

## All India Aakash Test Series for NEET - 2023

**OPEN MOCK TEST - 2 (Code-A)**

Test Date : 02/04/2023

**ANSWERS**

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

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

1. Answer (4)

**Hint & Sol.:** Bosons are interacting particles for weak forces.

2. Answer (3)

**Hint:** Use principle of homogeneity

**Sol.:**  $[xb]$  should be dimensionless

$$\therefore [b] = [L^{-1}]$$

$$[K] = \frac{[LT^{-1}]}{[ML^2T^{-2}]}$$

$$[Kb] = [M^{-1}L^{-2}T^1]$$

3. Answer (3)

**Hint:** Distance travelled in  $n^{\text{th}}$  second

$$S_n = u + \frac{a}{2}(2n-1)$$

$$\text{Sol.} \quad S_3 = 0 + \frac{4}{2}(2 \times 3 - 1) = 10 \text{ m}$$

$$S_4 = 0 + \frac{4}{2}(2 \times 4 - 1) = 14 \text{ m}$$

$$\text{Hence } \frac{S_3}{S_4} = \frac{10}{14} = \frac{5}{7}$$

4. Answer (3)

**Hint:** Velocity at any instant  $v^2 = u^2 - 2gh$

$$\text{Sol.} \quad v^2 = 2gh - 2g(h-5)$$

$$= 2 \times 10 \times 5 = 100$$

$$v = 10 \text{ m/s}$$

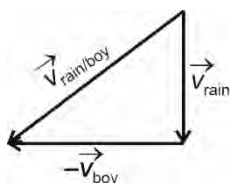
$$|a| = 10 \text{ m/s}^2$$

Hence, required ratio = 1

5. Answer (3)

**Hint:**  $\vec{v}_{\text{rain/boy}} = \vec{v}_{\text{rain}} - \vec{v}_{\text{boy}}$

**Sol.:**



$$|\vec{v}_{\text{rain}}| = \sqrt{v_{\text{rain/boy}}^2 - v_{\text{boy}}^2}$$

$$= \sqrt{125 - 16}$$

$$= \sqrt{109} \text{ km/h}$$

6. Answer (4)

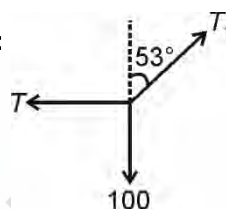
**Hint:** Average velocity =  $\frac{\text{Total displacement}}{\text{total time}}$

$$\text{Sol.} \quad v_{\text{avg}} = \frac{2v^2 \cdot \sin \theta \cdot \cos \theta}{g \times \frac{2v \sin \theta}{g}} = v \cos \theta$$

7. Answer (2)

**Hint:** For equilibrium  $\vec{F}_{\text{net}} = 0$

**Sol.:**



$$T = T_1 \sin 53^\circ = \frac{4T_1}{5} \quad \dots(i)$$

$$T_1 \cos 53^\circ = 100$$

$$\frac{3T_1}{5} = 100 \Rightarrow T_1 = \frac{500}{3} \text{ N} \dots(ii)$$

$$\text{From equation (i) \& (ii) } T = \frac{500}{3} \times \frac{4}{5} = \frac{400}{3} \text{ N}$$

For  $m$  to be in equilibrium

$$\mu mg \geq \frac{400}{3}$$

$$\Rightarrow 0.8 \times 10 \text{ m} \geq \frac{400}{3}$$

$$m \geq \frac{50}{3}$$

8. Answer (1)

**Hint & Sol.:** Tension in the string = Force developed in spring. Reading of spring balance will be 7 kg.

9. Answer (3)

**Hint:** Power  $P = \frac{dk}{dt}$

$$\text{Sol.} \quad dk = P \cdot dt = \frac{5}{3} t^4 dt$$

$$\Rightarrow \int_0^k dk = \frac{5}{3} \times \int_0^t t^4 dt$$

$$\Rightarrow K = \frac{t^5}{3}$$

$$\therefore \text{ at } t = 2, k = \frac{1}{2} \times 2 \times v^2 = \frac{32}{3}$$

$$v = \sqrt{\frac{32}{3}} \text{ m s}^{-1}$$

10. Answer (2)

**Hint:** Velocity of centre of mass remains constant.

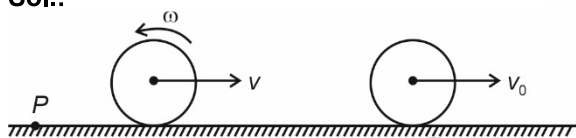
$$\text{Sol.: } \vec{v}_{\text{cm}} = \frac{5 \times 6\hat{i} + 8 \times (-8)\hat{i}}{5+8} = \frac{-34}{13}\hat{i}$$

$$\vec{v}_{\text{cm}} = -\frac{34}{13}\hat{i}$$

11. Answer (3)

**Hint:** Apply conservation of angular momentum

**Sol.:**



$$\vec{L}_i, \text{ about } P = \vec{L}_f, \text{ about } P$$

$$\Rightarrow mvR - I\omega = mv_0R$$

$$\Rightarrow mvR - \frac{2}{5}mR^2 \cdot \frac{v}{R} = mv_0R$$

$$\Rightarrow v_0 = \frac{3}{5}v$$

12. Answer (1)

$$\text{Hint: Young's modulus } Y = \frac{FL}{A \Delta L}$$

$$\text{Sol.: } Y = \frac{1000}{10^{-4}} \times \frac{100}{0.2} = 5 \times 10^9 \text{ N/m}^2$$

13. Answer (2)

**Hint & Sol.:**

- Young's modulus of a body depends only on the nature of material. It doesn't depend on the shape & size of the body.
- Young's modulus, bulk modulus and shear modulus are dimensionally equivalent

$$[K] = [M^1 L^{-1} T^{-2}]$$

14. Answer (3)

**Hint:** For non-isotropic material  $\beta = \alpha_x + \alpha_y$

$$\text{Sol.: } \beta = 5 \times 10^{-6} + 6 \times 10^{-6}$$

$$= 11 \times 10^{-6} / ^\circ\text{C}$$

$$\text{Hence } K = 11$$

15. Answer (1)

**Hint:** For polytropic process  $PV^N = \text{constant}$

$$\text{Sol.: } C_{\text{process}} = C_v + \frac{R}{-N+1}$$

$$C_{\text{process}} = \frac{3}{2}R + \frac{R}{-\frac{3}{2}+1} = -\frac{R}{2}$$

Heat exchanged

$$\Delta Q = nC_{\text{process}} \Delta T$$

$$= 2 \times -\frac{R}{2} \times (-38)$$

$$= 38R$$

16. Answer (1)

**Hint & Sol.:** Average translational kinetic energy

$$\text{per mole} = \frac{3}{2}RT$$

17. Answer (4)

**Hint:** Total oscillation energy of harmonic

$$\text{oscillator} = \frac{1}{2}m\omega^2 A^2$$

$$\text{Sol.: } \frac{1}{2}m\omega^2 A^2 = 8$$

$$\Rightarrow \frac{1}{2} \times 4 \times \omega^2 \times \frac{1}{100} = 8$$

$$w = \sqrt{400} = 20$$

$$T = \frac{2\pi}{\omega} = \frac{\pi}{10} \text{ second}$$

18. Answer (3)

**Hint & Sol.:** For standing wave, two travelling waves travelling in opposite direction superimpose each other.

19. Answer (3)

$$\text{Hint: Speed of transverse pulse } v = \sqrt{\frac{T}{\mu}}$$

$$\text{Sol.: } v = \sqrt{\frac{T}{\mu}} = \sqrt{\frac{\mu y g}{\mu}} = \sqrt{yg}$$

$$v = \sqrt{0.5 \times 10} = \sqrt{5} \text{ m/s}$$

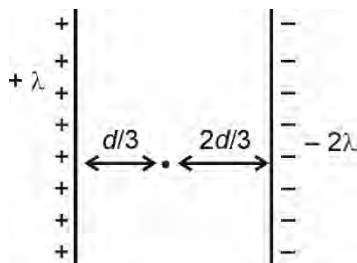
$$= 2.23 \text{ m/s}$$

20. Answer (4)

**Hint:** Electric field due to infinite line charge

$$E = \frac{2k\lambda}{r}$$

Sol.:



$$\vec{E}_{\text{net}} = \vec{E}_1 + \vec{E}_2$$

$$= \frac{2k\lambda}{(d/3)} + \frac{4k\lambda}{2d/3}$$

$$= \frac{4k\lambda}{d/3} = 4 \times \frac{1 \times 3\lambda}{4\pi\epsilon_0 d} = \frac{3\lambda}{\pi\epsilon_0 d}$$

21. Answer (3)

**Hint:** Electric field  $\vec{E} = -\frac{\partial V}{\partial x}\hat{i} - \frac{\partial V}{\partial y}\hat{j} - \frac{\partial V}{\partial z}\hat{k}$

**Sol.:**  $\vec{E} = -6x\hat{i} - 12y^2\hat{j}$

$$\vec{E}_{\text{at } (1,2,3)} = -6 \times 1\hat{i} - 12 \times 2^2\hat{j}$$

$$= -6\hat{i} - 48\hat{j} \text{ N/C}$$

Force on 2 C,  $\vec{F} = -12\hat{i} - 96\hat{j}$

$$|\vec{F}| = 12\sqrt{65} \text{ N}$$

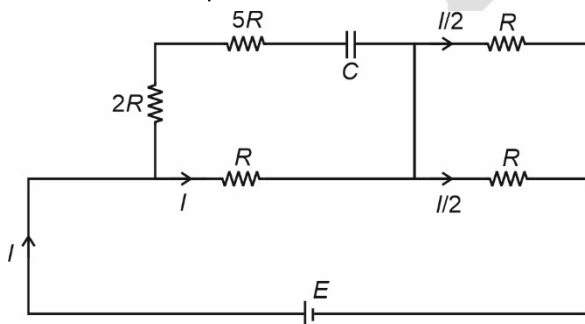
22. Answer (4)

**Hint & Sol.:** Capacitance of a parallel plate capacitor depends on size of plates and nature of medium between the plates.

23. Answer (1)

**Hint:** Use KCL & KVL

**Sol.:** Circuit is equivalent to



$$\text{Value of } I = \frac{E}{R_{\text{eq}}} = \frac{2E}{3R}$$

Hence energy stored in capacitor

$$U = \frac{1}{2}CV^2 = \frac{1}{2} \times C \times \frac{4E^2}{9}$$

$$= \frac{2CE^2}{9}$$

24. Answer (2)

**Hint:** If out of  $N$  cells in series ' $n$ ' cells are wrongly connected then  $E_{\text{eq}} = (N - 2n)E$ .

**Sol.:** Initially,  $16E = K\ell \dots (i)$

$$\text{Finally, } (16 - 2n)E = \frac{K\ell}{4} \dots (ii)$$

On solving equation (i) & (ii)  $n = 6$

25. Answer (4)

**Hint:** Magnetic field due to a long current carrying

$$\text{wire } B = \frac{\mu_0}{4\pi} \frac{2I}{r}$$

**Sol.:**

$$\vec{B}_{\text{net}} = \vec{B}_1 + \vec{B}_2 = 0 \quad (r \text{ is distance from 4 cm mark})$$

$$\Rightarrow \frac{\mu_0}{4\pi} \frac{2 \times 3}{r} - \frac{\mu_0}{4\pi} \frac{2 \times 5}{4+r} = 0$$

$$\Rightarrow \frac{3}{r} = \frac{5}{4+r}$$

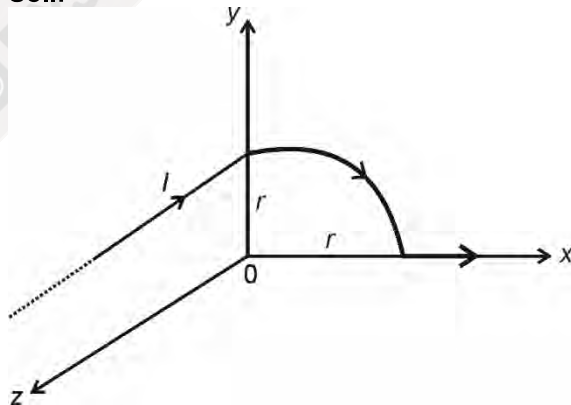
$$\Rightarrow r = 6$$

$$\text{Hence } x = -2$$

26. Answer (3)

**Hint:**  $\vec{B}_{\text{net}} = \vec{B}_1 + \vec{B}_2 + \vec{B}_3$

**Sol.:**



$$\vec{B}_1 = \frac{\mu_0}{4\pi} \frac{I}{r} (-\hat{i})$$

$$\vec{B}_2 = \frac{\mu_0}{4\pi} \frac{I\pi}{2r} (-\hat{k})$$

$$\vec{B}_3 = \text{Zero}$$

$$\text{Hence } \vec{B}_{\text{net}} = -\frac{\mu_0 I}{4r} \left[ \frac{\hat{i}}{\pi} + \frac{\hat{k}}{2} \right]$$

27. Answer (1)

**Hint & Sol.:** According to Faraday's law of electromagnetic induction

$$e \propto \frac{-d\phi}{dt}$$

28. Answer (2)

**Hint & Sol.:** Energy received  $E = P \cdot t$ 

$$= 30 \times 60 \times 50$$

$$= 90,000 \text{ J}$$

$$= 90 \text{ kJ}$$

29. Answer (2)

**Hint:** According to lens maker formula

$$\frac{1}{f} = (\mu - 1) \left[ \frac{1}{R_1} - \frac{1}{R_2} \right]$$

$$\text{Sol.: } \Rightarrow \frac{1}{30} = \left( \frac{8}{5} - 1 \right) \left[ \frac{1}{R} + \frac{1}{3R} \right]$$

$$\Rightarrow \frac{1}{30} = \frac{3}{5} \times \frac{4}{3R}$$

$$\Rightarrow R = 24 \text{ cm}$$

30. Answer (4)

**Hint:** Resultant intensity  $I = I_0 \cos^2(\phi/2)$ 

$$\text{Sol.: } \Delta\phi = \frac{2\pi}{\lambda} \Delta x = \frac{2\pi}{\lambda} \times \frac{\lambda}{4}$$

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

$$\text{Now, } I = I_0 \cos^2(\pi/4)$$

$$= 0.5 I_0$$

31. Delete

**Hint:** Use Malus law  $I = I_0 \cos^2\theta$ **Sol.:** Intensity after second polaroid

$$I_2 = I_1 \cos^2\theta = \frac{I_0}{2} \cos^2\theta$$

Intensity after third polaroid

$$I_3 = I_2 \cos^2(90 - \theta)$$

$$= \frac{I_0}{2} \cos^2\theta \cdot \sin^2\theta$$

$$\Rightarrow 6 = \frac{64}{2} \cos^2\theta \cdot \sin^2\theta = 8(\sin 2\theta)^2$$

$$\Rightarrow \sin 2\theta = \frac{\sqrt{3}}{2} \Rightarrow \theta = 30^\circ$$

32. Answer (2)

**Hint & Sol.:**  $K_{\max} = E - \phi$ 

$$= 10.6 - 5.6$$

$$= 5 \text{ eV}$$

33. Answer (1)

**Hint:** Effective half life

$$T_{\text{Half}} = \frac{T_{H1} \cdot T_{H2}}{T_{H1} + T_{H2}}$$

$$\text{Sol.: } T_{\text{Half}} = \frac{640 \times 1920}{640 + 1920} = 480 \text{ h}$$

$$\text{Now } \frac{N}{N_0} = \frac{1}{8}$$

i.e., required time  $t = 3 \times 480$ 

$$= 1440 \text{ h}$$

34. Answer (3)

**Hint & Sol.:**

| A | B | y |
|---|---|---|
| 0 | 0 | 1 |
| 0 | 1 | 1 |
| 1 | 0 | 1 |
| 1 | 1 | 0 |

35. Answer (4)

$$\text{Hint: } \frac{1}{\lambda} = R \left[ \frac{1}{n_f^2} - \frac{1}{n_i^2} \right]$$

$$\text{Sol.: } \frac{1}{\lambda_1} = R \left[ \frac{1}{1^2} - \frac{1}{3^2} \right] = \frac{R8}{9} \dots (i)$$

$$\frac{1}{\lambda_2} = R \left[ \frac{1}{2^2} - \frac{1}{5^2} \right] = \frac{R \times 21}{100} \dots (ii)$$

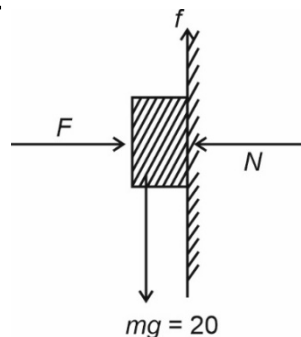
From equation (i) &amp; (ii)

$$\frac{\lambda_2}{\lambda_1} = \frac{8R}{9} \times \frac{100}{21R} = \frac{800}{189}$$

$$\lambda_2 = \frac{800}{189} \lambda_1 = \frac{800}{189} \lambda$$

## SECTION-B

36. Answer (3)

**Hint:** For block to move  $F_{\text{net}} \geq f_{s,\text{max}}$ **Sol.:**

$$f_{s, \text{max}} \geq mg$$

$$\mu F \geq 20$$

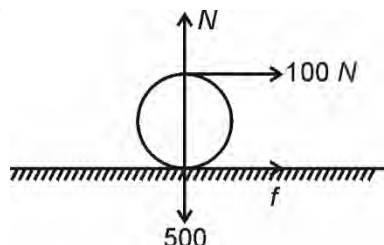
$$F \geq \frac{20}{0.4}$$

$$F \geq 50 \text{ N}$$

37. Answer (3)

**Hint:**  $\tau_{\text{ext}} = I\alpha$

**Sol.:**



$$100 + f = 50 \cdot a \dots (i)$$

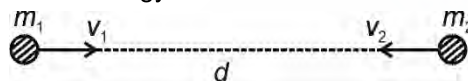
$$100 - f = \frac{I\alpha}{R} = \frac{MR^2}{2} \times \frac{a}{R^2} \dots (ii)$$

On solving equation (i) & (ii)

$$a = \frac{8}{3} \text{ m/s}^2 \quad \text{and} \quad f = \frac{100}{3} \text{ N}$$

