

All India Aakash Test Series for NEET - 2023

OPEN MOCK TEST - I (Code-A)

Test Date : 26/03/2023

ANSWERS

1. (2)	41. (1)	81. (4)	121. (2)	161. (3)
2. (1)	42. (4)	82. (4)	122. (2)	162. (3)
3. (2)	43. (1)	83. (4)	123. (3)	163. (3)
4. (3)	44. (1)	84. (3)	124. (3)	164. (2)
5. (4)	45. (4)	85. (1)	125. (2)	165. (3)
6. (2)	46. (4)	86. (3)	126. (1)	166. (3)
7. (3)	47. (1)	87. (2)	127. (2)	167. (2)
8. (2)	48. (3)	88. (3)	128. (4)	168. (4)
9. (2)	49. (1)	89. (2)	129. (1)	169. (1)
10. (3)	50. (3)	90. (2)	130. (4)	170. (4)
11. (1)	51. (1)	91. (2)	131. (3)	171. (1)
12. (1)	52. (4)	92. (4)	132. (3)	172. (3)
13. (3)	53. (3)	93. (4)	133. (2)	173. (4)
14. (4)	54. (2)	94. (4)	134. (3)	174. (4)
15. (1)	55. (1)	95. (3)	135. (3)	175. (4)
16. (1)	56. (1)	96. (3)	136. (3)	176. (2)
17. (3)	57. (2)	97. (4)	137. (2)	177. (2)
18. (2)	58. (4)	98. (1)	138. (3)	178. (1)
19. (4)	59. (3)	99. (1)	139. (4)	179. (2)
20. (2)	60. (2)	100. (2)	140. (4)	180. (2)
21. (1)	61. (4)	101. (1)	141. (2)	181. (2)
22. (3)	62. (3)	102. (2)	142. (3)	182. (2)
23. (3)	63. (2)	103. (2)	143. (3)	183. (1)
24. (2)	64. (2)	104. (2)	144. (2)	184. (3)
25. (4)	65. (3)	105. (1)	145. (2)	185. (2)
26. (3)	66. (4)	106. (1)	146. (3)	186. (2)
27. (4)	67. (3)	107. (2)	147. (3)	187. (4)
28. (2)	68. (1)	108. (3)	148. (2)	188. (4)
29. (4)	69. (4)	109. (3)	149. (2)	189. (2)
30. (2)	70. (4)	110. (3)	150. (3)	190. (1)
31. (1)	71. (4)	111. (3)	151. (2)	191. (3)
32. (4)	72. (1)	112. (2)	152. (4)	192. (3)
33. (1)	73. (3)	113. (1)	153. (2)	193. (3)
34. (3)	74. (4)	114. (1)	154. (2)	194. (2)
35. (2)	75. (2)	115. (4)	155. (2)	195. (1)
36. (1)	76. (2)	116. (2)	156. (2)	196. (1)
37. (4)	77. (2)	117. (3)	157. (2)	197. (3)
38. (2)	78. (3)	118. (2)	158. (2)	198. (2)
39. (2)	79. (2)	119. (2)	159. (2)	199. (3)
40. (1)	80. (2)	120. (1)	160. (3)	200. (2)

HINTS & SOLUTIONS**[PHYSICS]****SECTION-A**

1. Answer (2)

Hint and Sol.: $F_{SN} : F_E : F_{WN} : F_G = 1 : 10^{-2} : 10^{-13} : 10^{-39}$

2. Answer (1)

Hint: In multiplication or division, the final result should retain only that many significant figures as are there in the original number with the least number of significant figures.

Sol.: Volume = $1.1 \text{ m} \times 2.36 \text{ m} \times 3.1 \text{ m}$
 $\approx 8.0476 \text{ m}^3$
 $= 8.0 \text{ m}^3$

3. Answer (2)

Hint: $R = \frac{u^2 \sin 2\theta}{g}$

Sol.: $R_1 = R_2$

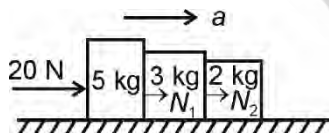
$$\frac{u_1^2}{g} = \frac{u_2^2 \sin 2\theta}{g}$$

$$\frac{u^2}{4} = u^2 \sin 2\theta \Rightarrow \theta = \frac{1}{2} \sin^{-1} \left(\frac{1}{4} \right)$$

4. Answer (3)

Hint: $F = ma$

Sol.:



$$F = ma$$

$$a = \frac{20}{5+3+2}$$

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

$$N_1 = (3+2)a$$

$$= 10 \text{ N}$$

$$N_2 = 2 \times a$$

$$= 4 \text{ N}$$

$$\frac{N_1}{N_2} = \frac{10}{4}$$

$$\frac{N_1}{N_2} = \frac{5}{2}$$

5. Answer (4)

Hint: Coefficient of restitution = $\frac{\text{Velocity of separation}}{\text{Velocity of approach}}$

Sol.:

$$e = \frac{v_1 - 5}{5 - 2}$$

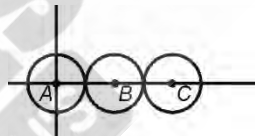
$$1 = \frac{v_1 - 5}{3}$$

$$V_2 = 8 \text{ m/s}$$

6. Answer (2)

Hint: $\vec{r}_{cm} = \frac{m_1 \vec{r}_1 + m_2 \vec{r}_2 + m_3 \vec{r}_3}{m_1 + m_2 + m_3}$

Sol.:



$$X_{cm} = \frac{mx0 + m \times 2R + mx4R}{m + m + m}$$

$$X_{cm} = 2R$$

7. Answer (3)

Hint & Sol.: Mass of lower half of sphere is more therefore, centre of mass shift towards lower half.

8. Answer (2)

Hint: $(K.E.)_{\max} = T.E. - P.E.$

Sol.: $(K.E.)_{\max} = 24 - 4$
 $= 20 \text{ J}$

$$\text{Average (K.E.)} = \frac{(K.E.)_{\max}}{2}$$

$$= \frac{20}{2}$$

$$= 10 \text{ J}$$

9. Answer (2)

Hint & Sol.: When a satellite is lifted from lower orbit to a higher orbit then its gravitational potential energy increases and kinetic energy of satellite decreases.

10. Answer (3)

$$\text{Hint: } W = \frac{1}{2} Y \left(\frac{\Delta \ell}{\ell} \right)^2 A \ell$$

$$\text{Sol.: } W_1 \propto \frac{A_1}{\ell_1}$$

$$W_2 \propto \frac{A_2}{\ell_2}$$

$$\frac{W_1}{W_2} = \frac{A_1}{\ell_1} \times \frac{\ell_2}{A_2}$$

$$\frac{W_1}{W_2} = \frac{A_1}{\ell_1} \times \frac{\ell_1}{2 \times 4 A_1}$$

$$\frac{W_1}{W_2} = \frac{1}{8}$$

$$W_2 = 8 \times 8$$

$$= 64 \text{ J}$$

11. Answer (1)

$$\text{Hint: Force on container} = \rho a v^2$$

$$\text{Sol.: } v = \sqrt{2gh}$$

Mass of liquid in the container

$$m_0 = \rho A h$$

$$F = \rho a 2gh$$

$$m_0 a_1 = \rho a 2gh$$

$$\rho A h a_1 = 2 \rho a g h$$

$$a_1 = \left(\frac{2ag}{A} \right)$$

12. Answer (1)

Hint & Sol.: The coefficient of cubical expansion of water is negative between the temperature 273 K and 277 K.

13. Answer (3)

$$\text{Hint: } \left(\frac{dP}{dV} \right)_{\text{adiabatic}} = -\gamma \frac{P}{V}$$

$$\text{Sol.: } \left(\frac{dP}{dV} \right)_{\text{isothermal}} = -\frac{P}{V}$$

$$\frac{\left(\frac{dP}{dV} \right)_{\text{adiabatic}}}{\left(\frac{dP}{dV} \right)_{\text{isothermal}}} = \gamma$$

$$\text{For monoatomic gas } \gamma = \left(\frac{5}{3} \right)$$

14. Answer (4)

Hint & Sol.: In isothermal process temperature remains constant therefore $\Delta U = 0$

$$Q = W + \Delta U$$

$$Q = W$$

15. Answer (1)

Hint & Sol.: In motion of star, doppler effect causes change in the observed frequency of light. Beats is used in the standardization of frequency and to measure the depth of ocean concept of echo is used.

16. Answer (1)

Hint: Equation of propagating wave moving in positive x-direction of $y = A \sin(kx - \omega t)$.

$$\text{Sol.: } A = 0.25$$

$$\omega = 2\pi f$$

$$= 8\pi$$

$$K = \frac{2\pi}{\lambda}$$

$$= \frac{2\pi}{2}$$

$$= \pi$$

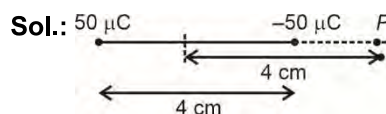
$$y = 0.25 A \sin(\pi x - 8\pi t)$$

17. Answer (3)

Hint and Sol.: The speed of sound in air is independent of pressure of the gas. It only depends on temperature of gas.

18. Answer (2)

$$\text{Hint: } E = \frac{kq}{r^2}$$



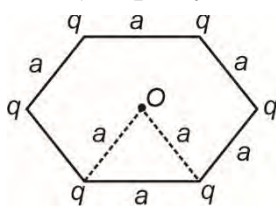
$$E_P = E_- + E_+$$

$$= \frac{k(50 \mu\text{C})}{(2 \text{ cm})^2} - \frac{k(50 \mu\text{C})}{(6 \text{ cm})^2}$$

$$= \frac{9 \times 10^9 \times 50 \times 10^{-6}}{4 \times 10^{-4}} - \frac{9 \times 10^9 \times 50 \times 10^{-6}}{36 \times 10^{-4}}$$

$$= 10^9 \text{ N/C}$$

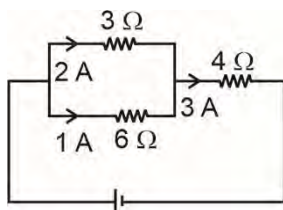
19. Answer (4)

Hint: $V = V_1 + V_2 + V_3 \dots V_6$ **Sol.:**

$$V = \left(\frac{kq}{a} \right) \times 6$$

$$= \frac{6kq}{a}$$

20. Answer (2)

Hint: $P = I^2 R$ **Sol.:**

$$P = I^2 R$$

$$= (3)^2 \times 4$$

$$= 36 \text{ W}$$

21. Answer (1)

Hint: $E \propto \ell$

$$\text{Sol.: } \frac{E_1}{E_2} = \frac{\ell_1}{\ell_2}$$

$$\frac{3}{2} = \frac{45}{\ell_2}$$

$$\ell_2 = 30 \text{ cm}$$

22. Answer (3)

Hint: $M = NIA$

$$\text{Sol.: } B = \frac{\mu_0 i}{2R}$$

$$0.2 = \frac{\mu_0 i}{2R}$$

$$\Rightarrow \frac{0.4}{\mu_0} = \frac{i}{R}$$

$$\Rightarrow \pi R^2 = \pi$$

$$R = 1$$

$$M = \frac{0.4\pi}{\mu_0}$$

23. Answer (3)

Hint: $\phi = \vec{B} \cdot \vec{A}$ and $\varepsilon = -\frac{d\phi}{dt}$

$$\text{Sol.: } \phi = B_z \pi r^2 \cos \omega t$$

$$\varepsilon = -\frac{d\phi}{dt}$$

$$= -\frac{d}{dt} (B_z \pi r^2 \cos \omega t)$$

$$\varepsilon = B_z \omega \pi r^2 \sin \omega t$$

24. Answer (2)

Hint: $X_C = \frac{1}{\omega C}$

$$\text{Sol.: } V = 100 \sin(314t)$$

$$\omega = 314$$

$$V_R = IR$$

$$I = \frac{80}{20}$$

$$I = 4 \text{ A}$$

$$\sqrt{V_R^2 + V_C^2} = 100$$

$$(80)^2 + V_C^2 = (100)^2$$

$$V_C^2 = (100)^2 - (80)^2$$

$$V_C = 60$$

$$V_C = I X_C$$

$$60 = 4 \times \frac{1}{\omega C}$$

$$C = \frac{4}{60 \times 314}$$

$$= 212 \mu\text{F}$$

25. Answer (4)

Hint: For minimum deviation $i = e$, $r_1 = r_2$ **Sol.:** By Snell's law

$$\frac{\sin i}{\sin r} = \mu$$

$$r_1 = r_2 = r$$

$$r_1 + r_2 = A$$

$$r = \frac{A}{2}$$

$$= 45^\circ$$

$$\frac{\sin i}{\sin 45^\circ} = \frac{\sqrt{3}}{\sqrt{2}}$$

$$\sin i = \frac{\sqrt{3}}{2}$$

$$i = 60^\circ$$

$$i + e = A + \delta$$

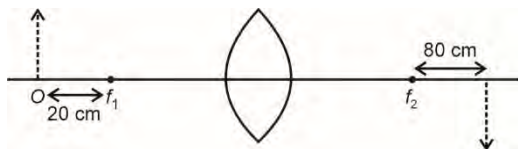
$$60^\circ + 60^\circ = 90^\circ + \delta$$

$$\delta = 30^\circ$$

26. Answer (3)

Hint: Use $\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$

Sol.:



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

$$\frac{1}{80+f} + \frac{1}{20+f} = \frac{1}{f}$$

$$(20+f+80+f)f = (80+f)(20+f)$$

$$100f + 2f^2 = 1600 + 100f + f^2$$

$$f^2 = 1600$$

$$f = 40 \text{ cm}$$

27. Answer (4)

Hint: Fringe width $= \frac{\lambda D}{d}$

Sol.: $\frac{n_1 \lambda_1 D}{d} = \frac{n_2 \lambda_2 D}{d}$

$$n_2 = \frac{n_1 \lambda_1}{\lambda_2}$$

$$= \frac{50 \times 4000}{5000}$$

$$= 40$$

28. Answer (2)

Hint & Sol.: $\mu = \tan(i_P)$

29. Answer (4)

Hint: $E = \frac{hc}{\lambda}$

Sol.: $\lambda = \frac{hc}{E}$

$$= \frac{12400}{14.4 \times 10^3}$$

$$\approx 0.86 \text{ \AA} \text{ belongs to x-ray region.}$$

30. Answer (2)

Hint: Momentum of photon $= \frac{h}{\lambda}$

Sol.: $mv = \frac{h}{\lambda}$

$$v = \frac{h}{\lambda \times m}$$

$$= \frac{6.6 \times 10^{-34}}{4800 \times 10^{-10} \times 9.1 \times 10^{-31}}$$

$$\approx 1500 \text{ m/s}$$

31. Answer (1)

Hint: $N = N_0 e^{-\lambda t}$

Sol.: $N_0 = N_1 e^{-\lambda t} \dots (i)$

$$\frac{N_0}{4} = N_1 e^{-2\lambda t} \dots (ii)$$

$$(i) \div (ii)$$

$$4 = e^{\lambda t}$$

$$\lambda t = \ln 4$$

$$N = N_1 e^{-\lambda \left(\frac{7t}{2}\right)}$$

$$N = N_1 e^{-\frac{7}{2} \ln 4}$$

$$N = \frac{N_1}{e^{\ln 2^7}}$$

$$N = \frac{N_1}{2^7}$$

$$N = \frac{N_0 2^2}{2^7}$$

$$N = \frac{N_0}{2^5}$$

$$= \frac{N_0}{32}$$

32. Answer (4)

Hint: $T \propto \frac{n^3}{Z^2}$

Sol.: $T_1 = 3T_2$

$$\frac{1^3}{1^2} = \frac{3(3)^3}{Z^2}$$

$$Z = 9$$

33. Answer (1)

Hint and Sol.: $Y_1 = \overline{A+B}$

$$Y = \overline{\overline{Y_1} \cdot \overline{Y_1}}$$

$$= Y_1$$

$$= \overline{A+B} \Rightarrow \text{NOR gate}$$

34. Answer (3)

Hint: $I_C = \beta I_B$ **Sol.:** Given $V_{R_C} = i_C R_C$

$$0.4 \text{ V} = i_C (400)$$

$$\Rightarrow i_C = 1 \text{ mA}$$

$$\therefore \alpha = 0.98$$

$$\therefore \beta = \frac{\alpha}{1-\alpha} = \frac{0.98}{1-0.98} = 49$$

$$i_B = \frac{i_C}{\beta} = \frac{1}{49} \text{ mA}$$

35. Answer (2)

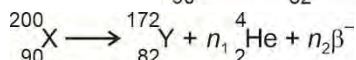
$$\text{Hint: } I = \frac{V}{R}$$

$$\text{Sol.: } I = \frac{10}{2+2}$$

$$= 2.5 \text{ A}$$

SECTION-B

36. Answer (1)

Hint & Sol.: ${}^{200}_{90}\text{X} \longrightarrow {}^{172}_{82}\text{Y} + n_1\alpha + n_2\beta^-$ 

On balancing the mass number and atomic number, we get

$$n_1 = 7 \text{ and } n_2 = 6$$

37. Answer (4)

Hint: Use $\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$

$$\text{Sol.: } f = \frac{R}{2}$$

$$= \frac{80}{2}$$

$$= 40 \text{ cm}$$

$$m = -\frac{v}{u} = \frac{h_i}{h_o}$$

$$-\frac{v}{u} = -\frac{1}{2}$$

$$|u| = 2 |v|$$

$$\frac{1}{|v|} + \frac{1}{-|u|} = \frac{1}{f}$$

$$1 - \frac{|v|}{|u|} = \frac{|v|}{f}$$

$$|v| = \frac{f}{2} = 20 \text{ cm}$$

$$|u| = 2|v| = 40 \text{ cm}$$

$$|u| + |v| = 40 + 20 = 60 \text{ cm}$$

38. Answer (2)

$$\text{Hint: } P = \frac{v^2}{R}$$

$$\text{Sol.: } P \propto \frac{1}{R}$$

$$\frac{P_1}{P_2} = \frac{R_2}{R_1} = \frac{3}{1}$$

39. Answer (2)

$$\text{Hint: } \phi = \vec{B} \cdot \vec{A}$$

$$\text{Sol.: } \phi = \mu H A$$

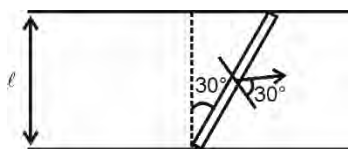
$$\mu = \frac{\phi}{HA}$$

$$= \frac{5 \times 10^{-5}}{5000 \times \frac{1}{2} \times 10^{-4}}$$

$$= 2 \times 10^{-4}$$

40. Answer (1)

$$\text{Hint: } \varepsilon = (\vec{v} \times \vec{B}) \cdot \vec{\ell}$$

Sol.:

$$\varepsilon = Bv\ell \cos 30^\circ$$

$$= \frac{Bv\ell\sqrt{3}}{2}$$

41. Answer (1)

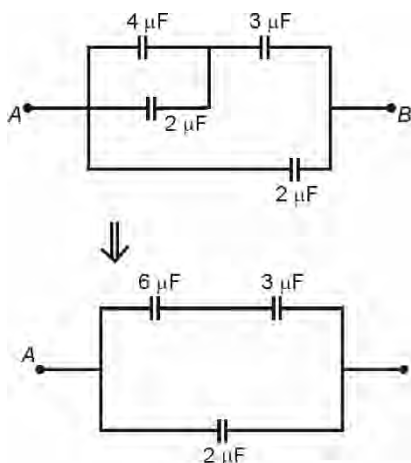
Hint: For parallel combination

$$C_{\text{eff}} = C_1 + C_2 + \dots + C_n$$

For series combination

$$\frac{1}{C_{\text{eff}}} = \frac{1}{C_1} + \frac{1}{C_2} + \dots + \frac{1}{C_n}$$

Sol.:



$$C_{AB} = \frac{6 \times 3}{6 + 3} + 2$$

$$= 4 \mu\text{F}$$

42. Answer (4)

Hint & Sol.: Charge will execute oscillatory motion but not S.H.M because electrostatic force acting on the charge is not proportional to displacement of charge particle from its mean position.

