All India Aakash Test Series for NEET-2023

TEST - 7 (Code-C)

Test Date : 27/03/2022

ANSWERS

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

HINTS & SOLUTIONS

[PHYSICS]

SECTION - A

1. Answer (1)

Hint: $A = l \times b$

$$\frac{\Delta A}{A} = \frac{\Delta l}{l} + \frac{\Delta b}{b}$$

Sol.: $A = l \times b$

$= 40 \times 30$

$= 1200\ \text{cm}^2$

$$\frac{\Delta A}{A} = \frac{0.2}{40} + \frac{0.1}{30}$$

$$\Delta A = \frac{0.2}{40} \times 1200 + \frac{0.1}{30} \times 1200$$

$\Delta A = 6 + 4 = 10\ \text{cm}^2$

2. Answer (3)

Hint: $\tan\alpha = \dfrac{u\sin\theta - gt}{u\cos\theta}$

Sol.: $\tan 37^\circ = \dfrac{u\sin 53^\circ - gt}{u\cos 53^\circ}$

$$\frac{3}{4} = \frac{\frac{4u}{5} - gt}{\frac{3}{5}u}$$

$$\frac{9u}{20} = \frac{4u}{5} - gt$$

$$gt = \frac{4u}{5} - \frac{9u}{20}$$

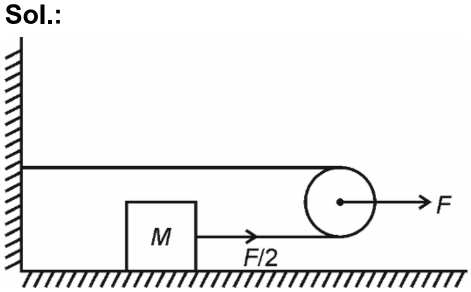
$$gt = \frac{16u - 9u}{20}$$

$$t = \frac{7u}{20g}$$

3. Answer (3)

Hint: $F - f = ma$

Sol.:



$$\frac{F}{2} - f = Ma$$

$12 - \mu Mg = Ma$

$12 - 0.2 \times 10M = M$

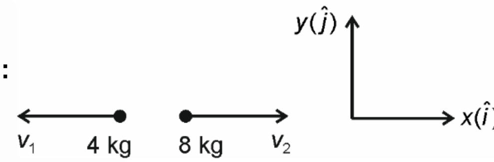
$12 = 3M$

$M = 4$ kg

4. Answer (3)

Hint: $\vec{v}_{\text{cm}} = \dfrac{M_1\vec{v}_1 + M_2\vec{v}_2}{M_1 + M_2}$

Sol.:



$$\vec{v}_{\text{cm}} = \frac{-2 \times 4\hat{i} + 8 \times 3\hat{i}}{4 + 8}$$

$$\vec{v}_{\text{cm}} = \frac{-8\hat{i} + 24\hat{i}}{12}$$

$$= \frac{16\hat{i}}{12} = \frac{4\hat{i}}{3}\ \text{m/s}$$

5. Answer (1)

Hint: $\tau = I\alpha$

Sol.: For solid cylinder $I_C = \dfrac{MR^2}{2}$

for solid sphere $I_S = \dfrac{2}{5}MR^2$

$I_C > I_S$

$\alpha_C < \alpha_S$

$\omega = \omega_0 + \alpha t$

$\omega_C < \omega_S$

6. Answer (4)

Hint: Area under force-displacement curve gives work done

Sol.: $W = \Delta K$ [From work-energy theorem]

$$\frac{1}{2}Mv^2 - 0 = 10 \times 10 + \frac{1}{2} \times 10 \times 25$$

$v^2 = 100 + 125$

$v^2 = 225$

$v = 15$ m/s

7. Answer (1)

Hint: $T = 2\pi\sqrt{\frac{m}{k}}$

Sol.: $T = 2\pi\sqrt{\frac{m}{k}}$

$2\pi = 2\pi\sqrt{\frac{m}{k}}$

$k = m$

$kx = mg$

$x = 10$ m

8. Answer (1)

Hint: $g = g_P - R\omega^2\cos^2\phi$

Sol.: At $\phi = 37°$, $g = 0$

$0 = g_P - R\omega^2\cos^2 37°$

$\omega = \frac{1}{\cos 37°}\sqrt{\frac{g_P}{R}}$

$\omega = \frac{5}{4}\sqrt{\frac{g_P}{R}}$

9. Answer (2)

Hint: At constant volume $C_V = \frac{R}{\gamma - 1}$

Sol.: For diatomic gas $\gamma = \left(\frac{7}{5}\right)$

$C_v = \frac{R}{\left(\frac{7}{5} - 1\right)}$

$C_v = \frac{R}{\frac{2}{5}}$

$R = \frac{2}{5}C_v$

$n = 0.4$

10. Answer (1)

Hint: $W_{\text{isothermal}} = nRT_0\ln\left(\frac{V_2}{V_1}\right)$

Sol.: $W_{\text{isobaric}} = nRT_0$

$W_1 = nRT_0$ (for isobaric process)

$W_2 = nRT_0\ln\left(\frac{2V}{V}\right)$ (for isothermal process)

$W_2 = nRT_0\ln 2$

$W_2 = W_1\ln 2$

11. Answer (1)

Hint: $V = \frac{-GM}{R}$

Sol.: $V = \frac{-GM}{R}$

On decreasing R gravitational potential V decreases.

12. Answer (3)

Hint: Energy of a satellite around earth in radius r is $= \frac{-GMm}{2r}$

Sol.: $U_i = \frac{-GMm}{6R}$

$U_f = \frac{-GMm}{8R}$

$W = U_f - U_i$

$= \frac{-GMm}{8R} + \frac{GMm}{6R}$

$= \frac{-3GMm + 4GMm}{24R}$

$= \frac{GMm}{24R}$

13. Answer (3)

Hint: $M = \rho V$

Sol.: $V_1 = \frac{m}{2\rho}$

$V_2 = \frac{m}{4\rho}$

$V_1 + V_2 = \frac{2m}{\rho'}$

$\frac{m}{2\rho} + \frac{m}{4\rho} = \frac{2m}{\rho'}$

$\frac{2+1}{4\rho} = \frac{2}{\rho'}$

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

14. Answer (3)

Hint: Force exerted on the side = $\frac{\rho g h A_1}{2}$

Sol.: Force exerted on the bottom = $\rho g h A_2$

Force exerted on sides = Average pressure × area

$= \frac{\rho g h}{2} \times 2\pi r h$

$\Rightarrow \frac{\rho g h}{2} \times 2\pi r h = \rho g h \times \pi r^2$

$\Rightarrow h = r$

15. Answer (1)

Hint & Sol.:

$$Y = \frac{FL}{A\Delta L}$$

$$F = \frac{YA}{L}\Delta L \quad \text{...(i)}$$

$F = kx$ ...(ii)

On comparing (i) and (ii), $K = \frac{YA}{L}$

16. Answer (4)

Hint: $Q_1 = mC\Delta\theta$,

$Q_2 = mL$

Sol.: Mass of ice melted $= \frac{Q}{L}$

$$= \frac{mC\theta}{L}$$

17. Answer (2)

Hint: $\Delta U = nC_v\Delta T = \frac{n \times 5R \times \Delta T}{2}$ ...(i)

Sol.: From first law of thermodynamics

$\Delta U = \Delta Q - \Delta W$

$$= Q - \frac{Q}{3}$$

$$\Delta U = Q - \frac{Q}{3} = \frac{2Q}{3} \quad \text{...(ii)}$$

$$\frac{n \times 5R}{2} \times \Delta T = \frac{2Q}{3} \Rightarrow \frac{15R}{4} = \frac{Q}{n\Delta T} \quad \text{...(iii)}$$

Using equations,

Molar heat capacity $C = \frac{Q}{n\Delta T}$ ...(iv)

Using equations (iii) and (iv)

$$\Rightarrow \quad C = \frac{15R}{4}$$

18. Answer (1)

Hint & Sol.: $P = \frac{1}{3} \times \frac{N}{V} \times m \times (V_{\text{rms}})^2$

$$P \propto m(V_{\text{rms}})^2$$

M is halved and v_{rms} is doubled

$\therefore$ P will become two times

19. Answer (3)

Hint & Sol.: The heating of glass bulb due to filament occurs by radiation.