38. Answer (2)

**Hint:** Use conservation of momentum & mechanical energy

**Sol.:** 

$$\frac{1}{2}m_1v_1^2 + \frac{1}{2}m_2v_2^2 - \frac{Gm_1m_2}{d} = 0 \dots (I)$$

$$\text{also } m_1v_1 = m_2v_2 \dots (II)$$

on solving I & II

$$V_1 = \sqrt{\frac{2Gm_2^2}{(m_1 + m_2)d}}$$

39. Answer (4)

**Hint:** Extension in rod  $\Delta L = \frac{TL}{AY}$

**Sol.:** Tension in the rod  $T = 3F$

$$\text{Extension of the rod } \Delta L = \frac{3FL}{AY}$$

40. Answer (4)

**Hint:** Work done = Area under P-V curve

**Sol.:**  $W = \frac{1}{2}P_0V_0$

$$= \frac{P_0V_0}{2}$$

41. Answer (3)

**Hint:**  $E = \frac{f}{2}(nRT)$

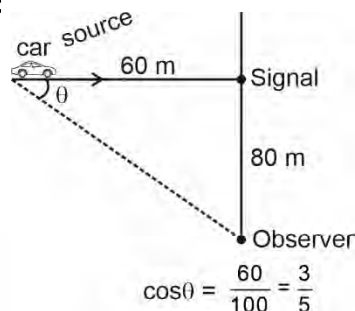
**Sol.:**  $U_{\text{total}} = U_1 + U_2$

$$= \left( 3 \times \frac{5}{2}R + 5 \times \frac{3}{2}R \right) T = 15RT$$

42. Answer (3)

**Hint:** Use Doppler's effect

**Sol.:**



$$f_{\text{app}} = f_0 \left[ \frac{v}{v - v_s \cos \theta} \right]$$

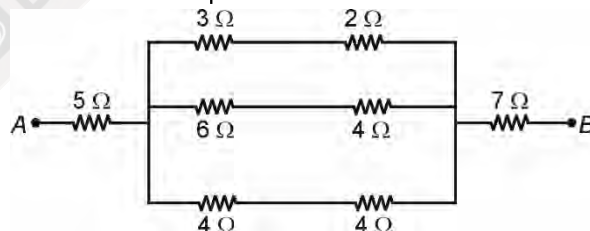
$$= 400 \left\{ \frac{330}{330 - 20 \times \frac{3}{5}} \right\}$$

$$= 415 \text{ Hz.}$$

43. Answer (1)

**Hint:** Parallel and series combination of resistance.

**Sol.:** Circuit is equivalent to



$$R_{\text{eq}} = 5 + \frac{80}{34} + 7 = \frac{244}{17}$$

44. Answer (4)

**Hint & Sol.:**  $\tan \delta_A = \frac{\tan \delta}{\cos \alpha} = \frac{\tan 60^\circ}{\cos 30^\circ}$

$$= \frac{\sqrt{3}}{(\sqrt{3}/2)} = 2$$

$$\delta_A = \tan^{-1}(2)$$

$$\Rightarrow \delta_A = \sin^{-1} \left[ \frac{2}{\sqrt{5}} \right]$$

45. Answer (3)

**Hint:** Efficiency  $\eta = \frac{P_{\text{output}}}{P_{\text{input}}}$

**Sol.:** Input power  $P_{\text{in}} = 5 \text{ kW}$

$$\Rightarrow V_{\text{in}} \cdot I_{\text{in}} = 5000$$

$$I_{\text{in}} = \frac{5000}{200} = 25 \text{ A}$$

Now  $\eta = \frac{P_{\text{out}}}{P_{\text{in}}} \Rightarrow \frac{80}{100} = \frac{P_{\text{out}}}{5 \text{ kW}}$

$$\Rightarrow P_{\text{out}} = V_{\text{out}} \times 4 = \frac{80 \times 5000}{100}$$

$$\Rightarrow V_{\text{out}} = 1000 \text{ volt}$$

46. Answer (3)

**Sol.:**  $E = \frac{1}{2} L I^2$

$$50 \times 10^{-6} = \frac{1}{2} L (25 \times 10^{-3})^2$$

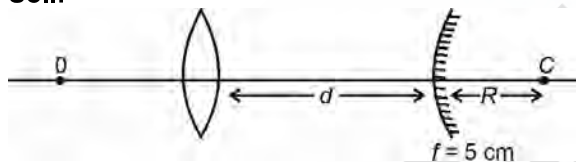
$$100 = L \times 625$$

$$L = 0.16 \text{ H}$$

47. Answer (2)

**Hint:** Use lens and mirror equation.

**Sol.:**



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

$$\Rightarrow \frac{1}{20} = \frac{1}{v} - \frac{1}{(-30)} \Rightarrow v = 60 \text{ cm}$$

Refracting rays from lens should fall normally on the mirror i.e., they should go for centre of curvature of mirror.

$$\text{Hence } d + R = 60$$

$$d = 60 - 10$$

$$= 50 \text{ cm}$$

48. Answer (2)

**Hint & Sol.:** Rest mass of a stable nucleus is less than the sum of the rest masses of its separated nucleons.

- In nuclear fission heavy nucleus splits into smaller daughter nuclei

49. Answer (4)

**Hint:**  $\frac{N}{N_0} = \left(\frac{1}{2}\right)^n$ ,  $n = \frac{t}{T_{\text{Half}_A}}$

**Sol.:** For sample A  $\Rightarrow \frac{1}{8} = \left(\frac{1}{2}\right)^n \Rightarrow \frac{t}{T_{\text{Half}_A}} = 3$

$$T_{\text{Half}} = \frac{1}{3} \text{ day}$$

For sample B  $\Rightarrow \frac{1}{256} = \left(\frac{1}{2}\right)^n \Rightarrow \frac{t}{T_{\text{Half}_B}} = 8$

$$\Rightarrow T_{\text{Half}_B} = \frac{t}{8} = \frac{1}{8} \text{ day}$$

Hence  $\frac{T_{\text{Half}_A}}{T_{\text{Half}_B}} = \frac{1}{3} \times \frac{8}{1}$

$$= \frac{8}{3}$$

50. Answer (4)

**Hint & Sol.:** In transistor emitter is heavily doped, base is lightly doped while collector is moderately doped.

## [CHEMISTRY]

### SECTION-A

51. Answer (2)

**Hint:** For  $n^{\text{th}}$  order reaction,

Unit of rate constant  $(k) = \left(\frac{\text{mol}}{\text{L}}\right)^{1-n} \text{ time}^{-1}$

**Sol.:** For  $1^{\text{st}}$  order reaction,

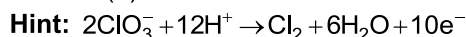
Unit of rate constant  $(k) = \left(\frac{\text{mol}}{\text{L}}\right)^{1-1} \text{ s}^{-1} = \text{s}^{-1}$

52. Answer (2)

**Hint:** Cu sol is negatively charged sol

**Sol.:** A negatively charged sol will be more easily coagulated by cation having more charge

53. Answer (3)



**Sol.:** To reduce, 2 mole  $\text{ClO}_3^-$ , charge required = 10 F

$\therefore$  To reduce, 0.1 mole  $\text{ClO}_3^-$ , charge required

$$= \frac{10}{2} \times 0.1 \text{ F}$$

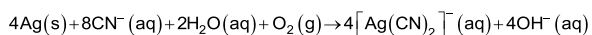
$$= 0.5 \times 96500 \text{ C}$$

$$= 48250 \text{ C}$$

54. Answer (1)

**Hint:** Composition of Magnetite is  $\text{Fe}_3\text{O}_4$

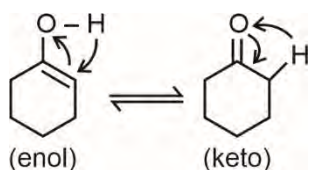
**Sol.:** During extraction of Ag, ores of Ag are treated with aqueous dilute solution of NaCN in the presence of oxygen.



55. Answer (4)

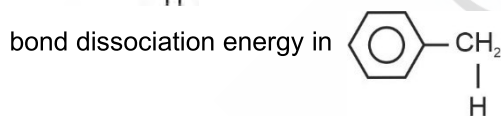
**Hint:** Ketone should contain active H-atom

**Sol.:** Vinyl alcohols show keto-enol tautomerism



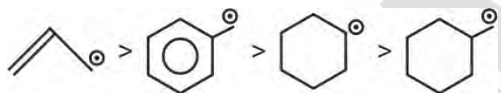
56. Answer (3)

**Hint:** C-H bond dissociation energy in  $\text{CH}_2=\text{CH}-\text{CH}_2$  ( $361 \text{ kJ mol}^{-1}$ ) is less than C-H



( $368 \text{ kJ mol}^{-1}$ )

**Sol.:** Stability order

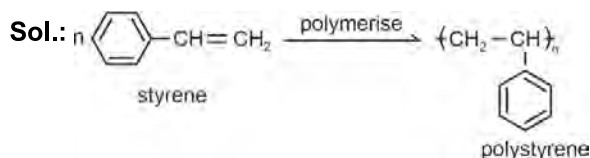
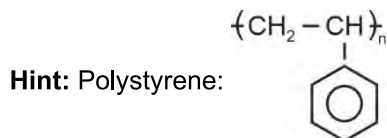


57. Answer (3)

**Hint:** In fcc unit cell atoms are present at corner as well as face centre of unit cell while in simple cubic unit cell atoms are present only on the corner of the unit cell

$$\text{Sol.: } \frac{Z_{\text{fcc}}}{Z_{\text{sc}}} = \frac{8 \times \frac{1}{8} + 6 \times \frac{1}{2}}{8 \times \frac{1}{8}} = \frac{1+3}{1} = \frac{4}{1}$$

58. Answer (1)



59. Answer (4)

**Hint and solution :**

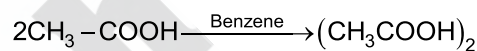
| Element                                     | He  | Ne   | Ar  | Kr  | Xe  |
|---------------------------------------------|-----|------|-----|-----|-----|
| $\Delta_{\text{eg}} H (\text{kJ mol}^{-1})$ | +48 | +116 | +96 | +96 | +77 |

60. Answer (3)

**Hint:** Ethanoic acid exist as dimer in benzene

**Sol.:**

- Relative lowering in vapour pressure is a colligative property
- In benzene, ethanoic acid exist as a dimer due to intermolecular H-bonding

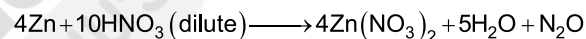


van't Hoff factor (i)  $\approx 0.5$

61. Answer (1)

**Hint:** Neutral oxide is obtained.

**Sol.:**

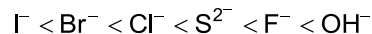


62. Answer (1)

**Hint and Sol.:** In lanthanoids, Ce, Pr, Nd, Tb and Dy exhibits +4 oxidation states.

63. Answer (3)

**Hint and Sol:** In general, increasing order of ligand field strength is



64. Answer (4)

**Hint:** 1 g-molecules = 1 mole of molecules

**Sol.:**

- $\text{O}_2$ : No. of atoms =  $\frac{12}{32} \times 2 \times N_A = 0.75 N_A$
- $\text{N}_2$ : No. of atoms =  $\frac{22.4}{22.4} \times 2 \times N_A = 2 N_A$
- $\text{SO}_2$ : No. of atoms =  $0.5 \times 3 \times N_A = 1.5 N_A$
- $\text{O}_3$ : No. of atoms =  $1 \times 3 \times N_A = 3 N_A$

65. Answer (3)

**Hint & Sol.:** Pauli Exclusion principle: "No two electrons in an atom can have the same set of all four quantum numbers".

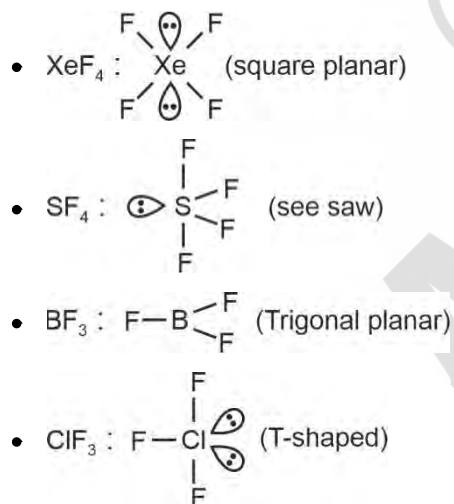
66. Answer (1)

**Hint & Sol.:**

| Element atomic number (Z) | IUPAC official name |
|---------------------------|---------------------|
| 101                       | Mendelevium         |
| 102                       | Nobelium            |
| 103                       | Lawrencium          |
| 104                       | Rutherfordium       |

67. Answer (2)

**Hint:** See saw and T – shape is observed in molecules, in which electron pair arrangement around central atom is trigonal bipyramidal.

**Sol.:**

68. Answer (2)

**Hint:** At 1 bar pressure boiling temperature is called standard boiling point.

**Sol.:**

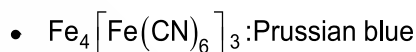
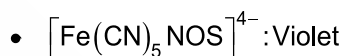
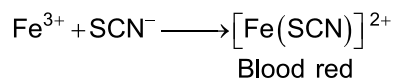
- At 1 atm pressure boiling temperature is called normal boiling point
- The temperature at which a real gas obeys ideal gas law over an appreciable range of pressure is called Boyle temperature

69. Answer (4)

**Hint and sol.:**  $\text{N}_2$  does not cause greenhouse effect

70. Answer (1)

**Hint:** Organic compounds containing both N and S gives blood red colour with  $\text{Fe}^{3+}$  in "Lassaigne's test".

**Sol.:**

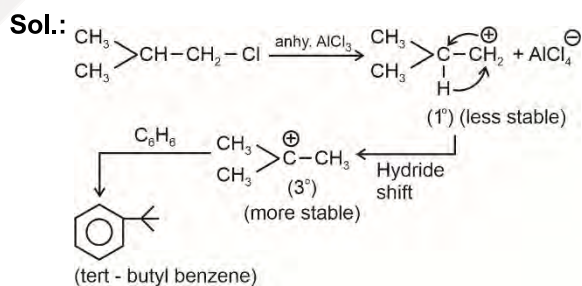
71. Answer (2)

**Hint:** Aromatic species are planar in shape**Sol.:**  is Tub – shaped (non – planar)

, so non – aromatic

72. Answer (3)

**Hint:** It is a Friedel Crafts alkylation reaction in which electrophile is carbocation



73. Answer (1)

**Hint:** Group – 7, 8, 9 elements do not form Hydrides

**Sol.:** In group – 6, only Cr can form Hydride

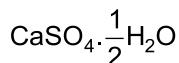
74. Answer (2)

**Hint:** A 30% solution of  $\text{H}_2\text{O}_2$  is marked as '100 volume' hydrogen peroxide

**Sol.:** A 30%  $\text{H}_2\text{O}_2$  solution means 1 ml of the solution will give 100 ml of  $\text{O}_2$  at STP

75. Answer (3)

**Hint:** Hemihydrate of calcium sulphate :



**Sol.:**

- Plaster of paris :  $\text{CaSO}_4 \cdot \frac{1}{2} \text{H}_2\text{O}$
- Gypsum :  $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$
- Dead burnt plaster :  $\text{CaSO}_4$
- Calgon :  $\text{Na}_6\text{P}_6\text{O}_{18}$

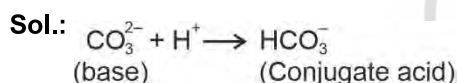
76. Answer (2)

**Hint:** Soframycin is used as an antiseptic

**Sol.:** Iproniazid is used as a tranquilizer

77. Answer (4)

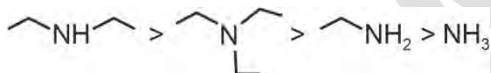
**Hint:**  $\text{Base} + \text{H}^+ \rightarrow \text{Conjugate Acid}$



78. Answer (1)

**Hint:** In aqueous medium basic nature of amine depends not only on electron releasing effect of alkyl group (+I effect) but also the solvation with water molecules

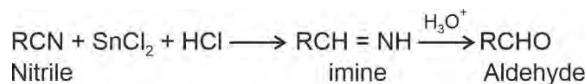
**Sol.:** Basic Nature



79. Answer (2)

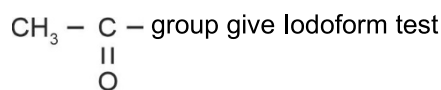
**Hint:** In Stephen reaction reduction of nitriles take place

**Sol.:** In Stephen reaction

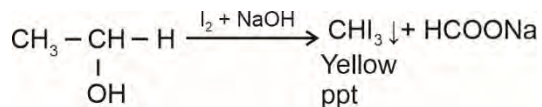


80. Answer (3)

**Hint:** Compounds containing  $\text{CH}_3 - \underset{\text{OH}}{\text{CH}} -$  group or

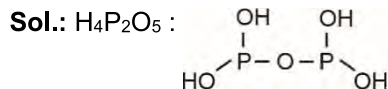


**Sol.:** Iodoform test



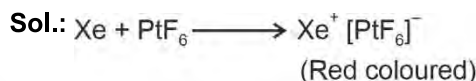
81. Answer (1)

**Hint:** Pyrophosphorus acid :  $\text{H}_4\text{P}_2\text{O}_5$



82. Answer (4)

**Hint:** Neil Bartlett, prepare first compound of inert by mixing Xe with  $\text{PtF}_6$



83. Answer (2)

**Hint:** Value of  $l$  is 0 to  $(n-1)$

**Sol.:** For  $n = 1$ ,  $l = 0$  only

84. Answer (3)

**Hint:** Due to H – bonding  $\text{NH}_3$  has higher boiling point than expected

**Sol.:**

| Hydride           | $\text{NH}_3$ | $\text{SbH}_3$ | $\text{AsH}_3$ | $\text{PH}_3$ |
|-------------------|---------------|----------------|----------------|---------------|
| Boiling point (K) | 238.5         | 254.6          | 210.6          | 185.5         |

85. Answer (3)

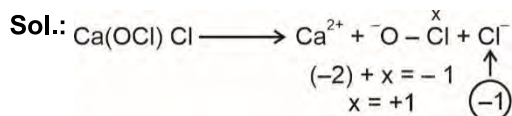
**Hint:** Molarity of water is the moles of  $\text{H}_2\text{O}$  present in 1 L of water

$$\text{Sol.} \quad \text{Molarity (M)} = \frac{n_{\text{H}_2\text{O}}}{V(\text{L})} = \frac{\left(\frac{1000 \times 1}{18}\right)}{1} = 55.55 \text{ M}$$

## SECTION-B

86. Answer (4)

**Hint:**  $\text{CaOCl}_2 : \text{Ca}(\text{OCl})\text{Cl}$



87. Answer (3)

**Hint:** In standard state  $\Delta_f H^\circ$  of elements in their reference state or most stable allotropic form is zero

**Sol.:**

- Reference state of Hydrogen is  $\text{H}_2$  (g)
- Reference state of Chlorine is  $\text{Cl}_2$  (g)
- Most stable allotrope of carbon is graphite

- Most stable allotrope of Sulphur is rhombic sulphur

88. Answer (2)

**Hint:** Salt of weak acid and weak base undergoes cationic and anionic salt hydrolysis.

**Sol.:**

- $K_2SO_4$  : Salt of strong acid ( $H_2SO_4$ ) and strong base (KOH)
- $NH_4CN$  : Salt of weak acid (HCN) and weak base ( $NH_4OH$ )
- $CH_3COONa$  : Salt of weak acid ( $CH_3COOH$ ) and strong base (NaOH)
- $NH_4Cl$  : Salt of strong acid (HCl) and weak base ( $NH_4OH$ )

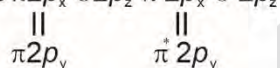
89. Answer (4)

**Hint:** Due to deficiency of vitamin  $B_2$ , fissuring at corners of mouth and lips take place

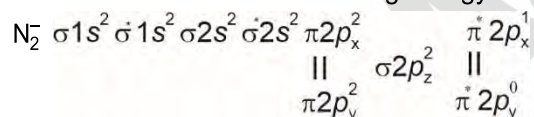
**Sol.:** Due to deficiency of vitamin  $B_2$  (Riboflavin), cheilosis (fissuring at corners of mouth and lips) diseases is caused