43. Answer (1)

Hint: Friction force = centripetal force

$$\text{Sol.: } \mu mg = \frac{mv^2}{R}$$

$$R = \frac{v^2}{\mu g}$$

$$= \frac{(10)^2}{0.5 \times 10}$$

$$= 20 \text{ m}$$

44. Answer (1)

Hint: Weight of the stone reduced due to upthrust force.

$$\text{Sol.: } \rho = \text{density of the material of stone} = \frac{m}{V}$$

$\therefore V = \text{Volume of the stone}$

$$= \frac{m}{\rho} = \frac{10}{2 \times 10^3} = 5 \times 10^{-3} \text{ m}^3$$

$$\text{loss in weight} = V\sigma g$$

$$= 5 \times 10^{-3} \times 10^3 \times 9.8$$

$$= 49 \text{ N}$$

$$\text{Net weight to be lifted} = 10 \times 9.8 - 49$$

$$= 49 \text{ N}$$

$$W = 49 \times 10$$

$$= 490 \text{ J}$$

45. Answer (4)

$$\text{Hint: } \tau = Fr_{\perp}$$

$$\text{Sol.: } \omega = 4 + 3t$$

$$\alpha = \frac{d\omega}{dt}$$

$$= 3 \text{ rad/s}^2$$

$$\tau = I \times \alpha$$

$$F \times R = \frac{mR^2}{2} \alpha$$

$$F = \frac{mR}{2} \alpha$$

$$= \frac{4 \times 0.1 \times 3}{2}$$

$$= 0.6 \text{ N}$$

46. Answer (4)

$$\text{Hint and Sol.: } S = \frac{dU}{dA}$$

47. Answer (1)

$$\text{Hint: } \frac{dQ}{dt} = \frac{T_1 - T_2}{R}$$

$$\text{Sol.: } \frac{Q}{t_1} = \frac{T_1 - T_2}{(2R)}$$

R is thermal resistance of one rod

$$\frac{Q}{t_2} = \frac{T_1 - T_2}{\left(\frac{R}{2}\right)}$$

$$\frac{t_2}{t_1} = \frac{1}{4} \Rightarrow t_2 = 4 \text{ s}$$

48. Answer (3)

$$\text{Hint: } v = \omega \sqrt{a^2 - x^2}$$

$$\text{Sol.: } v = \omega \sqrt{a^2 - x^2}$$

$$x = \frac{a}{2}$$

$$v = \frac{\sqrt{3}a \omega}{2}$$

$$\omega = \frac{2\pi}{T}$$

$$v = \frac{\sqrt{3}a\pi}{T}$$

49. Answer (1)

Hint: Distance between consecutive node and antinode is $\frac{\lambda}{4}$

Sol.: $y = 5 \sin\left(\frac{\pi x}{3}\right) \cos 40\pi t$

$$\frac{2\pi}{\lambda} = \frac{\pi}{3}$$

$$\lambda = 6$$

$$\frac{\lambda}{4} = \frac{6}{4}$$

$$= 1.5 \text{ m}$$

50. Answer (3)

Hint: Relative acceleration of both the bodies will be zero.

Sol.: $\vec{S} = \vec{v}_{rel} t + \frac{1}{2} \vec{a}_{rel} \times t^2$

$$\vec{a}_{rel} = 0$$

$$\vec{S} = \vec{v} \times t$$

[CHEMISTRY]

SECTION-A

51. Answer (1)

Hint: For fcc unit cell; $4r = \sqrt{2}a$

Sol.: $4r = \sqrt{2}a$

$$r = \frac{\sqrt{2}}{4}a$$

$$r = \frac{\sqrt{2}}{4} \times 420$$

$$r = 148.5 \text{ pm}$$

52. Answer (4)

Hint: Mass of HNO_3 required = $400 \times 3 \times 10^{-3} \times 63 = 75.6 \text{ g}$

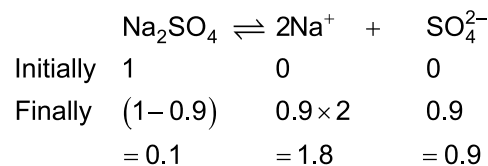
Sol.: 70 g of HNO_3 is present in 100 g of concentrated nitric acid solution

$$75.6 \text{ g of } \text{HNO}_3 \text{ is present in } \frac{100}{70} \times 75.6 = 108 \text{ g}$$

53. Answer (3)

Hint: $\Delta T_f = iK_f m$

Sol.:



$$i(\text{van't Hoff factor}) = 0.1 + 1.8 + 0.9$$

$$i = 2.8$$

$$\Delta T_f = iK_f m$$

$$\Delta T_f = 2.8 \times 1.86 \times \frac{14.2 \times 1000}{142 \times 200}$$

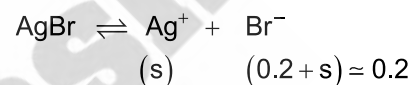
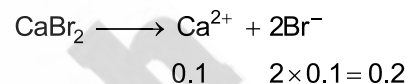
$$\Delta T_f = 2.6 \text{ K}$$

$$\text{Freezing point of solution} = -2.6^\circ \text{ C}$$

54. Answer (2)

Hint: Bromide of CaBr_2 (strong electrolyte) will act as common ion and will decrease the solubility of AgBr .

Sol.: CaBr_2 is strong electrolyte



$$[\text{Ag}^+][\text{Br}^-] = K_{sp}$$

$$s \times 0.2 = 5 \times 10^{-13}$$

$$s = \frac{5 \times 10^{-13}}{0.2}$$

$$s = 2.5 \times 10^{-12}$$

$$\text{Solubility of AgBr} = 2.5 \times 10^{-12} \text{ M}$$

55. Answer (1)

Hint: Number of atoms in molecule

$$= \frac{\text{Mass of molecule}}{\text{Molar mass}} \times \text{atomicity} \times N_A$$

Sol.:

- Number of atoms of $\text{CH}_4 = \frac{8}{16} \times 5 \times N_A$
- $= 0.75 N_A$

- Number of atoms of $\text{SO}_2 = \frac{16}{64} \times 3 N_A$

- Number of atom of $\text{C}_6\text{H}_{12}\text{O}_6 = \frac{9}{180} \times 24 N_A$
- $= 1.2 N_A$

$$\text{Number of atoms of } \text{CO}_2 = \frac{22}{44} \times 3 N_A = 1.5 N_A$$

56. Answer (1)

Hint: Higher is the effective nuclear charge smaller is the size of ion.

Sol.:

- O^{2-} and F^- are isoelectronic species having 10 electrons each.
- Effective nuclear charge on F^- is more hence F^- is smaller in size than O^{2-} .

57. Answer (2)

Hint: $r_n = a_0 \frac{n^2}{Z}$

de Broglie wavelength λ is given as

$$n\lambda = 2\pi r_n$$

Sol.: $r_3 = a_0 \times \frac{(3)^2}{2}$

$$r_3 = \frac{9}{2}a_0$$

$$\lambda = \frac{2\pi r_3}{3} \quad [\because n = 3]$$

$$\lambda = \frac{2\pi}{3} \times \frac{9}{2}a_0$$

$$\lambda = 3a_0\pi$$

$$\lambda = 3 \times 52.9\pi \text{ pm}$$

$$\lambda = 158.7\pi \text{ pm}$$

58. Answer (4)

Hint: Angular momentum = $\sqrt{l(l+1)}\hbar$

Sol.: For p -orbital $l = 1$

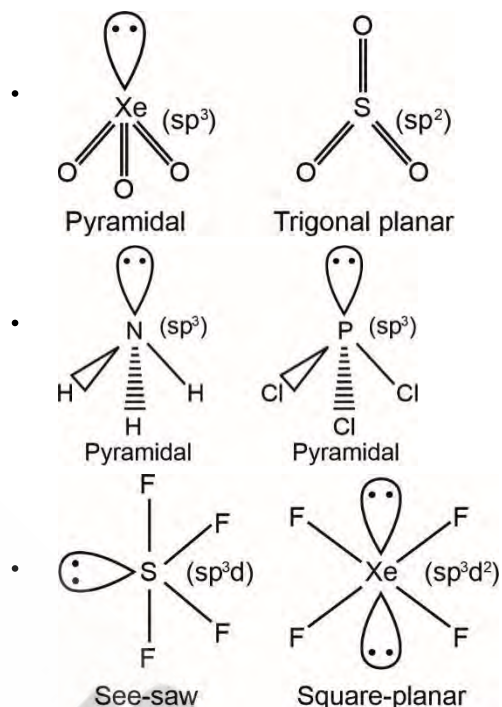
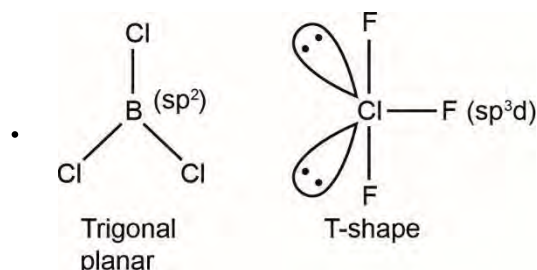
Angular momentum = $\sqrt{1(1+1)}\hbar$

$$= \sqrt{2}\hbar$$

59. Answer (3)

Hint: The molecules having same number of bond pairs and same number of lone pairs on central atom will be isostructural.

Sol.:



Same number of bond pairs and lone pair are present on central atom in NH_3 and PCl_3 hence they are isostructural.

60. Answer (2)

Hint: $d = \frac{PM}{RT}$

Sol.: $d = \frac{4.1 \times 32}{0.082 \times 400}$

$$d = 4 \text{ g/L}$$

$$\text{density of } O_2 \text{ gas} = 4 \text{ gL}^{-1}.$$

61. Answer (4)

Hint: Since unit of rate constant is s^{-1} hence it is a first order reaction.

For first order reaction, $k = \frac{2.303}{t} \log \frac{[R]_0}{[R]}$

Sol.: $t = \frac{2.303}{k} \log \frac{[R]_0}{[R]}$

$$t = \frac{2.303}{9.212 \times 10^{-3}} \log \frac{100}{80}$$

$$t = \frac{2.303}{9.212 \times 10^{-3}} [\log 10 - 3 \log 2]$$

$$t = \frac{2.303}{9.212 \times 10^{-3}} \times 0.1$$

$$t = 25 \text{ s}$$

62. Answer (3)

Hint: Malachite, Calamine and Siderite are carbonate ores.**Sol:**

Ores	Composition
Malachite	$\text{CuCO}_3 \cdot \text{Cu}(\text{OH})_2$
Calamine	ZnCO_3
Siderite	FeCO_3
Haematite	Fe_2O_3

63. Answer (2)

Hint: Higher is the number of unpaired electrons, greater is the value of spin only magnetic moment.**Sol.:**

Complex ion	Number of unpaired electrons (n)	$\mu = \sqrt{n(n+2)}$ BM
$[\text{Co}(\text{H}_2\text{O})_6]^{3+}$	0	0
$[\text{MnCl}_6]^{3-}$	4	4.9
$[\text{Fe}(\text{CN})_6]^{3-}$	1	1.7
$[\text{Mn}(\text{CN})_6]^{3-}$	2	2.8

64. Answer (2)

Hint: HF has exceptionally high boiling point because of the presence of intermolecular hydrogen bonding.**Sol.:**

Compound	Boiling point (K)
HF	293
HCl	189
HBr	206
HI	238

65. Answer (3)

Hint: 1 Faraday electricity deposits 1 g-equivalent of substance at electrode.**Sol.:** Number of Faraday passed

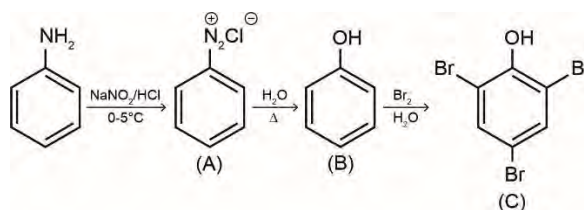
$$= \frac{3.86 \times 100 \times 60}{96500} = 0.24 \text{ F}$$

$$\text{Mass of nickel deposited} = 0.24 \times \frac{58.7}{2}$$

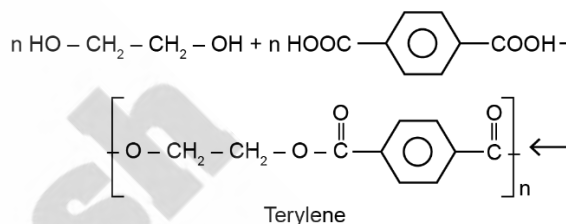
$$= 7.04 \text{ g}$$

$$\approx 7 \text{ g}$$

66. Answer (4)

Hint: Benzene diazonium chloride is converted to phenol on reaction with water**Sol.:**

67. Answer (3)

Hint: Condensation polymerisation occurs between two bi-functional or trifunctional monomeric units. In this process loss of simple molecules such as water, alcohol, hydrogen chloride etc. takes place.**Sol.:**

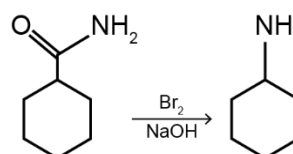
- Terylene is a condensation polymer.
- Buna-S, Teflon and Neoprene are addition polymers.

68. Answer (1)

Hint: Tranquilizers and analgesics are neurologically active drugs.**Sol.:**

Drugs	Classes of drugs
Meprobamate	Neurologically active drug (Tranquilizer)
Terfenadine	Antihistamine
Tetracycline	Antibiotic
Novestrol	Antifertility drug

69. Answer (4)

Hint: The given reaction is Hoffmann bromamide degradation reaction.**Sol.:**

Amine formed in this reaction is one carbon less than the given amide.

70. Answer (4)

Hint: More stable is the carbocation, faster is the S_N1 rate

Sol.:

- The intermediate species formed in the S_N1 reaction is a carbocation, More stable is the carbocation faster is S_N1 rate.
- Stability order of carbocation



- tert* butyl chloride () will react fastest by S_N1 reaction.

71. Answer (4)

Hint: Electron withdrawing group present at para-position increases acidity of phenol derivative.

Sol.:

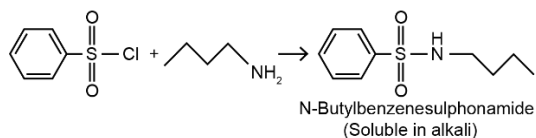
- Electron donating groups like $-CH_3$, $-OMe$ decrease acidity of phenol.
- Electron withdrawing group present at para position increases acidity of phenol.
- $-NO_2$ stabilises the conjugate base by $-R$ effect hence p-nitrophenol is most acidic among the given molecules.

72. Answer (1)

Hint: Benzenesulphonyl chloride reacts with primary and secondary amines to form sulphonamides.

Sol.:

- The reaction of benzenesulphonyl chloride with primary amine yields N-alkylbenzenesulphonamide. The hydrogen attached to nitrogen in sulphonamide is strongly acidic due to the presence of strong electron withdrawing sulphonyl group. Hence, it is soluble in alkali

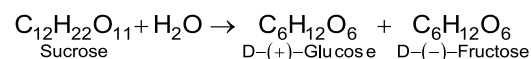


- In reaction with secondary amine, N, N-dialkylbenzenesulphonamide is formed which does not contain any hydrogen atom attached with nitrogen atom. It is not acidic and hence insoluble in alkali.
- Tertiary amine does not react with benzene sulphonyl chloride.

73. Answer (3)

Hint: Sucrose is a non-reducing sugar.

Sol.: • Sucrose on hydrolysis gives equimolar mixture of D-(+)-glucose and D-(-)-fructose



- Since the reducing groups of glucose and fructose are involved in glycosidic bond formation, hence sucrose is a non reducing sugar. It does not reduce Tollens' reagent

74. Answer (4)

Hint: More is the number of hyperconjugative structures, or α - hydrogens more is the stability of alkene and lesser is the energy released on catalytic hydrogenation.

Sol.:

Compounds	α -hydrogen atoms
	5
	8
	4
	2

75. Answer (2)

Hint: Percentage of

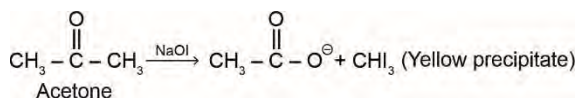
$$S = \frac{\text{Molar mass of S} \times \text{Mass of BaSO}_4 \times 100}{\text{Molar mass of BaSO}_4 \times \text{Mass of organic compound}}$$

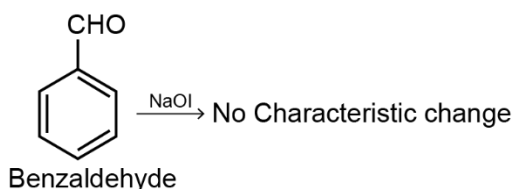
$$\text{Sol.: Percentage of sulphur} = \frac{32 \times 0.699 \times 100}{233 \times 0.5} = 19.2\%$$

76. Answer (2)

Hint: Compound containing $CH_3-C(=O)-$ and $CH_3CH(OH)-$ groups react with NaOI to give iodoform.

Sol.:



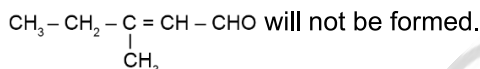
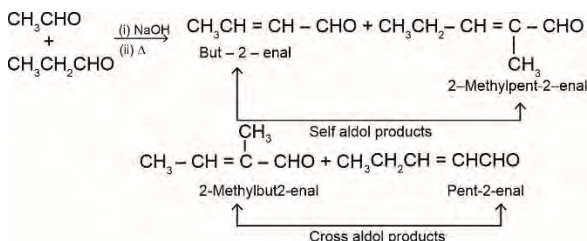


Benzaldehyde

77. Answer (2)

Hint: In a reaction of two different carbonyl compounds self aldol and cross aldol condensation reactions will take place.

