}{4}$$

$$B_1 = \frac{\mu_0 I}{4\pi a} \qquad ...(1)$$

Loop-2

$$B_2 . 2\pi 2a = \mu_0 I$$

$$\Rightarrow B_2 = \frac{\mu_0 I}{4\pi a} \qquad ...(2)$$

$$\frac{B_1}{B_2} = 1$$

165. Match the corresponding entries of column-1 with column-2. [Where m is the magnification produced by the mirror]

Column-1	Column-2
(A) $m = -2$	(a) Convex mirror
(B) $m = -\frac{1}{2}$	(b) Concave mirror
(C) $m = +2$	(c) Real image
(D) $m = +\frac{1}{2}$	(d) Virtual image

(1) A → a and c; B → a and d; C → a and b; D → c and d

(2) A → a and d; B → b and c; C → b and d; D → b and c

(3) A → c and d; B → b and d; C → b and c ; D → a and d

(4) A → b and c; B → b and c; C → b and d; D → a and d

Answer (4)

Sol. A → b and c; B → b and c; C → b and d; D → a and d

166. If the velocity of a particle is $v = At + Bt^2$, where A and B are constants, then the distance travelled by it between 1 s and 2 s is

(1) $3A + 7B$

(2) $\frac{3}{2}A + \frac{7}{3}B$

(3) $\frac{A}{2} + \frac{B}{3}$

(4) $\frac{3}{2}A + 4B$

Answer (2)

Sol. $v = At + Bt^2$

$$\Rightarrow \frac{dx}{dt} = At + Bt^2$$

$$\Rightarrow dx = (At + Bt^2)dt$$

$$\Rightarrow x = \left[\frac{At^2}{2} + \frac{Bt^3}{3}\right]_1^2$$

$$= \frac{A}{2}(4-1) + \frac{B}{3}(8-1)$$

$$= \frac{3}{2}A + \frac{7}{3}B$$

167. A disk and a sphere of same radius but different masses roll off on two inclined planes of the same altitude and length. Which one of the two objects gets to the bottom of the plane first?

(1) Sphere

(2) Both reach at the same time

(3) Depends on their masses

(4) Disk

Answer (1)

Sol. $a_{sphere} > a_{disc}$,

Acceleration $(a) = \dfrac{g\sin\theta}{1 + K^2/r^2}$, independent of mass and radius.

168. Two identical charged spheres suspended from a common point by two massless strings of lengths l, are initially at a distance $d(d \ll l)$ apart because of their mutual repulsion. The charges begin to leak from both the spheres at a constant rate. As a result, the spheres approach each other with a velocity v. Then v varies as a function of the distance x between the spheres, as

(1) $v \propto x$

(2) $v \propto x^{-\frac{1}{2}}$

(3) $v \propto x^{-1}$

(4) $v \propto x^{\frac{1}{2}}$

Answer (2)

Sol. $\dfrac{F}{mg} = \tan\theta$

$\dfrac{Kq^2}{x^2 mg} = \dfrac{\dfrac{x}{2}}{\sqrt{l^2 - \dfrac{x^2}{4}}}$
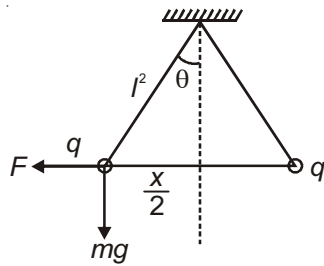
$\dfrac{Kq^2}{x^2 mg} = \dfrac{x}{2l}$

$q^2 \propto x^3$

$\Rightarrow q \propto x^{3/2}$

$\Rightarrow \dfrac{dq}{dt} \propto \dfrac{d(x^{3/2})}{dx}\dfrac{dx}{dt}$

$\Rightarrow \dfrac{dq}{dt} \propto x^{1/2}v$

$\Rightarrow v \propto \dfrac{1}{x^{\frac{1}{2}}}$

169. A particle moves so that its position vector is given by $\vec{r} = \cos\omega t\,\hat{x} + \sin\omega t\,\hat{y}$, where ω is a constant. Which of the following is true?