90. Answer (1)

**Hint:** Molecular orbital increasing energy order for  $N_2$



**Sol.:** Molecular orbital increasing energy order for  $N_2$

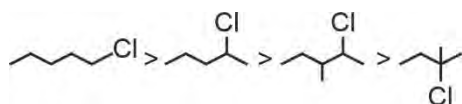


$$\text{Bond order} = \frac{N_b - N_a}{2} = \frac{10 - 5}{2} = 2.5$$

91. Answer (4)

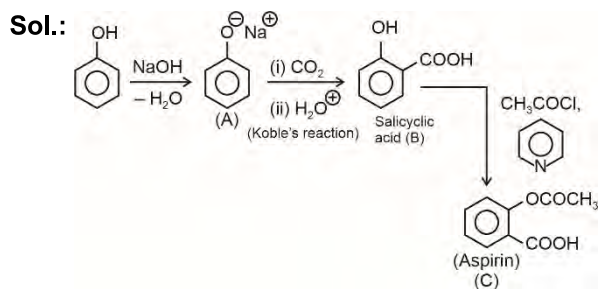
**Hint:** Lesser the steric crowding on halide carbon, more will be the rate of  $S_N2$  reactions

**Sol.:** Order for rate of  $S_N2$  reactions



92. Answer (3)

**Hint:** Alcohols undergo acetylation on reaction with acetyl chloride in presence of a base



93. Answer (1)

**Hint:** In 13<sup>th</sup> group inert pair effect take place

**Sol.:** Due to inert pair effect. In 13<sup>th</sup> group, Tl shows predominantly +1 oxidation state

94. Answer (3)

**Hint:** Osmotic pressure method is used to determine the molar masses of macromolecules

**Sol.:** Higher the  $K_H$  value for a gas, lower will be the solubility of gas in a liquid.

$$K_H = \frac{(p_{\text{gas}}) \text{ atmosphere}}{(X_{\text{gas}}) \text{ solution}}$$

95. Answer (2)

**Hint:** Species having no unpaired electron are diamagnetic in nature

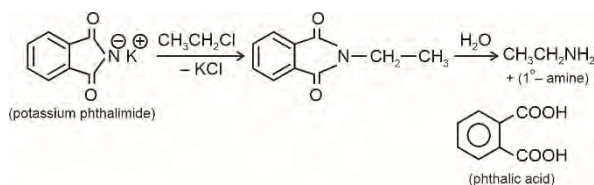
**Sol.:**

- Ferrimagnetic substance : Which posses very small net magnetic moment even though they have very large number of unpaired electrons. eg:  $MgFe_2O_4$
- Ferromagnetic substance : Which shows permanent magnetism even in the absence of external magnetic field eg :  $CrO_2$
- Antiferromagnetic substance : Which have zero net dipole moment even though they have large number of unpaired electrons eg :  $MnO$
- Diamagnetic substance : Which are weakly repelled by external magnetic field. eg :  $NaCl$

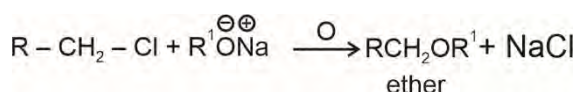
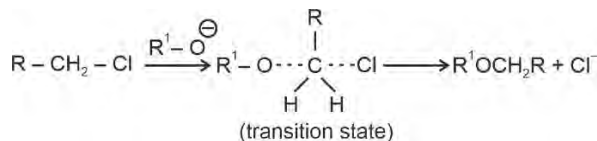
96. Answer (4)

**Hint:** Gabriel phthalimide reaction is used for the preparation of 1<sup>o</sup> – aliphatic amines

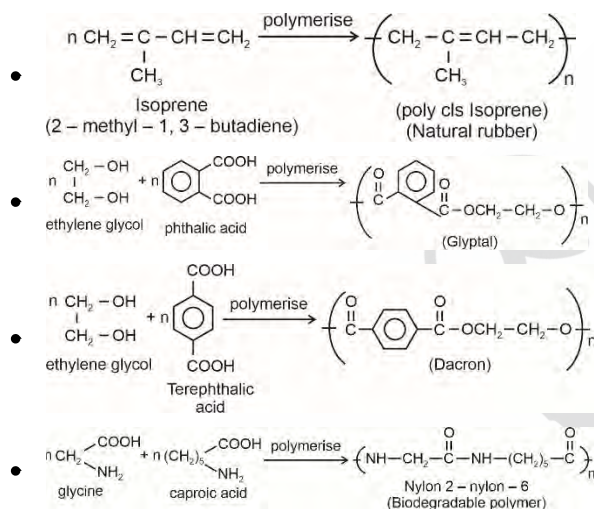
**Sol.:**



97. Answer (3)

**Hint:** Williamson synthesis :**Sol.:** Williamson synthesis : ( $S_N2$  pathway)

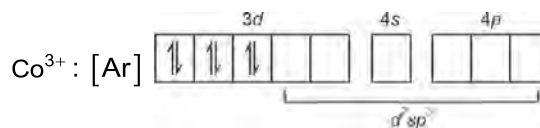
98. Answer (2)

**Hint:** Dacron is a polymer of ethylene glycol and terephthalic acid**Sol.:**

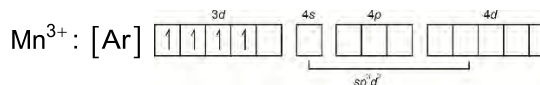
99. Answer (1)

**Hint:**  $[\text{Co}(\text{NH}_3)_6]^{3+}$  and  $[\text{Mn}(\text{CN})_6]^{3-}$  form inner orbital complexes**Sol.:**

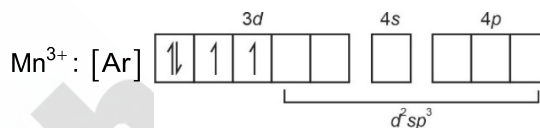
- $[\text{Co}(\text{NH}_3)_6]^{3+}$  :  $d^2sp^3$  hybridised, diamagnetic, zero unpaired electron



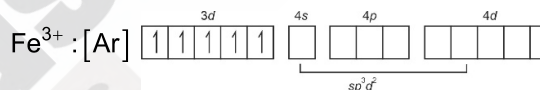
- $[\text{MnCl}_6]^{3-}$  :  $sp^3d^2$  hybridised, paramagnetic four unpaired electrons



- $[\text{Mn}(\text{CN})_6]^{3-}$  :  $d^2sp^3$  hybridised, paramagnetic, two unpaired electrons



- $[\text{FeF}_6]^{3-}$  :  $sp^3d^2$  hybridised, paramagnetic, five unpaired electron



100. Answer (2)

**Hint:** All irreversible process are spontaneous process**Sol.:** Third law of thermodynamics : the entropy of any pure crystalline substance approaches zero as the temperature approaches to absolute zero.

## [BOTANY]

### SECTION-A

101. Answer (4)

**Hint:** Polymorphism is the ability of an organelle to change shape and size according to its contents and functions.**Sol.:** Lysosomes are small spherical membrane bound structures rich in hydrolytic enzymes and are polymorphic in nature.

102. Answer (2)

**Hint:** When a flower can be divided into two equal halves in any radial plane passing through the centre then, it is known as actinomorphic. For examples, mustard, *Datura*, chilli etc.**Sol.:** Pea flower shows bilateral symmetry i.e., it can be divided into two similar halves only in one particular vertical plane.

103. Answer (3)

**Hint:** De-differentiation is conversion of functionally specialised primary permanent tissue into actively dividing secondary meristematic tissue.**Sol.:**

- Intrafascicular cambium is primary meristem already present within vascular bundle of dicot stem.

- Interfascicular cambium is formed due to de-differentiation of cells of medullary rays.
- Vascular fascicular cambium in dicot roots is formed due to de-differentiation of pericycle cells and conjunctive tissue.
- Cork cambium in dicot stem is formed due to de-differentiation of cells of cortex.

104. Answer (3)

**Hint:** For a fully turgid cell, TP is maximum and DPD is 0.

**Sol.:**  $DPD = OP - TP$

For a fully turgid cell,  $DPD = 0$

$\therefore OP = TP$

$DPD = -\psi_w$

For a fully turgid cell,  $\psi_w = 0$

105. Answer (1)

**Hint:** Botanical gardens have collections of living plants for reference.

**Sol.:** Herbarium serves as quick referral system. Keys are analytical in nature.

106. Answer (2)

**Hint:** Interphase of cell cycle is divided into  $G_1$  phase, S phase and  $G_2$  phase.

S-phase is phase of DNA replication.

**Sol.:**  $G_1$  phase is the interval between mitosis and initiation of DNA replication.

$G_2$  phase is phase of final preparation involving duplication of cell organelles like mitochondria, chloroplast and golgi complex and synthesis of tubulin proteins.

In  $G_0$  phase or quiescent phase, cells remain metabolically active but no longer proliferate.

107. Answer (1)

**Hint:** Synapsis or pairing of homologous chromosomes occurs during zygotene stage.

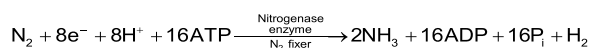
**Sol.:** Pachytene shows crossing over and recombination.

- Diplotene shows dissolution of synaptonemal complex.
- Diakinesis shows terminalisation of chiasmata and transition to metaphase-I.

108. Answer (2)

**Hint:** Biological fixation of one molecule of nitrogen yields two molecules of  $NH_3$ .

**Sol.:**



Synthesis of  $2NH_3$  molecules require 16 ATP, thus, 8 ATP per  $NH_3$  molecule are required during  $N_2$ -fixation.

109. Answer (1)

**Hint:** *Gracilaria* and *Gelidium* are members of red algae.

**Sol.:** Red tide of sea is caused due to rapid proliferation of dinoflagellate *Gonyaulax*.

110. Answer (2)

**Hint:** Triple fusion and double fertilisation is a unique feature of angiosperms.

**Sol.:** *Pinus* is a gymnosperm

*Fucus* is a brown alga

*Rhizopus* is a fungus

*Ficus* is an angiosperm

111. Answer (4)

**Hint:** Energy of ATP is used during activation phase of glycolysis.

**Sol.:** Water is released during conversion of 2-PGA into PEP and ATP is formed during conversion of PEP into pyruvate.

During the conversion of 3 PGAL to 1, 3-BPGA, two redox equivalents are removed.

112. Answer (1)

**Hint:** Weeds are unwanted plants. Auxin is used as weedicide.

**Sol.:** 2, 4-D is the most widely used weedicide. ABA is stress hormone and gibberellins help in breaking seed dormancy.

113. Answer (4)

**Hint:** Perennial plants have life span of more than 2 years and monocarpic plants show flowering and fruiting once in their entire life span and do not show interflowering or recovery phase.

**Sol.:** Wheat is an annual and monocarpic plant. *Strobilanthus* is perennial and monocarpic plant.

Grapevine and apple are polycarpic plants.

114. Answer (4)

**Hint:** Locules are the chambers in ovary.

**Sol.:** Megasporangium in angiosperms is ovule.

- The point of attachment of funicle and ovule is hilum.
- Cells filled inside the ovule forming its main body are nucellus.
- Basal part of ovule opposite to micropylar end is chalaza.

115. Answer (2)

**Hint:** RNA polymerase I synthesises 5.8S, 18S and 28S rRNA.

RNA polymerase III synthesises tRNA, snRNA, ScRNA and 5S rRNA.

**Sol.:** RNA polymerase II synthesises hnRNA.

RNA primase synthesises short stretches of RNA primers.

116. Answer (1)

**Hint:** *Saccharum barberi* has poor yield of sugar.

**Sol.:** Sonalika is high yielding variety of wheat.

117. Answer (2)

**Hint:** Haplodiploid method of sex determination is seen in some insects.

**Sol.:** Grasshopper shows (XX-XO) type of sex determination.

Fruit fly shows (XX-XY) type of sex determination.

Butterfly shows (ZO-ZZ) type of sex determination.

Male honey bees are haploid and female and worker bees are diploid.

118. Answer (2)

**Hint:** Mutualism is '+, +' obligate interaction.

**Sol.:** Protocooperation is mutually beneficial, non-obligate interaction i.e. interacting partners can survive without each other.

Commensalism is '+, 0' and ammensalism is '-, 0' interaction.

119. Answer (1)

**Hint:** Anthropogenic ecosystem possesses simple food chain, little diversity and high productivity.

**Sol.:** Self-regulatory mechanism is a feature of natural ecosystem.

120. Answer (1)

**Hint:** GPP is gross primary productivity

**Sol.:**  $NPP = GPP - R$

Where, R is respiratory losses.

121. Answer (1)

**Hint:** Bergmann's rule states that warm blooded animals (birds and mammals) have larger body size in cold climate than in hotter areas.

**Sol.:** Rensch's rule states that, in colder climate, birds possess narrow and acuminate wings as compared to broader wings of birds found in warmer areas.

Jordan's rule states that as the temperature is lowered, some fishes possess larger size with larger number of vertebrae.

According to Allen's rule, mammals from colder climate generally have shorter ears and limbs to minimise heat loss.

122. Answer (3)

**Hint:** Fruit of family Liliaceae is generally capsule, rarely berry.

**Sol.:** Tulip is the ornamental plant of family Liliaceae.

123. Answer (2)

**Hint:** Axial flower is dominant trait over terminal flower in pea.

**Sol.:**

| (Axial Flower) |    | (Terminal Flower) |    |
|----------------|----|-------------------|----|
| Aa             |    | x                 | aa |
|                |    | ↓                 |    |
| A              |    | a                 |    |
| a              | Aa | aa                |    |
| a              | Aa | aa                |    |

50% plants are Aa (axial flowers)

and 50% plants are aa (terminal flowers)

124. Answer (1)

**Hint:** CO<sub>2</sub> is already in limiting conditions in atmosphere.

**Sol.:** Dark reactions are temperature controlled because of the enzyme RuBisCO.

C<sub>3</sub> plants respond to low CO<sub>2</sub> concentration by showing decreased rates of photosynthesis.

125. Answer (3)

**Hint:** In the absence of essential elements the plants do not complete their life cycle or set the seeds.

**Sol.:** Essential elements must be directly involved in the metabolism of plant. These are specific and not replaceable by another element.

126. Answer (1)

**Hint:** Catalytic converters convert unburnt hydrocarbons into CO<sub>2</sub> and H<sub>2</sub>O, and CO and NO<sub>x</sub> are converted into CO<sub>2</sub> and N<sub>2</sub> respectively.

**Sol.:** A scrubber can remove gases like sulphur dioxide.

Electrostatic precipitator can remove 99% particulate matter present in the exhaust from a thermal power plant.

127. Answer (3)

**Hint:** Biomagnification happens because a toxic substance accumulated by an organism cannot be metabolised or excreted, and is thus passed on to the next higher trophic level.

**Sol.:** Biomagnification of DDT in aquatic food chain disturbs calcium metabolism in birds, which causes thinning of eggshell and their premature breaking, eventually decline in birds population.

128. Answer (4)

**Hint:** When a non-native or alien species is introduced unintentionally or deliberately for whatever purpose, turn invasive and cause decline or extinction of indigenous species, then this is known as alien species invasion.

**Sol.:** When any species is overharvested, overexploited, endangering its continued existence then it is termed as overexploitation. Steller's sea cow and passenger pigeon became extinct due to over-exploitation.

129. Answer (3)

**Hint:** The Earth Summit and the World Summit are Conventions of Biodiversity.

**Sol.:** Chipko Movement of Garhwal Himalayas, 1974 was to protect trees.

Montreal protocol was signed to control the emission of ozone depleting substances.

130. Answer (1)

**Hint:** Heterosporous species produce two different types of spores, large female megaspore and small male microspore.

**Sol.:** Majority of pteridophytes are homosporous while few are heterosporous like *Selaginella*, *Salvinia* etc.

131. Answer (4)

**Hint:** Nectar is a reward to pollinators.

**Sol.:** Wind pollinated flowers are not dependent on pollinators. They use wind as agent, thus, they are colourless, odourless and nectarless.

Presence of nectaries is a feature of insect pollinated flowers.

132. Answer (2)

**Hint:** Sickle cell anaemia is autosomal recessive disorder, thus, individuals with genotype  $Hb^S Hb^S$  are affected.

**Sol.:** It is caused by transversion mutation and is controlled by a single pair of alleles.

133. Answer (1)

**Hint:** Most abundant bacteria are heterotrophic (saprophytic) in nature.

**Sol.:** Heterotrophic bacteria are incapable of synthesising their own food and are helpful in making curd from milk, production of antibiotics and fixing nitrogen.

134. Answer (2)

**Hint:** Cellulose is present in cell wall of green plants.

**Sol.:** Phaeophyceae have reserve food in the form of laminarin or mannitol.

135. Answer (3)

**Hint:** PS I or  $P_{700}$  is found in both grana and stroma lamellae and its reaction centre, chlorophyll *a*, has an absorption peak at 700 nm.

**Sol.:** PS II is associated with splitting of water also termed as (OEC) oxygen evolving complex.

PS I is associated in both cyclic and non-cyclic photophosphorylation.

### SECTION-B

136. Answer (1)

**Hint:** RER helps in protein synthesis and SER is involved in lipid or steroid synthesis.

**Sol.:** Mitochondria are responsible for ATP synthesis by oxidative phosphorylation and nucleolus is the site of rRNA synthesis.

137. Answer (3)

**Hint:** Crossing over and recombination occur during pachytene stage.

**Sol.:** Recombinase enzyme helps in exchange of genetic material between non-sister chromatids of homologous chromosomes, that occur during pachytene stage of meiosis-I.

- Leptotene shows initiation of condensation of chromatin material.
- Zygotene shows pairing of homologous chromosomes.
- Diplotene shows dissolution of synaptonemal complex.

138. Answer (2)

**Hint:** Direct form of energy is obtained through (SLP) substrate level phosphorylation.

**Sol.:** Sucrose is converted into glucose and fructose and these monosaccharides enter the glycolytic pathway and each hexose forms 4 ATP via SLP.

139. Answer (2)

**Hint:** Morphologically distinct types of gametes are known as heterogametes.

**Sol.:** *Cladophora*, *Ulothrix* and *Rhizopus* produce isogametes. *Chara*, *Fucus* and *Marchantia* produce heterogametes.

140. Answer (1)

**Hint:** Photoperiodism is the response shown by plants to change in the relative length of light and dark duration for flowering. Its receptor is a blue green coloured pigment, phytochrome, present in leaves.

**Sol.:** Leaves are sites of perception of light/dark duration for flowering in plants.

Shoot apices are sites of perception of vernalisation.

141. Answer (3)

**Hint:** Geitonogamy is the transfer of pollen grains from anther to the stigma of another flower of the same plant.

It is functionally cross pollination but genetically self pollination.

**Sol.:** Cleistogamy is production of closed flowers, which never open at all thus can perform autogamy only.

142. Answer (4)

**Hint:** Predation is +, 0 interaction where one partner is benefited (predator) and other is harmed (prey).

**Sol.:** Predators transfer energy across trophic levels, keep prey population under control and maintain species diversity in a community. Predators in nature are 'prudent'.

143. Answer (4)

**Hint:** Prions are infectious proteinaceous particles.

**Sol.:** Prions are infectious abnormally folded proteins, similar in size to viruses. They do not have DNA or RNA.

144. Answer (4)

**Hint:** Capping and tailing are modification of 5' & 3' ends of hnRNA respectively during post-transcriptional modification.