Sol.:



78. Answer (3)

Hint: The species which does not contain d electron(s) will not show colour in aqueous medium.

Sol.: Cu^{2+} , V^{3+} and Ni^{2+} contain d electrons hence these are coloured species in aqueous medium while Sc^{3+} does not contain any d electron. Hence Sc^{3+} is colourless in aqueous medium.

79. Answer (2)

Hint: The species which contains paired electron are diamagnetic in nature.

Sol.:

Compound /Ion	Shape & hybridisation	Magnetic behaviour
[PtCl ₄] ²⁻	Square planar and dsp^2	Diamagnetic
[Ni(CO) ₄]	Tetrahedral and sp^3	Diamagnetic
[Cu(NH ₃) ₄] ²⁺	Square planar and dsp^2	Paramagnetic
[Pt(NH ₃) ₂ Cl ₂]	Square planar and dsp^2	Diamagnetic

80. Answer (2)

Hint: $\Delta_r G^\circ = -nFE^\circ_{\text{cell}}$

Sol.: $E_{\text{cell}}^{\circ} = E_{\text{Cu}^{2+}/\text{Cu}}^{\circ} - E_{\text{Al}^{3+}/\text{Al}}^{\circ}$

$$E_{\text{cell}}^{\circ} = 0.34 + 1.66$$

$$E^{\circ}_{\text{cell}} = 2V$$

$$\Delta_r G^\circ = -6 \times 96500 \times 2$$

$$= -1158 \text{ kJ mole}^{-1}$$

81. Answer (4)

Hint: $4\text{Zn} + 10\text{HNO}_3 \text{ (dilute)} \rightarrow 4\text{Zn}(\text{NO}_3)_2 + 5\text{H}_2\text{O} + \text{N}_2\text{O}$

Sol.: $3\text{Cu} + 8\text{HNO}_3 \text{ (dilute)} \rightarrow 3\text{Cu}(\text{NO}_3)_2 + 2\text{NO} + 4\text{H}_2\text{O}$

82. Answer (4)

Hint: • The process is adiabatic, hence $q = 0$

- $w = -P_{\text{ex}}\Delta V$

Sol.: $w = -5(v_f - v_i)$

$$= -5(3.25 - 1.25)$$

$$w = -10 \text{ L atm}$$

From first law of thermodynamics

$$\Delta U = q + w$$

$$\Delta U = w \text{ (for adiabatic process)}$$

$$\Delta U = -10 \text{ L atm}$$

$$= -10 \times 101.3$$

$$\Delta U = -1013 \text{ J}$$

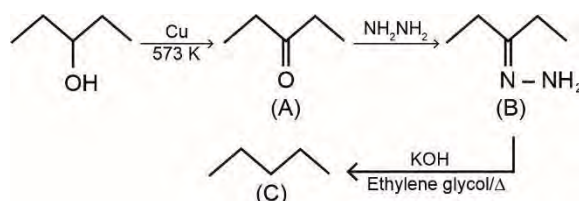
83. Answer (4)

Hint and Sol: Maximum permissible limit of lead in drinking water is 50 ppb.

84. Answer (3)

Hint: Secondary alcohol is oxidised to ketone by heating it with copper at 573 K.

Sol.:



85. Answer (1)

Hint: Amphoteric oxides behave as acid with bases and base with acids, whereas neutral oxides have no acidic or basic properties.

Sol.:

Compounds	Chemical nature
CO	Neutral
Na ₂ O	Basic
Cl ₂ O ₇	Acidic
Al ₂ O ₃	Amphoteric

SECTION-B

86. Answer (3)

Hint: Root mean square speed (v_{rms}) = $\sqrt{\frac{3RT}{M}}$

$$\text{Sol.: } \frac{v_{rms}(\text{O}_2)}{v_{rms}(\text{He})} = \sqrt{\frac{M_{\text{He}}}{M_{\text{O}_2}}} = \sqrt{\frac{4}{32}} = 1:2\sqrt{2}$$

87. Answer (2)

Hint: Cyclic species containing $(4n + 2)\pi$ electrons in conjugation are aromatic in nature.

Sol.:

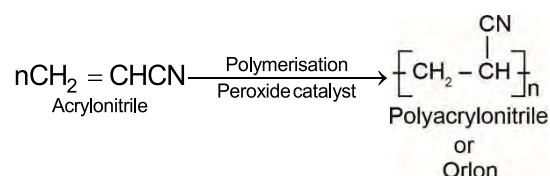
- Tropylium cation  contains 6π electrons in conjugation which follows Huckel's $(4n + 2)\pi$ electron rule.

-  and  are antiaromatic

-  is non-aromatic

88. Answer (3)

Hint: Orlon is $\left[\text{CH}_2 - \underset{\text{CN}}{\text{CH}} \right]_n$

Sol.:

89. Answer (2)

Hint: At constant pressure, on introduction of inert gas, volume increases hence equilibrium moves in a direction where number of moles of gases increases.

Sol.: At constant pressure, introduction of inert gas (helium) will lead to the increase in volume hence dissociation of ammonia increases.

90. Answer (2)

Hint: The element in its lowest or in its highest oxidation state does not undergo disproportionation reaction.

Sol.: Among the given oxoanions of chlorine, ClO_4^- does not disproportionate because in this oxoanion, chlorine is present in its highest oxidation state that is +7.

91. Answer (2)

Hint: Volume strength of $\text{H}_2\text{O}_2 = 11.2 \times \text{Molarity (M)}$

Sol.: $22.4 = 11.2 \times M$

$M = 2$

$$\left(\frac{w}{V} \right) \% \text{ of } \text{H}_2\text{O}_2 = \frac{34 \times 2}{1000} \times 100 = 6.8\%$$

92. Answer (4)

Hint and Sol.:

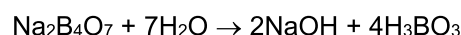
Element	Flame colour
Sodium	Yellow
Caesium	Blue
Calcium	Brick red
Barium	Apple green

93. Answer (4)

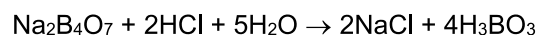
Hint: Borax is a salt of weak acid and strong base.

Sol.:

- Borax is a salt of weak acid and strong base hence its aqueous solution will be alkaline in nature.



- Borax on reaction with dilute HCl gives boric acid as one of the products.



94. Answer (4)

Hint: Smaller is the size of cation, greater is the hydration enthalpy.

Sol.:

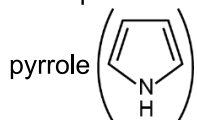
- In the given metal sulphates, size of Mg^{2+} is smallest. Greater hydration enthalpy of Mg^{2+} ions overcome the lattice enthalpy factor hence MgSO_4 is highly soluble in water.
- The solubility decreases as the size of metal cation increases.

95. Answer (3)

Hint: Lone pair present on sp^3 hybridised nitrogen atom will be most easily available for protonation.

Sol.:

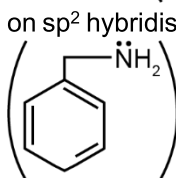
- Lone pair of electrons present on nitrogen of



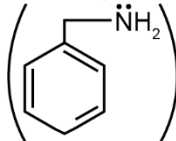
pyrrole are involved in resonance and the molecule becomes aromatic hence it is least basic.

- Lone pair of electrons present on the nitrogen of aniline is delocalised in the benzene ring hence its basicity decreases.

- In pyridine the lone pair is present



on sp^2 hybridised nitrogen while in benzylamine



the lone pair of electron is present on sp^3 hybridised nitrogen atom hence benzyl amine is most basic among the given options.

96. Answer (3)

Hint: Since unit of rate constant is $\text{mol L}^{-1}\text{s}^{-1}$ hence order of reaction is zero.

Sol.:

	X	→	Y
Initial	3 M		0
Final	3-kt		kt

Concentration of Y = kt

$$= 2.5 \times 10^{-4} \times 100 \times 60$$

$$= 1.5 \text{ M}$$

97. Answer (4)

Hint: Sodium acetate will undergo hydrolysis in water and pH of the solution will be determined as

$$\text{pH} = 7 + \frac{1}{2}[\text{pK}_a + \log c]$$

$$\text{Sol.: } \text{pH} = 7 + \frac{1}{2}[4.76 + \log 0.2]$$

$$\text{pH} = 7 + \frac{1}{2}[4.76 - 0.7]$$

$$\text{pH} = 9$$

98. Answer (1)

Hint: Enthalpy of neutralization of a strong base with a strong acid is -57.1 kJ eq^{-1}

Sol.:

	HCl	+	NaOH	→	NaCl	+	H ₂ O
Initial:	400 × 0.5		600 × 0.2				
	= 200 mmol		120 mmol				
Final	(200 - 120)				120 mmol		
	= 80 mmol						

NaOH is limiting reagent

$$\therefore \text{Heat released} = 120 \times 10^{-3} \times 57.1$$

$$= 6.85 \text{ kJ}$$

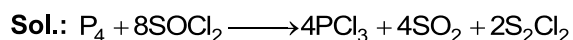
99. Answer (1)

Hint: Copper sol is negatively charged sol.

Sol.: A given sol is coagulated by oppositely charged ion. Copper sol is a negatively charged sol hence it is coagulated by positively charged ion. Higher is the value of charge more easily the sol will be coagulated.

100. Answer (2)

Hint: Thionyl chloride is SOCl_2



[BOTANY]

SECTION-A

101. Answer (1)

Hint: A pure line plant is a true-breeding plant which shows stable trait expression and inheritance for several generation due to self-pollination

Sol.: Mendel choose 7 pairs of contrasting traits in pea plants.

102. Answer (2)

Hint: Homologous chromosomes pair before the crossing over process which occurs in pachytene

Sol.: Leptotene – Condensation of chromosomes.
Zygotene – Pairing of homologous chromosomes.
Pachytene – Crossing over.
Diplotene – Separation of homologous chromosomes.

103. Answer (2)

Hint: Cells of this region differentiate to form certain structures.

Sol.: The epidermal cells from the zone of maturation form fine and delicate, thread-like structures called root hairs.

104. Answer (2)

Hint: Heterostyly refers to difference in the length of stamen filament and style of stigma in a bisexual flower.

Sol.: It is a morphological method in some plants like *Primrose* to prevent self pollination.

105. Answer (1)

Hint: In one turn of Krebs cycle NAD^+ and FAD^+ are reduced.

Sol.: In one turn of Krebs cycle, 3 molecules of NAD^+ are reduced to $\text{NADH} + \text{H}^+$ and one molecule of FADH_2 is synthesized.

106. Answer (1)

Hint: RNA polymerase synthesizes mRNA.

Sol.: DNA polymerase can polymerise 2,000 bp per second only in one direction i.e., $5' \rightarrow 3'$ direction.

107. Answer (2)

Hint: In parasitism and predation, one species is benefitted and another one is harmed.

Sol.: Plants and fungi in mycorrhiza share mutualistic relationship.

Eagle is a predator of rat.

Penicillium produces antibiotic penicillin, which kills many bacteria.

Lice are ectoparasites on humans.

108. Answer (3)

Hint: Along with water, dissolved minerals are absorbed by roots and translocated by xylem.

Sol.: Xylem translocates water, absorbed minerals, fixed nitrogen (as nitrates) and hormones. Photosynthates are transported by phloem.

109. Answer (3)

Hint: Phylogenetic system of classification was proposed by Engler and Prantl, Hutchinson and Takhtajan.

Sol.: Mosses (bryophytes) show haplo-diplontic life cycle.

Eudorina is an alga in which two types of gametes are produced.

In brown algae, the food is stored in the form of laminarin or mannitol.

110. Answer (3)

Hint: The pigment that traps sunlight for light reaction of photosynthesis has a tadpole like structure.

Sol.: Photorespiration is a wasteful process as it involves loss of fixed carbon.

Ruben and Kamen proved that the O_2 liberated during photosynthesis comes from water.

Kranz anatomy is observed in C_4 plants.

111. Answer (3)

Hint: This chromosome appears J-shaped during anaphase.

Sol.: One arm of the acrocentric chromosome is very small and one very long, gives it a J-shaped appearance during anaphase.

112. Answer (2)

Hint: Hypodermis is absent in roots.

Sol.: Conjoint and open vascular bundles, presence of medullary rays and pith, and collenchymatous hypodermis are the characteristics of dicot stem.

113. Answer (1)

Hint: NAD^+ is a co-enzyme which accepts electrons during different steps of respiration.

Sol.: NAD^+ acts as an electron carrier by transporting electrons to the ETS.

114. Answer (1)

Hint: Vegetative propagation in ginger occurs through underground stem.

Sol.: Eye of tuber – Potato

Leaf buds – *Bryophyllum*

Offset – Water hyacinth

Rhizome – Ginger

115. Answer (4)

Hint: In the most tedious step of plant breeding, the pollen grain from male parent has to be collected and placed on the stigma of female parent, manually.

Sol.: Cross-hybridisation among the selected parents is performed which is very tedious and time-consuming process.

116. Answer (2)

Hint: The pioneer species in hydrarch succession are microscopic autotrophic organisms.

Sol.: Phytoplanktons are the pioneer species in primary succession in water, followed by rooted-submerged, submerged free-floating plants, reed-swamp stage, marsh-meadow stage, scrub stage and finally forest.

117. Answer (3)

Hint: In case of female heterogamety, ZW-ZZ type of sex determination is seen.

Sol.: Grasshopper and *Drosophila* show male heterogamety.

In birds, females produce heterogametes A + Z and A + W.

118. Answer (2)

Hint: Ribosomes bound to ER perform protein synthesis.

Sol.: RER → Protein synthesis

SER → Lipids synthesis

Golgi complex → Glycosylation

Centrioles → Spindle formation in cell division

119. Answer (2)

Hint: Mortality reduces population density of an area.

Sol.: Mortality is the rate of deaths in a population.

120. Answer (1)

Hint: It nourishes the developing pollen grains.

Sol.: Epidermis, endothecium and middle layers are protective in function while tapetum provide nourishment.

121. Answer (2)

Hint: It is absorbed in oxidation state of +2

Sol.: Copper is absorbed as cupric (Cu^{2+}) ions by plants.

122. Answer (2)

Hint: Bad ozone is present in Troposphere.

Sol.: Good ozone is present in Stratosphere.

123. Answer (3)

Hint: This hormone is responsible for apical dominance in plants.

Sol.: Auxin was isolated from human urine.

124. Answer (3)

Hint: Tropical regions have higher species diversity than temperate regions.

Sol.: Tropical Amazonian rain forest has the greatest biodiversity on earth with >40,000 species of plants, 3000 species of fishes, 1300 species of birds, 427 species of mammals, etc.

125. Answer (2)

Hint: Viroids are made up of RNA only.

Sol.: Prions cause mad cow disease in cattle and Cr-Jacob disease in humans. Their size is similar to that of viruses.

126. Answer (1)

Hint: *Chlamydomonas* and *Volvox* are unicellular and colonial algae, respectively.

Sol.: *Ulothrix* and *Spirogyra* are filamentous algae.

127. Answer (2)

Hint: Dumb-bell shaped guard cells are present in grasses.

Sol.: Guard cells are usually kidney or bean shaped in dicot leaves.

128. Answer (4)

Hint: Acetic acid is obtained from of a bacterium

Sol.: *Penicillium* → Penicillin

Aspergillus → Citric acid

Lactobacillus → Lactic acid

Acetobacter → Acetic acid

129. Answer (1)

Hint: Probes used in DNA fingerprinting are made up of repetitive DNA.

Sol.: Variable Number of Tandem Repeats (VNTRs) are used as probe for DNA fingerprinting.

130. Answer (4)

Hint: In grassland ecosystems, the ecological pyramids are upright

Sol.: Pyramid of biomass in sea is inverted because the number of zooplanktons (consumers) is usually much higher than that of producers (phytoplanktons).

131. Answer (3)

Hint: Cork is formed by the differentiation of cells produced by cork cambium on the outer side and is protective in function.

Sol.: Due to origin of cork cambium outside the stele, it is also called the extra-stelar cambium.

132. Answer (3)

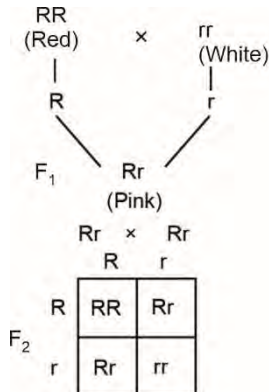
Hint: In the S-phase, a non-membrane bound cell organelle is duplicated.

Sol.: In S-phase, DNA is duplicated in the nucleus and centrioles in the cytoplasm.

133. Answer (2)

Hint: In *Antirrhinum*, incomplete dominance is seen.

Sol.:



134. Answer (3)

Hint: Some algae and fungi can be in a symbiotic association.

Sol.: A = Lichens, composed of phycobiont and mycobiont, and it cannot grow in polluted environment.

B = Viruses, inside host they act as living and outside them they act as non-living.

135. Answer (3)

Hint: Bacterial blight is a disease of Cowpea.

Sol.: Pusa Komal variety of cow pea is resistant to bacterial blight.

SECTION-B

136. Answer (3)

Hint: Each statement of the contrasting pair in a key is called a lead.

Sol.: The keys are based on the contrasting character generally in a pair called couplet.

137. Answer (2)

Hint: Ribulose-1, 5-biphosphate is the primary acceptor of CO_2 in Calvin cycle.

Sol.: Hatch and Slack pathway is observed in C_4 plants. Cyclic photophosphorylation involves only PS I.

138. Answer (3)

Hint: Zoospores are meant for asexual reproduction.

Sol.: Zoospores are produced by mitosis in *Chlamydomonas* for asexual reproduction. Megaspore cells are produced by meiotic division of megaspore mother cell.

139. Answer (4)

Hint: Colourful flowers and nectar are present in insect-pollinated plants.

Sol.: The pollen grains of the water-pollinated flowers are protected from wetting by mucilaginous covering.

140. Answer (4)

Hint: World Summit of 2002 at Johannesburg involved 190 countries, who took a pledge for reducing loss of biodiversity.

Sol.: Reducing the rate of biodiversity loss – World Summit, 2002

Reducing emission of Greenhouse gases – Kyoto protocol

Protecting the stratosphere – Montreal protocol

Conservation of Biodiversity and Sustainable utilization of its benefits – Earth Summit, Rio De Janeiro, 1992

141. Answer (2)

Hint: Histone protein synthesis takes place in S-phase of interphase. Longest stage of Meiosis I is Prophase I.

Sol.: Duplication of DNA $\rightarrow$ S-phase

Longest phase of cell cycle $\rightarrow$ Interphase

Longest stage of meiosis I $\rightarrow$ Prophase I

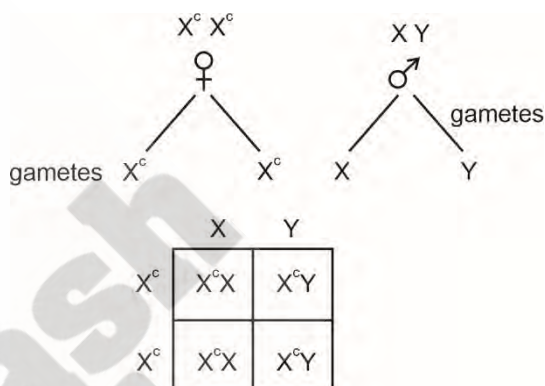
Terminalisation of chiasmata $\rightarrow$ Diakinesis

142. Answer (3)

Hint: Colour blindness is a sex linked recessive disorder.