20. Answer (2)

Hint: On heating all the dimensions increases.

Sol.: Fractional change in radius is $\frac{\Delta R}{R}$

$\Rightarrow$ Fractional change area $\frac{\Delta A}{A} = \frac{2\Delta R}{R}$

$\Rightarrow$ Fractional change in volume $\frac{\Delta V}{V} = \frac{3\Delta R}{R}$

21. Answer (2)

Hint: $\vec{v}_{RC} = \vec{v}_{RG} - \vec{v}_{CG}$

Sol.: $(V_{RC})^2 = (V_{RG})^2 + (V_{CG})^2$

$$(20)^2 = (10)^2 + (V_{CG})^2$$

$$\Rightarrow \quad V_{CG} = 10\sqrt{3} \text{ m/s}$$

22. Answer (3)

Hint: Area under acceleration time graph gives change in velocity.

Sol.: $v_f - v_i = \int a dt$

$$v_f - 2 = \frac{1}{2} \times 8 \times 4$$

$$v_f = 16 + 2$$

v_f = 18 m/s

23. Answer (2)

Hint: For stable equilibrium, $\frac{dF}{dx} < 0$

Sol.: $F = x^2 - 5x + 6$

Now, $F = 0$

$\Rightarrow$ $x^2 - 5x + 6 = 0$

$\Rightarrow$ $x = 3, 2$

$$\frac{dF}{dx} = 2x - 5 \Rightarrow \left.\frac{dF}{dx}\right|_{x=2} < 0$$

$$\left.\frac{dF}{dx}\right|_{x=3} > 0$$

$x = 2$ is position of stable equilibrium

24. Answer (2)

Hint & Sol.: $T - 2mg = 2ma$

$\Rightarrow$ $T = 2ma + 2mg$

$2ma + 2mg \le 6mg$

$2ma \le 4mg$

$\Rightarrow$ $a \le 2g$

25. Answer (4)

Hint & Sol.: Direction of acceleration is continuously changing and is always towards the centre for uniform circular motion.

26. Answer (4)

Hint & Sol.: For perfectly elastic collision, $e = 1$

For inelastic collision, $0 < e < 1$

For perfectly inelastic collision, $e = 0$

In explosion final kinetic energy is greater than initial kinetic energy.

27. Answer (1)

Hint: $W = \vec{F}\cdot\vec{d}$

Sol.: $a = \frac{F}{m}$

$= \frac{5}{20}$

$= \frac{1}{4}$ m/s^2

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

$= \frac{1}{2}\times\frac{1}{4}(2\times 3 - 1)$

$= \frac{5}{8}$ m

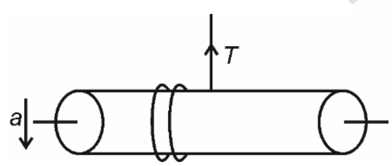
$W = 5\times\frac{5}{8}$

$= \frac{25}{8}$ J

28. Answer (2)

Hint: $\tau = I\alpha$ and $F = ma$

Sol.:



$Mg - T = Ma$ ...(i)

$T\times R = I\alpha$

$T\times R = \frac{MR^2}{2}\frac{a}{R}$

$T = \frac{Ma}{2}$ ...(ii)

(i) + (ii)

$Mg = \frac{3Ma}{2}$

$a = \frac{2g}{3}$

29. Answer (1)

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

Sol.: $v_{max} = A\omega$

$\frac{A\omega}{2} = \omega\sqrt{A^2 - x^2}$

$\frac{A^2}{4} = A^2 - x^2$

$x^2 = \frac{3A^2}{4}$

$x = \frac{\sqrt{3}A}{2}$

30. Answer (3)

Hint & Sol.: In stationary waves energy is minimum at nodes and maximum at antinodes.

31. Answer (2)

Hint: Beats frequency = $|f_1 - f_2|$

Sol.: $\frac{1}{2l}\frac{10}{\sqrt{\mu}} - f = 5$ ...(i)

$f - \frac{9}{2l\sqrt{\mu}} = 5$ ...(ii)

(i) + (ii)

$\frac{1}{2l\sqrt{\mu}} = 10$

On putting $\frac{1}{2l\sqrt{\mu}} = 10$

$100 - f = 5$

$f = 95$ Hz

32. Answer (3)

Hint: $f = \frac{(2n+1)v}{4l}$

Sol.: $f_0 = \frac{v}{4l}$

$f_2 = \frac{5v}{4l}$

$\frac{f_0}{f_2} = \frac{1}{5}$

$f_2 = 5 \times 40$

= 200 Hz

33. Answer (4)

Hint: $f = f_0\left(\frac{v \pm v_0}{v \pm v_s}\right)$

Sol.: $f_1 = f_0\left(\frac{340}{340-34}\right)$

$f_2 = f_0\left(\frac{340}{340-17}\right)$

$\frac{f_1}{f_2} = \frac{340-17}{340-34}$

$= \frac{19}{18}$

34. Answer (3)

Hint & Sol.: $v = \sqrt{\frac{\gamma RT}{M}}$

$v_{\text{rms}} = \sqrt{\frac{3RT}{M}}$

$\frac{v}{v_{\text{rms}}} = \sqrt{\frac{\gamma}{3}}$

$v \propto v_{\text{rms}}$

35. Answer (4)

Hint: $\widehat{PQ} = \frac{\overrightarrow{PQ}}{|\overrightarrow{PQ}|}$

Sol.: $\overrightarrow{PQ} = \overrightarrow{OQ} - \overrightarrow{OP}$

$= (5\hat{i} + 4\hat{j} - 3\hat{k}) - (2\hat{i} + 3\hat{j} - 4\hat{k})$

$= 3\hat{i} + \hat{j} + \hat{k}$

$|\overrightarrow{PQ}| = \sqrt{3^2 + 1^2 + 1^2}$

$= \sqrt{11}$

$\widehat{PQ} = \frac{3\hat{i} + \hat{j} + \hat{k}}{\sqrt{11}}$

SECTION - B

36. Answer (4)

Hint: The quantity $\left(\frac{t}{a} - 1\right)$ should be dimensionless

Sol.: $\frac{dt}{\sqrt{2at - t^2}}$

$\Rightarrow$ a should have the dimension of 't' so the term on LHS is dimensionless.

The argument of sine function is dimensionless. So the power of a should be zero to make RHS dimensionless.

37. Answer (3)

Hint: $\tan\theta = \frac{u_y}{u_x}$

Sol.: $v^2 = u^2 + 2as$ (along y direction)

$g = 10$ m/s^2

$2^2 = u^2 - 2 \times 0.4 \times 10$

$u^2 = 12$

$u_y = 2\sqrt{3}$ m/s

$\tan\theta = \frac{2\sqrt{3}}{6}$

$\theta = 30°$

38. Answer (2)

Hint: $F_{\text{applied}} < f_{s_{\max}}$ then friction force acting on the block will be equal to applied force.