(1) Velocity and acceleration both are parallel to $\vec{r}$

(2) Velocity is perpendicular to $\vec{r}$ and acceleration is directed towards the origin

(3) Velocity is perpendicular to $\vec{r}$ and acceleration is directed away from the origin

(4) Velocity and acceleration both are perpendicular to $\vec{r}$

Answer (2)

Sol. $\vec{r} = \cos\omega t\,\hat{x} + \sin\omega t\,\hat{y}$,

$\vec{v} = \dfrac{d\vec{r}}{dt} = -\omega\sin\omega t\,\hat{x} + \omega\cos\omega t\,\hat{y}$ $\Big|$ $\Rightarrow \vec{v}\cdot\vec{r} = 0$

$\vec{a} = -\omega^2\cos\omega t\,\hat{x} - \omega^2\sin\omega t\,\hat{y} = -\omega^2\vec{r}$

170. A piece of ice falls from a height h so that it melts completely. Only one-quarter of the heat produced is absorbed by the ice and all energy of ice gets converted into heat during its fall. The value of h is

[Latent heat of ice is 3.4×10^5 J/kg and $g = 10$ N/kg]

(1) 544 km

(2) 136 km

(3) 68 km

(4) 34 km

Answer (2)

Sol. $\dfrac{mgh}{4} = mL_f$

$\Rightarrow h = \dfrac{4L_f}{g} = \dfrac{4 \times 3.4 \times 10^5}{10} = 136$ km

171. A uniform circular disc of radius 50 cm at rest is free to turn about an axis which is perpendicular to its plane and passes through its centre. It is subjected to a torque which produces a constant angular acceleration of 2.0 rad s^{-2}. Its net acceleration in ms^{-2} at the end of 2.0 s is approximately

(1) 7.0

(2) 6.0

(3) 3.0

(4) 8.0

Answer (4)
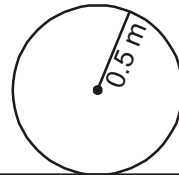
Sol.

Angular acceleration $\alpha = 2$ rad s^{-2}

Angular speed $\omega = \alpha t = 4$ rad s^{-1}

$a_c = r\omega^2 = 0.5 \times 16 = 8$ m/s^2

$a_t = \alpha r = 1$ rad/s

$a = \sqrt{a_c^2 + a_t^2} = \sqrt{8^2 + 1^2} \approx 8$ m/s^2

172. What is the minimum velocity with which a body of mass m must enter a vertical loop of radius R so that it can complete the loop?

(1) $\sqrt{2gR}$

(2) $\sqrt{3gR}$

(3) $\sqrt{5gR}$

(4) $\sqrt{gR}$

Answer (3)

Sol. $v_{\min} = \sqrt{5\,gR}$

173. A small signal voltage $V(t) = V_0\sin\omega t$ is applied across an ideal capacitor C

(1) Over a full cycle the capacitor C does not consume any energy from the voltage source

(2) Current $I(t)$ is in phase with voltage $V(t)$

(3) Current $I(t)$ leads voltage $V(t)$ by 180°

(4) Current $I(t)$ lags voltage $V(t)$ by 90°

Answer (1)

Sol. Current leads voltage by phase $\frac{\pi}{2}(90°)$

Power consumed = 0.

174. A uniform rope of length L and mass m_1 hangs vertically from a rigid support. A block of mass m_2 is attached to the free end of the rope. A transverse pulse of wavelength λ_1 is produced at the lower end of the rope. The wavelength of the pulse when it reaches the top of the rope is λ_2. The ratio λ_2/λ_1 is

(1) $\sqrt{\dfrac{m_1 + m_2}{m_2}}$

(2) $\sqrt{\dfrac{m_2}{m_1}}$

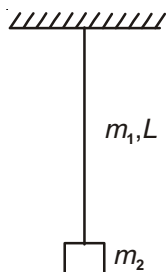(3) $\sqrt{\dfrac{m_1 + m_2}{m_1}}$

(4) $\sqrt{\dfrac{m_1}{m_2}}$

Answer (1)

Sol. $\lambda = \dfrac{v}{f} \qquad \left(v = \sqrt{\dfrac{T}{\mu}}\right)$

$\dfrac{\lambda_2}{\lambda_1} = \dfrac{v_2}{v_1}$

$= \sqrt{\dfrac{T_2}{T_1}}$

$= \sqrt{\dfrac{(m_1 + m_2)}{m_2}}$

175. An inductor 20 mH, a capacitor 50 µF and a resistor 40 Ω are connected in series across a source of emf V = 10sin340t. The power loss in A.C. circuit is

(1) 0.67 W

(2) 0.76 W

(3) 0.89 W

(4) 0.51 W

Answer (4)

Sol. $L = \dfrac{20\text{ mH}}{2} \qquad C = 50\text{ µF} \qquad R = 40\ \Omega$

$P_{av} = I_v^2 R = \left(\dfrac{E_v}{Z}\right)^2 R = \left(\dfrac{10}{\sqrt{2}}\right)^2$