Sol.: Colourblind female: X^cX^c

Normal male: XY



All the females are carrier of this disease i.e., no female progeny is colourblind.

143. Answer (3)

Hint: The events of ETS occur only in the mitochondria.

Sol.: During the transportation of electrons in the ETS, the protons move to intermembrane space from mitochondrial matrix.

144. Answer (2)

Hint: At low light conditions and high CO_2 concentration, neither C_3 nor C_4 plants show any change in rate of photosynthesis.

Sol.: More than 0.05% CO_2 concentrations can be damaging over longer periods.

At high light intensity, both C_3 and C_4 plants show higher productivity.

145. Answer (2)

Hint: Cucurbits have stem tendrils

Sol.: Cactus $\rightarrow$ spines

Pisum sativum $\rightarrow$ leaf tendrils

Members of Cucurbitaceae $\rightarrow$ stem tendril

Bryophyllum $\rightarrow$ leaf buds

146. Answer (3)

Hint: Females suffering from this condition show monosomy of sex chromosome.

Sol.: Down's syndrome: Trisomy at chromosome 21

Klinefelter's syndrome : 44 + XXY

Turner's syndrome : 44 + XO

Edwards syndrome : Trisomy at chromosome 18.

147. Answer (3)

Hint: Statins are produced by a fungus.

Sol.: *Trichoderma polysporum* – Cyclosporin A

Streptococcus – Streptokinase

Monascus purpureus – Statins

Clostridium – Butyric acid

148. Answer (2)

Hint: RNA polymerase III transcribes tRNA, 5S rRNA and snRNAs.

Sol.: RNA polymerase II transcribes hnRNA only. RNA polymerase I transcribes 28S, 18S and 5.8S rRNAs.

149. Answer (2)

Hint: Most of the organelles duplicate in G₁ phase and centrioles duplicate in S-phase.

Sol.: Tubulin protein is synthesized in G₂ phase. Only the organelles like mitochondria, chloroplasts and Golgi complex duplicate in this phase.

150. Answer (3)

Hint: Dormancy is broken by ethylene and auxins lead to apical dominance.

Sol.: Gibberellin – Helps in seed germination

Auxins – Present in root and shoot apex

Abscissic acid – Shows inhibitory effect

Cytokinin – Overcomes apical dominance

[ZOOLOGY]

SECTION-A

151. Answer (2)

Hint: Connects the cytoplasm of adjoining cells

Sol.: Three types of cell junctions are found in the epithelium and other tissues.

1. Tight junctions – Help to stop substances from leaking across a tissue
2. Adhering junctions – Perform cementing to keep neighbouring cells together
3. Gap junctions – Facilitate the cells to communicate with each other by connecting the cytoplasm of adjoining cells for rapid transfer of ions, small molecules, etc.

152. Answer (4)

Hint: Inner cell mass differentiates into embryo.

Sol.: In later phase of pregnancy, a hormone called relaxin is also secreted by the ovary. hCG, hPL and relaxin are produced in women only during pregnancy. Inner cell mass contains certain cells called stem cells which have the potency to give rise to all the tissues and organs.

153. Answer (2)

Hint: Diabetes insipidus

Sol.: ADH facilitates water reabsorption from latter parts of renal tubule, thereby preventing diuresis.

Presence of proteins in urine is termed proteinuria.

154. Answer (2)

Hint: It has 16 carbons including carboxyl carbon

Sol.: Palmitic acid has 16 carbons including the carboxyl carbon.

Glutamic acid and aspartic acid are acidic amino acids.

155. Answer (2)

Hint: Female *Anopheles* mosquito is a vector of this disease

Sol.: Symptoms of amoebiasis include constipation, abdominal pain and cramps, stool with excess mucous and blood clots.

Filariasis is characterised by the inflammation of lymphatic vessels of the lower limbs.

Appearance of dry, scaly lesions on various parts of the body such as skin, nails and scalp are the main symptoms of ringworms.

156. Answer (2)

Hint: Production of 6 – 8 eggs

Sol.: MOET (Multiple Ovulation Embryo Transfer Technology) is a programme for herd improvement.

In AI, the semen is collected from the selected male and injected into the reproductive tract of the selected female by the breeders.

In cross-breeding, superior males of one breed are mated with superior females of another breed. Mating between two different related species is called interspecific hybridisation.

157. Answer (2)

Hint: Related to structure involved in haemopoiesis

Sol.: Gene therapy is an attempt as a corrective therapy of a person who was born with a hereditary disease.

cry gene is isolated from *Bacillus thuringiensis*.

ADA enzyme is crucial for the immune system to function. In some children, ADA deficiency can be cured by bone marrow transplantation.

α -interferon is a biological response modifier which activates the immune system and helps in destroying the tumor.

158. Answer (2)

Hint: One of the major cause is cigarette smoking

Sol.: Asthma is a difficulty in breathing causing wheezing due to inflammation of bronchi and bronchioles.

Diarrhoea is abnormal frequency of bowel movement and increased liquidity of the faecal discharge.

Muscular dystrophy is the progressive degeneration of skeletal muscle mostly due to genetic disorder.

159. Answer (2)

Hint: Bones of hind limb

Sol.: The vertebral column is differentiated into cervical (7), thoracic (12), lumbar (5), sacral (1-fused) and coccygeal (1-fused) regions starting from the skull.

Atlas is the first vertebra. Atlas articulates with the occipital condyles.

Ethmoid and sphenoid are cranial bones.

Sternum and ribs are axial bones which participates in formation of thoracic cage.

160. Answer (3)

Hint: Primary spermatocyte undergoes meiosis-I

Sol.: Primary spermatocyte	} Diploid cells
Primary oocyte	
Spermatogonia	
Oogonia	
Ootid	} Haploid cells
Spermatozoa	
Spermatids	

161. Answer (3)

Hint: Exclude the anti-diuretic hormone.

Sol.: Foetal ejection reflex triggers the release of oxytocin from maternal pituitary. ACTH is a tropic hormone secreted from pars distalis.

ADH or vasopressin stimulates reabsorption of water from distal part of renal tubules.

162. Answer (3)

Hint: Related to human involvement

Sol.: Adaptive radiation leads to homology. Evolution for Darwin was gradual while de Vries believed mutation caused speciation and hence called it saltation. The process of evolution of antibiotic resistant bacteria, pesticide resistant pests, etc. are due to anthropogenic action.

163. Answer (3)

Hint: Low pH favours dissociation of oxyhaemoglobin

Sol.: O_2 can bind with haemoglobin in a reversible manner to form oxyhaemoglobin. Low pO_2 , high pCO_2 , high H^+ concentration and high temperature are favourable conditions for dissociation of oxygen from oxyhaemoglobin. This clearly indicates that O_2 gets bound to haemoglobin in the lung surface and gets dissociated at the tissues. Oxyhaemoglobin dissociation curve shifts to right on increasing temperature, pCO_2 , H^+ and BPG.

164. Answer (2)

Hint: Progestasert belongs to the same category

Sol.: IUDs increase phagocytosis of sperms within the uterus and the copper ions released suppress sperm motility and the fertilising capacity of sperms.

Lippes loop and Multiload-375 are non-medicated and Cu releasing IUDs, respectively.

165. Answer (3)

Hint: A reduction in number of thrombocytes leads to clotting disorders

Sol.: Platelets, also called thrombocytes, are cell fragments produced from megakaryocytes. Blood normally contains 1,50,00 – 3,50,00 platelets mm^{-3} . Platelet factors and tissue factors interact in presence of Ca^{+2} to form an enzyme complex thrombokinase which converts prothrombin into active thrombin.

166. Answer (3)

Hint: Metameric segmentations are seen in *Pheretima*

Sol.: The canal system in sponges is helpful in food gathering, respiratory exchange and removal of wastes.

In metamerism, the body is externally and internally divided into segments with a serial repetition of at least some organs.

In ctenophores, body bears 8 external rows of ciliated comb plates.

167. Answer (2)

Hint: According to Chargaff rule,

$A = T, C = G$

Sol.: Out of 500 nucleotide base pairs

i.e., $500 \times 2 = 1000$ nucleotides

$C = 40\%$

So, $G = 40\%$

$A + T \% = 100 - [G + C]\%$

$= 100 - 80 = 20\%$

$A + T = 20\%$

$\therefore A = T$ so, $A = 10\%$ of total nucleotides

$$A = \frac{1000 \times 10}{100} = 100$$

168. Answer (4)

Hint: Cystic duct along with hepatic ducts form common hepatic duct

Sol.: Brunner's glands are submucosal glands.

The bile duct and the pancreatic duct open together into the duodenum as the common hepato-pancreatic duct which is guarded by sphincter of Oddi.

169. Answer (1)

Hint: In barrier methods, ovum and sperms are prevented from physical meeting

Sol.: Diaphragms, cervical caps, and vaults prevent conception by blocking the entry of sperms through the cervix. Surgical methods (sterilization) are generally advised for the male/female partner as a terminal method to prevent any more pregnancies.

170. Answer (4)

Hint: Roundworms

Sol.: Aschelminthes exhibit bilateral symmetry. Adult echinoderms, cnidarians and ctenophores exhibit radial symmetry.

171. Answer (1)

Hint: Present in hemichordates

Sol.: Proboscis glands are reported in hemichordates. Metanephric kidney, 4-chambered heart and presence of feathers are features of birds.

172. Answer (3)

Hint: Class VI of enzymes

Sol.: Restriction endonuclease cut DNA at specific site (their sugar phosphate backbone).

The resulting DNA fragments will have complementary overhanging stretches (sticky ends). Flush end is also called blunt end.

173. Answer (4)

Hint: Restriction endonuclease was isolated from it in 1963

Sol.: Plasmid of *E.coli* is used in production of humulin.

Thermus aquaticus is a thermophilic bacteria and *Taq* polymerase is used in PCR.

Meloidogyne incognita (nematode) infects the roots of tobacco plants and causes a great reduction in yield.

174. Answer (4)

Hint: Used for treatment of cancer

Sol.:

PCR – Detect HIV in suspected AIDS patients

ELISA – Detecting presence of antigens or antibodies synthesized against pathogen

Radiotherapy – Used to treat cancer

Radiography – Diagnosis of cancer

175. Answer (4)

Hint: Diabetes mellitus

Sol.: PCR, ELISA and rDNA technology serves the purpose of early diagnosis of diseases. Hepatitis-B and HIV are viral STDs.

Mature insulin has two polypeptide chains.

176. Answer (2)

Hint: Identify a domestic animal

Sol.: *Corvus* is a bird and *Chelone* is a reptile.

Ascidia is a protochordate and *Canis* is a mammal.

177. Answer (2)

Hint: Identify an amino acid

Sol.:

Pigments	Carotenoids, Anthocyanins, <i>etc.</i>
Alkaloids	Morphine, Codeine, <i>etc.</i>
Terpenoides	Monoterpenes, Diterpenes <i>etc.</i>

Essential oils	Lemon grass oil, etc.
Toxins	Abrin, Ricin
Lectins	Concanavalin A
Drugs	Vinblastin, curcumin, etc.
Polymeric substances	Rubber, gums, cellulose

178. Answer (1)

Hint: Prevents polyspermy

Sol.: The secretions of the acrosome help the sperm enter into the cytoplasm of the ovum through the zona pellucida and the plasma membrane. Sperm attaches with zona pellucida layer of ovum and induces stabilization of membrane to prevent further entry of sperms.

179. Answer (2)

Hint: Blood group devoid of antigens A and B**Sol.:**

Blood Group	Antigens on RBCs	Antibodies in Plasma	Donor's Group
A	A	anti-B	A, O
B	B	anti-A	B, O
AB	A, B	nil	AB, A, B, O
O	nil	anti-A, B	O

180. Answer (2)

Hint: May lead to paralysis of skeletal muscles

Sol.: Osteoporosis is characterized by decreased bone mass and increased chances of fractures.

Myasthenia gravis – Fatigue, weakening and paralysis of skeletal muscles.

Gout occurs due to accumulation of uric acid crystals in joints.

181. Answer (2)

Hint: Movement of ovum in fallopian tube is not a voluntary action.

Sol.: Smooth muscles (non-striated/visceral muscles) are not under the voluntary control of the nervous system and are therefore known as involuntary muscles.

182. Answer (2)

Hint: Bone resorption

Sol.: Along with TCT, it plays a significant role in calcium balance in the body.

PTH acts on bones and stimulates the process of bone resorption (dissolution/demineralisation).

183. Answer (1)

Hint: Commonly known as sea fan

Sol.: *Limulus* (arthropod), *Pinctada* (mollusc) and *Nereis* (annelid) are triploblastic coelomates. *Gorgonia* is a diploblastic cnidarian.

184. Answer (3)

Hint: pCO₂ in deoxygenated blood is 45 mmHg.**Sol.:**

Respiratory Gas	Atmospheric air	Alveoli	Blood (De-oxygenated)	Blood (Oxygenated)	Tissues
O ₂	159	104	40	95	40
CO ₂	0.3	40	45	40	45

185. Answer (2)

Hint: Secretion of brush border cells

Sol.: The food mixes thoroughly with the acidic gastric juice of the stomach by the churning movements of its muscular wall and is called chyme.

Pancreatic juice contains nucleases. Gastric juice contains pepsinogen and HCl.

SECTION-B

186. Answer (2)

Hint: Includes the segment containing a pair of spermatheca

Sol.: A pair of ovaries lie laterally in 2nd to 6th abdominal segments.

Anal cerci are paired, jointed outgrowths, which arise from the 10th tergum.

Mushroom or utricular glands are present in 6th – 7th abdominal segments of a male cockroach.

187. Answer (4)

Hint: ADH is released during dehydration condition**Sol.:** ANF can cause vasodilation.

Angiotensin I $\xrightarrow{\text{Renin}}$ Angiotensin II

Erythropoietin is produced by juxtaglomerular cells of the kidneys.

188. Answer (4)

Hint: DNA contains deoxyribose sugar.

Sol.: The sugar found in polynucleotides is either ribose or 2' deoxyribose. Proteins are polymers of amino acids. Starch forms helical structure which can hold I₂ in its helices.

189. Answer (2)

Hint: Tetracycline resistance gene has two restriction sites.

Sol.: amp^R gene in pBR322 can be cleaved by *Pvu* I and *Pst* I.

The rop codes for the proteins involved in the replication of the plasmid.

When a rDNA is injected within the coding sequence of β -galactosidase, it results into insertional inactivation.

190. Answer (1)

Hint: Lined by sarcolemma

Sol.: Each organised skeletal muscle in our body is made of a number of muscle bundles or fascicles held together by a common collagenous connective tissue layer called fascia. Each muscle bundle contains a number of muscle fibres. Each muscle fibre is lined by the plasma membrane called sarcolemma enclosing the sarcoplasm.

191. Answer (3)

Hint: Class of transferases

Sol.: Catalyses the transfer of a group, G (other than hydrogen) between a pair of substrate S and S'. Class I includes oxidoreductases, class III includes hydrolases and class IV includes lyases.

192. Answer (3)

Hint: Founder effect

Sol.: Founder effect is the example of genetic drift. Sometimes, the change in allelic frequency is so different in the new sample of population that they become a different species.

193. Answer (3)

Hint: An organisation set up by Indian government

Sol.: GEAC – Genetic Engineering Approval Committee.

European Federation of Biotechnology gave the definition of biotechnology.

194. Answer (2)

Hint: *Thermus aquaticus*

Sol.: *Taq* polymerase adds nucleotides in 5' $\rightarrow$ 3' direction.

PCR is a reaction that is utilized to amplify a gene or fragment of DNA of interest.

Each cycle of PCR has 3 steps

1. Denaturation : Starting solution is heated to 94°C
2. Annealing : Reaction mixture is cooled in between 50-60°C
3. Extension : Mixture is heated to 72°C

195. Answer (1)

Hint: One cannot see pure DNA fragments in the visible light

Sol.: Since DNA fragments are negatively charged molecules, they can be separated by forcing them

to move towards the anode under an electric field through a medium/matrix.

196. Answer (1)

Hint: One cardiac cycle represents one heart beat.

Sol.: Normal haemoglobin in blood = 12 – 16 g/dl.

$$\text{Normal blood pressure} = \frac{120}{80} \text{ mmHg}$$

Duration of a cardiac cycle = 0.8 sec.

$$\text{Lub} \xleftarrow{0.3 \text{ sec}} \xrightarrow{0.5 \text{ sec}} \text{Dub}$$

197. Answer (3)

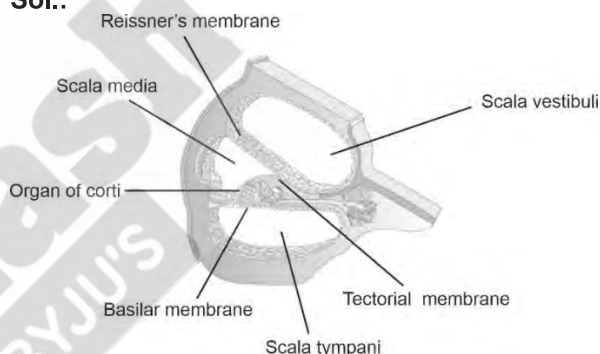
Hint: It is not a true segment

Sol.: The first body segment of earthworm called peristomium, bears mouth and a prostomium, that covers the mouth partially. Prostomium helps in formation of burrow.

198. Answer (2)

Hint: The coiled portion of the labyrinth is called cochlea

Sol.:



199. Answer (3)

Hint: Hardy-Weinberg principle – The gene pool (total genes and their alleles in a population) remains constant.

Sol.: The frequency of homozygous recessive

$$\text{babies } (q^2) = \frac{90}{1000} = 0.09$$

$$q = \sqrt{0.09} = 0.3$$

$$p = 1 - q = 0.7$$

$$\text{The frequency of heterozygous individuals} = 2pq = 2 \times 0.7 \times 0.3 = 0.42$$

200. Answer (2)

Hint: Hypothalamus is associated with thermoregulation.

Sol.: The hypothalamus contains a number of centres, which control body temperature, urge for eating and drinking.