Sol.: $f_{s_{\max}} = \mu_s N$

$= \frac{1}{2} \times 4 \times 10$

$= 20$ N

$F_{\text{applied}} < f_{s_{\max}}$

$f = 16$ N

39. Answer (3)

Hint: $\frac{T_1 - T_2}{t} = k\left(\frac{T_1 + T_2}{2} - T_0\right)$

Sol.: $\frac{75° - 65°}{2} = k\left(\frac{75° + 65°}{2} - 30°\right)$

$5 = k(40)$

$k = \frac{1}{8}$

$\frac{55° - 45°}{t} = k\left(\frac{55° + 45°}{2} - 30°\right)$

$\frac{10°}{t} = \frac{1}{8}(50° - 30°)$

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

$= 4$ min

40. Answer (4)

Hint: $\frac{T - \text{ice point}}{\text{Steam point} - \text{ice point}} = \frac{F - 32}{180}$

Sol.: $\dfrac{52° - 5°}{99° - 5°} = \dfrac{F - 32}{180°}$

$\dfrac{47°}{94°} = \dfrac{F - 32°}{180°}$

$\dfrac{1}{2} = \dfrac{F - 32°}{180°}$

F = 122°F

41. Answer (2)

Hint & Sol.: Inside the water, weight = upthrust

$\therefore$ apparent weight = 0

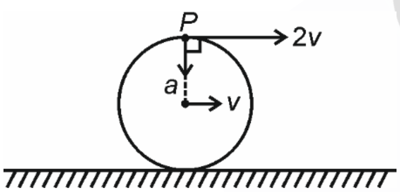
42. Answer (2)

Hint & Sol.: Due to weight of the rope, the tension will increase along the rope from the lower end to the upper end. Hence, the pulse will travel with increasing speed of $v = \sqrt{\dfrac{T}{\mu}}$

43. Answer (3)

Hint: Acceleration at point $P = \dfrac{v^2}{R}$ towards the centre

Sol.:



Since the body is having constant angular velocity hence only centripetal acceleration would be there. Hence angle between acceleration and velocity at point P is 90°.

44. Answer (4)

Hint & Sol.: $\tau = I\alpha$

Rotational K.E $= \dfrac{1}{2}I\omega^2$

$L = I\omega$

work done by centripetal force is zero.

45. Answer (1)

Hint: Use conservation of linear momentum

Sol.: $Mv_1 = 2Mv_2$

$v_1 = 2v_2$

By conservation of linear momentum

$Mv_1 + Mv_2 = 2Mv$

$v = \dfrac{3v_2}{2}$

$\dfrac{1}{2}2M(v)^2 = M\left(\dfrac{3v_2}{2}\right)^2$

$= \dfrac{9Mv_2^2}{4}$

$\dfrac{Mv_2^2}{2} \times \dfrac{9}{2} = 9$

$\dfrac{Mv_2^2}{2} = 2$ J

46. Answer (3)

Hint & Sol.: $\left[\dfrac{\text{T}}{\eta}\right] = \left[\dfrac{\text{MT}^{-2}}{\text{ML}^{-1}\text{T}^{-1}}\right]$

$= [\text{LT}^{-1}]$

47. Answer (2)

Hint: $-\sqrt{a^2 + b^2} \le a\sin\theta + b\cos\theta \le \sqrt{a^2 + b^2}$

Sol.: $-\sqrt{3^2 + 4^2} \le 3\sin\omega t + 4\cos\omega t \le \sqrt{3^2 + 4^2}$

$-5 \le 3\sin\omega t + 4\cos\omega t \le 5$

$y_{\text{min}} = 6 - 5$

= 1

48. Answer (2)

Hint: L.C = 1MSD – 1 VSD

Sol.: (N)VSD = 10 MSD

1VSD$= \dfrac{10}{N}$ MSD

$L.C = 1\text{MSD} - \dfrac{10}{\text{N}}\text{MSD}$

$0.05 \text{ cm} = \left(1 - \dfrac{10}{\text{N}}\right)\dfrac{1 \text{ cm}}{10}$

N = 20 division

49. Answer (3)

Hint: $v = \dfrac{dx}{dt}$

Sol.: $v = \dfrac{d}{dt}(t^2 - 3t + 4)$

$v = 2t - 3$

$v = 0$

t = 1.5 s

50. Answer (3)

Hint: $v = \dfrac{\omega}{k}$ and $K = \dfrac{2\pi}{\lambda}$

Sol.: $v = \dfrac{\omega}{k}$

$= \dfrac{50\pi}{10\pi}$

= 5 m/s

[CHEMISTRY]

SECTION - A

51. Answer (2)

Hint: Empirical formula is the simplest whole number ratio of atoms of the various elements present in the molecule of the compound.

Sol.:

Element	Percentage	Atomic Mass	Number of moles	Simple ratio
C	26.67	12	$\frac{26.67}{12}=2.22$	$\frac{2.22}{2.22}=1$
H	2.22	1	$\frac{2.22}{1}=2.22$	$\frac{2.22}{2.22}=1$
O	71.11	16	$\frac{71.11}{16}=4.44$	$\frac{4.44}{2.22}=2$

$\therefore$ Empirical formula of the compound is CHO_2

52. Answer (4)

Hint: Number of atoms = Number of moles × Avogadro's Number × Atomicity

Sol.:

- 2 mol of H_2 = 2 × 2 N_A atoms = 4 N_A atoms
- 22 g of CO_2 = $\frac{22}{44}$ mol of CO_2 = 0.5 × 3 N_A atoms = 1.5 N_A atoms
- 44.8 L of O_2 at STP = $\frac{44.8}{22.4}$ mole of O_2 = 2 × 2 N_A atoms = 4 N_A atoms
- 27 ml of H_2O =27 g of H_2O = $\frac{27}{18}$ mol = 1.5 × 3 N_A atoms = 4.5 N_A atoms

53. Answer (3)

Hint: Number of angular nodes = l

Number of radial nodes = n – l – 1

Sol.:

- For 5*d*, angular nodes = 2

  radial nodes = 5 – 2 – 1 = 2
- For 5*p*, angular node = 1

  radial nodes = 5 – 1 – 1 = 3
- For 4*p*, angular node = 1

  radial nodes = 4 – 1 – 1 = 2
- For 4*d*, angular nodes = 2

  radial node = 4 – 2 – 1 = 1

54. Answer (4)

Hint: For any value of l, the value of m_l ranges from –l to + l.

Sol.:

- Energy of the orbitals in the same subshell decreases with increase in the atomic number ($Z_{eff.}$)

  $\therefore$ $E_{2s}(H) > E_{2s}(Li) > E_{2s}(Na) > E_{2s}(K)$
- For hydrogen atom, the energy of the orbital depends only upon the principal quantum number

  $\therefore$ $E_{3s} = E_{3p} = E_{3d}$

So, total 9 degenerate orbitals in the third energy level.

- For any value of l, maximum possible value of m_l is 2l + 1.

55. Answer (3)

Hint and Sol.:

Atomic Number	IUPAC official Name
101	Mendelevium
107	Bohrium
102	Nobelium
106	Seaborgium
105	Dubnium

56. Answer (4)

Hint: The electron gain enthalpy of O and F (i.e., second period element) is less negative than those of the succeeding elements as when electron adds to n = 2 quantum level, it suffers significant electronic repulsion from the other electrons.

Sol.:

- Down the group, in the Modern Periodic Table, the metallic character increases.
- On moving left to right in periodic table, the electronegativity increases.
- Generally, on moving left to right, IE increases but IE of N is more than that of O because of the stable electronic configuration of N.