**Sol.:** Splicing is removal of introns and joining of exons.

Aminoacylation is an event in translation when amino acid is transferred to tRNA.

145. Answer (2)

**Hint:** Pyramid of biomass is upright in terrestrial ecosystem and inverted in aquatic ecosystem.

**Sol.:** 10% law of energy transfer shows gradual loss of energy, thus energy is maximum at producer level and minimum at top carnivore level.

This justifies that pyramid of energy is always upright.

146. Answer (1)

**Hint:** Phosphorous cycle and nitrogen cycle are sedimentary and gaseous cycle respectively.

**Sol.:** Grasses are producers. Lichens are pioneer communities.

147. Answer (3)

**Hint:** FADH<sub>2</sub> is produced during respiration.

**Sol.:** Non-cyclic photophosphorylation involves PS II, which is (OEC) oxygen evolving complex. Thus, it results in production of NADPH, ATP and O<sub>2</sub>.

148. Answer (1)

**Hint:** In monocot stems, atactostele is present i.e., vascular bundles are scattered in ground tissue.

**Sol.:** In monocot stems, vascular bundles are conjoint, collateral and closed. They are scattered in ground tissue.

They usually lack phloem parenchyma and have water containing cavities.

In dicot stems, vascular bundles are conjoint, collateral, open and arranged in a ring. Such condition is known as eustele.

149. Answer (1)

**Hint:** Osmosis is movement of water molecules or solvent molecules from its high concentration to low concentration across semi-permeable or selectively permeable membrane.

**Sol.:** Imbibition is a special type of diffusion by which water loving (hydrophilic) solids absorb solvents.

Guttation is loss of water in the form of droplets from opening of vein endings.

150. Answer (3)

**Hint:** Statins produced by yeast *Monascus purpureus* is a blood cholesterol lowering agent.

**Sol.:** *Streptococcus* produces streptokinase which is used as clot buster.

- Fungus *Trichoderma polysporum* produces cyclosporin A which is used as immunosuppressive agent.

- Fungus *Aspergillus niger* produces citric acid.

**[ZOOLOGY]****SECTION-A**

151. Answer (3)

**Hint:** Inulin is a polymer of fructose.**Sol.:** Physiologic value of fats is 9.0 kcal/g.

Gross calorific value of proteins is 5.65 kcal/g.

Inulin is a carbohydrate.

Castle's intrinsic factor is essential for the absorption of vitamin B<sub>12</sub>.

152. Answer (3)

**Hint:** Blood group antigens are absent**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             |

153. Answer (4)

**Hint:** *Oryza sativa***Sol.:** Bees are pollinating agents of crops like sunflower, *Brassica*, apple, pear, etc.

Rice, wheat, maize, etc., are wind pollinated plants.

154. Answer (3)

**Hint:** *Salamandra***Sol.:** The body of amphibians is divisible into head and trunk. Tail may be present in some.

155. Answer (2)

**Hint:** Q is secreted by parathyroid glands.**Sol.:** PTH (parathormone) is a hypercalcemic hormone and TCT (thyrocalcitonin) is a hypocalcemic hormone. TCT is secreted by the thyroid gland. TCT and PTH play a significant role in calcium balance in the body.

156. Answer (2)

**Hint:** Hydrolases**Sol.:** Enzymes are divided into 6 classes each with 4-13 subclasses.

The 6 classes are as follows-

- (a) Oxidoreductases – Succinic dehydrogenase
- (b) Transferases – Transaminases
- (c) Hydrolases – Nucleases, amylases
- (d) Lyases – Carbonic anhydrase
- (e) Isomerases – Isomerases

(f) Ligases – DNA ligases

157. Answer (3)

**Hint:** Cardiac muscle tissue is striated and involuntary.**Sol.:** Smooth muscle fibres are fusiform and do not show striations. Smooth muscles are involuntary in nature as their functioning cannot be directly controlled.

Cardiac muscle shows striations but is involuntary.

This shows that presence or absence of striations do not determine if the muscle is voluntary or not.

158. Answer (3)

**Hint:** Primates show menstrual cycle.**Sol.:** Non-primate mammals like cows, sheep, rats, deers, dogs, tiger, etc., show the oestrus cycle.

Primates like monkeys, apes and humans show the menstrual cycle.

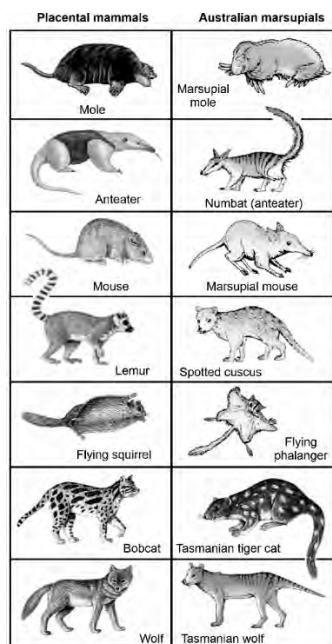
159. Answer (3)

**Hint:** Emphysema is caused due to cigarette smoking.**Sol.:** Memory-based acquired immunity evolved in higher vertebrates.

Rheumatoid arthritis is one of the many auto-immune diseases that affects many people in our society. In auto immune disorders, the body attacks self-cells.

160. Answer (1)

**Hint:** Placental mammals and Australian marsupials show convergent evolution.**Sol.:**



161. Answer (2)

**Hint:** EC = 1500 – 1600 mL**Sol.:** TV ≈ 500 mL

IRV ≈ 2500 mL to 3000 mL

ERV ≈ 1000 mL to 1100 mL

RV ≈ 1100 mL to 1200 mL

IC ≈ 3000 mL to 3500 mL

EC ≈ 1500 mL to 1600 mL

FRC ≈ 2100 mL to 2300 mL

VC ≈ 4000 mL to 4600 mL

TLC ≈ 5100 mL to 5800 mL

162. Answer (4)

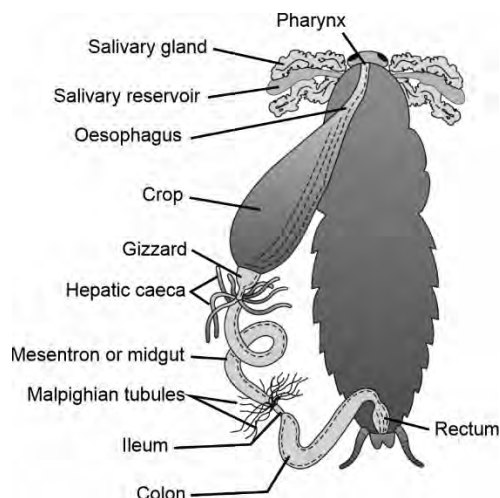
**Hint:** Thin watery fluid

**Sol.:** Aqueous humor is a watery fluid present in aqueous chamber, which is present in between cornea and lens. The space between the lens and retina is called vitreous chamber and is filled with a transparent gel called vitreous humor.

163. Answer (1)

**Hint:** Sac-like structure is called crop.

**Sol.:** The foregut of cockroach is made of mouth, pharynx, oesophagus, crop and gizzard.



164. Answer (4)

**Hint:** Also known as gene gun

**Sol.:** In plants, cells are bombarded with high velocity micro-particles of gold/ tungsten coated with DNA in a method called biolistics/gene gun.

In micro-injection, rDNA is directly injected into the nucleus of an animal cell.

The separated bands of DNA are cut out from the agarose gel and extracted from the gel piece. This step is known as elution.

165. Answer (2)

**Hint:** Absence of menstrual cycle

**Sol.:** In human females, menstrual cycle ceases around 50 years of age, which is termed as menopause.

A post-menopausal woman has low levels of oestrogen in blood.

166. Answer (1)

**Hint:** Diabetes insipidus

**Sol.:** ADH is also known as vasopressin. It facilitates water reabsorption from later parts of the renal tubules. Its deficiency causes diabetes insipidus.

Presence of glucose (glycosuria) and ketone bodies (ketonuria) in urine are indicative of diabetes mellitus.

Liver is the largest gland of our body.

Urine analysis is a conventional method of diagnosis of diseases.

167. Answer (3)

**Hint:** *Balanoglossus*

**Sol.:** *Balanoglossus* belongs to the phylum Hemichordata. Proboscis gland is its excretory organ.

An excretory system is absent in echinoderms.

168. Answer (4)

**Hint:** Fungal disease

**Sol.:** Many fungi belonging to the genera *Microsporum*, *Trichophyton* and *Epidermophyton* are responsible for ringworms which is one of the most common infectious diseases in man.

169. Answer (1)

**Hint:** Cardiac output = Heart rate  $\times$  stroke volume

**Sol.:** If the cardiac output is 5.6 L and the heart rate is 63 beats per minute, then

$$\text{Stroke volume} = \frac{5600}{63}$$

$$= 88.88 \text{ mL}$$

$$\approx 89 \text{ mL}$$

170. Answer (3)

**Hint:** Exhibits tertiary structure

**Sol.:** Haemoglobin is the red coloured respiratory pigment present in erythrocytes. Myoglobin is the red coloured pigment present in red muscle fibres. Anthocyanin is a plant pigment. Niacin is vitamin B<sub>3</sub> complex.

171. Answer (3)

**Hint:** Based on antigen-antibody interaction

**Sol.:** ELISA (Enzyme Linked Immuno Sorbent Assay) is a non-conventional diagnostic procedure based on antigen-antibody interaction. It serves the purpose of early diagnosis.

172. Answer (3)

**Hint:** Domesticated fowl

**Sol.:**

Leghorn is an improved breed of chicken used for their eggs.

Dairying is the management of animals for milk and its products for human consumption.

173. Answer (2)

**Hint:** Facial bone

**Sol.:** Cranial bones

Paired – Parietal and temporal

Unpaired bones – Frontal, occipital, sphenoid, ethmoid

**Facial bones**

Paired bones – Nasal, maxilla, zygomatic, lacrimal, palatine, inferior nasal conchae

Unpaired bones – Vomer, mandible

174. Answer (4)

**Hint:** Found in ANS

**Sol.:** Myelinated nerve fibres have a myelin sheath around their axons. The myelin sheath of myelinated nerve fibres in CNS is made up of oligodendrocytes, whereas, the myelin sheath of myelinated nerve fibres in PNS is made up of Schwann cells.

Unmyelinated nerve fibre is enclosed by a Schwann cell that does not form a myelin sheath around the axon.

175. Answer (4)

**Hint:** Duct from gall bladder is the cystic duct.

**Sol.:** Bile is secreted by the hepatic cells. It is stored and concentrated in the gall bladder.

Common hepatic duct joins the cystic duct to form the common bile duct. This common bile duct joins the pancreatic duct to form hepato-pancreatic duct.

Bile is hence carried by common hepatic duct, cystic duct, common bile duct as well as hepato-pancreatic duct.

176. Answer (3)

**Hint:** Lichens do not grow in polluted areas

**Sol.:** During pre-industrialisation, the air was not polluted, hence, tree trunks were covered by lichen which provided camouflage to the white-winged moths. This worked in favour of the white-winged moths and their number was higher than the dark-winged moths as the predators spotted the dark-winged moths easily.

The conditions reversed post-industrialisation and the soot covered trees were now a camouflage for dark-winged moths, whereas the predators easily spotted the white-winged moths.

This scenario is an apt example of natural selection.

177. Answer (1)

**Hint:** 200 mL/minute

**Sol.:** Our lungs remove large amounts of CO<sub>2</sub> (approximately 200 mL/minute).

$$\therefore 1 \text{ day} = 1440 \text{ minutes}$$

$$\therefore \text{In one day lungs remove } 288 \text{ L of CO}_2 \text{ by an adult man under normal physiological conditions.}$$

178. Answer (4)

**Hint:** Parthenogenesis

**Sol.:** The process in which the female gamete (egg) undergoes development to form new organisms without fertilisation is called parthenogenesis.

Organisms like rotifers, honeybees, some lizards and birds like Turkey show parthenogenesis.

179. Answer (2)

**Hint:** Exclude opioids

**Sol.:** Morphine, heroin (smack) are depressants and slow down the body functions while cocaine also known as crack or coke is a stimulant.

180. Answer (4)

**Hint:** TLC is increased

**Sol.:** Emphysema is a chronic disorder in which alveolar walls are damaged due to which respiratory surface is decreased. One of the major causes of this is cigarette smoking. In emphysema, FRC as well as TLC increase.

181. Answer (2)

**Hint:** Testosterone is a steroid hormone

**Sol.:** Cell membrane according to the fluid mosaic model has a lipid bilayer. It allows lipophilic substances to pass through the cell. Testosterone is a steroid hormone, it passes through the cell membrane and it has intracellular receptors.

182. Answer (2)

**Hint:** Male sex accessory ducts

**Sol.:** The male sex accessory ducts include rete testis, vasa efferentia, epididymis and vas deferens. Vas deferens receives a duct from seminal vesicle and opens into urethra as the ejaculatory duct.

The male sex accessory ducts carry the fraction of semen without the fluids secreted by male accessory glands.

183. Answer (2)

**Hint:** Arthropods

**Sol.:** Exoskeleton of arthropods is made up of chitin. In chitin, the basic unit is a nitrogen containing glucose derivative known as N-acetyl glucosamine.

184. Answer (4)

**Hint:** Cyclostome

**Sol.:** All living members of the class Cyclostomata are ectoparasites on some fishes. They have an elongated body bearing 6-15 pairs of gill slits for respiration. Cyclostomes have a sucking and circular mouth without jaws. Their body is devoid of scales and paired fins. Cranium and vertebral column are cartilaginous. Circulation is of closed type. Cyclostomes are marine but migrate for spawning to fresh water. After spawning, within a few days, they die. Their larvae, after metamorphosis, return to the ocean.

185. Answer (2)

**Hint:** Includes curcumin

**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         |

### SECTION-B

186. Answer (3)

**Hint:** Hormone-secreting cells

**Sol.:** Crypts of Lieberkuhn have epithelial cells which secrete mucus, Paneth cells which secrete digestive enzymes and Argentaffin cells which probably secrete hormones.

Plexus of Auerbach or Myenteric plexus consists of fibre from both autonomic divisions and mostly controls the peristaltic movements in alimentary canal.

187. Answer (1)

**Hint:** Structure where sperms are stored in female

**Sol.:** Phallic gland, ejaculatory duct and titillator are reproductive structures found in the male cockroach.

The female cockroach has a pair of spermatheca which opens into the genital chamber. The spermathecae store the sperms inside the female post copulation and prior to fertilisation.

188. Answer (1)

**Hint:** Common passage for food and air

**Sol.:** Compound epithelium is made up of more than one layer of cells and involved in providing protection. They cover the dry surface of skin, moist surface of buccal cavity, pharynx, etc.

Squamous epithelium is present in air sacs of lungs, cuboidal epithelium is present in proximal convoluted tubule and columnar epithelium lines the intestine.

189. Answer (3)

**Hint:** 1 to 1.5 litre urine excreted per day

**Sol.:** An adult human excretes, on an average 1 to 1.5 litres of urine per day that contains 25-30 gms of urea.

190. Answer (1)

**Hint:** Not conducting any impulse

**Sol.:** The electrical potential difference across the resting plasma membrane is called the resting potential.

191. Answer (1)

**Hint:** Acts as vector of diseases

**Sol.:** *Aedes* – Transmits chikungunya

*Bombyx* – Sericulture

*Limulus* – Living fossil

*Laccifer* – Lac insect

192. Answer (2)

**Hint:** Surrogate mothers do not contribute to the genotype of the progeny.

**Sol.:** The superior cow is given FSH-like hormone and is made to superovulate, i.e., produce 6-8 eggs in one ovulation. This cow is either mated with an elite bull or artificially inseminated. The fertilised eggs at 8-32 cells stages are recovered non-surgically and transferred to surrogate mothers.

The genetic information only comes from the mother who provided the egg.

193. Answer (3)

**Hint:** *Dryopithecus* was common ancestor of man and ape.

**Sol.:** About 15 mya, primates called *Dryopithecus* and *Ramapithecus* were existing. They were hairy and walked like gorillas and chimpanzees.

*Ramapithecus* was more man-like while *Dryopithecus* was more ape-like.

194. Answer (4)

**Hint:** Normal cells have cellular oncogenes

**Sol.:** Cancer causing viruses called oncogenic viruses have genes called viral oncogenes. Several genes called cellular oncogenes (c-onc) or proto oncogenes have been identified in normal cells which, when activated under certain conditions, could lead to oncogenic transformation of the cells.

195. Answer (1)

**Hint:** Inability to conceive

**Sol.:** Inability to conceive or produce children even after 2 years of unprotected sexual cohabitation is called infertility. The reasons for this could be physical, congenital, diseases, drugs, immunological or even psychological.

196. Answer (2)

**Hint:** Functional unit between foetus and maternal body

**Sol.:** Placenta and corpus luteum are two temporary endocrine tissues formed in women.

197. Answer (4)

**Hint:** Caused due to allergy as well

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

Silicosis and asbestosis are examples of occupational respiratory disorders. Anthrax is a bacterial disease.

198. Answer (3)

**Hint:** Isolated from *Escherichia coli*

**Sol.:**

| Enzyme   | Microbial origin                  | Recognition site                       | Type of ends after restriction enzyme digestion |
|----------|-----------------------------------|----------------------------------------|-------------------------------------------------|
| Bam HI   | <i>Bacillus amyloliquefaciens</i> | 5'-G↓G-A-T-C-C-3'<br>3'-C-C-T-A-G-G-5' | Sticky ends                                     |
| Eco RI   | <i>Escherichia coli</i>           | 5'-G↓A-A-T-T-C-3'<br>3'-C-T-T-A-A-G-5' | Sticky ends                                     |
| Hind III | <i>Haemophilus influenzae</i>     | 5'-A-A-G-C-T-T-3'<br>3'-T-T-C-G-A-A-5' | Sticky ends                                     |
| Pst I    | <i>Providencia stuartii</i>       | 5'-C-T-G-C-A-G-3'<br>3'-G-A-C-G-T-C-5' | Sticky ends                                     |
| Sal I    | <i>Streptomyces albus</i>         | 5'-G↓T-C-G-A-C-3'<br>3'-C-A-G-C-T-G-5' | Sticky ends                                     |
| Sma I    | <i>Serratia marcescens</i>        | 5'-C-C-C↓G-G-3'<br>3'-G-G-G-C-C-5'     | Blunt ends                                      |

199. Answer (1)

**Hint:** *Bacillus thuringiensis* is an insecticidal bacteria

**Sol.:** Bioremediation is the use of microorganism's metabolism to remove pollutants.

*Pseudomonas putida* or super bug was developed by A. M. Chakravorty and is used for clearing oil spills.

200. Answer (3)

**Hint:** Brain capacity has 650-800 cc.

**Sol.:** The first human-like being the hominid was called *Homo habilis*. The brain capacity was between 650-800 cc. They probably did not ate meat.