All India Aakash Test Series for NEET - 2023

OPEN MOCK TEST - I (Code-B)

Test Date : 26/03/2023

ANSWERS

1. (2)	41. (4)	81. (1)	121. (4)	161. (4)
2. (3)	42. (1)	82. (2)	122. (1)	162. (4)
3. (1)	43. (1)	83. (3)	123. (1)	163. (4)
4. (4)	44. (4)	84. (4)	124. (2)	164. (3)
5. (1)	45. (1)	85. (1)	125. (3)	165. (1)
6. (2)	46. (1)	86. (2)	126. (3)	166. (4)
7. (4)	47. (2)	87. (1)	127. (3)	167. (1)
8. (2)	48. (2)	88. (1)	128. (3)	168. (4)
9. (4)	49. (4)	89. (4)	129. (2)	169. (2)
10. (3)	50. (1)	90. (3)	130. (1)	170. (3)
11. (4)	51. (1)	91. (3)	131. (1)	171. (3)
12. (2)	52. (3)	92. (4)	132. (2)	172. (2)
13. (3)	53. (4)	93. (4)	133. (2)	173. (3)
14. (3)	54. (4)	94. (4)	134. (2)	174. (3)
15. (1)	55. (4)	95. (2)	135. (1)	175. (3)
16. (2)	56. (2)	96. (2)	136. (3)	176. (3)
17. (4)	57. (2)	97. (2)	137. (2)	177. (2)
18. (2)	58. (3)	98. (3)	138. (2)	178. (2)
19. (3)	59. (2)	99. (2)	139. (3)	179. (2)
20. (1)	60. (2)	100. (3)	140. (3)	180. (2)
21. (1)	61. (2)	101. (3)	141. (2)	181. (2)
22. (4)	62. (4)	102. (3)	142. (2)	182. (2)
23. (3)	63. (3)	103. (2)	143. (3)	183. (2)
24. (1)	64. (1)	104. (3)	144. (3)	184. (4)
25. (1)	65. (4)	105. (3)	145. (2)	185. (2)
26. (3)	66. (4)	106. (4)	146. (4)	186. (2)
27. (2)	67. (4)	107. (1)	147. (4)	187. (3)
28. (2)	68. (1)	108. (4)	148. (3)	188. (2)
29. (3)	69. (3)	109. (2)	149. (2)	189. (3)
30. (2)	70. (4)	110. (1)	150. (3)	190. (1)
31. (4)	71. (3)	111. (2)	151. (2)	191. (1)
32. (3)	72. (2)	112. (3)	152. (3)	192. (2)
33. (2)	73. (2)	113. (3)	153. (1)	193. (3)
34. (1)	74. (3)	114. (2)	154. (2)	194. (3)
35. (2)	75. (4)	115. (2)	155. (2)	195. (3)
36. (3)	76. (2)	116. (1)	156. (2)	196. (1)
37. (1)	77. (3)	117. (2)	157. (2)	197. (2)
38. (3)	78. (4)	118. (2)	158. (1)	198. (4)
39. (1)	79. (2)	119. (3)	159. (2)	199. (4)
40. (4)	80. (1)	120. (2)	160. (2)	200. (2)

HINTS & SOLUTIONS**[PHYSICS]****SECTION-A**

1. Answer (2)

$$\text{Hint: } I = \frac{V}{R}$$

$$\text{Sol.: } I = \frac{10}{2+2}$$

$$= 2.5 \text{ A}$$

2. Answer (3)

$$\text{Hint: } I_C = \beta I_B$$

$$\text{Sol.: Given } V_{RC} = i_C R_C$$

$$0.4 \text{ V} = i_C (400)$$

$$\Rightarrow i_C = 1 \text{ mA}$$

$$\therefore \alpha = 0.98$$

$$\therefore \beta = \frac{\alpha}{1-\alpha} = \frac{0.98}{1-0.98} = 49$$

$$i_B = \frac{i_C}{\beta} = \frac{1}{49} \text{ mA}$$

3. Answer (1)

$$\text{Hint and Sol.: } Y_1 = \overline{A+B}$$

$$Y = \overline{Y_1 \cdot Y_1}$$

$$= Y_1$$

$$= \overline{A+B} \Rightarrow \text{NOR gate}$$

4. Answer (4)

$$\text{Hint: } T \propto \frac{n^3}{Z^2}$$

$$\text{Sol.: } T_1 = 3T_2$$

$$\frac{T_1^3}{T_2^3} = \frac{3(3)^3}{Z^2}$$

$$Z = 9$$

5. Answer (1)

$$\text{Hint: } N = N_0 e^{-\lambda t}$$

$$\text{Sol.: } N_0 = N_1 e^{-\lambda t} \dots (i)$$

$$\frac{N_0}{4} = N_1 e^{-2\lambda t} \dots (ii)$$

$$(i) \div (ii)$$

$$4 = e^{\lambda t}$$

$$\lambda t = \ln 4$$

$$N = N_1 e^{-\lambda \left(\frac{7t}{2}\right)}$$

$$N = N_1 e^{-\frac{7}{2} \ln 4}$$

$$N = \frac{N_1}{e^{\ln 2^7}}$$

$$N = \frac{N_1}{2^7}$$

$$N = \frac{N_0 2^2}{2^7}$$

$$N = \frac{N_0}{2^5}$$

$$= \frac{N_0}{32}$$

6. Answer (2)

$$\text{Hint: Momentum of photon} = \frac{h}{\lambda}$$

$$\text{Sol.: } mv = \frac{h}{\lambda}$$

$$v = \frac{h}{\lambda \times m}$$

$$= \frac{6.6 \times 10^{-34}}{4800 \times 10^{-10} \times 9.1 \times 10^{-31}}$$

$$\approx 1500 \text{ m/s}$$

7. Answer (4)

$$\text{Hint: } E = \frac{hc}{\lambda}$$

$$\text{Sol.: } \lambda = \frac{hc}{E}$$

$$= \frac{12400}{14.4 \times 10^3}$$

$$\approx 0.86 \text{ \AA} \text{ belongs to x-ray region.}$$

8. Answer (2)

Hint & Sol.: $\mu = \tan(i_p)$

9. Answer (4)

Hint: Fringe width $= \frac{\lambda D}{d}$

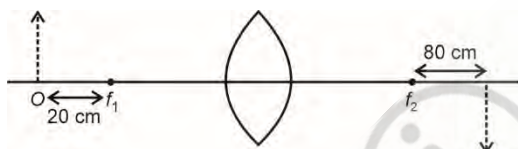
$$\text{Sol.: } \frac{n_1 \lambda_1 D}{d} = \frac{n_2 \lambda_2 D}{d}$$

$$n_2 = \frac{n_1 \lambda_1}{\lambda_2}$$

$$= \frac{50 \times 4000}{5000}$$

$$= 40$$

10. Answer (3)

Hint: Use $\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$ **Sol.:**

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

$$\frac{1}{80+f} + \frac{1}{20+f} = \frac{1}{f}$$

$$(20+f+80+f)f = (80+f)(20+f)$$

$$100f + 2f^2 = 1600 + 100f + f^2$$

$$f^2 = 1600$$

$$f = 40 \text{ cm}$$

11. Answer (4)

Hint: For minimum deviation $i = e$, $r_1 = r_2$ **Sol.:** By Snell's law

$$\frac{\sin i}{\sin r} = \mu$$

$$r_1 = r_2 = r$$

$$r_1 + r_2 = A$$

$$r = \frac{A}{2}$$

$$= 45^\circ$$

$$\frac{\sin i}{\sin 45^\circ} = \frac{\sqrt{3}}{\sqrt{2}}$$

$$\sin i = \frac{\sqrt{3}}{2}$$

$$i = 60^\circ$$

$$i + e = A + \delta$$

$$60^\circ + 60^\circ = 90^\circ + \delta$$

$$\delta = 30^\circ$$

12. Answer (2)

$$\text{Hint: } X_C = \frac{1}{\omega C}$$

$$\text{Sol.: } V = 100 \sin(314t)$$

$$\omega = 314$$

$$V_R = IR$$

$$I = \frac{80}{20}$$

$$I = 4 \text{ A}$$

$$\sqrt{V_R^2 + V_C^2} = 100$$

$$(80)^2 + V_C^2 = (100)^2$$

$$V_C^2 = (100)^2 - (80)^2$$

$$V_C = 60$$

$$V_C = I X_C$$

$$60 = 4 \times \frac{1}{\omega C}$$

$$C = \frac{4}{60 \times 314}$$

$$= 212 \mu\text{F}$$

13. Answer (3)

Hint: $\phi = \vec{B} \cdot \vec{A}$ and $\varepsilon = -\frac{d\phi}{dt}$

$$\text{Sol.: } \phi = B_z \pi r^2 \cos \omega t$$

$$\varepsilon = -\frac{d\phi}{dt}$$

$$= -\frac{d}{dt} (B_z \pi r^2 \cos \omega t)$$

$$\varepsilon = B_z \omega \pi r^2 \sin \omega t$$

14. Answer (3)

Hint: $M = NIA$

$$\text{Sol.: } B = \frac{\mu_0 i}{2R}$$

$$0.2 = \frac{\mu_0 i}{2R}$$

$$\Rightarrow \frac{0.4}{\mu_0} = \frac{i}{R}$$

$$\Rightarrow \pi R^2 = \pi$$

$$R = 1$$

$$M = \frac{0.4\pi}{\mu_0}$$

15. Answer (1)

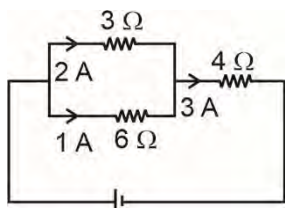
Hint: $E \propto \ell$

$$\text{Sol.: } \frac{E_1}{E_2} = \frac{\ell_1}{\ell_2}$$

$$\frac{3}{2} = \frac{45}{\ell_2}$$

$$\ell_2 = 30 \text{ cm}$$

16. Answer (2)

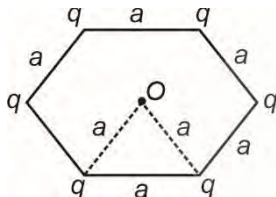
Hint: $P = I^2 R$ **Sol.:**

$$P = I^2 R$$

$$= (3)^2 \times 4$$

$$= 36 \text{ W}$$

17. Answer (4)

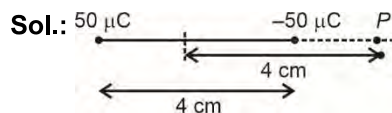
Hint: $V = V_1 + V_2 + V_3 \dots V_6$ **Sol.:**

$$V = \left(\frac{kq}{a} \right) \times 6$$

$$= \frac{6kq}{a}$$

18. Answer (2)

$$\text{Hint: } E = \frac{kq}{r^2}$$



$$E_P = E_- + E_+$$

$$= \frac{k(50 \mu\text{C})}{(2 \text{ cm})^2} - \frac{k(50 \mu\text{C})}{(6 \text{ cm})^2}$$

$$= \frac{9 \times 10^9 \times 50 \times 10^{-6}}{4 \times 10^{-4}} - \frac{9 \times 10^9 \times 50 \times 10^{-6}}{36 \times 10^{-4}}$$

$$= 10^9 \text{ N/C}$$

19. Answer (3)

Hint and Sol.: The speed of sound in air is independent of pressure of the gas. It only depends on temperature of gas.

20. Answer (1)

Hint: Equation of propagating wave moving in positive x-direction of $y = A \sin(kx - \omega t)$.**Sol.:** $A = 0.25$

$$\omega = 2\pi f$$

$$= 8\pi$$

$$K = \frac{2\pi}{\lambda}$$

$$= \frac{2\pi}{2}$$

$$= \pi$$

$$y = 0.25A \sin(\pi x - 8\pi t)$$

21. Answer (1)

Hint & Sol.: In motion of star, doppler effect causes change in the observed frequency of light. Beats is used in the standardization of frequency and to measure the depth of ocean concept of echo is used.

22. Answer (4)

Hint & Sol.: In isothermal process temperature remains constant therefore $\Delta U = 0$

$$Q = W + \Delta U$$

$$Q = W$$

23. Answer (3)

$$\text{Hint: } \left(\frac{dP}{dV} \right)_{\text{adiabatic}} = -\gamma \frac{P}{V}$$

$$\text{Sol.: } \left(\frac{dP}{dV} \right)_{\text{isothermal}} = -\frac{P}{V}$$

$$\frac{\left(\frac{dP}{dV} \right)_{\text{adiabatic}}}{\left(\frac{dP}{dV} \right)_{\text{isothermal}}} = \gamma$$

$$\text{For monoatomic gas } \gamma = \left(\frac{5}{3} \right)$$

24. Answer (1)

Hint & Sol.: The coefficient of cubical expansion of water is negative between the temperature 273 K and 277 K.

25. Answer (1)

Hint: Force on container = $\rho a v^2$ **Sol.:** $v = \sqrt{2gh}$

Mass of liquid in the container

$$m_0 = \rho Ah$$

$$F = \rho a 2gh$$

$$m_0 a_1 = \rho a 2gh$$

$$\rho A h a_1 = 2\rho a g h$$

$$a_1 = \left(\frac{2ag}{A} \right)$$

26. Answer (3)

Hint: $W = \frac{1}{2} Y \left(\frac{\Delta \ell}{\ell} \right)^2 A \ell$ **Sol.:** $W_1 \propto \frac{A_1}{\ell_1}$

$$W_2 \propto \frac{A_2}{\ell_2}$$

$$\frac{W_1}{W_2} = \frac{A_1}{\ell_1} \times \frac{\ell_2}{A_2}$$

$$\frac{W_1}{W_2} = \frac{A_1}{\ell_1} \times \frac{\ell_1}{2 \times 4 A_1}$$

$$\frac{W_1}{W_2} = \frac{1}{8}$$

$$W_2 = 8 \times 8$$

$$= 64 \text{ J}$$

27. Answer (2)

Hint & Sol.: When a satellite is lifted from lower orbit to a higher orbit then its gravitational potential energy increases and kinetic energy of satellite decreases.

28. Answer (2)

Hint: $(K.E.)_{\max} = T.E. - P.E.$ **Sol.:** $(K.E.)_{\max} = 24 - 4$

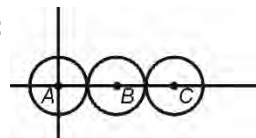
$$= 20 \text{ J}$$

$$\begin{aligned} \text{Average (K.E.)} &= \frac{(K.E.)_{\max}}{2} \\ &= \frac{20}{2} \\ &= 10 \text{ J} \end{aligned}$$

29. Answer (3)

Hint & Sol.: Mass of lower half of sphere is more therefore, centre of mass shift towards lower half.

30. Answer (2)

Hint: $\vec{r}_{cm} = \frac{m_1 \vec{r}_1 + m_2 \vec{r}_2 + m_3 \vec{r}_3}{m_1 + m_2 + m_3}$ **Sol.:**

$$X_{cm} = \frac{m \times 0 + m \times 2R + m \times 4R}{m + m + m}$$

$$X_{cm} = 2R$$

31. Answer (4)

Hint: Coefficient of restitution = $\frac{\text{Velocity of separation}}{\text{Velocity of approach}}$

Sol.: $\begin{matrix} 5 \text{ m/s} & 2 \text{ m/s} \\ \rightarrow & \rightarrow \end{matrix}$ J. B. C

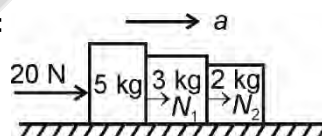
$\begin{matrix} 5 \text{ m/s} & & V_1 \\ \rightarrow & \rightarrow & \end{matrix}$ J. A. C

$$e = \frac{v_1 - 5}{5 - 2}$$

$$1 = \frac{v_1 - 5}{3}$$

$$V_2 = 8 \text{ m/s}$$

32. Answer (3)

Hint: $F = ma$ **Sol.:**

$$F = ma$$

$$a = \frac{20}{5 + 3 + 2}$$

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

$$N_1 = (3 + 2) a$$

$$= 10 \text{ N}$$

$$N_2 = 2 \times a$$

$$= 4 \text{ N}$$

$$\frac{N_1}{N_2} = \frac{10}{4}$$

$$\frac{N_1}{N_2} = \frac{5}{2}$$

33. Answer (2)

$$\text{Hint: } R = \frac{u^2 \sin 2\theta}{g}$$

$$\text{Sol.: } R_1 = R_2$$

$$\frac{u_1^2}{g} = \frac{u_2^2 \sin 2\theta}{g}$$

$$\frac{u^2}{4} = u^2 \sin 2\theta \Rightarrow \theta = \frac{1}{2} \sin^{-1} \left(\frac{1}{4} \right)$$

34. Answer (1)

Hint: In multiplication or division, the final result should retain only that many significant figures as are there in the original number with the least number of significant figures.

$$\begin{aligned} \text{Sol.: Volume} &= 1.1 \text{ m} \times 2.36 \text{ m} \times 3.1 \text{ m} \\ &\approx 8.0476 \text{ m}^3 \\ &= 8.0 \text{ m}^3 \end{aligned}$$

35. Answer (2)

$$\text{Hint and Sol.: } F_{SN} : F_E : F_{WN} : F_G = 1 : 10^{-2} : 10^{-13} : 10^{-39}$$

SECTION-B

36. Answer (3)

Hint: Relative acceleration of both the bodies will be zero.

$$\text{Sol.: } \vec{S} = \vec{v}_{rel} t + \frac{1}{2} \vec{a}_{rel} \times t^2$$

$$\vec{a}_{rel} = 0$$

$$\vec{S} = \vec{v} \times t$$

37. Answer (1)

Hint: Distance between consecutive node and antinode is $\frac{\lambda}{4}$

$$\text{Sol.: } y = 5 \sin \left(\frac{\pi x}{3} \right) \cos 40\pi t$$

$$\frac{2\pi}{\lambda} = \frac{\pi}{3}$$

$$\lambda = 6$$

$$\frac{\lambda}{4} = \frac{6}{4}$$

$$= 1.5 \text{ m}$$

38. Answer (3)

$$\text{Hint: } v = \omega \sqrt{a^2 - x^2}$$

$$\text{Sol.: } v = \omega \sqrt{a^2 - x^2}$$

$$x = \frac{a}{2}$$

$$v = \frac{\sqrt{3}a\omega}{2}$$

$$\omega = \frac{2\pi}{T}$$

$$v = \frac{\sqrt{3}a\pi}{T}$$

39. Answer (1)

$$\text{Hint: } \frac{dQ}{dt} = \frac{T_1 - T_2}{R}$$

$$\text{Sol.: } \frac{Q}{t_1} = \frac{T_1 - T_2}{(2R)}$$

R is thermal resistance of one rod

$$\frac{Q}{t_2} = \frac{T_1 - T_2}{\left(\frac{R}{2} \right)}$$

$$\frac{t_2}{t_1} = \frac{1}{4} \Rightarrow t_2 = 4 \text{ s}$$

40. Answer (4)

$$\text{Hint and Sol.: } S = \frac{dU}{dA}$$

41. Answer (4)

$$\text{Hint: } \tau = Fr_{\perp}$$

$$\text{Sol.: } \omega = 4 + 3t$$

$$\alpha = \frac{d\omega}{dt}$$

$$= 3 \text{ rad/s}^2$$

$$\tau = I \times \alpha$$

$$F \times R = \frac{mR^2}{2} \alpha$$

$$F = \frac{mR}{2} \alpha$$

$$= \frac{4 \times 0.1 \times 3}{2}$$

$$= 0.6 \text{ N}$$

42. Answer (1)

Hint: Weight of the stone reduced due to upthrust force.