Element	$\Delta_{eg}H$ (kJ mol^{-1})
O	–141
S	–200
Se	–195
Te	–190

57. Answer (4)

Hint: Volume of n mole of a gas at (STP) = n × 22.4 L

Sol.:

$$C_2H_6(g) + \frac{7}{2}O_2(g) \rightarrow 2CO_2 + 3H_2O(l)$$

1 mol	$\frac{7}{2}$ mol	
$\frac{4.5}{30}$ mol	$\frac{7}{2}\times 0.15$ mol	
0.15 mol	0.525 mol	

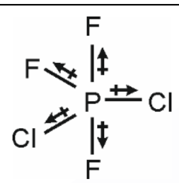
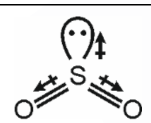
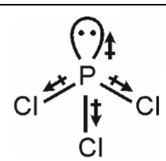
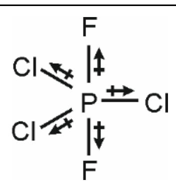
∴ Volume of O_2 required at STP = 0.525 × 22.4

= 11.76 L

58. Answer (4)

Hint: Species for which $\mu_{net} = 0$, are non-polar

Sol.:

	Structure	
• PCl_2F_3		$\mu_{net} \neq 0$
• SO_2		$\mu_{net} \neq 0$
• PCl_3		$\mu_{net} \neq 0$
• PCl_3F_2	 (All bond dipoles cancel out each other)	$\mu_{net} = 0$

59. Answer (4)

Hint:

- Species which contains unpaired electrons are paramagnetic in nature.
- Species which contains no unpaired electrons are diamagnetic in nature.
- $\text{B.O.} = \frac{1}{2}(N_b - N_a)$

Sol.:

Molecular orbital configurations

- $H_2(2e^-) : \sigma 1s^2$

B.O. = 1, (Diamagnetic)

- $H_2^-(3e^-) : \sigma 1s^2 \sigma^* 1s^1$

$\text{B.O.} = \frac{1}{2}$, (Paramagnetic)

- $N_2(14e^-) : \sigma 1s^2 \sigma^* 1s^2 \sigma 2s^2 \sigma^* 2s^2 \begin{cases}\pi 2p_x^2 \\ \pi 2p_y^2\end{cases} \sigma 2p_z^2$

B.O. = 3, (Diamagnetic)

- $N_2^-(15e^-) : \sigma 1s^2 \sigma^* 1s^2 \sigma 2s^2 \sigma^* 2s^2 \begin{cases}\pi 2p_x^2 \\ \pi 2p_y^2\end{cases} \sigma 2p_z^2 \begin{cases}\pi^* 2p_x^1 \\ \pi^* 2p_y\end{cases}$

B.O. = 2.5, (Paramagnetic)

- $O_2(16e^-) : \sigma 1s^2 \sigma^* 1s^2 \sigma 2s^2 \sigma^* 2s^2 \sigma 2p_z^2 \begin{cases}\pi 2p_x^2 \\ \pi 2p_y^2\end{cases} \begin{cases}\pi^* 2p_x^1 \\ \pi^* 2p_y^1\end{cases}$

B.O. = 2, (Paramagnetic)

- $O_2^+(15e^-) : \sigma 1s^2 \sigma^* 1s^2 \sigma 2s^2 \sigma^* 2s^2 \sigma 2p_z^2 \begin{cases}\pi 2p_x^2 \\ \pi 2p_y^2\end{cases} \begin{cases}\pi^* 2p_x^1 \\ \pi^* 2p_y\end{cases}$

B.O. = 2.5, (Paramagnetic)

- $C_2(12e^-) : \sigma 1s^2 \sigma^* 1s^2 \sigma 2s^2 \sigma^* 2s^2 \begin{cases}\pi 2p_x^2 \\ \pi 2p_y^2\end{cases}$

B.O. = 2, (Diamagnetic)

- $C_2^-(13e^-) : \sigma 1s^2 \sigma^* 1s^2 \sigma 2s^2 \sigma^* 2s^2 \begin{cases}\pi 2p_x^2 \\ \pi 2p_y^2\end{cases} \sigma 2p_z^1$

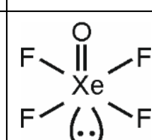
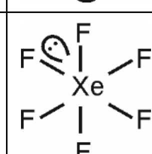
B.O. = 2.5, (paramagnetic)

60. Answer (3)

Hint:

- Hybridization depends upon number of hybrid orbitals.
- Number of hybrid orbitals = number of σ bonds + number of lone pairs of electrons on central atom.

Sol.:

	Structure	Number of hybrid orbitals	Hybridization of Xe
$XeOF_4$		5 + 1 = 6	sp^3d^2
XeF_6		6 + 1 = 7	sp^3d^3

61. Answer (4)

Hint: According to Graham's Law of diffusion.

$$\frac{r_1}{r_2} = \frac{(V/t)_1}{(V/t)_2} = \sqrt{\frac{M_2}{M_1}}$$

Sol.: $\frac{r_x}{r_{He}} = \frac{t_{He}}{t_x} = \sqrt{\frac{M_{He}}{M_x}}$

or $\frac{1}{4} = \sqrt{\frac{4}{M_x}} \Rightarrow \frac{1}{16} = \frac{4}{M_x}$

M_x = 64 u

∴ The gas could be SO_2

62. Answer (3)

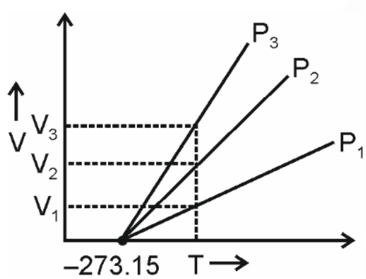
Hint: Stronger is the intermolecular forces of attraction, more easily the gas will be liquified.

Sol.: Hydrogen bonding exist in NH_3. So, it will be most easily liquified.

63. Answer (3)

Hint: At constant temperature, $P \propto \frac{1}{V}$

Sol.:



At constant temperature, $P \propto \frac{1}{V}$

$\because V_3 > V_2 > V_1$

$\therefore P_1 > P_2 > P_3$

64. Answer (2)

Hint: For irreversible process, P_{ext} is constant

$\therefore w = -P_{ext}\Delta V$

According to first law of thermodynamics.

- $\Delta U = q + w$

Sol.: Work done $= -10^5(10^{-2} - 10^{-4})$

$= -10^5(9.9 \times 10^{-3})$

$= -9.9 \times 10^2$ J

$= -990$ J

According to first law of thermodynamics

$\Delta U = q + w$

$\because \Delta U = 0$ (isothermal process)

$\therefore q = -w$

$= -(-990 \text{ J})$

$= 990$ J

65. Answer (1)

Hint: $\Delta_r H = \Sigma(BE)_{Reactants} - \Sigma(BE)_{Products}$

Sol.: $\frac{1}{2}A_2(g) + \frac{1}{2}B_2(g) \rightarrow AB(g)$

$$\Delta_f H = \Delta_r H = \frac{1}{2}\times BE_{A_2} + \frac{1}{2}\times BE_{B_2} - BE_{A-B}$$

$$= \frac{1}{2}a + \frac{1}{2}b - c$$

66. Answer (2)

Hint: Enthalpy of combustion is the amount of heat released when 1 mole of the substance is completely burnt.

Sol.: $C(s) + O_2(g) \rightarrow CO_2(g)$

When 12 g of C, undergoes combustion, heat released is 393.5 kJ

When 1.2 g of C, undergoes combustion, heat released will be 39.35 kJ.

67. Answer (2)

Hint: $pOH = -\log[OH^-]$

Sol.:

- $[OH^-] = 0.1 = 10^{-1}$ M
- $pOH = -\log(10^{-1})$
  $= 1$
- pH + pOH = 14
- pH = 14 – 1
  = 13

68. Answer (3)

Hint:

- Bronsted acid $-H^+ \rightarrow$ Conjugate base
- Bronsted base $+H^+ \rightarrow$ Conjugate acid

Sol.:

- $HCO_3^- + H^+ \rightarrow H_2CO_3$

Bronsted base Conjugate acid

- $HCO_3^- - H^+ \rightarrow CO_3^{2-}$

Bronsted acid Conjugate base

69. Answer (4)

Hint: For endothermic reaction, increase in temperature shifts the equilibrium in the forward direction.