$40\left[\dfrac{1}{40^2 + \left(340 \times 20 \times 10^{-3} - \dfrac{1}{340 \times 50 \times 10^{-6}}\right)}\right]$

$= \dfrac{100}{2} \times 40 \dfrac{1}{1600 + [6.8 - 58.8]^2}$

$= \dfrac{2000}{1600 + 2704} \approx 0.46\text{ W} = 0.51\text{ W}$

176. An electron of mass m and a photon have same energy E. The ratio of de-Broglie wavelengths associated with them is (c being velocity of light)

(1) $\left(\dfrac{E}{2m}\right)^{\frac{1}{2}}$

(2) $c(2mE)^{\frac{1}{2}}$

(3) $\dfrac{1}{c}\left(\dfrac{2m}{E}\right)^{\frac{1}{2}}$

(4) $\dfrac{1}{c}\left(\dfrac{E}{2m}\right)^{\frac{1}{2}}$

Answer (4)

Sol. $\lambda_e = \dfrac{h}{\sqrt{2mE}}, \lambda_p = \dfrac{hc}{E}, E = \dfrac{hc}{\lambda_p}$

$\dfrac{\lambda_e}{\lambda_p} = \dfrac{h}{\sqrt{2mE}}\dfrac{E}{hc}$

$= \dfrac{1}{c}\sqrt{\dfrac{E}{2m}}$

177. When an α-particle of mass m moving with velocity v bombards on a heavy nucleus of charge 'Ze', its distance of closest approach from the nucleus depends on m as

(1) $\dfrac{1}{\sqrt{m}}$

(2) $\dfrac{1}{m^2}$

(3) m

(4) $\dfrac{1}{m}$

Answer (4)

Sol. Initial kinetic energy = potential energy at closest approach

$$\frac{1}{2}mv^2 = \frac{2Ze^2}{4\pi\varepsilon_0 r_0}$$

$$\Rightarrow \quad r_0 \propto \frac{1}{m}$$

178. A refrigerator works between 4°C and 30°C. It is required to remove 600 calories of heat every second in order to keep the temperature of the refrigerated space constant. The power required is [Take 1 cal = 4.2 joules)

    (1) 23.65 W

    (2) 236.5 W

    (3) 2365 W

    (4) 2.365 W

Answer (2)

Sol. $T_2 = 4°C = 277$ K

$T_1 = 303$ K

$Q_2 = 600$ cal

$$\frac{Q_1}{Q_2} = \frac{T_1}{T_2}$$

$$\Rightarrow \quad \frac{Q_2 + W}{Q_2} = \frac{T_1}{T_2}$$

W = 236.5 W

179. A particle of mass 10 g moves along a circle of radius 6.4 cm with a constant tangential acceleration. What is the magnitude of this acceleration if the kinetic energy of the particle becomes equal to 8 × 10⁻⁴ J by the end of the second revolution after the beginning of the motion?

    (1) 0.15 m/s²

    (2) 0.18 m/s²

    (3) 0.2 m/s²

    (4) 0.1 m/s²

Answer (4)

Sol. $m = 0.01$ kg

$r = 6.4$ cm

$$\frac{1}{2}mv^2 = 8 \times 10^{-4} \text{ J}$$

$$v^2 = \frac{16 \times 10^{-4}}{0.01} = 16 \times 10^{-2}$$
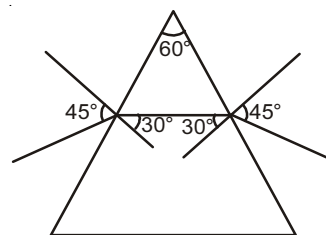
Speed $v^2 = 2a_t s$

$v^2 = 2a_t 4\pi r$

$$\Rightarrow \quad a_t = \frac{v^2}{8\pi r} = \frac{16 \times 10^{-2}}{8 \times 3.14 \times 6.4 \times 10^{-2}}$$

$$= 0.1 \text{ m/s}^2$$

180. The angle of incidence for a ray of light at a refracting surface of a prism is 45°. The angle of prism is 60°. If the ray suffers minimum deviation through the prism, the angle of minimum deviation and refractive index of the material of the prism respectively, are

    (1) $30°; \sqrt{2}$

    (2) $45°; \sqrt{2}$

    (3) $30°; \dfrac{1}{\sqrt{2}}$

    (4) $45°; \dfrac{1}{\sqrt{2}}$

Answer (1)

Sol.

Ray pass symmetrically through prism

$\delta_{min} = (i + e) - A = 30°$

$$\mu = \frac{\sin\left(\dfrac{A + \delta_m}{2}\right)}{\sin\dfrac{A}{2}} = \sqrt{2}$$

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