Sol.: ρ = density of the material of stone = $\frac{m}{V}$

$\therefore V$ = Volume of the stone

$$= \frac{m}{\rho} = \frac{10}{2 \times 10^3} = 5 \times 10^{-3} \text{ m}^3$$

loss in weight = $V\sigma g$

$$= 5 \times 10^{-3} \times 10^3 \times 9.8$$

$$= 49 \text{ N}$$

Net weight to be lifted = $10 \times 9.8 - 49$

$$= 49 \text{ N}$$

$$W = 49 \times 10$$

$$= 490 \text{ J}$$

43. Answer (1)

Hint: Friction force = centripetal force

$$\text{Sol.: } \mu mg = \frac{mv^2}{R}$$

$$R = \frac{v^2}{\mu g}$$

$$= \frac{(10)^2}{0.5 \times 10}$$

$$= 20 \text{ m}$$

44. Answer (4)

Hint & Sol.: Charge will execute oscillatory motion but not S.H.M because electrostatic force acting on the charge is not proportional to displacement of charge particle from its mean position.

45. Answer (1)

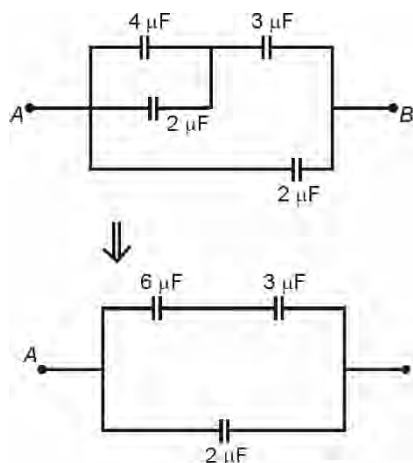
Hint: For parallel combination

$$C_{\text{eff}} = C_1 + C_2 + \dots C_n$$

For series combination

$$\frac{1}{C_{\text{eff}}} = \frac{1}{C_1} + \frac{1}{C_2} + \dots \frac{1}{C_n}$$

Sol.:

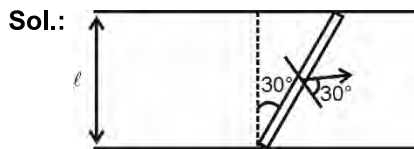


$$C_{AB} = \frac{6 \times 3}{6 + 3} + 2$$

$$= 4 \mu\text{F}$$

46. Answer (1)

$$\text{Hint: } \varepsilon = (\vec{v} \times \vec{B}) \cdot \vec{\ell}$$



$$\varepsilon = Bv\ell \cos 30^\circ$$

$$= \frac{Bv\ell\sqrt{3}}{2}$$

47. Answer (2)

$$\text{Hint: } \phi = \vec{B} \cdot \vec{A}$$

$$\text{Sol.: } \phi = \mu HA$$

$$\mu = \frac{\phi}{HA}$$

$$= \frac{5 \times 10^{-5}}{5000 \times \frac{1}{2} \times 10^{-4}}$$

$$= 2 \times 10^{-4}$$

48. Answer (2)

$$\text{Hint: } P = \frac{v^2}{R}$$

$$\text{Sol.: } P \propto \frac{1}{R}$$

$$\frac{P_1}{P_2} = \frac{R_2}{R_1} = \frac{3}{1}$$

49. Answer (4)

$$\text{Hint: Use } \frac{1}{v} + \frac{1}{u} = \frac{1}{f}$$

$$\text{Sol.: } f = \frac{R}{2}$$

$$= \frac{80}{2}$$

$$= 40 \text{ cm}$$

$$m = -\frac{v}{u} = \frac{h_i}{h_o}$$

$$-\frac{v}{u} = -\frac{1}{2}$$

$$|u| = 2 |v|$$

$$\frac{1}{|v|} + \frac{1}{-|u|} = \frac{1}{f}$$

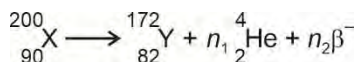
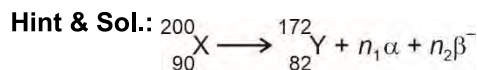
$$1 - \frac{|v|}{|u|} = \frac{|v|}{f}$$

$$|v| = \frac{f}{2} = 20 \text{ cm}$$

$$|u| = 2|v| = 40 \text{ cm}$$

$$|u| + |v| = 40 + 20 = 60 \text{ cm}$$

50. Answer (1)



On balancing the mass number and atomic number, we get

$$n_1 = 7 \text{ and } n_2 = 6$$

[CHEMISTRY]

SECTION-A

51. Answer (1)

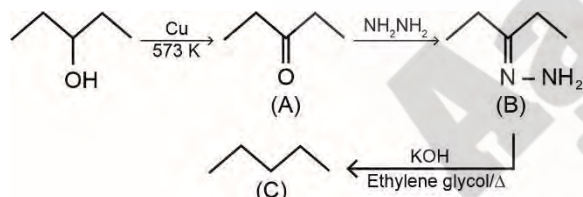
Hint: Amphoteric oxides behave as acid with bases and base with acids, whereas neutral oxides have no acidic or basic properties.

Sol.:

Compounds	Chemical nature
CO	Neutral
Na ₂ O	Basic
Cl ₂ O ₇	Acidic
Al ₂ O ₃	Amphoteric

52. Answer (3)

Hint: Secondary alcohol is oxidised to ketone by heating it with copper at 573 K.

Sol.:

53. Answer (4)

Hint and Sol: Maximum permissible limit of lead in drinking water is 50 ppb.

54. Answer (4)

Hint: • The process is adiabatic, hence $q = 0$

$$\bullet w = -P_{\text{ex}}\Delta V$$

$$\text{Sol.}: w = -5(v_f - v_i)$$

$$= -5(3.25 - 1.25)$$

$$w = -10 \text{ L atm}$$

From first law of thermodynamics

$$\Delta U = q + w$$

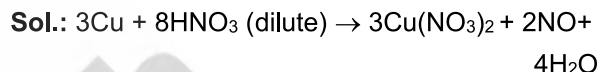
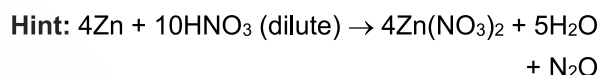
$$\Delta U = w \text{ (for adiabatic process)}$$

$$\Delta U = -10 \text{ L atm}$$

$$= -10 \times 101.3$$

$$\Delta U = -1013 \text{ J}$$

55. Answer (4)



56. Answer (2)

Hint: $\Delta_r G^\circ = -nFE_{\text{cell}}^\circ$

Sol.: $E_{\text{cell}}^\circ = E_{\text{Cu}^{2+}/\text{Cu}}^\circ - E_{\text{Al}^{3+}/\text{Al}}^\circ$

$$E_{\text{cell}}^\circ = 0.34 + 1.66$$

$$E_{\text{cell}}^\circ = 2\text{V}$$

$$\Delta_r G^\circ = -6 \times 96500 \times 2$$

$$= -1158 \text{ kJ mole}^{-1}$$

57. Answer (2)

Hint: The species which contains paired electron are diamagnetic in nature.

Sol.:

Compound / Ion	Shape & hybridisation	Magnetic behaviour
[PtCl ₄] ²⁻	Square planar and dsp^2	Diamagnetic
[Ni(CO) ₄]	Tetrahedral and sp^3	Diamagnetic
[Cu(NH ₃) ₄] ²⁺	Square planar and dsp^2	Paramagnetic
[Pt(NH ₃) ₂ Cl ₂]	Square planar and dsp^2	Diamagnetic

58. Answer (3)

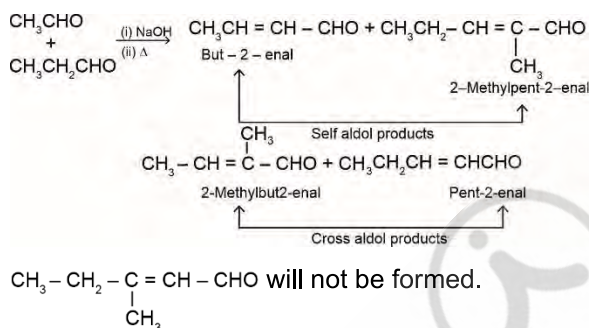
Hint: The species which does not contain d electron(s) will not show colour in aqueous medium.

Sol.: Cu^{2+} , V^{3+} and Ni^{2+} contain d electrons hence these are coloured species in aqueous medium while Sc^{3+} does not contain any d electron. Hence Sc^{3+} is colourless in aqueous medium.

59. Answer (2)

Hint: In a reaction of two different carbonyl compounds self aldol and cross aldol condensation reactions will take place.

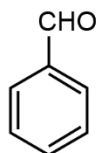
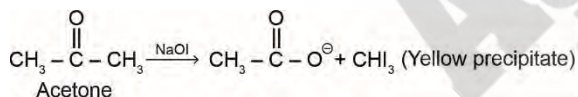
Sol.:



60. Answer (2)

Hint: Compound containing $\text{CH}_3-\overset{\text{O}}{\parallel}{\text{C}}-$ and $\text{CH}_3\text{CH}(\text{OH})-$ groups react with NaOI to give iodoform.

Sol.:



Benzaldehyde

61. Answer (2)

Hint: Percentage of

$$S = \frac{\text{Molar mass of S} \times \text{Mass of BaSO}_4 \times 100}{\text{Molar mass of BaSO}_4 \times \text{Mass of organic compound}}$$

$$\begin{aligned}
 \text{Sol.: Percentage of sulphur} &= \frac{32 \times 0.699 \times 100}{233 \times 0.5} \\
 &= 19.2\%
 \end{aligned}$$

62. Answer (4)

Hint: More is the number of hyperconjugative structures, or α -hydrogens more is the stability of alkene and lesser is the energy released on catalytic hydrogenation.

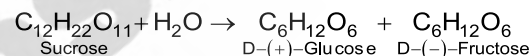
Sol.:

Compounds	α -hydrogen atoms
	5
	8
	4
	2

63. Answer (3)

Hint: Sucrose is a non-reducing sugar.

Sol.: • Sucrose on hydrolysis gives equimolar mixture of D-(+)-glucose and D-(-)-fructose



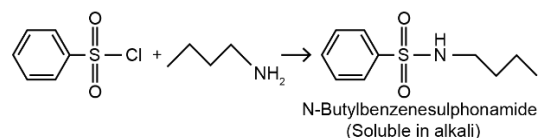
• Since the reducing groups of glucose and fructose are involved in glycosidic bond formation, hence sucrose is a non-reducing sugar. It does not reduce Tollens' reagent

64. Answer (1)

Hint: Benzenesulphonyl chloride reacts with primary and secondary amines to form sulphonamides.

Sol.:

• The reaction of benzenesulphonyl chloride with primary amine yields N-alkylbenzenesulphonamide. The hydrogen attached to nitrogen in sulphonamide is strongly acidic due to the presence of strong electron withdrawing sulphonyl group. Hence, it is soluble in alkali



• In reaction with secondary amine, N, N-dialkylbenzenesulphonamide is formed which does not contain any hydrogen atom attached with

nitrogen atom. It is not acidic and hence insoluble in alkali.

- Tertiary amine does not react with benzene sulphonyl chloride.

65. Answer (4)

Hint: Electron withdrawing group present at para position increases acidity of phenol derivative.

Sol.:

- Electron donating groups like -CH_3 , -OMe decrease acidity of phenol.
- Electron withdrawing group present at para position increases acidity of phenol.
- -NO_2 stabilises the conjugate base by -R effect hence p-nitrophenol is most acidic among the given molecules.

66. Answer (4)

Hint: More stable is the carbocation, faster is the $\text{S}_{\text{N}}1$ rate

Sol.:

- The intermediate species formed in the $\text{S}_{\text{N}}1$ reaction is a carbocation, More stable is the carbocation faster is $\text{S}_{\text{N}}1$ rate.
- Stability order of carbocation

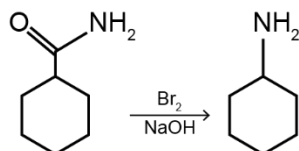


- *tert* butyl chloride (tert-butyl-Cl) will react fastest by $\text{S}_{\text{N}}1$ reaction.

67. Answer (4)

Hint: The given reaction is Hoffmann bromamide degradation reaction.

Sol.:



Amine formed in this reaction is one carbon less than the given amide.

68. Answer (1)

Hint: Tranquilizers and analgesics are neurologically active drugs.

Sol.:

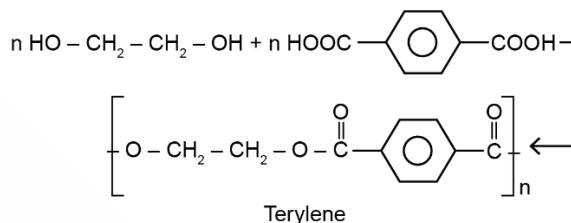
Drugs	Classes of drugs
Meprobamate	Neurologically active drug (Tranquilizer)

Terfenadine	Antihistamine
Tetracycline	Antibiotic
Novestrol	Antifertility drug

69. Answer (3)

Hint: Condensation polymerisation occurs between two bi-functional or trifunctional monomeric units. In this process loss of simple molecules such as water, alcohol, hydrogen chloride etc. takes place.

Sol.:

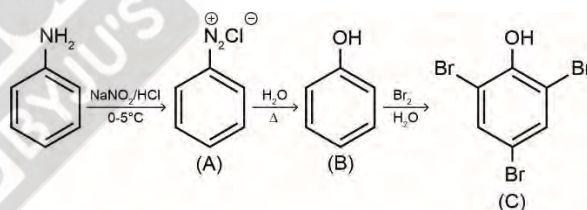


- Terylene is a condensation polymer.
- Buna-S, Teflon and Neoprene are addition polymers.

70. Answer (4)

Hint: Benzene diazonium chloride is converted to phenol on reaction with water

Sol.:



71. Answer (3)

Hint: 1 Faraday electricity deposits 1 g-equivalent of substance at electrode.

Sol.: Number of Faraday passed

$$= \frac{3.86 \times 100 \times 60}{96500} = 0.24 \text{ F}$$

$$\text{Mass of nickel deposited} = 0.24 \times \frac{58.7}{2}$$

$$= 7.04 \text{ g}$$

$$\approx 7 \text{ g}$$

72. Answer (2)

Hint: HF has exceptionally high boiling point because of the presence of intermolecular hydrogen bonding.

Sol.:

Compound	Boiling point (K)
HF	293
HCl	189
HBr	206
HI	238

73. Answer (2)

Hint: Higher is the number of unpaired electrons, greater is the value of spin only magnetic moment.**Sol.:**

Complex ion	Number of unpaired electrons (n)	$\mu = \sqrt{n(n+2)}$ BM
$[\text{Co}(\text{H}_2\text{O})_6]^{3+}$	0	0
$[\text{MnCl}_6]^{3-}$	4	4.9
$[\text{Fe}(\text{CN})_6]^{3-}$	1	1.7
$[\text{Mn}(\text{CN})_6]^{3-}$	2	2.8

74. Answer (3)

Hint: Malachite, Calamine and Siderite are carbonate ores.**Sol:**

Ores	Composition
Malachite	$\text{CuCO}_3 \cdot \text{Cu}(\text{OH})_2$
Calamine	ZnCO_3
Siderite	FeCO_3
Haematite	Fe_2O_3

75. Answer (4)

Hint: Since unit of rate constant is s^{-1} hence it is a first order reaction.

$$\text{For first order reaction, } k = \frac{2.303}{t} \log \frac{[R]_0}{[R]}$$

$$\text{Sol.: } t = \frac{2.303}{k} \log \frac{[R]_0}{[R]}$$

$$t = \frac{2.303}{9.212 \times 10^{-3}} \log \frac{100}{80}$$

$$t = \frac{2.303}{9.212 \times 10^{-3}} [\log 10 - 3 \log 2]$$

$$t = \frac{2.303}{9.212 \times 10^{-3}} \times 0.1$$

$$t = 25 \text{ s}$$

76. Answer (2)

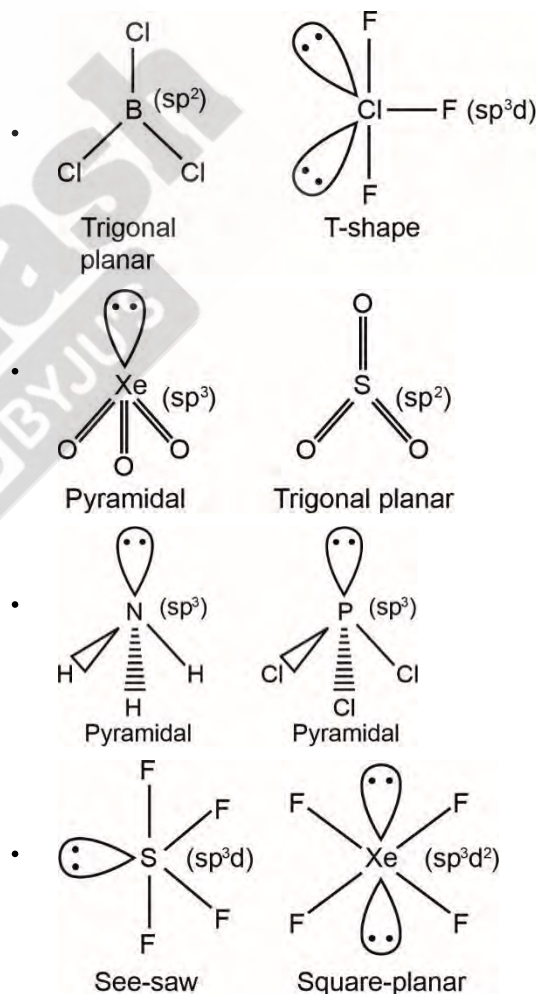
$$\text{Hint: } d = \frac{PM}{RT}$$

$$\text{Sol.: } d = \frac{4.1 \times 32}{0.082 \times 400}$$

$$d = 4 \text{ g/L}$$

$$\text{density of O}_2 \text{ gas} = 4 \text{ gL}^{-1}.$$

77. Answer (3)

Hint: The molecules having same number of bond pairs and same number of lone pairs on central atom will be isostructural.**Sol.:**Same number of bond pairs and lone pair are present on central atom in NH_3 and PCl_3 hence they are isostructural.

78. Answer (4)

Hint: Angular momentum = $\sqrt{l(l+1)}\hbar$ **Sol.:** For p-orbital $l = 1$ Angular momentum = $\sqrt{1(1+1)}\hbar$

$$= \sqrt{2}\hbar$$

79. Answer (2)

Hint: $r_n = a_0 \frac{n^2}{Z}$ de Broglie wavelength λ is given as

$$n\lambda = 2\pi r_n$$

Sol.: $r_3 = a_0 \times \frac{(3)^2}{2}$

$$r_3 = \frac{9}{2}a_0$$

$$\lambda = \frac{2\pi r_3}{3} \quad [\because n = 3]$$

$$\lambda = \frac{2\pi}{3} \times \frac{9}{2}a_0$$

$$\lambda = 3a_0\pi$$

$$\lambda = 3 \times 52.9 \pi \text{ pm}$$

$$\lambda = 158.7 \pi \text{ pm}$$

80. Answer (1)

Hint: Higher is the effective nuclear charge smaller is the size of ion.**Sol.:**

- O^{2-} and F^- are isoelectronic species having 10 electrons each.