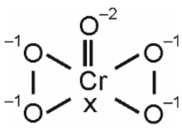
Sol.:

- Increasing the concentration of products, will shift the equilibrium in the backward direction.
- Decreasing the temperature of endothermic reaction, will shift the equilibrium in the backward direction.
- Addition of inert gas at constant volume, will not change the state of equilibrium.
- Addition of inert gas at constant pressure, will shift the equilibrium towards more number of gaseous mole *i.e.*, in forward direction.

70. Answer (4)

Hint: CrO_5 contains 2 peroxide bonds.

Sol.:



x + 4(–1) +1(–2) = 0

x = +6

71. Answer (1)

Hint and Sol.: Balance equation is

$$Cr_2O_7^{2-}(aq) + 3SO_3^{2-}(aq) + 8H^+(aq) \rightarrow 2Cr^{3+}(aq) + 3SO_4^{2-}(aq) + 4H_2O(l)$$

72. Answer (2)

Hint: Lower is the value of standard reduction potential, higher will be the reducing power of the metal.

Sol.: Correct order of reducing power of the metals is

Cu < Fe < Al < K

73. Answer (3)

Hint: Presence of soluble salts of magnesium and calcium in the form of chlorides and sulphate in water causes permanent hardness of water.

Sol.: Temporary hardness of water is due to the presence of magnesium and calcium hydrogen carbonates.

74. Answer (4)

Hint: Volume strength of H_2O_2 = 11.2 × molarity

Sol.: Volume strength of H_2O_2 = 11.2 × 0.5 = 5.6 V

75. Answer (4)

Hint: In acidic medium, H_2O_2 oxidises PbS into $PbSO_4$

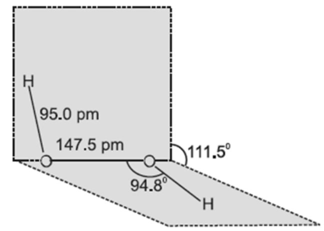
$PbS(s) + 4H_2O_2(aq) \rightarrow PbSO_4(s) + 4H_2O(l)$

Sol.:

- H_2O_2 decomposes slowly on exposure to light

  $2H_2O_2(l) \rightarrow 2H_2O(l) + O_2(g)$

  It is therefore, stored in wax lined glass or plastic vessels in dark.
- Dihedral angle of H_2O_2 in gas phase is 111.5°



76. Answer (2)

Hint: All alkaline earth metal nitrates decompose on heating to give the corresponding oxides.

Sol.:

- Among alkali metal nitrates, only lithium nitrate on heating gives oxide whereas, other alkali metal nitrates give corresponding nitrites.
- $4LiNO_3 \rightarrow 2Li_2O + 4NO_2 + O_2$
- $2NaNO_3 \rightarrow 2NaNO_2 + O_2$
- $2Mg(NO_3)_2 \rightarrow 2MgO + 4NO_2 + O_2$
- $2Ba(NO_3)_2 \rightarrow 2BaO + 4NO_2 + O_2$

77. Answer (3)

Hint: In pyrosilicates, one oxygen atom is shared between two SiO_4^{4-} tetrahedron.

Sol.:

- Orthosilicates : SiO_4^{4-}
- Chain silicates : $\left(SiO_3^{2-}\right)_n$
- Pyrosilicates : $Si_2O_7^{6-}$
- Sheet silicates : $\left(Si_2O_5^{2-}\right)_n$

78. Answer (2)

Hint: In 13th group, down the group, the stability of lower oxidation state increases because of inert pair effect.

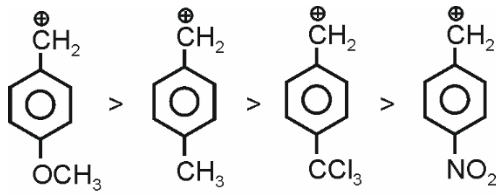
Sol.: Down the group, due to poor shielding effect of intervening *d* and *f* orbitals, the increased effective nuclear charge holds n*s* electrons tightly and thereby, restricting their participation in bonding.

∴ The relative stability of +1 oxidation state progressively increases for heavier elements: i.e., Al < Ga < In < Tl

79. Answer (4)

Hint: Electron donating group increases the stability of the carbocation.

Sol.: Correct order of stability of carbocation is



(+M) (+H) (–H) (–M)

80. Answer (4)

Hint: Hybridization depends upon number of σ bonds and lone pairs of electrons.

Sol.:

$$\underset{sp^3}{H_3C} - \underset{sp^2}{CH} = \underset{sp^2}{CH} - \underset{sp^2}{\overset{\overset{\large :\ddot{O}}{||}}{C}} - \underset{sp^3}{CH_2} - \underset{sp}{C} \equiv N$$

Number of *sp* hybridized carbon atom = 1

Number of sp^2 hybridized carbon atoms = 3

81. Answer (1)

Hint: % of bromine $= \dfrac{80 \times W_{AgBr} \times 100}{188 \times W_{Organic\ comp}}$

Sol.: Molar Mass of AgBr = 108 + 80 = 188 g

188 g of AgBr contains 80 g of bromine

0.15 g of AgBr contains $\dfrac{80}{188} \times 0.15$ g of bromine

% of bromine $= \dfrac{80 \times 0.15 \times 100}{188 \times 0.2}$

$= 31.9\% \simeq 32\%$

82. Answer (2)

Hint: Equilibrium constant for the reverse reaction is the inverse of the equilibrium constant for the reaction in the forward direction.

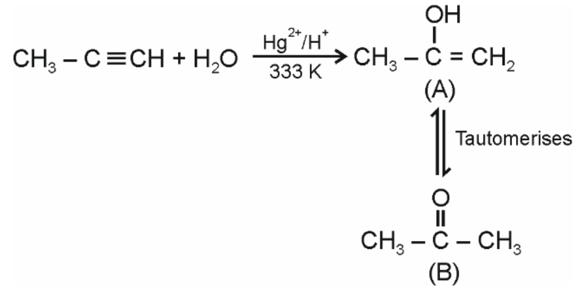
Sol.:

- $A_2(g) + B_2(g) \rightleftharpoons 2AB(g) \qquad K = K_C$
- $2AB(g) \rightleftharpoons A_2(g) + B_2(g) \qquad K' = \dfrac{1}{K_C}$
- $AB(g) \rightleftharpoons \dfrac{1}{2}A_2(g) + \dfrac{1}{2}B_2(g) \qquad K'' = \dfrac{1}{\sqrt{K_C}}$

83. Answer (1)

Hint: Addition of water takes place according to Markovnikov's addition.

Sol.:



84. Answer (3)

Hint: Cyclic planar species which follows Huckel rule with complete delocalisation of π electrons in the ring are aromatic in nature.

Sol.:

-  : Cyclic, planar, 4π electrons: anti-aromatic
-  : Cyclic, non-planar (Tub like structure): non-Aromatic
-  : Cyclic, planar, 6π electrons: aromatic
-  : Cyclic, planar, 4π electron: anti-aromatic

85. Answer (2)

Hint and Sol.: The maximum limit of nitrate in drinking water is 50 ppm. Excess of nitrate in drinking water causes disease such as methemoglobinemia ('blue baby' syndrome).