## All India Aakash Test Series for NEET - 2023

**OPEN MOCK TEST - 2 (Code-B)**

Test Date : 02/04/2023

**ANSWERS**

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

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

1. Answer (4)

**Hint:**  $\frac{1}{\lambda} = R \left[ \frac{1}{n_f^2} - \frac{1}{n_i^2} \right]$

**Sol.:**  $\frac{1}{\lambda_1} = R \left[ \frac{1}{1^2} - \frac{1}{3^2} \right] = \frac{R8}{9} \dots (i)$

$\frac{1}{\lambda_2} = R \left[ \frac{1}{2^2} - \frac{1}{5^2} \right] = \frac{R \times 21}{100} \dots (ii)$

From equation (i) &amp; (ii)

$$\frac{\lambda_2}{\lambda_1} = \frac{8R}{9} \times \frac{100}{21R} = \frac{800}{189}$$

$$\lambda_2 = \frac{800}{189} \lambda_1 = \frac{800}{189} \lambda$$

2. Answer (3)

**Hint & Sol.:**

| A | B | y |
|---|---|---|
| 0 | 0 | 1 |
| 0 | 1 | 1 |
| 1 | 0 | 1 |
| 1 | 1 | 0 |

3. Answer (1)

**Hint:** Effective half life

$$T_{\text{Half}} = \frac{T_{H1} \cdot T_{H2}}{T_{H1} + T_{H2}}$$

**Sol.:**  $T_{\text{Half}} = \frac{640 \times 1920}{640 + 1920} = 480 \text{ h}$

Now  $\frac{N}{N_0} = \frac{1}{8}$

i.e. required time  $t = 3 \times 480$   
 $= 1440 \text{ h}$

4. Answer (2)

**Hint & Sol.:**  $K_{\text{max}} = E - \phi$ 

$$= 10.6 - 5.6$$

$$= 5 \text{ eV}$$

5. **Delete****Hint:** Use Malus law  $I = I_0 \cos^2 \theta$ **Sol.:** Intensity after second polaroid

$$I_2 = I_1 \cos^2 \theta = \frac{I_0}{2} \cos^2 \theta$$

Intensity after third polaroid

$$I_3 = I_2 \cos^2 (90 - \theta)$$

$$= \frac{I_0}{2} \cos^2 \theta \cdot \sin^2 \theta$$

$$\Rightarrow 6 = \frac{64}{2} \cos^2 \theta \cdot \sin^2 \theta = 8 (\sin 2\theta)^2$$

$$\Rightarrow \sin 2\theta = \frac{\sqrt{3}}{2} \Rightarrow \theta = 30^\circ$$

6. Answer (4)

**Hint:** Resultant intensity  $I = I_0 \cos^2(\phi/2)$ 

**Sol.:**  $\Delta\phi = \frac{2\pi}{\lambda} \cdot \Delta x = \frac{2\pi}{\lambda} \times \frac{\lambda}{4}$

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

Now,  $I = I_0 \cos^2(\pi/4)$

$$= 0.5 I_0$$

7. Answer (2)

**Hint:** According to lens maker formula

$$\frac{1}{f} = (\mu - 1) \left[ \frac{1}{R_1} - \frac{1}{R_2} \right]$$

**Sol.:**  $\Rightarrow \frac{1}{30} = \left( \frac{8}{5} - 1 \right) \left[ \frac{1}{R} + \frac{1}{3R} \right]$

$$\Rightarrow \frac{1}{30} = \frac{3}{5} \times \frac{4}{3R}$$

$$\Rightarrow R = 24 \text{ cm}$$

8. Answer (2)

**Hint & Sol.:** Energy received  $E = P \cdot t$ 

$$= 30 \times 60 \times 50$$

$$= 90,000 \text{ J}$$

$$= 90 \text{ kJ}$$

9. Answer (1)

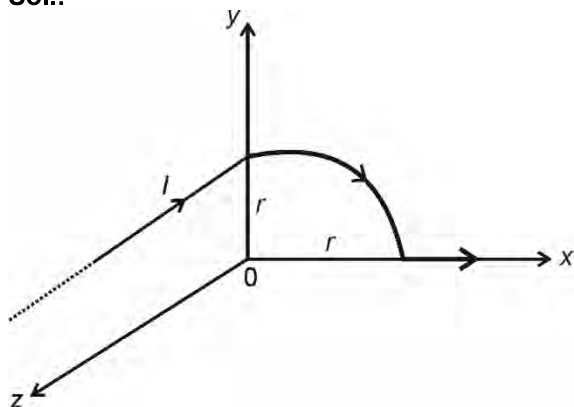
**Hint & Sol.:** According to Faraday's law of electromagnetic induction

$$e \propto \frac{-d\phi}{dt}$$

10. Answer (3)

**Hint:**  $\vec{B}_{\text{net}} = \vec{B}_1 + \vec{B}_2 + \vec{B}_3$

**Sol.:**



$$\vec{B}_1 = \frac{\mu_0 I}{4\pi r} (-\hat{j})$$

$$\vec{B}_2 = \frac{\mu_0 I \pi}{4\pi 2r} (-\hat{k})$$

$$\vec{B}_3 = \text{Zero}$$

$$\text{Hence } \vec{B}_{\text{net}} = -\frac{\mu_0 I}{4r} \left[ \frac{\hat{j}}{\pi} + \frac{\hat{k}}{2} \right]$$

11. Answer (4)

**Hint:** Magnetic field due to a long current carrying

$$\text{wire } B = \frac{\mu_0 2I}{4\pi r}$$

**Sol.:**

$$\vec{B}_{\text{net}} = \vec{B}_1 + \vec{B}_2 = 0 \quad (r \text{ is distance from 4 cm mark})$$

$$\Rightarrow \frac{\mu_0 2 \times 3}{4\pi r} - \frac{\mu_0 2 \times 5}{4\pi (4+r)} = 0$$

$$\Rightarrow \frac{3}{r} = \frac{5}{4+r}$$

$$\Rightarrow r = 6$$

$$\text{Hence } x = -2$$

12. Answer (2)

**Hint:** If out of  $N$  cells in series ' $n$ ' cells are wrongly connected then  $E_{\text{eq}} = (N - 2n)E$ .

**Sol.:** Initially,  $16E = K\ell \dots (i)$

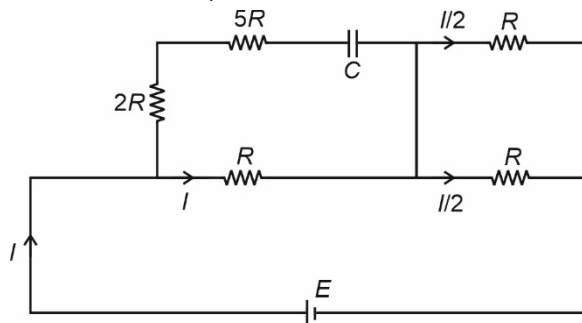
$$\text{Finally, } (16 - 2n)E = \frac{K\ell}{4} \dots (ii)$$

On solving equation (i) & (ii)  $n = 6$

13. Answer (1)

**Hint:** Use KCL & KVL

**Sol.:** Circuit is equivalent to



$$\text{Value of } I = \frac{E}{R_{\text{eq}}} = \frac{2E}{3R}$$

Hence energy stored in capacitor

$$U = \frac{1}{2} CV^2 = \frac{1}{2} \times C \times \frac{4E^2}{9} = \frac{2CE^2}{9}$$

14. Answer (4)

**Hint & Sol.:** Capacitance of a parallel plate capacitor depends on size of plates and nature of medium between the plates.

15. Answer (3)

**Hint:** Electric field  $\vec{E} = -\frac{\partial V}{\partial x} \hat{i} - \frac{\partial V}{\partial y} \hat{j} - \frac{\partial V}{\partial z} \hat{k}$

**Sol.:**  $\vec{E} = -6x\hat{i} - 12y^2\hat{j}$

$$\vec{E}_{\text{at } (1,2,3)} = -6 \times 1 \hat{i} - 12 \times 2^2 \hat{j}$$

$$= -6\hat{i} - 48\hat{j} \text{ N/C}$$

$$\text{Force on 2 C, } \vec{F} = -12\hat{i} - 96\hat{j}$$

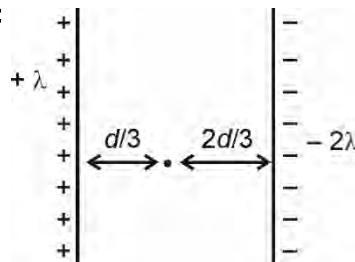
$$|\vec{F}| = 12\sqrt{65} \text{ N}$$

16. Answer (4)

**Hint:** Electric field due to infinite line charge

$$E = \frac{2k\lambda}{r}$$

**Sol.:**



$$\vec{E}_{\text{net}} = \vec{E}_1 + \vec{E}_2$$

$$= \frac{2k\lambda}{(d/3)} + \frac{4k\lambda}{2d/3}$$

$$= \frac{4k\lambda}{d/3} = 4 \times \frac{1 \times 3\lambda}{4\pi\epsilon_0 d} = \frac{3\lambda}{\pi\epsilon_0 d}$$

17. Answer (3)

**Hint:** Speed of transverse pulse  $v = \sqrt{\frac{T}{\mu}}$

$$\text{Sol.: } v = \sqrt{\frac{T}{\mu}} = \sqrt{\frac{\mu y g}{\mu}} = \sqrt{yg}$$

$$v = \sqrt{0.5 \times 10} = \sqrt{5} \text{ m/s}$$

$$= 2.23 \text{ m/s}$$

18. Answer (3)

**Hint & Sol.:** For standing wave, two travelling waves travelling in opposite direction superimpose each other.

19. Answer (4)

**Hint:** Total oscillation energy of harmonic oscillator  $= \frac{1}{2} m \omega^2 A^2$

$$\text{Sol.: } \frac{1}{2} m \omega^2 A^2 = 8$$

$$\Rightarrow \frac{1}{2} \times 4 \times \omega^2 \times \frac{1}{100} = 8$$

$$\omega = \sqrt{400} = 20$$

$$T = \frac{2\pi}{\omega} = \frac{\pi}{10} \text{ second}$$

20. Answer (1)

**Hint & Sol.:** Average translational kinetic energy per mole  $= \frac{3}{2} RT$

21. Answer (1)

**Hint:** For polytropic process  $PV^N = \text{constant}$

$$\text{Sol.: } C_{\text{process}} = C_v + \frac{R}{-N+1}$$

$$C_{\text{process}} = \frac{3}{2}R + \frac{R}{-\frac{3}{2}+1} = -\frac{R}{2}$$

Heat exchanged

$$\Delta Q = n C_{\text{process}} \Delta T$$

$$= 2 \times -\frac{R}{2} \times (-38)$$

$$= 38R$$

22. Answer (3)

**Hint:** For non-isotropic material  $\beta = \alpha_x + \alpha_y$

$$\text{Sol.: } \beta = 5 \times 10^{-6} + 6 \times 10^{-6}$$

$$= 11 \times 10^{-6} / ^\circ\text{C}$$

$$\text{Hence } K = 11$$

23. Answer (2)

**Hint & Sol.:**

- Young's modulus of a body depends only on the nature of material. It doesn't depend on the shape & size of the body.
- Young's modulus, bulk modulus and shear modulus are dimensionally equivalent

$$[K] = [M^1 L^{-1} T^{-2}]$$

24. Answer (1)

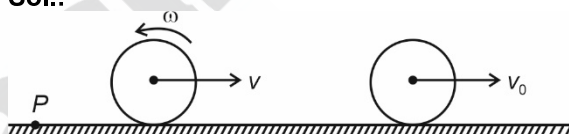
**Hint:** Young's modulus  $Y = \frac{FL}{A \Delta L}$

$$\text{Sol.: } Y = \frac{1000}{10^{-4}} \times \frac{100}{0.2} = 5 \times 10^9 \text{ N/m}^2$$

25. Answer (3)

**Hint:** Apply conservation of angular momentum

**Sol.:**



$$\vec{L}_i \text{ about } P = \vec{L}_f \text{ about } P$$

$$\Rightarrow mvR - I\omega = mv_0R$$

$$\Rightarrow mvR - \frac{2}{5}mR^2 \cdot \frac{v}{R} = mv_0R$$

$$\Rightarrow v_0 = \frac{3}{5}v$$

26. Answer (2)

**Hint:** Velocity of centre of mass remains constant.

$$\text{Sol.: } \vec{v}_{\text{cm}} = \frac{5 \times 6\hat{i} + 8 \times (-8)\hat{i}}{5 + 8} = \frac{-34}{13}\hat{i}$$

$$\vec{v}_{\text{cm}} = -\frac{34}{13}\hat{i}$$

27. Answer (3)

**Hint:** Power  $P = \frac{dk}{dt}$

$$\text{Sol.: } dk = P \cdot dt = \frac{5}{3}t^4 dt$$

$$\Rightarrow \int_0^k dk = \frac{5}{3} \times \int_0^t t^4 dt$$

$$\Rightarrow K = \frac{t^5}{3}$$

$$\therefore \text{ at } t = 2, k = \frac{1}{2} \times 2 \times v^2 = \frac{32}{3}$$

$$v = \sqrt{\frac{32}{3}} \text{ m s}^{-1}$$

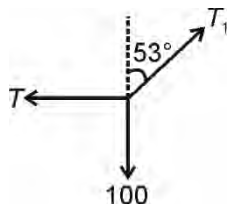
28. Answer (1)

**Hint & Sol.:** Tension in the string = Force developed in spring. Reading of spring balance will be 7 kg.

29. Answer (2)

**Hint:** For equilibrium  $\vec{F}_{\text{net}} = 0$

**Sol.:**



$$T = T_1 \sin 53^\circ = \frac{4T_1}{5} \quad \dots(i)$$

$$T_1 \cos 53^\circ = 100$$

$$\frac{3T_1}{5} = 100 \Rightarrow T_1 = \frac{500}{3} \text{ N} \dots(ii)$$

$$\text{From equation (i) \& (ii) } T = \frac{500}{3} \times \frac{4}{5} = \frac{400}{3} \text{ N}$$

For  $m$  to be in equilibrium

$$\mu mg \geq \frac{400}{3}$$

$$\Rightarrow 0.8 \times 10 \text{ m} \geq \frac{400}{3}$$

$$m \geq \frac{50}{3}$$

30. Answer (4)

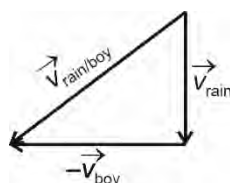
**Hint:** Average velocity =  $\frac{\text{Total displacement}}{\text{total time}}$

$$\text{Sol.: } v_{\text{avg}} = \frac{2v^2 \cdot \sin \theta \cdot \cos \theta}{g \times \frac{2v \sin \theta}{g}} = v \cos \theta$$

31. Answer (3)

**Hint:**  $\vec{v}_{\text{rain/boy}} = \vec{v}_{\text{rain}} - \vec{v}_{\text{boy}}$

**Sol.:**



$$|\vec{v}_{\text{rain}}| = \sqrt{v_{\text{rain/boy}}^2 - v_{\text{boy}}^2}$$

$$= \sqrt{125 - 16}$$

$$= \sqrt{109} \text{ km/h}$$

32. Answer (3)

**Hint:** Velocity at any instant  $v^2 = u^2 - 2gh$

$$\text{Sol.: } v^2 = 2gh - 2g(h - 5)$$

$$= 2 \times 10 \times 5 = 100$$

$$v = 10 \text{ m/s}$$

$$|a| = 10 \text{ m/s}^2$$

Hence, required ratio = 1

33. Answer (3)

**Hint:** Distance travelled in  $n^{\text{th}}$  second

$$S_n = u + \frac{a}{2}(2n - 1)$$

$$\text{Sol.: } S_3 = 0 + \frac{4}{2}(2 \times 3 - 1) = 10 \text{ m}$$

$$S_4 = 0 + \frac{4}{2}(2 \times 4 - 1) = 14 \text{ m}$$

$$\text{Hence } \frac{S_3}{S_4} = \frac{10}{14} = \frac{5}{7}$$

34. Answer (3)

**Hint:** Use principle of homogeneity

**Sol.:**  $[xb]$  should be dimensionless

$$\therefore [b] = [L^{-1}]$$

$$[K] = \frac{[LT^{-1}]}{[ML^2T^{-2}]}$$

$$[Kb] = [M^{-1}L^{-2}T^1]$$

35. Answer (4)

**Hint & Sol.:** Bosons are interacting particles for weak forces.

## SECTION-B

36. Answer (4)

**Hint & Sol.:** In transistor emitter is heavily doped, base is lightly doped while collector is moderately doped.

37. Answer (4)

$$\text{Hint: } \frac{N}{N_0} = \left(\frac{1}{2}\right)^n, \quad n = \frac{t}{T_{\text{Half}_A}}$$

$$\text{Sol.: For sample A } \Rightarrow \frac{1}{8} = \left(\frac{1}{2}\right)^n \Rightarrow \frac{t}{T_{\text{half}_A}} = 3$$

$$T_{\text{Half}} = \frac{1}{3} \text{ day}$$

$$\text{For sample B} \Rightarrow \frac{1}{256} = \left(\frac{1}{2}\right)^n \Rightarrow \frac{t}{T_{\text{Half}_B}} = 8$$

$$\Rightarrow T_{\text{Half}_B} = \frac{t}{8} = \frac{1}{8} \text{ day}$$

$$\text{Hence } \frac{T_{\text{Half}_A}}{T_{\text{Half}_B}} = \frac{1}{3} \times \frac{8}{1}$$

$$= \frac{8}{3}$$

38. Answer (2)

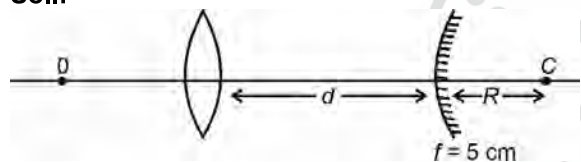
**Hint & Sol.:** Rest mass of a stable nucleus is less than the sum of the rest masses of its separated nucleons.