- Effective nuclear charge on F^- is more hence F^- is smaller in size than O^{2-} .

81. Answer (1)

Hint: Number of atoms in molecule

$$= \frac{\text{Mass of molecule}}{\text{Molar mass}} \times \text{atomicity} \times N_A$$

Sol.:

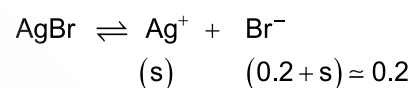
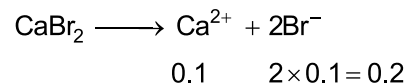
- Number of atoms of $CH_4 = \frac{8}{16} \times 5 \times N_A$
 $= 0.75 N_A$

- Number of atoms of $SO_2 = \frac{16}{64} \times 3 N_A$

- Number of atom of $C_6H_{12}O_6 = \frac{9}{180} \times 24 N_A$
 $= 1.2 N_A$

$$\text{Number of atoms of } CO_2 = \frac{22}{44} \times 3 N_A = 1.5 N_A$$

82. Answer (2)

Hint: Bromide of $CaBr_2$ (strong electrolyte) will act as common ion and will decrease the solubility of $AgBr$.**Sol.:** $CaBr_2$ is strong electrolyte

$$[Ag^+][Br^-] = K_{sp}$$

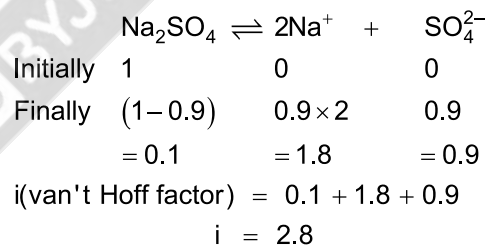
$$s \times 0.2 = 5 \times 10^{-13}$$

$$s = \frac{5 \times 10^{-13}}{0.2}$$

$$s = 2.5 \times 10^{-12}$$

$$\text{Solubility of } AgBr = 2.5 \times 10^{-12} \text{ M}$$

83. Answer (3)

Hint: $\Delta T_f = iK_f m$ **Sol.:**

$$\Delta T_f = iK_f m$$

$$\Delta T_f = 2.8 \times 1.86 \times \frac{14.2 \times 1000}{142 \times 200}$$

$$\Delta T_f = 2.6 \text{ K}$$

$$\text{Freezing point of solution} = -2.6^\circ \text{ C}$$

84. Answer (4)

Hint: Mass of HNO_3 required = $400 \times 3 \times 10^{-3} \times 63 = 75.6 \text{ g}$ **Sol.:** 70 g of HNO_3 is present in 100 g of concentrated nitric acid solution

$$75.6 \text{ g of } HNO_3 \text{ is present in } \frac{100}{70} \times 75.6 = 108 \text{ g}$$

85. Answer (1)

Hint: For fcc unit cell; $4r = \sqrt{2}a$ **Sol.:** $4r = \sqrt{2}a$

$$r = \frac{\sqrt{2}}{4}a$$

$$r = \frac{\sqrt{2}}{4} \times 420$$

$$r = 148.5 \text{ pm}$$

SECTION-B

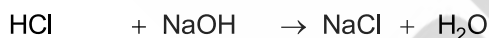
86. Answer (2)

Hint: Thionyl chloride is SOCl_2 **Sol.:** $\text{P}_4 + 8\text{SOCl}_2 \longrightarrow 4\text{PCl}_3 + 4\text{SO}_2 + 2\text{S}_2\text{Cl}_2$

87. Answer (1)

Hint: Copper sol is negatively charged sol.**Sol.:** A given sol is coagulated by oppositely charged ion. Copper sol is a negatively charged sol hence it is coagulated by positively charged ion. Higher is the value of charge more easily the sol will be coagulated.

88. Answer (1)

Hint: Enthalpy of neutralization of a strong base with a strong acid is -57.1 kJ eq^{-1} **Sol.:**

$$\text{Initial: } 400 \times 0.5 \quad 600 \times 0.2$$

$$= 200 \text{ mmol } 120 \text{ mmol}$$

$$\text{Final } (200 - 120) \quad 120 \text{ mmol}$$

$$= 80 \text{ mmol}$$

NaOH is limiting reagent

$$\therefore \text{Heat released} = 120 \times 10^{-3} \times 57.1$$

$$= 6.85 \text{ kJ}$$

89. Answer (4)

Hint: Sodium acetate will undergo hydrolysis in water and pH of the solution will be determined as

$$\text{pH} = 7 + \frac{1}{2}[\text{pK}_a + \log c]$$

$$\text{Sol.} \text{ pH} = 7 + \frac{1}{2}[4.76 + \log 0.2]$$

$$\text{pH} = 7 + \frac{1}{2}[4.76 - 0.7]$$

$$\text{pH} = 9$$

90. Answer (3)

Hint: Since unit of rate constant is $\text{mol L}^{-1}\text{s}^{-1}$ hence order of reaction is zero.**Sol.:**

$$\text{Initial} \quad 3 \text{ M} \quad 0$$

$$\text{Final} \quad 3-kt \quad kt$$

$$\text{Concentration of Y} = kt$$

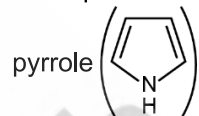
$$= 2.5 \times 10^{-4} \times 100 \times 60$$

$$= 1.5 \text{ M}$$

91. Answer (3)

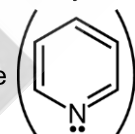
Hint: Lone pair present on sp^3 hybridised nitrogen atom will be most easily available for protonation.**Sol.:**

- Lone pair of electrons present on nitrogen of

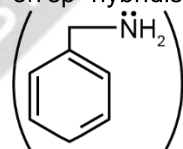


pyrrole are involved in resonance and the molecule becomes aromatic hence it is least basic.

- Lone pair of electrons present on the nitrogen of aniline is delocalised in the benzene ring hence its basicity decreases.



- In pyridine the lone pair is present on sp^2 hybridised nitrogen while in benzylamine



the lone pair of electron is present on sp^3 hybridised nitrogen atom hence benzyl amine is most basic among the given options.

92. Answer (4)

Hint: Smaller is the size of cation, greater is the hydration enthalpy.**Sol.:**

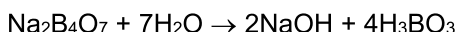
- In the given metal sulphates, size of Mg^{2+} is smallest. Greater hydration enthalpy of Mg^{2+} ions overcome the lattice enthalpy factor hence MgSO_4 is highly soluble in water.
- The solubility decreases as the size of metal cation increases.

93. Answer (4)

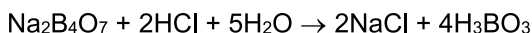
Hint: Borax is a salt of weak acid and strong base.

Sol.:

- Borax is a salt of weak acid and strong base hence its aqueous solution will be alkaline in nature.



- Borax on reaction with dilute HCl gives boric acid as one of the products.



94. Answer (4)

Hint and Sol.:

Element	Flame colour
Sodium	Yellow
Caesium	Blue
Calcium	Brick red
Barium	Apple green

95. Answer (2)

Hint: Volume strength of $\text{H}_2\text{O}_2 = 11.2 \times \text{Molarity (M)}$ **Sol.:** $22.4 = 11.2 \times M$ $M = 2$

$$\left(\frac{w}{V}\right) \% \text{ of } \text{H}_2\text{O}_2 = \frac{34 \times 2}{1000} \times 100 = 6.8\%$$

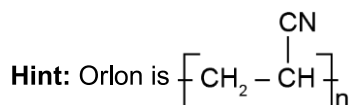
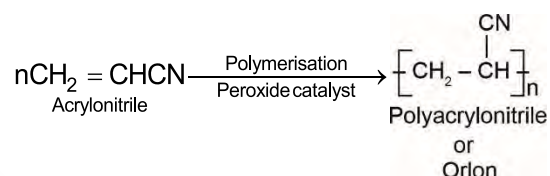
96. Answer (2)

Hint: The element in its lowest or in its highest oxidation state does not undergo disproportionation reaction.**Sol.:** Among the given oxoanions of chlorine, ClO_4^- does not disproportionate because in this oxoanion, chlorine is present in its highest oxidation state that is +7.

97. Answer (2)

Hint: At constant pressure, on introduction of inert gas, volume increases hence equilibrium moves in a direction where number of moles of gases increases.**Sol.:** At constant pressure, introduction of inert gas (helium) will lead to the increase in volume hence dissociation of ammonia increases.

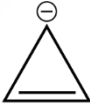
98. Answer (3)

**Sol.:**

99. Answer (2)

Hint: Cyclic species containing $(4n + 2)\pi$ electrons in conjugation are aromatic in nature.**Sol.:**

- Tropylium cation  contains 6π electrons in conjugation which follows Huckel's $(4n + 2)\pi$ electron rule.

-  and  are antiaromatic
-  is non-aromatic

100. Answer (3)

Hint: Root mean square speed (v_{rms}) = $\sqrt{\frac{3RT}{M}}$

$$\text{Sol.} \quad \frac{v_{\text{rms}}(\text{O}_2)}{v_{\text{rms}}(\text{He})} = \sqrt{\frac{M_{\text{He}}}{M_{\text{O}_2}}} = \sqrt{\frac{4}{32}} = 1:2\sqrt{2}$$

[BOTANY]

SECTION-A

101. Answer (3)

Hint: Bacterial blight is a disease of Cowpea.**Sol.:** Pusa Komal variety of cow pea is resistant to bacterial blight.

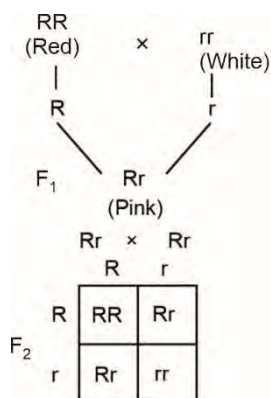
102. Answer (3)

Hint: Some algae and fungi can be in a symbiotic association.**Sol.:** A = Lichens, composed of phycobiont and mycobiont, and it cannot grow in polluted environment.

B = Viruses, inside host they act as living and outside them they act as non-living.

103. Answer (2)

Hint: In *Antirrhinum*, incomplete dominance is seen.

Sol.:

Red : Pink : White = 1 : 2 : 1

104. Answer (3)

Hint: In the S-phase, a non-membrane bound cell organelle is duplicated.**Sol.:** In S-phase, DNA is duplicated in the nucleus and centrioles in the cytoplasm.

105. Answer (3)

Hint: Cork is formed by the differentiation of cells produced by cork cambium on the outer side and is protective in function.**Sol.:** Due to origin of cork cambium outside the stele, it is also called the extra-stelar cambium.

106. Answer (4)

Hint: In grassland ecosystems, the ecological pyramids are upright**Sol.:** Pyramid of biomass in sea is inverted because the number of zooplanktons (consumers) is usually much higher than that of producers (phytoplanktons).

107. Answer (1)

Hint: Probes used in DNA fingerprinting are made up of repetitive DNA.**Sol.:** Variable Number of Tandem Repeats (VNTRs) are used as probe for DNA fingerprinting.

108. Answer (4)

Hint: Acetic acid is obtained from of a bacterium**Sol.:** *Penicillium* → Penicillin*Aspergillus* → Citric acid*Lactobacillus* → Lactic acid*Acetobacter* → Acetic acid

109. Answer (2)

Hint: Dumb-bell shaped guard cells are present in grasses.**Sol.:** Guard cells are usually kidney or bean shaped in dicot leaves.

110. Answer (1)

Hint: *Chlamydomonas* and *Volvox* are unicellular and colonial algae, respectively.**Sol.:** *Ulothrix* and *Spirogyra* are filamentous algae.

111. Answer (2)

Hint: Viroids are made up of RNA only.**Sol.:** Prions cause mad cow disease in cattle and Cr-Jacob disease in humans. Their size is similar to that of viruses.

112. Answer (3)

Hint: Tropical regions have higher species diversity than temperate regions.**Sol.:** Tropical Amazonian rain forest has the greatest biodiversity on earth with >40,000 species of plants, 3000 species of fishes, 1300 species of birds, 427 species of mammals, etc.

113. Answer (3)

Hint: This hormone is responsible for apical dominance in plants.**Sol.:** Auxin was isolated from human urine.

114. Answer (2)

Hint: Bad ozone is present in Troposphere.**Sol.:** Good ozone is present in Stratosphere.

115. Answer (2)

Hint: It is absorbed in oxidation state of +2**Sol.:** Copper is absorbed as cupric (Cu^{2+}) ions by plants.

116. Answer (1)

Hint: It nourishes the developing pollen grains.**Sol.:** Epidermis, endothecium and middle layers are protective in function while tapetum provide nourishment.

117. Answer (2)

Hint: Mortality reduces population density of an area.**Sol.:** Mortality is the rate of deaths in a population.

118. Answer (2)

Hint: Ribosomes bound to ER perform protein synthesis.**Sol.:** RER → Protein synthesis

SER → Lipids synthesis

Golgi complex → Glycosylation

Centrioles → Spindle formation in cell division

119. Answer (3)

Hint: In case of female heterogamety, ZW-ZZ type of sex determination is seen.**Sol.:** Grasshopper and *Drosophila* show male heterogamety.

In birds, females produce heterogametes A + Z and A + W.

120. Answer (2)

Hint: The pioneer species in hydrarch succession are microscopic autotrophic organisms.

Sol.: Phytoplanktons are the pioneer species in primary succession in water, followed by rooted-submerged, submerged free-floating plants, reed-swamp stage, marsh-meadow stage, scrub stage and finally forest.

121. Answer (4)

Hint: In the most tedious step of plant breeding, the pollen grain from male parent has to be collected and placed on the stigma of female parent, manually.

Sol.: Cross-hybridisation among the selected parents is performed which is very tedious and time-consuming process.

122. Answer (1)

Hint: Vegetative propagation in ginger occurs through underground stem.

Sol.: Eye of tuber – Potato

Leaf buds – *Bryophyllum*

Offset – Water hyacinth

Rhizome – Ginger

123. Answer (1)

Hint: NAD⁺ is a co-enzyme which accepts electrons during different steps of respiration.

Sol.: NAD⁺ acts as an electron carrier by transporting electrons to the ETS.

124. Answer (2)

Hint: Hypodermis is absent in roots.

Sol.: Conjoint and open vascular bundles, presence of medullary rays and pith, and collenchymatous hypodermis are the characteristics of dicot stem.

125. Answer (3)

Hint: This chromosome appears J-shaped during anaphase.

Sol.: One arm of the acrocentric chromosome is very small and one very long, gives it a J-shaped appearance during anaphase.

126. Answer (3)

Hint: The pigment that traps sunlight for light reaction of photosynthesis has a tadpole like structure.

Sol.: Photorespiration is a wasteful process as it involves loss of fixed carbon.

Ruben and Kamen proved that the O₂ liberated during photosynthesis comes from water.

Kranz anatomy is observed in C₄ plants.

127. Answer (3)

Hint: Phylogenetic system of classification was proposed by Engler and Prantl, Hutchinson and Takhtajan.

Sol.: Mosses (bryophytes) show haplo-diplontic life cycle.

Eudorina is an alga in which two types of gametes are produced.

In brown algae, the food is stored in the form of laminarin or mannitol.

128. Answer (3)

Hint: Along with water, dissolved minerals are absorbed by roots and translocated by xylem.

Sol.: Xylem translocates water, absorbed minerals, fixed nitrogen (as nitrates) and hormones. Photosynthates are transported by phloem.

129. Answer (2)

Hint: In parasitism and predation, one species is benefitted and another one is harmed.

Sol.: Plants and fungi in mycorrhiza share mutualistic relationship.

Eagle is a predator of rat.

Penicillium produces antibiotic penicillin, which kills many bacteria.

Lice are ectoparasites on humans.

130. Answer (1)

Hint: RNA polymerase synthesizes mRNA.

Sol.: DNA polymerase can polymerise 2,000 bp per second only in one direction i.e., 5' → 3' direction.

131. Answer (1)

Hint: In one turn of Krebs cycle NAD⁺ and FAD⁺ are reduced.

Sol.: In one turn of Krebs cycle, 3 molecules of NAD⁺ are reduced to NADH + H⁺ and one molecule of FADH₂ is synthesized.

132. Answer (2)

Hint: Heterostyly refers to difference in the length of stamen filament and style of stigma in a bisexual flower.

Sol.: It is a morphological method in some plants like *Primrose* to prevent self pollination.

133. Answer (2)

Hint: Cells of this region differentiate to form certain structures.

Sol.: The epidermal cells from the zone of maturation form fine and delicate, thread-like structures called root hairs.

134. Answer (2)

Hint: Homologous chromosomes pair before the crossing over process which occurs in pachytene

Sol.: Leptotene – Condensation of chromosomes.

Zygotene – Pairing of homologous chromosomes.

Pachytene – Crossing over.

Diplotene – Separation of homologous chromosomes.

135. Answer (1)

Hint: A pure line plant is a true-breeding plant which shows stable trait expression and inheritance for several generation due to self-pollination

Sol.: Mendel choose 7 pairs of contrasting traits in pea plants.

SECTION-B

136. Answer (3)

Hint: Dormancy is broken by ethylene and auxins lead to apical dominance.

Sol.: Gibberellin – Helps in seed germination

Auxins – Present in root and shoot apex

Abscissic acid – Shows inhibitory effect

Cytokinin – Overcomes apical dominance

137. Answer (2)

Hint: Most of the organelles duplicate in G_1 phase and centrioles duplicate in S-phase.

Sol.: Tubulin protein is synthesized in G_2 phase. Only the organelles like mitochondria, chloroplasts and Golgi complex duplicate in this phase.

138. Answer (2)

Hint: RNA polymerase III transcribes tRNA, 5S rRNA and snRNAs.

Sol.: RNA polymerase II transcribes hnRNA only. RNA polymerase I transcribes 28S, 18S and 5.8S rRNAs.

139. Answer (3)

Hint: Statins are produced by a fungus.

Sol.: *Trichoderma polysporum* – Cyclosporin A

Streptococcus – Streptokinase

Monascus purpureus – Statins

Clostridium – Butyric acid

140. Answer (3)

Hint: Females suffering from this condition show monosomy of sex chromosome.

Sol.: Down's syndrome: Trisomy at chromosome 21

Klinefelter's syndrome : $44 + XXY$

Turner's syndrome : $44 + XO$

Edwards syndrome : Trisomy at chromosome 18.