SECTION - B

86. Answer (2)

Hint:

$\because$ Number of equivalents of metal = Number of equivalents of oxygen.

$$\therefore \frac{\text{Mass of metal}}{\text{Equivalent weight of metal}} = \frac{\text{Mass of oxygen}}{\text{Equivalent weight of oxygen}}$$

Sol.:

- Mass of metal oxide = a g
- Mass of oxygen = b g

$\therefore$ Mass of metal = (a – b) g

$$\text{Now, } \frac{\text{Mass of metal}}{\text{Equivalent weight of metal}} = \frac{\text{Mass of oxygen}}{\text{Equivalent weight of oxygen}}$$

$$\frac{a-b}{E_M}=\frac{b}{8}\ (\because \text{ Equivalent mass of oxygen = 8 g})$$

$$E_M=\frac{8(a-b)}{b}$$

87. Answer (3)

Hint: $\frac{1}{\lambda}=R_H Z^2\left(\frac{1}{n_1^2}-\frac{1}{n_2^2}\right)$

Sol.: For first line of Paschen series, n_1 = 3 and n_2 = 4

$$\therefore \quad \frac{1}{\lambda_1}=R_H 2^2\left(\frac{1}{(3)^2}-\frac{1}{(4)^2}\right) \qquad \text{...(i)}$$

For second line of Balmer series, n_1 = 2 and n_2 = 4

$$\therefore \quad \frac{1}{\lambda_2}=R_H 2^2\left(\frac{1}{(2)^2}-\frac{1}{(4)^2}\right) \qquad \text{...(ii)}$$

Dividing (ii) by (i)

$$\frac{\lambda_1}{\lambda_2}=\frac{R_H(2)^2\left(\frac{(4)^2-(2)^2}{(2)^2(4)^2}\right)}{R_H(2)^2\left(\frac{(4)^2-(3)^2}{(3)^2(4)^2}\right)}$$

$$=\frac{12\times 144}{64\times 7}=\frac{27}{7}$$

88. Answer (2)

Hint: Alkali and Alkaline earth metal oxides are generally basic in nature.

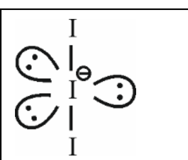
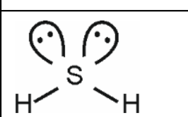
Sol.:

- N_2O : Neutral
- MgO : Basic
- As_2O_3 : Amphoteric
- CO_2 : Acidic

89. Answer (4)

Hint: *sp* hybridized molecule is linear in shape

Sol.:

I_3^-		Linear
CO_2	O = C = O	Linear
C_2H_2	$H-C\equiv C-H$	Linear
H_2S		Bent

90. Answer (2)

Hint: van der Waals equation for n mole of a real gas is

$$\left(P+\frac{an^2}{V^2}\right)(V-nb)=nRT$$

Sol.: At high pressure, $P+\frac{an^2}{V^2}\simeq P$

So, van der Waals equation for 1 mol gas becomes,

$P(V-b)=RT$

or, $PV-Pb=RT$

Dividing by RT

$$\frac{PV}{RT}-\frac{Pb}{RT}=\frac{RT}{RT}=1$$

$$Z=1+\frac{Pb}{RT}\quad\left(\because \frac{PV}{RT}=Z\right)$$

91. Answer (3)

Hint: An intensive property is a property whose value does not depends on the quantity or size of matter present in the system.

Sol.:

- Density is an intensive property
- Heat capacity, Internal energy and volume are extensive properties.

92. Answer (3)

Hint: A salt of strong acid and weak base undergoes cationic hydrolysis only.

Sol.:

- CH_3COONH_4 : Salt of weak acid and weak base.
  It undergoes both cationic and anionic hydrolysis.
- CH_3COONa : Salt of weak acid and strong base
  It undergoes only anionic hydrolysis
- NH_4Cl : Salt of strong acid and weak base
  It undergoes cationic hydrolysis only
- $NaCl$: Salt of strong acid and strong base
  It does not undergo hydrolysis

93. Answer (2)

Hint: In a disproportionation reaction, an element in one oxidation state is simultaneously oxidised and reduced

Sol.:

Reduction

$$\overset{0}{S_8}(s) + 12OH^-(aq) \rightarrow 4S^{2-}(aq) + \overset{+2}{2S_2O_3^{2-}}(aq) + 6H_2O$$

Oxidation

Disproportionation reaction

94. Answer (1)

Hint: Among alkaline earth metals, as the atomic number of the metal increases, the basic character of their hydroxides also increases.

Sol.: Correct order of basic character of hydroxides is

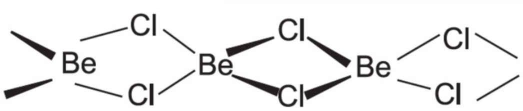
$Ba(OH)_2 > Sr(OH)_2 > Ca(OH)_2 > Mg(OH)_2$

95. Answer (2)

Hint: Smaller the cations, more will be the covalent character in ionic compound.

Sol.:

- Because of small size of Be, its halides are essentially covalent in nature and are soluble in organic solvent.
- In solid state, $BeCl_2$ has a chain structure.



96. Answer (3)

Hint: On heating, orthoboric acid above 370 K forms metaboric acid, HBO_2 which on further heating yields boric oxide, B_2O_3.

$$H_3BO_3 \xrightarrow{\Delta} HBO_2 \xrightarrow{\Delta} B_2O_3$$

Sol.:

- Borax dissolves in water to give an alkaline solution.

  $Na_2B_4O_7 + 7H_2O \rightarrow 2NaOH + 4H_3BO_3$

  Orthoboric acid

- Boric acid can be prepared by acidifying an aqueous solution of borax

$Na_2B_4O_7 + 2HCl + 5H_2O \rightarrow 2NaCl + 4B(OH)_3$

97. Answer (2)

Hint: Two or more compounds having the same molecular formula but different functional groups are called functional group isomers.

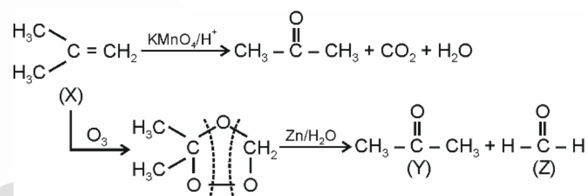
Sol.:

- $CH_3CH_2CH_2CH_3$ and $CH_3-\underset{}{\overset{CH_3}{\overset{|}{C}H}}-CH_3$: Chain isomers
- $CH_3-\overset{O}{\overset{\|}{C}}-OH$ and $H-\overset{O}{\overset{\|}{C}}-OCH_3$: Functional group isomers
- $CH_3CH_2CH_2\overset{OH}{\overset{|}{C}H_2}$ and $CH_3-\overset{OH}{\overset{|}{C}H}-CH_2CH_3$: Position isomers
- $CH_3CH_2CH_2OCH_3$ and $CH_3CH_2OCH_2CH_3$: Metamers

98. Answer (3)

Hint: Acidic potassium permanganate oxidises alkenes to ketones and/or acids depending upon the nature of the alkene.

Sol.:



99. Answer (4)

Hint: In the presence of peroxide, free radical mechanism takes place.

Sol.: Mechanism: Free radical addition reaction.