- In nuclear fission heavy nucleus splits into smaller daughter nuclei

39. Answer (2)

**Hint:** Use lens and mirror equation.

**Sol.:**



$$\text{For lens } \frac{1}{f} = \frac{1}{v} - \frac{1}{u}$$

$$\Rightarrow \frac{1}{20} = \frac{1}{v} - \frac{1}{(-30)} \Rightarrow v = 60 \text{ cm}$$

Refracting rays from lens should fall normally on the mirror i.e., they should go for centre of curvature of mirror.

$$\text{Hence } d + R = 60$$

$$d = 60 - 10$$

$$= 50 \text{ cm}$$

40. Answer (3)

$$\text{Sol.: } E = \frac{1}{2} LI^2$$

$$50 \times 10^{-6} = \frac{1}{2} L (25 \times 10^{-3})^2$$

$$100 = L \times 625$$

$$L = 0.16 \text{ H}$$

41. Answer (3)

$$\text{Hint: Efficiency } \eta = \frac{P_{\text{output}}}{P_{\text{input}}}$$

$$\text{Sol.: Input power } P_{\text{in}} = 5 \text{ kW}$$

$$\Rightarrow V_{\text{in}} \cdot I_{\text{in}} = 5000$$

$$I_{\text{in}} = \frac{5000}{200} = 25 \text{ A}$$

$$\text{Now } \eta = \frac{P_{\text{out}}}{P_{\text{in}}} \Rightarrow \frac{80}{100} = \frac{P_{\text{out}}}{5 \text{ kW}}$$

$$\Rightarrow P_{\text{out}} = V_{\text{out}} \times 4 = \frac{80 \times 5000}{100}$$

$$\Rightarrow V_{\text{out}} = 1000 \text{ volt}$$

42. Answer (4)

$$\text{Hint & Sol.: } \tan \delta_A = \frac{\tan \delta}{\cos \alpha} = \frac{\tan 60^\circ}{\cos 30^\circ}$$

$$= \frac{\sqrt{3}}{(\sqrt{3}/2)} = 2$$

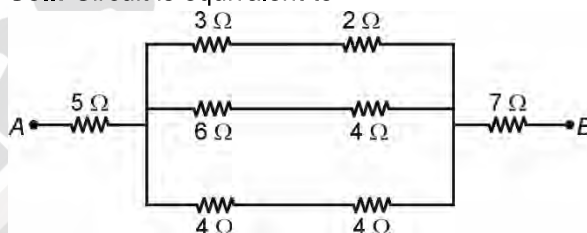
$$\delta_A = \tan^{-1}(2)$$

$$\Rightarrow \delta_A = \sin^{-1} \left[ \frac{2}{\sqrt{5}} \right]$$

43. Answer (1)

**Hint:** Parallel and series combination of resistance.

**Sol.:** Circuit is equivalent to

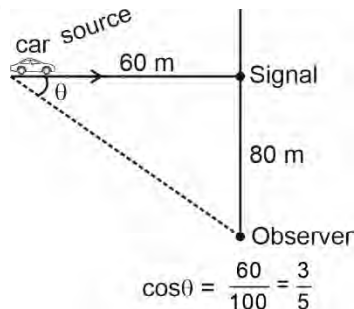


$$R_{\text{eq}} = 5 + \frac{80}{34} + 7 = \frac{244}{17}$$

44. Answer (3)

**Hint:** Use Doppler's effect

**Sol.:**



$$f_{\text{app}} = f_0 \left[ \frac{v}{v - v_s \cos \theta} \right]$$

$$= 400 \left\{ \frac{330}{330 - 20 \times \frac{3}{5}} \right\}$$

$$= 415 \text{ Hz.}$$

45. Answer (3)

**Hint:**  $E = \frac{f}{2}(nRT)$

**Sol.:**  $U_{\text{total}} = U_1 + U_2$

$$= \left( 3 \times \frac{5}{2} R + 5 \times \frac{3}{2} R \right) T = 15RT$$

46. Answer (4)

**Hint:** Work done = Area under P-V curve

**Sol.:**  $W = \frac{1}{2} P_0 V_0$

$$= \frac{P_0 V_0}{2}$$

47. Answer (4)

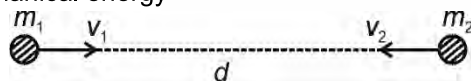
**Hint:** Extension in rod  $\Delta L = \frac{TL}{AY}$

**Sol.:** Tension in the rod  $T = 3F$

Extension of the rod  $\Delta L = \frac{3FL}{AY}$

48. Answer (2)

**Hint:** Use conservation of momentum & mechanical energy

**Sol.:** 

$$\frac{1}{2} m_1 v_1^2 + \frac{1}{2} m_2 v_2^2 - \frac{Gm_1 m_2}{d} = 0 \dots (I)$$

also  $m_1 v_1 = m_2 v_2 \dots (II)$

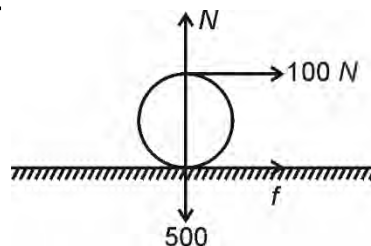
on solving I & II

$$V_1 = \sqrt{\frac{2Gm_2^2}{(m_1 + m_2)d}}$$

49. Answer (3)

**Hint:**  $\tau_{\text{ext}} = I\alpha$

**Sol.:**



$$100 + f = 50 \cdot a \dots (i)$$

$$100 - f = \frac{I\alpha}{R} = \frac{MR^2}{2} \times \frac{a}{R^2} \dots (ii)$$

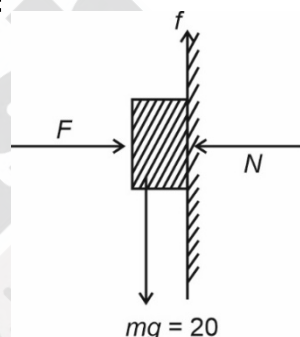
On solving equation (i) & (ii)

$$a = \frac{8}{3} \text{ m/s}^2 \quad \text{and} \quad f = \frac{100}{3} \text{ N}$$

50. Answer (3)

**Hint:** For block to move  $F_{\text{net}} \geq f_{s,\text{max}}$

**Sol.:**



$$f_{s,\text{max}} \geq mg$$

$$\mu F \geq 20$$

$$F \geq \frac{20}{0.4}$$

$$F \geq 50 \text{ N}$$

## [CHEMISTRY]

### SECTION-A

51. Answer (3)

**Hint:** Molarity of water is the moles of  $\text{H}_2\text{O}$  present in 1 L of water

**Sol.:** Molarity (M) =  $\frac{n_{\text{H}_2\text{O}}}{V(\text{L})} = \frac{\left( \frac{1000 \times 1}{18} \right)}{1} = 55.55 \text{ M}$

52. Answer (3)

**Hint:** Due to H – bonding  $\text{NH}_3$  has higher boiling point than expected

**Sol.:**

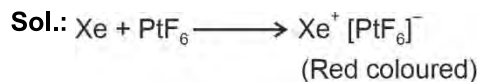
| Hydride           | $\text{NH}_3$ | $\text{SbH}_3$ | $\text{AsH}_3$ | $\text{PH}_3$ |
|-------------------|---------------|----------------|----------------|---------------|
| Boiling point (K) | 238.5         | 254.6          | 210.6          | 185.5         |

53. Answer (2)

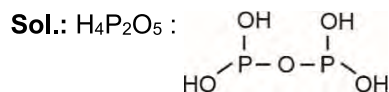
**Hint:** Value of l is 0 to (n – 1)

**Sol.:** For n = 1, l = 0 only

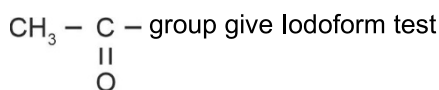
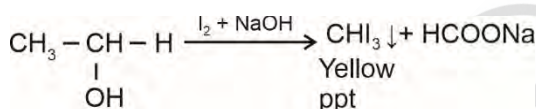
54. Answer (4)

**Hint:** Neil Bartlett, prepare first compound of inert by mixing Xe with  $\text{PtF}_6$ 

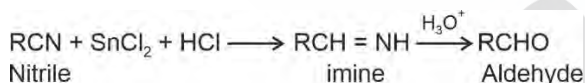
55. Answer (1)

**Hint:** Pyrophosphorus acid :  $\text{H}_4\text{P}_2\text{O}_5$ 

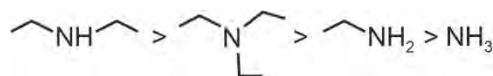
56. Answer (3)

**Hint:** Compounds containing  $\text{CH}_3 - \underset{\text{OH}}{\text{CH}}$  - group or**Sol.:** Iodoform test

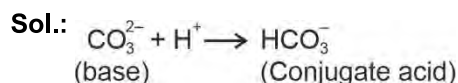
57. Answer (2)

**Hint:** In Stephen reaction reduction of nitriles take place**Sol.:** In Stephen reaction

58. Answer (1)

**Hint:** In aqueous medium basic nature of amine depends not only on electron releasing effect of alkyl group (+I effect) but also the solvation with water molecules**Sol.:** Basic Nature

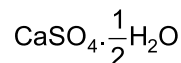
59. Answer (4)

**Hint:**  $\text{Base} + \text{H}^+ \rightarrow \text{Conjugate Acid}$ 

60. Answer (2)

**Hint:** Soframycin is used as an antiseptic**Sol.:** Iproniazid is used as a tranquilizer

61. Answer (3)

**Hint:** Hemihydrate of calcium sulphate :**Sol.:**

- Plaster of paris :  $\text{CaSO}_4 \cdot \frac{1}{2}\text{H}_2\text{O}$
- Gypsum :  $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$
- Dead burnt plaster :  $\text{CaSO}_4$
- Calgon :  $\text{Na}_6\text{P}_6\text{O}_{18}$

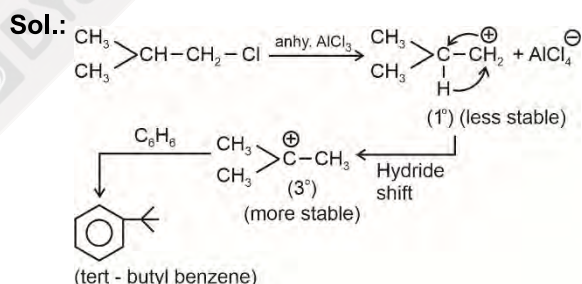
62. Answer (2)

**Hint:** A 30% solution of  $\text{H}_2\text{O}_2$  is marked as '100 volume' hydrogen peroxide**Sol.:** A 30%  $\text{H}_2\text{O}_2$  solution means 1 ml of the solution will give 100 ml of  $\text{O}_2$  at STP

63. Answer (1)

**Hint:** Group - 7, 8, 9 elements do not form Hydrides**Sol.:** In group - 6, only Cr can form Hydride

64. Answer (3)

**Hint:** It is a Friedel Crafts alkylation reaction in which electrophile is carbocation

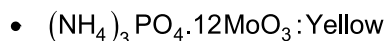
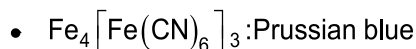
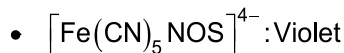
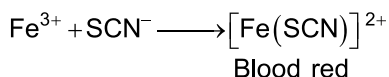
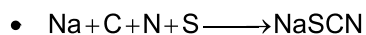
65. Answer (2)

**Hint:** Aromatic species are planar in shape**Sol.:** is Tub - shaped (non - planar)

, so non - aromatic

66. Answer (1)

**Hint:** Organic compounds containing both N and S gives blood red colour with  $\text{Fe}^{3+}$  in "Lassaigne's test".

**Sol.:**

67. Answer (4)

**Hint and sol.:**  $\text{N}_2$  does not cause greenhouse effect

68. Answer (2)

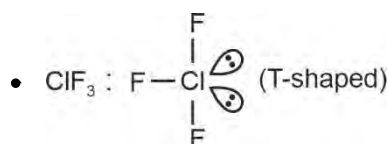
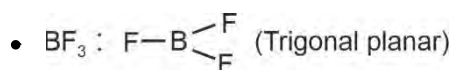
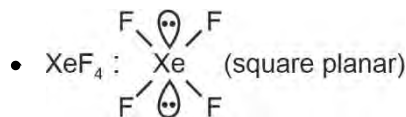
**Hint:** At 1 bar pressure boiling temperature is called standard boiling point.

**Sol.:**

- At 1 atm pressure boiling temperature is called normal boiling point
- The temperature at which a real gas obeys ideal gas law over an appreciable range of pressure is called Boyle temperature

69. Answer (2)

**Hint:** See saw and T – shape is observed in molecules, in which electron pair arrangement around central atom is trigonal bipyramidal.

**Sol.:**

70. Answer (1)

**Hint & Sol.:**

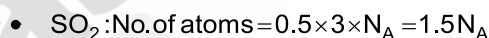
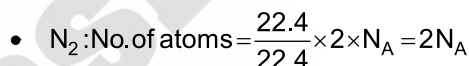
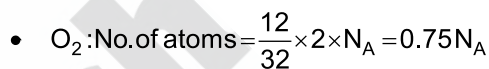
| Element atomic number (Z) | IUPAC official name |
|---------------------------|---------------------|
| 101                       | Mendelevium         |
| 102                       | Nobelium            |
| 103                       | Lawrencium          |
| 104                       | Rutherfordium       |

71. Answer (3)

**Hint & Sol.:** Pauli Exclusion principle: "No two electrons in an atom can have the same set of all four quantum numbers".

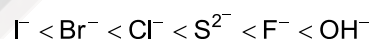
72. Answer (4)

**Hint:** 1 g-molecules = 1 mole of molecules

**Sol.:**

73. Answer (3)

**Hint and Sol:** In general, increasing order of ligand field strength is

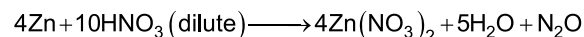


74. Answer (1)

**Hint and Sol.:** In lanthanoids, Ce, Pr, Nd, Tb and Dy exhibits +4 oxidation states.

75. Answer (1)

**Hint:** Neutral oxide is obtained.

**Sol.:**

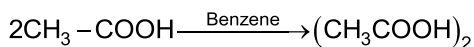
76. Answer (3)

**Hint:** Ethanoic acid exist as dimer in benzene

**Sol.:**

- Relative lowering in vapour pressure is a colligative property

- In benzene, ethanoic acid exist as a dimer due to intermolecular H – bonding



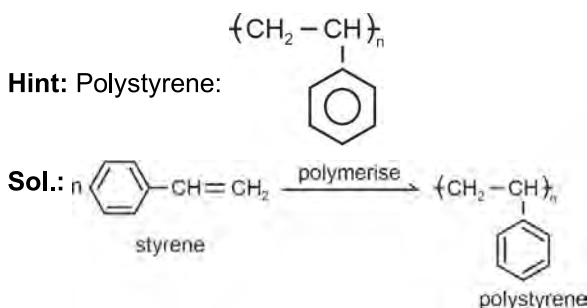
van't Hoff factor (i)  $\approx 0.5$

77. Answer (4)

**Hint and solution :**

| Element                                     | He  | Ne   | Ar  | Kr  | Xe  |
|---------------------------------------------|-----|------|-----|-----|-----|
| $\Delta_{\text{eg}} H (\text{kJ mol}^{-1})$ | +48 | +116 | +96 | +96 | +77 |

78. Answer (1)



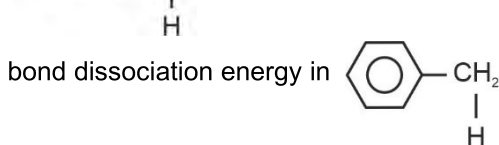
79. Answer (3)

**Hint:** In fcc unit cell atoms are present at corner as well as face centre of unit cell while in simple cubic unit cell atoms are present only on the corner of the unit cell

$$\text{Sol.} \quad \frac{Z_{\text{fcc}}}{Z_{\text{sc}}} = \frac{8 \times \frac{1}{8} + 6 \times \frac{1}{2}}{8 \times \frac{1}{8}} = \frac{1+3}{1} = 4$$

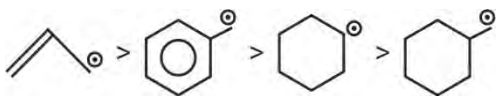
80. Answer (3)

**Hint:** C–H bond dissociation energy in  $\text{CH}_2 = \text{CH} - \text{CH}_2$  ( $361 \text{ kJ mol}^{-1}$ ) is less than C – H



( $368 \text{ kJ mol}^{-1}$ )

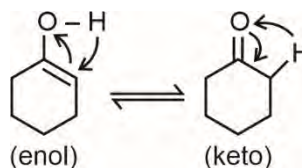
**Sol.:** Stability order



81. Answer (4)

**Hint:** Ketone should contain active H-atom

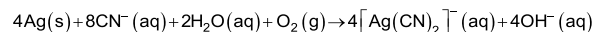
**Sol.:** Vinyl alcohols show keto-enol tautomerism



82. Answer (1)

**Hint:** Composition of Magnetite is  $\text{Fe}_3\text{O}_4$

**Sol.:** During extraction of Ag, ores of Ag are treated with aqueous dilute solution of NaCN in the presence of oxygen.



83. Answer (3)

**Hint:**  $2\text{ClO}_3^- + 12\text{H}^+ \rightarrow \text{Cl}_2 + 6\text{H}_2\text{O} + 10\text{e}^-$

**Sol.:** To reduce, 2 mole  $\text{ClO}_3^-$ , charge required = 10 F

$\therefore$  To reduce, 0.1 mole  $\text{ClO}_3^-$ , charge required

$$= \frac{10}{2} \times 0.1 \text{ F}$$

$$= 0.5 \times 96500 \text{ C}$$

$$= 48250 \text{ C}$$

84. Answer (2)

**Hint:** Cu sol is negatively charged sol

**Sol.:** A negatively charged sol will be more easily coagulated by cation having more charge

85. Answer (2)

**Hint:** For  $n^{\text{th}}$  order reaction,

$$\text{Unit of rate constant (k)} = \left( \frac{\text{mol}}{\text{L}} \right)^{1-n} \text{ time}^{-1}$$

**Sol.:** For 1<sup>st</sup> order reaction,

$$\text{Unit of rate constant (k)} = \left( \frac{\text{mol}}{\text{L}} \right)^{1-1} \text{ s}^{-1} = \text{s}^{-1}$$

## SECTION-B

86. Answer (2)

**Hint:** All irreversible process are spontaneous process

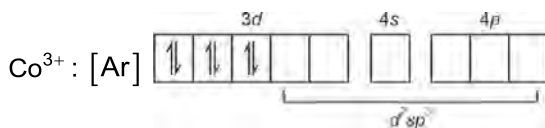
**Sol.:** Third law of thermodynamics : the entropy of any pure crystalline substance approaches zero as the temperature approaches to absolute zero.