141. Answer (2)

Hint: Cucurbits have stem tendrils

Sol.: Cactus → spines

Pisum sativum → leaf tendril

Members of Cucurbitaceae → stem tendril

Bryophyllum → leaf buds

142. Answer (2)

Hint: At low light conditions and high CO_2 concentration, neither C_3 nor C_4 plants show any change in rate of photosynthesis.

Sol.: More than 0.05% CO_2 concentrations can be damaging over longer periods.

At high light intensity, both C_3 and C_4 plants show higher productivity.

143. Answer (3)

Hint: The events of ETS occur only in the mitochondria.

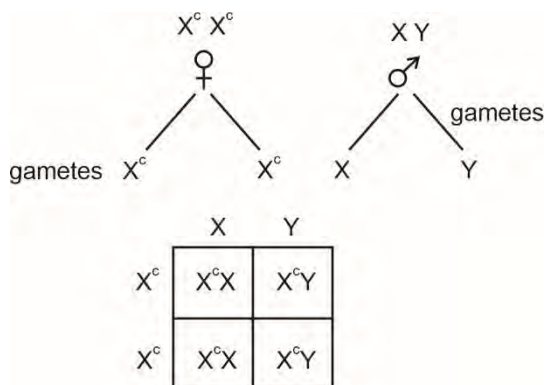
Sol.: During the transportation of electrons in the ETS, the protons move to intermembrane space from mitochondrial matrix.

144. Answer (3)

Hint: Colour blindness is a sex linked recessive disorder.

Sol.: Colourblind female: X^cX^c

Normal male: XY



All the females are carrier of this disease i.e., no female progeny is colourblind.

145. Answer (2)

Hint: Histone protein synthesis takes place in S-phase of interphase. Longest stage of Meiosis I is Prophase I.

Sol.: Duplication of DNA → S-phase

Longest phase of cell cycle → Interphase

Longest stage of meiosis I → Prophase I

Terminalisation of chiasmata → Diakinesis

146. Answer (4)

Hint: World Summit of 2002 at Johannesburg involved 190 countries, who took a pledge for reducing loss of biodiversity.

Sol.: Reducing the rate of biodiversity loss – World Summit, 2002

Reducing emission of Greenhouse gases – Kyoto protocol

Protecting the stratosphere – Montreal protocol

Conservation of Biodiversity and Sustainable utilization of its benefits – Earth Summit, Rio De Janeiro, 1992

147. Answer (4)

Hint: Colourful flowers and nectar are present in insect-pollinated plants.

Sol.: The pollen grains of the water-pollinated flowers are protected from wetting by mucilaginous covering.

148. Answer (3)

Hint: Zoospores are meant for asexual reproduction.

Sol.: Zoospores are produced by mitosis in *Chlamydomonas* for asexual reproduction. Megaspore cells are produced by meiotic division of megaspore mother cell.

149. Answer (2)

Hint: Ribulose-1, 5-biphosphate is the primary acceptor of CO₂ in Calvin cycle.

Sol.: Hatch and Slack pathway is observed in C₄ plants. Cyclic photophosphorylation involves only PS I.

150. Answer (3)

Hint: Each statement of the contrasting pair in a key is called a lead.

Sol.: The keys are based on the contrasting character generally in a pair called couplet.

[ZOOLOGY]

SECTION-A

151. Answer (2)

Hint: Secretion of brush border cells

Sol.: The food mixes thoroughly with the acidic gastric juice of the stomach by the churning movements of its muscular wall and is called chyme.

Pancreatic juice contains nucleases. Gastric juice contains pepsinogen and HCl.

152. Answer (3)

Hint: pCO₂ in deoxygenated blood is 45 mmHg.

Sol.:

Respiratory Gas	Atmospheric air	Alveoli	Blood (De-oxygenated)	Blood (Oxygenated)	Tissues
O ₂	159	104	40	95	40
CO ₂	0.3	40	45	40	45

153. Answer (1)

Hint: Commonly known as sea fan

Sol.: *Limulus* (arthropod), *Pinctada* (mollusc) and *Nereis* (annelid) are triploblastic coelomates. *Gorgonia* is a diploblastic cnidarian.

154. Answer (2)

Hint: Bone resorption

Sol.: Along with TCT, it plays a significant role in calcium balance in the body.

PTH acts on bones and stimulates the process of bone resorption (dissolution/demineralisation).

155. Answer (2)

Hint: Movement of ovum in fallopian tube is not a voluntary action.

Sol.: Smooth muscles (non-striated/visceral muscles) are not under the voluntary control of the nervous system and are therefore known as involuntary muscles.

156. Answer (2)

Hint: May lead to paralysis of skeletal muscles

Sol.: Osteoporosis is characterized by decreased bone mass and increased chances of fractures.

Myasthenia gravis – Fatigue, weakening and paralysis of skeletal muscles.

Gout occurs due to accumulation of uric acid crystals in joints.

157. Answer (2)

Hint: Blood group devoid of antigens A and B

Sol.:

Blood Group	Antigens on RBCs	Antibodies in Plasma	Donor's Group
A	A	anti-B	A, O
B	B	anti-A	B, O
AB	A, B	nil	AB, A, B, O
O	nil	anti-A, B	O

158. Answer (1)

Hint: Prevents polyspermy

Sol.: The secretions of the acrosome help the sperm enter into the cytoplasm of the ovum through the zona pellucida and the plasma membrane. Sperm attaches with zona pellucida layer of ovum and induces stabilization of membrane to prevent further entry of sperms.

159. Answer (2)

Hint: Identify an amino acid**Sol.:**

Pigments	Carotenoids, Anthocyanins, etc.
Alkaloids	Morphine, Codeine, etc.
Terpenoids	Monoterpenes, Diterpenes etc.
Essential oils	Lemon grass oil, etc.
Toxins	Abrin, Ricin
Lectins	Concanavalin A
Drugs	Vinblastin, curcumin, etc.
Polymeric substances	Rubber, gums, cellulose

160. Answer (2)

Hint: Identify a domestic animal**Sol.:** *Corvus* is a bird and *Chelone* is a reptile.*Ascidia* is a protochordate and *Canis* is a mammal.

161. Answer (4)

Hint: Diabetes mellitus

Sol.: PCR, ELISA and rDNA technology serves the purpose of early diagnosis of diseases. Hepatitis-B and HIV are viral STDs.

Mature insulin has two polypeptide chains.

162. Answer (4)

Hint: Used for treatment of cancer**Sol.:**

PCR – Detect HIV in suspected AIDS patients

ELISA – Detecting presence of antigens or antibodies synthesized against pathogen

Radiotherapy – Used to treat cancer

Radiography – Diagnosis of cancer

163. Answer (4)

Hint: Restriction endonuclease was isolated from it in 1963**Sol.:** Plasmid of *E.coli* is used in production of humulin.

Thermus aquaticus is a thermophilic bacteria and *Taq* polymerase is used in PCR.

Meloidogyne incognita (nematode) infects the roots of tobacco plants and causes a great reduction in yield.

164. Answer (3)

Hint: Class VI of enzymes**Sol.:** Restriction endonuclease cut DNA at specific site (their sugar phosphate backbone).

The resulting DNA fragments will have complementary overhanging stretches (sticky ends). Flush end is also called blunt end.

165. Answer (1)

Hint: Present in hemichordates

Sol.: Proboscis glands are reported in hemichordates. Metanephric kidney, 4-chambered heart and presence of feathers are features of birds.

166. Answer (4)

Hint: Roundworms

Sol.: Aschelminthes exhibit bilateral symmetry. Adult echinoderms, cnidarians and ctenophores exhibit radial symmetry.

167. Answer (1)

Hint: In barrier methods, ovum and sperms are prevented from physical meeting

Sol.: Diaphragms, cervical caps, and vaults prevent conception by blocking the entry of sperms through the cervix. Surgical methods (sterilization) are generally advised for the male/female partner as a terminal method to prevent any more pregnancies.

168. Answer (4)

Hint: Cystic duct along with hepatic ducts form common hepatic duct

Sol.: Brunner's glands are submucosal glands.

The bile duct and the pancreatic duct open together into the duodenum as the common hepato-pancreatic duct which is guarded by sphincter of Oddi.

169. Answer (2)

Hint: According to Chargaff rule,

$$A = T, C = G$$

Sol.: Out of 500 nucleotide base pairs

$$\text{i.e., } 500 \times 2 = 1000 \text{ nucleotides}$$

$$C = 40\%$$

$$\text{So, } G = 40\%$$

$$A + T \% = 100 - [G + C]\%$$

$$= 100 - 80 = 20\%$$

$$A + T = 20\%$$

$$\therefore A = T \text{ so, } A = 10\% \text{ of total nucleotides}$$

$$A = \frac{1000 \times 10}{100} = 100$$

170. Answer (3)

Hint: Metameric segmentations are seen in *Pheretima*

Sol.: The canal system in sponges is helpful in food gathering, respiratory exchange and removal of wastes.

In metamerism, the body is externally and internally divided into segments with a serial repetition of at least some organs.

In ctenophores, body bears 8 external rows of ciliated comb plates.

171. Answer (3)

Hint: A reduction in number of thrombocytes leads to clotting disorders

Sol.: Platelets, also called thrombocytes, are cell fragments produced from megakaryocytes. Blood normally contains $1,500,00 - 3,500,00$ platelets mm^{-3} . Platelet factors and tissue factors interact in presence of Ca^{+2} to form an enzyme complex thrombokinase which converts prothrombin into active thrombin.

172. Answer (2)

Hint: Progestasert belongs to the same category

Sol.: IUDs increase phagocytosis of sperms within the uterus and the copper ions released suppress sperm motility and the fertilising capacity of sperms.

Lippes loop and Multiload-375 are non-medicated and Cu releasing IUDs, respectively.

173. Answer (3)

Hint: Low pH favours dissociation of oxyhaemoglobin

Sol.: O_2 can bind with haemoglobin in a reversible manner to form oxyhaemoglobin. Low pO_2 , high pCO_2 , high H^+ concentration and high temperature are favourable conditions for dissociation of oxygen from oxyhaemoglobin. This clearly indicates that O_2 gets bound to haemoglobin in the lung surface and gets dissociated at the tissues. Oxyhaemoglobin dissociation curve shifts to right on increasing temperature, pCO_2 , H^+ and BPG.

174. Answer (3)

Hint: Related to human involvement

Sol.: Adaptive radiation leads to homology. Evolution for Darwin was gradual while de Vries believed mutation caused speciation and hence called it saltation. The process of evolution of antibiotic resistant bacteria, pesticide resistant pests, etc. are due to anthropogenic action.

175. Answer (3)

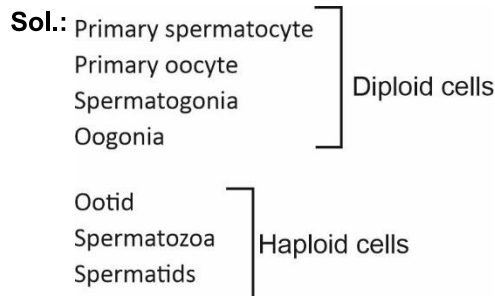
Hint: Exclude the anti-diuretic hormone.

Sol.: Foetal ejection reflex triggers the release of oxytocin from maternal pituitary. ACTH is a tropic hormone secreted from pars distalis.

ADH or vasopressin stimulates reabsorption of water from distal part of renal tubules.

176. Answer (3)

Hint: Primary spermatocyte undergoes meiosis-I



177. Answer (2)

Hint: Bones of hind limb

Sol.: The vertebral column is differentiated into cervical (7), thoracic (12), lumbar (5), sacral

(1-fused) and coccygeal (1-fused) regions starting from the skull.

Atlas is the first vertebra. Atlas articulates with the occipital condyles.

Ethmoid and sphenoid are cranial bones.

Sternum and ribs are axial bones which participate in formation of thoracic cage.

178. Answer (2)

Hint: One of the major cause is cigarette smoking

Sol.: Asthma is a difficulty in breathing causing wheezing due to inflammation of bronchi and bronchioles.

Diarrhoea is abnormal frequency of bowel movement and increased liquidity of the faecal discharge.

Muscular dystrophy is the progressive degeneration of skeletal muscle mostly due to genetic disorder.

179. Answer (2)

Hint: Related to structure involved in haemopoiesis

Sol.: Gene therapy is an attempt as a corrective therapy of a person who was born with a hereditary disease.

cry gene is isolated from *Bacillus thuringiensis*.

ADA enzyme is crucial for the immune system to function. In some children, ADA deficiency can be cured by bone marrow transplantation.

α -interferon is a biological response modifier which activates the immune system and helps in destroying the tumor.

180. Answer (2)

Hint: Production of 6 – 8 eggs

Sol.: MOET (Multiple Ovulation Embryo Transfer Technology) is a programme for herd improvement.

In AI, the semen is collected from the selected male and injected into the reproductive tract of the selected female by the breeders.

In cross-breeding, superior males of one breed are mated with superior females of another breed. Mating between two different related species is called interspecific hybridisation.

181. Answer (2)

Hint: Female *Anopheles* mosquito is a vector of this disease

Sol.: Symptoms of amoebiasis include constipation, abdominal pain and cramps, stool with excess mucous and blood clots.

Filariasis is characterised by the inflammation of lymphatic vessels of the lower limbs.

Appearance of dry, scaly lesions on various parts of the body such as skin, nails and scalp are the main symptoms of ringworms.

182. Answer (2)

Hint: It has 16 carbons including carboxyl carbon

Sol.: Palmitic acid has 16 carbons including the carboxyl carbon.

Glutamic acid and aspartic acid are acidic amino acids.

183. Answer (2)

Hint: Diabetes insipidus

Sol.: ADH facilitates water reabsorption from latter parts of renal tubule, thereby preventing diuresis.

Presence of proteins in urine is termed proteinuria.

184. Answer (4)

Hint: Inner cell mass differentiates into embryo.

Sol.: In later phase of pregnancy, a hormone called relaxin is also secreted by the ovary. hCG, hPL and relaxin are produced in women only during pregnancy. Inner cell mass contains certain cells called stem cells which have the potency to give rise to all the tissues and organs.

185. Answer (2)

Hint: Connects the cytoplasm of adjoining cells

Sol.: Three types of cell junctions are found in the epithelium and other tissues.

1. Tight junctions – Help to stop substances from leaking across a tissue
2. Adhering junctions – Perform cementing to keep neighbouring cells together
3. Gap junctions – Facilitate the cells to communicate with each other by connecting the cytoplasm of adjoining cells for rapid transfer of ions, small molecules, etc.

SECTION-B

186. Answer (2)

Hint: Hypothalamus is associated with thermoregulation.

Sol.: The hypothalamus contains a number of centres, which control body temperature, urge for eating and drinking.

187. Answer (3)

Hint: Hardy-Weinberg principle – The gene pool (total genes and their alleles in a population) remains constant.

Sol.: The frequency of homozygous recessive babies (q^2) = $\frac{90}{1000} = 0.09$

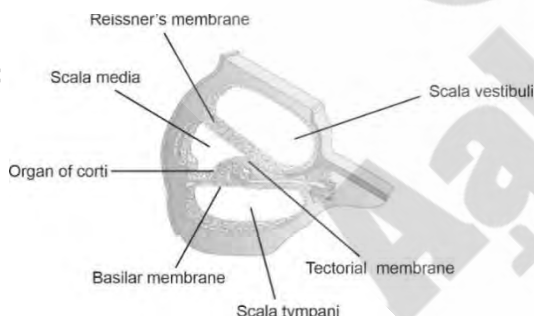
$$q = \sqrt{0.09} = 0.3$$

$$p = 1 - q = 0.7$$

The frequency of heterozygous individuals = $2pq$
 $= 2 \times 0.7 \times 0.3 = 0.42$

188. Answer (2)

Hint: The coiled portion of the labyrinth is called cochlea

Sol.:

189. Answer (3)

Hint: It is not a true segment

Sol.: The first body segment of earthworm called peristomium, bears mouth and a prostomium, that covers the mouth partially. Prostomium helps in formation of burrow.

190. Answer (1)

Hint: One cardiac cycle represents one heart beat.

Sol.: Normal haemoglobin in blood = 12 – 16 g/dl.

$$\text{Normal blood pressure} = \frac{120}{80} \text{ mmHg}$$

Duration of a cardiac cycle = 0.8 sec.

$$\text{Lub} \xrightleftharpoons[0.5 \text{ sec}]{0.3 \text{ sec}} \text{Dub}$$

191. Answer (1)

Hint: One cannot see pure DNA fragments in the visible light

Sol.: Since DNA fragments are negatively charged molecules, they can be separated by forcing them to move towards the anode under an electric field through a medium/matrix.

192. Answer (2)

Hint: *Thermus aquaticus*

Sol.: *Taq* polymerase adds nucleotides in 5' → 3' direction.

PCR is a reaction that is utilized to amplify a gene or fragment of DNA of interest.

Each cycle of PCR has 3 steps

1. Denaturation : Starting solution is heated to 94°C
2. Annealing : Reaction mixture is cooled in between 50-60°C
3. Extension : Mixture is heated to 72°C

193. Answer (3)

Hint: An organisation set up by Indian government

Sol.: GEAC – Genetic Engineering Approval Committee.

European Federation of Biotechnology gave the definition of biotechnology.

194. Answer (3)

Hint: Founder effect

Sol.: Founder effect is the example of genetic drift. Sometimes, the change in allelic frequency is so different in the new sample of population that they become a different species.

195. Answer (3)

Hint: Class of transferases

Sol.: Catalyses the transfer of a group, G (other than hydrogen) between a pair of substrate S and S'. Class I includes oxidoreductases, class III includes hydrolases and class IV includes lyases.

196. Answer (1)

Hint: Lined by sarcolemma

Sol.: Each organised skeletal muscle in our body is made of a number of muscle bundles or fascicles held together by a common collagenous connective tissue layer called fascia. Each muscle bundle contains a number of muscle fibres. Each muscle fibre is lined by the plasma membrane called sarcolemma enclosing the sarcoplasm.

197. Answer (2)

Hint: Tetracycline resistance gene has two restriction sites.

Sol.: amp^R gene in pBR322 can be cleaved by *Pvu*I and *Pst*I.

The *rop* codes for the proteins involved in the replication of the plasmid.

When a rDNA is injected within the coding sequence of β -galactosidase, it results into insertional inactivation.

198. Answer (4)

Hint: DNA contains deoxyribose sugar.

Sol.: The sugar found in polynucleotides is either ribose or 2' deoxyribose. Proteins are polymers of amino acids. Starch forms helical structure which can hold I_2 in its helices.

199. Answer (4)

Hint: ADH is released during dehydration condition

Sol.: ANF can cause vasodilation.

Angiotensin I $\xrightarrow{\text{Renin}}$ Angiotensin II

Erythropoietin is produced by juxtaglomerular cells of the kidneys.

200. Answer (2)

Hint: Includes the segment containing a pair of spermatheca

Sol.: A pair of ovaries lie laterally in 2nd to 6th abdominal segments.

Anal cerci are paired, jointed outgrowths, which arise from the 10th tergum.

Mushroom or utricular glands are present in 6th – 7th abdominal segments of a male cockroach.