(i) $C_6H_5-\overset{O}{\overset{\|}{C}}-O-O-\overset{O}{\overset{\|}{C}}-C_6H_5 \xrightarrow{\text{Homolysis}} 2C_6H_5-\overset{O}{\overset{\|}{C}}-\dot{O} \rightarrow 2\dot{C}_6H_5 + 2CO_2$

(ii) $\dot{C}_6H_5 + H-Br \xrightarrow{\text{Homolysis}} C_6H_6 + \dot{B}r$

(iii) $CH_3-CH=CH_2 + \dot{B}r \xrightarrow{\text{Homolysis}} \underset{\text{(Minor)}}{CH_3-\underset{Br}{\underset{|}{C}H}-\dot{C}H_2} + \underset{\text{(Major)}}{CH_3-\dot{C}H-\underset{Br}{\underset{|}{C}H_2}}$

(iv) $CH_3-\dot{C}H-CH_2Br + H-Br \xrightarrow{\text{Homolysis}} \underset{\text{(Major)}}{CH_3-CH_2-CH_2Br} + \dot{B}r$

100. Answer (1)

Hint: The common components of photochemical smog are ozone, nitric oxide, acrolein, formaldehyde and peroxyacetyl nitrate (PAN)

Sol.: Both ozone and PAN act as powerful eye irritants.

[BOTANY]

SECTION - A

101. Answer (3)

Hint: Aloe belongs to a monocot family.

Sol.: *Aloe* belongs to family Liliaceae.

102. Answer (2)

Hint: This region is few millimetres above the root cap.

Sol.: The cells of the region of meristem are very small, thin walled with dense protoplasm and divide repeatedly.

103. Answer (4)

Hint: Ploidy is the number of sets of chromosomes in a cell of an organism.

Sol.: Pollen grains and cells of embryo sac have only one set of chromosomes inside the nucleus. So they are haploid.

- Zygote-diploid
- Endosperm-mostly triploid in angiosperms
- Seeds-diploid

104. Answer (3)

Hint: In bryophytes, both gametophyte and sporophyte phases are multicellular.

Sol.: Bryophyte show haplo-diplontic life cycle pattern.

105. Answer (1)

Hint: Plastoquinone is small, lipid soluble molecule that can easily move in thylakoid membrane.

Sol.: Excited electrons from photosystem II are picked up by primary electron acceptor pheophytin, then it is transferred to cytochrome b_6f complex via plastoquinone and then transferred to PS I via plastocyanin.

106. Answer (2)

Hint: Uphill transport of molecules requires energy.

Sol.: In facilitated diffusion, transfer of molecules occur from their high concentration to low concentration which do not require energy (ATP).

107. Answer (4)

Hint: PS I involves in both cyclic and non-cyclic photophosphorylation.

Sol.:

- PS I lies on the outer surface of the thylakoid.
- PS I is found in both grana and stroma lamellae. It participates in both cyclic as well as non-cyclic flow of electrons.
- PS I is not associated with splitting of water, only PS II is associated with splitting of water and release of O_2.

108. Answer (2)

Hint: Euglenoids have pigments identical to those present in higher plants.

Sol.: Euglenoids are photosynthetic in the presence of sunlight and when they are deprived of sunlight they behave like heterotrophs by predating on other smaller organisms.

109. Answer (1)

Sol.: *Trypanosoma* is flagellated protozoan.

110. Answer (3)

Hint: Stomata regulate the process of transpiration.

Sol.: Palisade parenchyma are adaxially placed which is made up of elongated cells arranged vertically and parallel to each other.

Spongy parenchyma are loosely arranged oval or round cells situated below the palisade cells.

Bulliform cells are large, empty, colourless cells on adaxial epidermis in grasses.

111. Answer (3)

Hint: In a cross section of old wood, the greater part of it is darker region called heartwood and peripheral region is light in colour called sapwood.

Sol.: Sapwood differs from heartwood as former is involved in conduction of water and minerals from the root to leaf.

112. Answer (3)

Hint: An activator of alcohol dehydrogenase is also required for synthesis of auxin.

Sol.: Zinc is an essential element which is an activator of enzyme alcohol dehydrogenase. It activates various enzymes and also needed in the synthesis of auxin.

113. Answer (1)

Hint: Phycomycetes have aseptate and coenocytic mycelium.

Sol.: In phycomycetes asexual spores, *i.e.*, sporangiospores are produced endogenously in sporangium. These spores are mitospores.

114. Answer (1)

Hint: Dikaryophase is observed in members of ascomycetes and basidiomycetes.

Sol.: *Agaricus* is a member of basidiomycetes shows dikaryophase. Members of Deuteromycetes reproduce only by asexual spores.

Basidiospores are exogenously produced on basidium.

Deuteromycetes help in mineral cycling.

115. Answer (4)

Hint: Characteristic features which are exclusively present in all living organisms are defining features.

Sol.: Cellular organisation, consciousness and metabolism are regarded as defining features of all living organisms.

116. Answer (2)

Hint: During S phase, DNA synthesis or replication takes place.

Sol.: There is no increase in chromosome number, if the cell had diploid or 2n number of chromosome at G_1 phase, even after S phase the number of chromosome remains the same *i.e.*, 2n.

117. Answer (3)

Hint: The given figure is of Golgi apparatus, a densely stained reticular structure near the nucleus.

Sol.: Golgi apparatus was first observed by Camillo Golgi.

- These structures principally perform the function of packaging of materials.
- It is the important site for the formation of glycoproteins and glycolipids.

118. Answer (2)

Hint: For complete oxidation of each glucose molecule, 2 turns of TCA cycle are required.

Sol.: From 1 glucose molecule

Glycolysis yields – 2 ATP (Net gain)

TCA yields – 2 ATP

∴ From two molecules of glucose

4 × 2 = 8 ATP is the net gain.

119. Answer (4)

Hint: The complex is called cytochrome *c* oxidase complex.

Sol.: In ETS, complex IV or cytochrome *c* oxidase complex contains cytochrome *a* and a_3 and two copper centres.

120. Answer (3)

Hint: This hormone is also known as stress hormone.

Sol.: Abscisic acid can be used as anti transpirant and induce dormancy of buds, seeds and storage organ.

121. Answer (3)

Hint: Pneumatophores are respiratory roots.

Sol.: In *Rhizophora* or plants growing in swampy areas, many roots come out of the ground and grow vertically upwards. Such roots are called pneumatophores that help to get oxygen for respiration.

122. Answer (2)

Hint: In vexillary aestivation, largest posterior petal overlaps lateral petals.

Sol.: In bean and pea flower, vexillary or papilionaceous aestivation is found.

- China rose and cotton have twisted aestivation.
- *Calotropis* has valvate aestivation.

123. Answer (3)

Sol.: *Psilotum*-Psilopsida.

Selaginella-Lycopsida.

Equisetum-Sphenopsida.

Dryopteris-Pteropsida.

124. Answer (2)

Hint: Water moves from its higher water potential to lower water potential. Pure water has maximum ψ_w.

Sol.: By mixing salt into the water, water potential decreases.

Therefore, water will move from higher water potential *i.e.*, from container A to lower water potential *i.e.*, container B.

125. Answer (4)

Hint: This reaction is one of the steps in nitrification.

Sol.: Ammonia is first oxidised to nitrite by the bacteria *Nitrosomonas* and *Nitrococcus.*

Denitrification is carried out by bacteria *Pseudomonas* and *Thiobacillus*.

126. Answer (3)

Hint: They are pathogenic in both plants and animals.

Sol.: The Mycoplasma completely lacks cell wall. It is smallest living cell known so far and can survive without oxygen.

127. Answer (1)

Hint: Cruciform corolla is found in family Brassicaceae.

Sol.: Floral formula for members of Brassicaceae is $\oplus$ ⚥ $K_{2+2}C_{\times 4}A_{2+4}\underline{G}_{(2)}$

128. Answer (4)

Hint: All tissues inner to the endodermis constitute stele.

Sol.: Stele comprises of pericycle, vascular bundles and pith.

129. Answer (2)

Hint: Ribosomes are not surrounded by any membrane.

Sol.: Lysosome and Golgi apparatus are single membrane bound cell organelles.

The chloroplast and mitochondria are double membrane bound structures.

130. Answer (4)

Hint: This element is an activator of RuBisCO and PEPcase.