87. Answer (1)

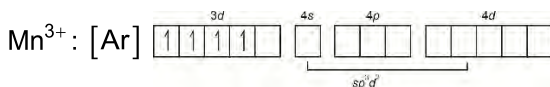
**Hint:**  $[\text{Co}(\text{NH}_3)_6]^{3+}$  and  $[\text{Mn}(\text{CN})_6]^{3-}$  form inner orbital complexes

**Sol.:**

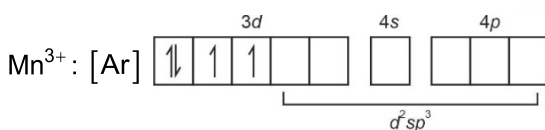
- $[\text{Co}(\text{NH}_3)_6]^{3+}$ :  $d^2sp^3$  hybridised, diamagnetic, zero unpaired electron



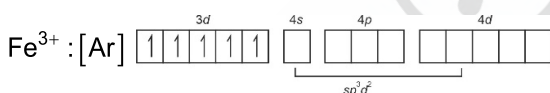
- $[\text{MnCl}_6]^{3-}$ :  $sp^3d^2$  hybridised, paramagnetic, four unpaired electrons



- $[\text{Mn}(\text{CN})_6]^{3-}$ :  $d^2sp^3$  hybridised, paramagnetic, two unpaired electrons

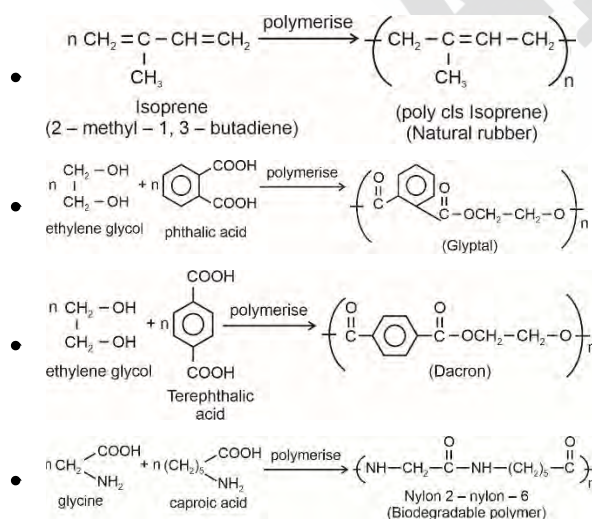


- $[\text{FeF}_6]^{3-}$ :  $sp^3d^2$  hybridised, paramagnetic, five unpaired electrons



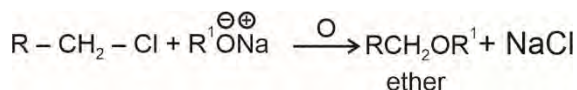
88. Answer (2)

**Hint:** Dacron is a polymer of ethylene glycol and terephthalic acid

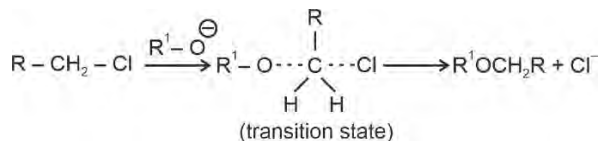
**Sol.:**

89. Answer (3)

**Hint:** Williamson synthesis :

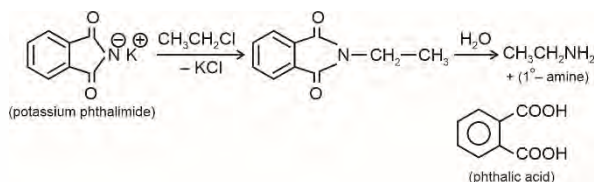


**Sol.:** Williamson synthesis : ( $\text{S}_\text{N}2$  pathway)



90. Answer (4)

**Hint:** Gabriel phthalimide reaction is used for the preparation of  $1^\circ$  - aliphatic amines

**Sol.:**

91. Answer (2)

**Hint:** Species having no unpaired electron are diamagnetic in nature

**Sol.:**

- Ferrimagnetic substance : Which posses very small net magnetic moment even though they have very large number of unpaired electrons. eg:  $\text{Mg Fe}_2\text{O}_4$
- Ferromagnetic substance : Which shows permanent magnetism even in the absence of external magnetic field eg :  $\text{CrO}_2$
- Antiferromagnetic substance : Which have zero net dipole moment even though they have large number of unpaired electrons eg :  $\text{MnO}$
- Diamagnetic substance : Which are weakly repelled by external magnetic field. eg :  $\text{NaCl}$

92. Answer (3)

**Hint:** Osmotic pressure method is used to determine the molar masses of macromolecules

**Sol.:** Higher the  $K_\text{H}$  value for a gas, lower will be the solubility of gas in a liquid.

$$K_\text{H} = \frac{(p_\text{gas}) \text{ atmosphere}}{(X_\text{gas}) \text{ solution}}$$

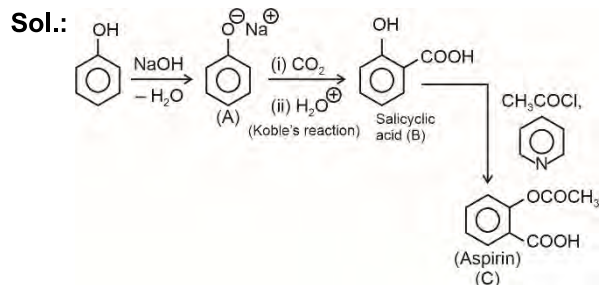
93. Answer (1)

**Hint:** In  $13^\text{th}$  group inert pair effect take place

**Sol.:** Due to inert pair effect. In  $13^\text{th}$  group, Tl shows predominantly +1 oxidation state

94. Answer (3)

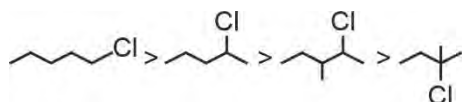
**Hint:** Alcohols undergo acetylation on reaction with acetyl chloride in presence of a base



95. Answer (4)

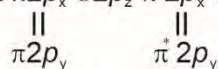
**Hint:** Lesser the steric crowding on halide carbon, more will be the rate of  $\text{S}_{\text{N}}2$  reactions

**Sol.:** Order for rate of  $\text{S}_{\text{N}}2$  reactions

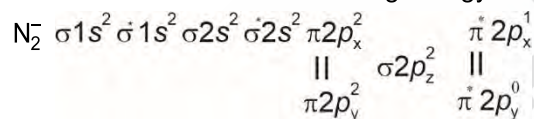


96. Answer (1)

**Hint:** Molecular orbital increasing energy order for  $\text{N}_2$



**Sol.:** Molecular orbital increasing energy order for  $\text{N}_2^-$



$$\text{Bond order} = \frac{N_b - N_a}{2} = \frac{10 - 5}{2} = 2.5$$

97. Answer (4)

**Hint:** Due to deficiency of vitamin  $\text{B}_2$ , fissuring at corners of mouth and lips take place

**Sol.:** Due to deficiency of vitamin  $\text{B}_2$  (Riboflavin), cheilosis (fissuring at corners of mouth and lips) diseases is caused

98. Answer (2)

**Hint:** Salt of weak acid and weak base undergoes cationic and anionic salt hydrolysis.

**Sol.:**

- $\text{K}_2\text{SO}_4$  : Salt of strong acid ( $\text{H}_2\text{SO}_4$ ) and strong base ( $\text{KOH}$ )
- $\text{NH}_4\text{CN}$  : Salt of weak acid ( $\text{HCN}$ ) and weak base ( $\text{NH}_4\text{OH}$ )
- $\text{CH}_3\text{COONa}$  : Salt of weak acid ( $\text{CH}_3\text{COOH}$ ) and strong base ( $\text{NaOH}$ )
- $\text{NH}_4\text{Cl}$  : Salt of strong acid ( $\text{HCl}$ ) and weak base ( $\text{NH}_4\text{OH}$ )

99. Answer (3)

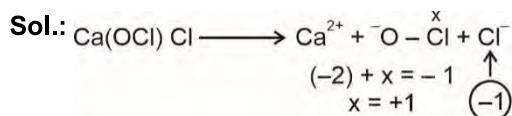
**Hint:** In standard state  $\Delta_f H^\circ$  of elements in their reference state or most stable allotropic form is zero

**Sol.:**

- Reference state of Hydrogen is  $\text{H}_2$  (g)
- Reference state of Chlorine is  $\text{Cl}_2$  (g)
- Most stable allotrope of carbon is graphite
- Most stable allotrope of Sulphur is rhombic sulphur

100. Answer (4)

**Hint:**  $\text{CaOCl}_2 : \text{Ca}(\text{OCl}) \text{Cl}$



## [BOTANY]

### SECTION-A

101. Answer (3)

**Hint:** PS I or  $\text{P}_{700}$  is found in both grana and stroma lamellae and its reaction centre, chlorophyll a, has an absorption peak at 700 nm.

**Sol.:** PS II is associated with splitting of water also termed as (OEC) oxygen evolving complex.

PS I is associated in both cyclic and non-cyclic photophosphorylation.

102. Answer (2)

**Hint:** Cellulose is present in cell wall of green plants.

**Sol.:** Phaeophyceae have reserve food in the form of laminarin or mannitol.

103. Answer (1)

**Hint:** Most abundant bacteria are heterotrophic (saprophytic) in nature.

**Sol.:** Heterotrophic bacteria are incapable of synthesising their own food and are helpful in making curd from milk, production of antibiotics and fixing nitrogen.

104. Answer (2)

**Hint:** Sickle cell anaemia is autosomal recessive disorder, thus, individuals with genotype  $Hb^S Hb^S$  are affected.

**Sol.:** It is caused by transversion mutation and is controlled by a single pair of alleles.

105. Answer (4)

**Hint:** Nectar is a reward to pollinators.

**Sol.:** Wind pollinated flowers are not dependent on pollinators. They use wind as agent, thus, they are colourless, odourless and nectarless.

Presence of nectaries is a feature of insect pollinated flowers.

106. Answer (1)

**Hint:** Heterosporous species produce two different types of spores, large female megaspore and small male microspore.

**Sol.:** Majority of pteridophytes are homosporous while few are heterosporous like *Selaginella*, *Salvinia* etc.

107. Answer (3)

**Hint:** The Earth Summit and the World Summit are Conventions of Biodiversity.

**Sol.:** Chipko Movement of Garhwal Himalayas, 1974 was to protect trees.

Montreal protocol was signed to control the emission of ozone depleting substances.

108. Answer (4)

**Hint:** When a non-native or alien species is introduced unintentionally or deliberately for whatever purpose, turn invasive and cause decline or extinction of indigenous species, then this is known as alien species invasion.

**Sol.:** When any species is overharvested, overexploited, endangering its continued existence then it is termed as overexploitation. Steller's sea cow and passenger pigeon became extinct due to over-exploitation.

109. Answer (3)

**Hint:** Biomagnification happens because a toxic substance accumulated by an organism cannot be

metabolised or excreted, and is thus passed on to the next higher trophic level.

**Sol.:** Biomagnification of DDT in aquatic food chain disturbs calcium metabolism in birds, which causes thinning of eggshell and their premature breaking, eventually decline in birds population.

110. Answer (1)

**Hint:** Catalytic converters convert unburnt hydrocarbons into  $CO_2$  and  $H_2O$ , and  $CO$  and  $NO_x$  are converted into  $CO_2$  and  $N_2$  respectively.

**Sol.:** A scrubber can remove gases like sulphur dioxide.

Electrostatic precipitator can remove 99% particulate matter present in the exhaust from a thermal power plant.

111. Answer (3)

**Hint:** In the absence of essential elements the plants do not complete their life cycle or set the seeds.

**Sol.:** Essential elements must be directly involved in the metabolism of plant. These are specific and not replaceable by another element.

112. Answer (1)

**Hint:**  $CO_2$  is already in limiting conditions in atmosphere.

**Sol.:** Dark reactions are temperature controlled because of the enzyme RuBisCO.

$C_3$  plants respond to low  $CO_2$  concentration by showing decreased rates of photosynthesis.

113. Answer (2)

**Hint:** Axial flower is dominant trait over terminal flower in pea.

**Sol.:**

|   | (Axial Flower) |   | (Terminal Flower) |
|---|----------------|---|-------------------|
|   | Aa             | × | Aa                |
|   |                | ↓ |                   |
|   | A              |   | a                 |
| a | Aa             |   | aa                |
| a | Aa             |   | aa                |

50% plants are Aa (axial flowers)

and 50% plants are aa (terminal flowers)

114. Answer (3)

**Hint:** Fruit of family Liliaceae is generally capsule, rarely berry.

**Sol.:** Tulip is the ornamental plant of family Liliaceae.

115. Answer (1)

**Hint:** Bergmann's rule states that warm blooded animals (birds and mammals) have larger body size in cold climate than in hotter areas.

**Sol.:** Rensch's rule states that, in colder climate, birds possess narrow and acuminate wings as compared to broader wings of birds found in warmer areas.

Jordan's rule states that as the temperature is lowered, some fishes possess larger size with larger number of vertebrae.

According to Allen's rule, mammals from colder climate generally have shorter ears and limbs to minimise heat loss.

116. Answer (1)

**Hint:** GPP is gross primary productivity

**Sol.:**  $NPP = GPP - R$

Where, R is respiratory losses.

117. Answer (1)

**Hint:** Anthropogenic ecosystem possesses simple food chain, little diversity and high productivity.

**Sol.:** Self-regulatory mechanism is a feature of natural ecosystem.

118. Answer (2)

**Hint:** Mutualism is '+, +' obligate interaction.

**Sol.:** Protocooperation is mutually beneficial, non-obligate interaction i.e. interacting partners can survive without each other.

Commensalism is '+, 0' and ammensalism is '-, 0' interaction.

119. Answer (2)

**Hint:** Haplodiploid method of sex determination is seen in some insects.

**Sol.:** Grasshopper shows (XX-XO) type of sex determination.

Fruit fly shows (XX-XY) type of sex determination.

Butterfly shows (ZO-ZZ) type of sex determination.

Male honey bees are haploid and female and worker bees are diploid.

120. Answer (1)

**Hint:** *Saccharum barberi* has poor yield of sugar.

**Sol.:** Sonalika is high yielding variety of wheat.

121. Answer (2)

**Hint:** RNA polymerase I synthesises 5.8S, 18S and 28S rRNA.

RNA polymerase III synthesises tRNA, snRNA, ScRNA and 5S rRNA.

**Sol.:** RNA polymerase II synthesises hnRNA.

RNA primase synthesises short stretches of RNA primers.

122. Answer (4)

**Hint:** Locules are the chambers in ovary.

**Sol.:** Megasporangium in angiosperms is ovule.

- The point of attachment of funicle and ovule is hilum.
- Cells filled inside the ovule forming its main body are nucellus.
- Basal part of ovule opposite to micropylar end is chalaza.

123. Answer (4)

**Hint:** Perennial plants have life span of more than 2 years and monocarpic plants show flowering and fruiting once in their entire life span and do not show interflowering or recovery phase.

**Sol.:** Wheat is an annual and monocarpic plant. *Strobilanthus* is perennial and monocarpic plant.

Grapevine and apple are polycarpic plants.

124. Answer (1)

**Hint:** Weeds are unwanted plants. Auxin is used as weedicide.

**Sol.:** 2, 4-D is the most widely used weedicide. ABA is stress hormone and gibberellins help in breaking seed dormancy.

125. Answer (4)

**Hint:** Energy of ATP is used during activation phase of glycolysis.

**Sol.:** Water is released during conversion of 2-PGA into PEP and ATP is formed during conversion of PEP into pyruvate.

During the conversion of 3 PGAL to 1, 3-BPGA, two redox equivalents are removed.

126. Answer (2)

**Hint:** Triple fusion and double fertilisation is a unique feature of angiosperms.

**Sol.:** *Pinus* is a gymnosperm

*Fucus* is a brown alga

*Rhizopus* is a fungus

*Ficus* is an angiosperm

127. Answer (1)

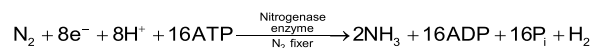
**Hint:** *Gracilaria* and *Gelidium* are members of red algae.

**Sol.:** Red tide of sea is caused due to rapid proliferation of dinoflagellate *Gonyaulax*.

128. Answer (2)

**Hint:** Biological fixation of one molecule of nitrogen yields two molecules of  $\text{NH}_3$ .

**Sol.:**



Synthesis of  $2\text{NH}_3$  molecules require 16 ATP, thus, 8 ATP per  $\text{NH}_3$  molecule are required during  $\text{N}_2$ -fixation.

129. Answer (1)

**Hint:** Synapsis or pairing of homologous chromosomes occurs during zygotene stage.

**Sol.:** Pachytene shows crossing over and recombination.

- Diplotene shows dissolution of synaptonemal complex.
- Diakinesis shows terminalisation of chiasmata and transition to metaphase-I.

130. Answer (2)

**Hint:** Interphase of cell cycle is divided into  $G_1$  phase, S phase and  $G_2$  phase.

S-phase is phase of DNA replication.

**Sol.:**  $G_1$  phase is the interval between mitosis and initiation of DNA replication.

$G_2$  phase is phase of final preparation involving duplication of cell organelles like mitochondria, chloroplast and golgi complex and synthesis of tubulin proteins.

In  $G_0$  phase or quiescent phase, cells remain metabolically active but no longer proliferate.

131. Answer (1)

**Hint:** Botanical gardens have collections of living plants for reference.

**Sol.:** Herbarium serves as quick referral system. Keys are analytical in nature.

132. Answer (3)

**Hint:** For a fully turgid cell, TP is maximum and DPD is 0.

**Sol.:**  $\text{DPD} = \text{OP} - \text{TP}$

For a fully turgid cell,  $\text{DPD} = 0$

$\therefore \text{OP} = \text{TP}$

$\text{DPD} = -\psi_w$

For a fully turgid cell,  $\psi_w = 0$

133. Answer (3)

**Hint:** De-differentiation is conversion of functionally specialised primary permanent tissue

into actively dividing secondary meristematic tissue.

**Sol.:**

- Intrafascicular cambium is primary meristem already present within vascular bundle of dicot stem.
- Interfascicular cambium is formed due to de-differentiation of cells of medullary rays.
- Vascular fascicular cambium in dicot roots is formed due to de-differentiation of pericycle cells and conjunctive tissue.
- Cork cambium in dicot stem is formed due to de-differentiation of cells of cortex.

134. Answer (2)

**Hint:** When a flower can be divided into two equal halves in any radial plane passing through the centre then, it is known as actinomorphic. For examples, mustard, *Datura*, chilli etc.

**Sol.:** Pea flower shows bilateral symmetry *i.e.*, it can be divided into two similar halves only in one particular vertical plane.

135. Answer (4)

**Hint:** Polymorphism is the ability of an organelle to change shape and size according to its contents and functions.

**Sol.:** Lysosomes are small spherical membrane bound structures rich in hydrolytic enzymes and are polymorphic in nature.

## SECTION-B

136. Answer (3)

**Hint:** Statins produced by yeast *Monascus purpureus* is a blood cholesterol lowering agent.

**Sol.:** *Streptococcus* produces streptokinase which is used as clot buster.

- Fungus *Trichoderma polysporum* produces cyclosporin A which is used as immunosuppressive agent.
- Fungus *Aspergillus niger* produces citric acid.

137. Answer (1)

**Hint:** Osmosis is movement of water molecules or solvent molecules from its high concentration to low concentration across semi-permeable or selectively permeable membrane.

**Sol.:** Imbibition is a special type of diffusion by which water loving (hydrophilic) solids absorb solvents.

Guttation is loss of water in the form of droplets from opening of vein endings.

138. Answer (1)

**Hint:** In monocot stems, atactostele is present i.e., vascular bundles are scattered in ground tissue.

**Sol.:** In monocot stems, vascular bundles are conjoint, collateral and closed. They are scattered in ground tissue.

They usually lack phloem parenchyma and have water containing cavities.

In dicot stems, vascular bundles are conjoint, collateral, open and arranged in a ring. Such condition is known as eustele.

139. Answer (3)

**Hint:**  $FADH_2$  is produced during respiration.

**Sol.:** Non-cyclic photophosphorylation involves PS II, which is (OEC) oxygen evolving complex. Thus, it results in production of NADPH, ATP and  $O_2$ .

140. Answer (1)

**Hint:** Phosphorous cycle and nitrogen cycle are sedimentary and gaseous cycle respectively.

**Sol.:** Grasses are producers. Lichens are pioneer communities.

141. Answer (2)

**Hint:** Pyramid of biomass is upright in terrestrial ecosystem and inverted in aquatic ecosystem.

**Sol.:** 10% law of energy transfer shows gradual loss of energy, thus energy is maximum at producer level and minimum at top carnivore level. This justifies that pyramid of energy is always upright.

142. Answer (4)

**Hint:** Capping and tailing are modification of 5' & 3' ends of hnRNA respectively during post-transcriptional modification.

**Sol.:** Splicing is removal of introns and joining of exons.

Aminoacylation is an event in translation when amino acid is transferred to tRNA.

143. Answer (4)

**Hint:** Prions are infectious proteinaceous particles.

**Sol.:** Prions are infectious abnormally folded proteins, similar in size to viruses. They do not have DNA or RNA.

144. Answer (4)

**Hint:** Predation is +, 0 interaction where one partner is benefited (predator) and other is harmed (prey).

**Sol.:** Predators transfer energy across trophic levels, keep prey population under control and

maintain species diversity in a community. Predators in nature are 'prudent'.

145. Answer (3)

**Hint:** Geitonogamy is the transfer of pollen grains from anther to the stigma of another flower of the same plant.

It is functionally cross pollination but genetically self pollination.

**Sol.:** Cleistogamy is production of closed flowers, which never open at all thus can perform autogamy only.

146. Answer (1)

**Hint:** Photoperiodism is the response shown by plants to change in the relative length of light and dark duration for flowering. Its receptor is a blue green coloured pigment, phytochrome, present in leaves.

**Sol.:** Leaves are sites of perception of light/dark duration for flowering in plants.

Shoot apices are sites of perception of vernalisation.

147. Answer (2)

**Hint:** Morphologically distinct types of gametes are known as heterogametes.

**Sol.:** *Cladophora*, *Ulothrix* and *Rhizopus* produce isogametes. *Chara*, *Fucus* and *Marchantia* produce heterogametes.

148. Answer (2)

**Hint:** Direct form of energy is obtained through (SLP) substrate level phosphorylation.

**Sol.:** Sucrose is converted into glucose and fructose and these monosaccharides enter the glycolytic pathway and each hexose forms 4 ATP via SLP.

149. Answer (3)

**Hint:** Crossing over and recombination occur during pachytene stage.

**Sol.:** Recombinase enzyme helps in exchange of genetic material between non-sister chromatids of homologous chromosomes, that occur during pachytene stage of meiosis-I.

- Leptotene shows initiation of condensation of chromatin material.
- Zygotene shows pairing of homologous chromosomes.
- Diplotene shows dissolution of synaptonemal complex.

150. Answer (1)

**Hint:** RER helps in protein synthesis and SER is involved in lipid or steroid synthesis.

**Sol.:** Mitochondria are responsible for ATP synthesis by oxidative phosphorylation and nucleolus is the site of rRNA synthesis.

## [ZOOLOGY]

### SECTION-A

151. Answer (2)

**Hint:** Includes curcumin

**Sol.:**

|                      |                                 |
|----------------------|---------------------------------|
| Pigments             | Carotenoids, Anthocyanins, etc. |
| Alkaloids            | Morphine, Codeine, etc.         |
| Terpenoides          | Monoterpenes, Diterpenes etc.   |
| Essential oils       | Lemon grass oil, etc.           |
| Toxins               | Abrin, Ricin                    |
| Lectins              | Concanavalin A                  |
| Drugs                | Vinblastin, curcumin, etc.      |
| Polymeric substances | Rubber, gums, cellulose         |

152. Answer (4)

**Hint:** Cyclostome

**Sol.:** All living members of the class Cyclostomata are ectoparasites on some fishes. They have an elongated body bearing 6-15 pairs of gill slits for respiration. Cyclostomes have a sucking and circular mouth without jaws. Their body is devoid of scales and paired fins. Cranium and vertebral column are cartilaginous. Circulation is of closed type. Cyclostomes are marine but migrate for spawning to fresh water. After spawning, within a few days, they die. Their larvae, after metamorphosis, return to the ocean.

153. Answer (2)

**Hint:** Arthropods

**Sol.:** Exoskeleton of arthropods is made up of chitin. In chitin, the basic unit is a nitrogen containing glucose derivative known as N-acetyl glucosamine.

154. Answer (2)

**Hint:** Male sex accessory ducts

**Sol.:** The male sex accessory ducts include rete testis, vasa efferentia, epididymis and vas deferens. Vas deferens receives a duct from seminal vesicle and opens into urethra as the ejaculatory duct.

The male sex accessory ducts carry the fraction of semen without the fluids secreted by male accessory glands.

155. Answer (2)

**Hint:** Testosterone is a steroid hormone

**Sol.:** Cell membrane according to the fluid mosaic model has a lipid bilayer. It allows lipophilic substances to pass through the cell. Testosterone is a steroid hormone, it passes through the cell membrane and it has intracellular receptors.

156. Answer (4)

**Hint:** TLC is increased

**Sol.:** Emphysema is a chronic disorder in which alveolar walls are damaged due to which respiratory surface is decreased. One of the major causes of this is cigarette smoking. In emphysema, FRC as well as TLC increase.

157. Answer (2)

**Hint:** Exclude opioids

**Sol.:** Morphine, heroin (smack) are depressants and slow down the body functions while cocaine also known as crack or coke is a stimulant.

158. Answer (4)

**Hint:** Parthenogenesis

**Sol.:** The process in which the female gamete (egg) undergoes development to form new organisms without fertilisation is called parthenogenesis.

Organisms like rotifers, honeybees, some lizards and birds like Turkey show parthenogenesis.

159. Answer (1)

**Hint:** 200 mL/minute

**Sol.:** Our lungs remove large amounts of CO<sub>2</sub> (approximately 200 mL/minute).

$\therefore$  1 day = 1440 minutes

$\therefore$  In one day lungs remove 288L of CO<sub>2</sub> by an adult man under normal physiological conditions.

160. Answer (3)

**Hint:** Lichens do not grow in polluted areas

**Sol.:** During pre-industrialisation, the air was not polluted, hence, tree trunks were covered by lichen which provided camouflage to the white-winged moths. This worked in favour of the white-winged moths and their number was higher than

the dark-winged moths as the predators spotted the dark-winged moths easily.

The conditions reversed post-industrialisation and the soot covered trees were now a camouflage for dark-winged moths, whereas the predators easily spotted the white-winged moths.

This scenario is an apt example of natural selection.

161. Answer (4)

**Hint:** Duct from gall bladder is the cystic duct.

**Sol.:** Bile is secreted by the hepatic cells. It is stored and concentrated in the gall bladder.

Common hepatic duct joins the cystic duct to form the common bile duct. This common bile duct joins the pancreatic duct to form hepato-pancreatic duct.

Bile is hence carried by common hepatic duct, cystic duct, common bile duct as well as hepato-pancreatic duct.

162. Answer (4)

**Hint:** Found in ANS

**Sol.:** Myelinated nerve fibres have a myelin sheath around their axons. The myelin sheath of myelinated nerve fibres in CNS is made up of oligodendrocytes, whereas, the myelin sheath of myelinated nerve fibres in PNS is made up of Schwann cells.

Unmyelinated nerve fibre is enclosed by a Schwann cell that does not form a myelin sheath around the axon.

163. Answer (2)

**Hint:** Facial bone

**Sol.:** Cranial bones

Paired – Parietal and temporal

Unpaired bones – Frontal, occipital, sphenoid, ethmoid

**Facial bones**

Paired bones – Nasal, maxilla, zygomatic, lacrimal, palatine, inferior nasal conchae

Unpaired bones – Vomer, mandible

164. Answer (3)

**Hint:** Domesticated fowl

**Sol.:**

Leghorn is an improved breed of chicken used for their eggs.

Dairying is the management of animals for milk and its products for human consumption.

165. Answer (3)

**Hint:** Based on antigen-antibody interaction

**Sol.:** ELISA (Enzyme Linked Immuno Sorbent Assay) is a non-conventional diagnostic procedure based on antigen-antibody interaction. It serves the purpose of early diagnosis.

166. Answer (3)

**Hint:** Exhibits tertiary structure

**Sol.:** Haemoglobin is the red coloured respiratory pigment present in erythrocytes. Myoglobin is the red coloured pigment present in red muscle fibres. Anthocyanin is a plant pigment. Niacin is vitamin B<sub>3</sub> complex.

167. Answer (1)

**Hint:** Cardiac output = Heart rate × stroke volume

**Sol.:** If the cardiac output is 5.6 L and the heart rate is 63 beats per minute, then

$$\text{Stroke volume} = \frac{5600}{63}$$

$$= 88.88 \text{ mL}$$

$$\approx 89 \text{ mL}$$

168. Answer (4)

**Hint:** Fungal disease

**Sol.:** Many fungi belonging to the genera *Microsporum*, *Trichophyton* and *Epidermophyton* are responsible for ringworms which is one of the most common infectious diseases in man.

169. Answer (3)

**Hint:** *Balanoglossus*

**Sol.:** *Balanoglossus* belongs to the phylum Hemichordata. Proboscis gland is its excretory organ.

An excretory system is absent in echinoderms.

170. Answer (1)

**Hint:** Diabetes insipidus

**Sol.:** ADH is also known as vasopressin. It facilitates water reabsorption from later parts of the renal tubules. Its deficiency causes diabetes insipidus.

Presence of glucose (glycosuria) and ketone bodies (ketonuria) in urine are indicative of diabetes mellitus.

Liver is the largest gland of our body.

Urine analysis is a conventional method of diagnosis of diseases.

171. Answer (2)

**Hint:** Absence of menstrual cycle

**Sol.:** In human females, menstrual cycle ceases around 50 years of age, which is termed as menopause.

A post-menopausal woman has low levels of oestrogen in blood.

172. Answer (4)

**Hint:** Also known as gene gun

**Sol.:** In plants, cells are bombarded with high velocity micro-particles of gold/ tungsten coated with DNA in a method called biolistics/gene gun.

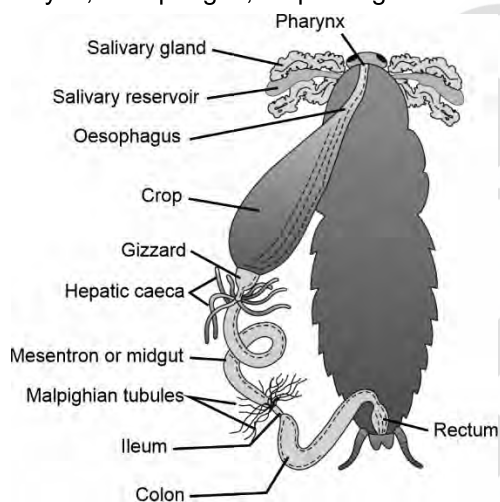
In micro-injection, rDNA is directly injected into the nucleus of an animal cell.

The separated bands of DNA are cut out from the agarose gel and extracted from the gel piece. This step is known as elution.

173. Answer (1)

**Hint:** Sac-like structure is called crop.

**Sol.:** The foregut of cockroach is made of mouth, pharynx, oesophagus, crop and gizzard.



174. Answer (4)

**Hint:** Thin watery fluid

**Sol.:** Aqueous humor is a watery fluid present in aqueous chamber, which is present in between cornea and lens. The space between the lens and retina is called vitreous chamber and is filled with a transparent gel called vitreous humor.

175. Answer (2)

**Hint:** EC = 1500 – 1600 mL

**Sol.:** TV  $\approx$  500 mL

IRV  $\approx$  2500 mL to 3000 mL

ERV  $\approx$  1000 mL to 1100 mL

RV  $\approx$  1100 mL to 1200 mL

IC  $\approx$  3000 mL to 3500 mL

EC  $\approx$  1500 mL to 1600 mL

FRC  $\approx$  2100 mL to 2300 mL

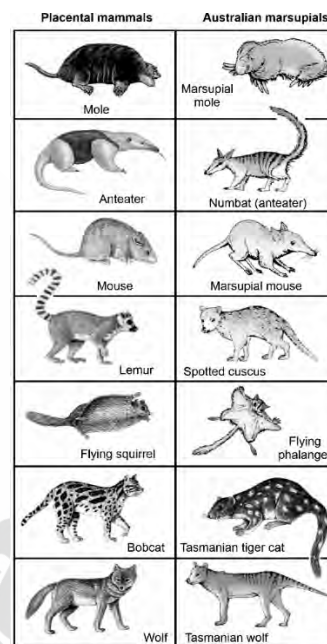
VC  $\approx$  4000 mL to 4600 mL

TLC  $\approx$  5100 mL to 5800 mL

176. Answer (1)

**Hint:** Placental mammals and Australian marsupials show convergent evolution.

**Sol.:**



177. Answer (3)

**Hint:** Emphysema is caused due to cigarette smoking.

**Sol.:** Memory-based acquired immunity evolved in higher vertebrates.

Rheumatoid arthritis is one of the many autoimmune diseases that affects many people in our society. In autoimmune disorders, the body attacks self-cells.

178. Answer (3)

**Hint:** Primates show menstrual cycle.

**Sol.:** Non-primate mammals like cows, sheep, rats, deers, dogs, tiger, etc., show the oestrus cycle.

Primates like monkeys, apes and humans show the menstrual cycle.

179. Answer (3)

**Hint:** Cardiac muscle tissue is striated and involuntary.

**Sol.:** Smooth muscle fibres are fusiform and do not show striations. Smooth muscles are

involuntary in nature as their functioning cannot be directly controlled.

Cardiac muscle shows striations but is involuntary.

This shows that presence or absence of striations do not determine if the muscle is voluntary or not.

180. Answer (2)

**Hint:** Hydrolases

**Sol.:** Enzymes are divided into 6 classes each with 4-13 subclasses.

The 6 classes are as follows-

- (a) Oxidoreductases – Succinic dehydrogenase
- (b) Transferases – Transaminases
- (c) Hydrolases – Nucleases, amylases
- (d) Lyases – Carbonic anhydrase
- (e) Isomerases – Isomerases
- (f) Ligases – DNA ligases

181. Answer (2)

**Hint:** Q is secreted by parathyroid glands.

**Sol.:** PTH (parathormone) is a hypercalcemic hormone and TCT (thyrocalcitonin) is a hypocalcemic hormone. TCT is secreted by the thyroid gland. TCT and PTH play a significant role in calcium balance in the body.

182. Answer (3)

**Hint:** *Salamandra*

**Sol.:** The body of amphibians is divisible into head and trunk. Tail may be present in some.

183. Answer (4)

**Hint:** *Oryza sativa*

**Sol.:** Bees are pollinating agents of crops like sunflower, *Brassica*, apple, pear, etc.

Rice, wheat, maize, etc., are wind pollinated plants.

184. Answer (3)

**Hint:** Blood group antigens are absent

**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             |

185. Answer (3)

**Hint:** Inulin is a polymer of fructose.

**Sol.:** Physiologic value of fats is 9.0 kcal/g.

Gross calorific value of proteins is 5.65 kcal/g.

Inulin is a carbohydrate.

Castle's intrinsic factor is essential for the absorption of vitamin B<sub>12</sub>.

## SECTION-B

186. Answer (3)

**Hint:** Brain capacity has 650-800 cc.

**Sol.:** The first human-like being the hominid was called *Homo habilis*. The brain capacity was between 650-800 cc. They probably did not ate meat.

187. Answer (1)

**Hint:** *Bacillus thuringiensis* is an insecticidal bacteria

**Sol.:** Bioremediation is the use of microorganism's metabolism to remove pollutants.

*Pseudomonas putida* or super bug was developed by A. M. Chakravorty and is used for clearing oil spills.

188. Answer (3)

**Hint:** Isolated from *Escherichia coli*

**Sol.:**

| Enzyme   | Microbial origin                  | Recognition site                       | Type of ends after restriction enzyme digestion |
|----------|-----------------------------------|----------------------------------------|-------------------------------------------------|
| Bam HI   | <i>Bacillus amyloliquefaciens</i> | 5'-G↓G-A-T-C-C-3'<br>3'-C-C-T-A-G-G-5' | Sticky ends                                     |
| Eco RI   | <i>Escherichia coli</i>           | 5'-G↓A-A-T-T-C-3'<br>3'-C-T-T-A-A-G-5' | Sticky ends                                     |
| Hind III | <i>Haemophilus influenzae</i>     | 5'-A↓A-G-C-T-T-3'<br>3'-T-T-C-G-A-A-5' | Sticky ends                                     |
| Pst I    | <i>Providencia stuartii</i>       | 5'-C-T-G-C-A-G-3'<br>3'-G-A-C-G-T-C-5' | Sticky ends                                     |
| Sal I    | <i>Streptomyces albus</i>         | 5'-G↓T-C-G-A-C-3'<br>3'-C-A-G-C-T-G-5' | Sticky ends                                     |
| Sma I    | <i>Serratia marcescens</i>        | 5'-C-C-C-G-G-G-3'<br>3'-G-G-G-C-C-C-5' | Blunt ends                                      |

189. Answer (4)

**Hint:** Caused due to allergy as well

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

Silicosis and asbestosis are examples of occupational respiratory disorders. Anthrax is a bacterial disease.

190. Answer (2)

**Hint:** Functional unit between foetus and maternal body

**Sol.:** Placenta and corpus luteum are two temporary endocrine tissues formed in women.

191. Answer (1)

**Hint:** Inability to conceive

**Sol.:** Inability to conceive or produce children even after 2 years of unprotected sexual cohabitation is called infertility. The reasons for this could be physical, congenital, diseases, drugs, immunological or even psychological.

192. Answer (4)

**Hint:** Normal cells have cellular oncogenes

**Sol.:** Cancer causing viruses called oncogenic viruses have genes called viral oncogenes. Several genes called cellular oncogenes (c-onc) or proto oncogenes have been identified in normal cells which, when activated under certain conditions, could lead to oncogenic transformation of the cells.

193. Answer (3)

**Hint:** *Dryopithecus* was common ancestor of man and ape.

**Sol.:** About 15 mya, primates called *Dryopithecus* and *Ramapithecus* were existing. They were hairy and walked like gorillas and chimpanzees.

*Ramapithecus* was more man-like while *Dryopithecus* was more ape-like.

194. Answer (2)

**Hint:** Surrogate mothers do not contribute to the genotype of the progeny.

**Sol.:** The superior cow is given FSH-like hormone and is made to superovulate, i.e., produce 6-8 eggs in one ovulation. This cow is either mated with an elite bull or artificially inseminated. The fertilised eggs at 8-32 cells stages are recovered non-surgically and transferred to surrogate mothers.

The genetic information only comes from the mother who provided the egg.

195. Answer (1)

**Hint:** Acts as vector of diseases

**Sol.:** *Aedes* – Transmits chikungunya

*Bombyx* – Sericulture

*Limulus* – Living fossil

*Laccifer* – Lac insect

196. Answer (1)

**Hint:** Not conducting any impulse

**Sol.:** The electrical potential difference across the resting plasma membrane is called the resting potential.

197. Answer (3)

**Hint:** 1 to 1.5 litre urine excreted per day

**Sol.:** An adult human excretes, on an average 1 to 1.5 litres of urine per day that contains 25-30 gms of urea.

198. Answer (1)

**Hint:** Common passage for food and air

**Sol.:** Compound epithelium is made up of more than one layer of cells and involved in providing protection. They cover the dry surface of skin, moist surface of buccal cavity, pharynx, etc.

Squamous epithelium is present in air sacs of lungs, cuboidal epithelium is present in proximal convoluted tubule and columnar epithelium lines the intestine.

199. Answer (1)

**Hint:** Structure where sperms are stored in female

**Sol.:** Phallic gland, ejaculatory duct and titillator are reproductive structures found in the male cockroach.

The female cockroach has a pair of spermatheca which opens into the genital chamber. The spermathecae store the sperms inside the female post copulation and prior to fertilisation.

200. Answer (3)

**Hint:** Hormone-secreting cells

**Sol.:** Crypts of Lieberkuhn have epithelial cells which secrete mucus, Paneth cells which secrete digestive enzymes and Argentaffin cells which probably secrete hormones.

Plexus of Auerbach or Myenteric plexus consists of fibre from both autonomic divisions and mostly controls the peristaltic movements in alimentary canal.