Sol.: When concentration of Mg^{2+} reduces below critical level both ribosomal subunits get separated. By raising the concentration of Mg^{2+} ion in the matrix, the two ribosome sub units become associated with each other.

131. Answer (1)

Hint: During final stage of prophase I, the chromosomes become fully condensed.

Sol.: Final stage of prophase-I is diakinesis. During this stage, meiotic spindle is assembled for separation of homologous chromosomes.

132. Answer (3)

Hint: Lower the taxa more common are the characteristics that the members within the taxon share.

Sol.: When we move from kingdom to the species the number of common characteristics will increase.

133. Answer (2)

Hint: The arrangement of ovules within the ovary is known as placentation. Parietal placentation is found in mustard and *Argemone.*

Sol.:

- Axile placentation - Lemon.
- Basal placentation - Marigold.
- Free central placentation - *Primrose.*

134. Answer (3)

Hint: Members of Rhodophyceae show oogamy and accompanied by post fertilisation development.

Sol.: *Gracilaria, Gelidium* and *Porphyra* are members of Rhodophyceae.

135. Answer (1)

Sol.: In C_3 plant during photorespiration the RuBP binds to oxygen to form one molecule of phosphoglycerate (3-carbon) and phosphoglycolate (2-carbon).

SECTION - B

136. Answer (2)

Hint: During incomplete oxidation of glucose, the reducing agent NADH + H^+ is reoxidised to NAD^+.

Sol.: During fermentation, the incomplete oxidation of glucose is achieved under anaerobic condition and NADH + H^+ is reoxidised to NAD^+.

137. Answer (2)

Hint: Plant absorbs water from the root hairs and it is transported to leaves of plants through xylem.

Sol.: The correct sequence of tissue in the pathway of movement of water in the root is

Epidermis $\rightarrow$ Cortex $\rightarrow$ Endodermis $\rightarrow$ Pericycle $\rightarrow$ Xylem.

138. Answer (3)

Hint: Xylem and phloem fibres are infact sclerenchymatous.

Sol.: Tracheids, vessels and xylem fibres are dead elements of xylem. Xylem parenchyma cells are living cells.

Sieve tube element, companion cells and phloem parenchyma are living elements.

Phloem fibres/bast fibres are dead cells.

139. Answer (3)

Hint: Potato spindle tuber disease is caused by an infectious agent that was discovered by T.O. Diener.

Sol.: T.O. Diener discovered a new infectious agent viroid that was smaller than viruses and caused potato spindle tuber disease.

140. Answer (1)

Hint: In racemose inflorescence, the main axis continues to grow and flower are borne laterally.

Sol.:

- In cymose type of inflorescence flowers are borne in a basipetal order.
- Flower *Cassia* can be divided into two similar halves only in one particular vertical plane. It has zygomorphic symmetry.
- Flowers of Guava, Cucumber and ray floret of sunflower have inferior ovary.

141. Answer (4)

Hint: The large forms of brown algae possess air bladder for providing buoyancy.

Sol.: *Fucus* has air bladder which provides buoyancy.

142. Answer (3)

Sol.: Key is taxonomical aid used for identification of plants and animal and they are generally analytical in nature.

143. Answer (3)

Hint: Plant body of liverwort is thalloid.

Sol.: In *Marchantia*, thallus is dorsiventral and closely appressed to the substratum.

Funaria, Polytrichum and *Sphagnum* are mossess.

144. Answer (1)

Hint: The pattern of arrangement of leaves on the stem or branch is called phyllotaxy.

Sol.: In *Alstonia*, more than two leaves arise at a node and form a whorl. It is called whorled phyllotaxy.

145. Answer (2)

Hint: When condensation of chromosomes is completed, they can be observed under microscope.

Sol.: At metaphase stage of M phase, morphology of chromosome is most easily studied.

146. Answer (3)

Hint: In photosynthesis, ATP synthesis is linked to the development of proton gradient across a membrane.

Sol.: Splitting of water molecules takes place in the inner side of the thylakoid membrane. The protons or hydrogen ions that are produced by the splitting of water accumulate within the lumen of the thylakoids.

147. Answer (4)

Hint: Two molecules of ATP are used up in the activation phase of glycolysis.

Sol.: The net gain of ATP in the process of glycolysis from one molecule of glucose is two.

148. Answer (3)

Hint: Members of Basidiomycetes produce basidiospores exogenously on the basidium.

Sol.:

- *Ustilago,* is a member of basidiomycetes in which basidiospores are produced exogenously on the basidium.
- *Aspergillus, Claviceps* and *Neurospora* are members of Ascomycetes produce ascospores endogenously in sac like asci.

149. Answer (1)

Sol.: An embryo sac has one egg cell, two synergids, three antipodal cells and one central cell.

150. Answer (3)

Sol.: In fungi, asexual reproduction is by spore called conidia, sporangiospores or zoospores.

Sexual reproduction takes place by oospores, ascospores and basidiospores

[ZOOLOGY]

SECTION - A

151. Answer (1)

Hint: Member of phylum Aschelminthes

Sol.: Members of phylum Aschelminthes are pseudocoelomates and have bilateral symmetry e.g., *Wuchereria*. *Hirudinaria*, *Limulus* and *Fasciola* belongs to phylum Annelida, Arthropoda and Platyhelminthes respectively.

152. Answer (2)

Hint: Human beings have different types of teeth

Sol.:

Monophyodont	–	Teeth which appear only once in the lifetime.
Diphyodont	–	Teeth which appear two times in the lifetime.
Acrodont	–	Teeth are superficially attached to the jaw bone, *e.g.*, in fishes.
Thecodont	–	Each tooth is embedded in a socket of jaw bone.

Homodont – All teeth are similar.

Heterodont – Teeth are of different types

153. Answer (2)

Hint: Invertase is also known as sucrase.

Sol.: $\text{Sucrose} \xrightarrow{\text{Sucrase/invertase}} \text{Glucose} + \text{Fructose}$

$\text{Lactose} \xrightarrow{\text{Lactase}} \text{Glucose + Galactose}$

$\text{Maltose} \xrightarrow{\text{Maltase}} \text{Glucose + Glucose}$

$\text{Proteins} \xrightarrow[\text{Carboxypeptidase}]{\text{Trypsin/Chymotrypsin}} \text{Dipeptides}$

154. Answer (2)

Hint: Acts as good antioxidant

Sol.: The deficiency of vitamin K causes faulty blood clotting and deficiency of vitamin E (Tocopherol) may cause reproductive failure.

155. Answer (1)

Hint: Nucleic acids are digested by enzymes in pancreatic juice

Sol.: Lactase, sucrase, lipases, dipeptidases and nucleosidases are present in succus entericus.

Chymotrypsinogen and nucleases are present in pancreatic juice.

Chymotrypsin helps in digestion of proteins, peptones and proteoses into dipeptides, whereas nucleases help in digestion of nucleic acids into nucleotides.

156. Answer (3)

Hint: *Ascidia* belongs to this sub-phylum

Sol.: Amphioxus (*Branchiostoma*) is a member of sub-phylum Cephalochordata. *Ascidia*, *Salpa* and *Doliolum* are members of sub-phylum Urochordata.

157. Answer (2)

Hint: It can alter the pH of blood

Sol.: High concentration of enzyme carbonic anhydrase is present in RBCs and minute quantities are also present in plasma. At the tissue level, CO_2 diffuses into blood (RBCs and plasma) and forms HCO_3^- and H^+. At the alveolar site where pCO_2 is low, the reaction proceeds in the opposite direction leading to formation of CO_2 and H_2O.

158. Answer (3)

Hint: Abdominal muscles help in forceful expiration

Sol.:

During inspiration	–	Diaphragm and external intercostal muscles contract.
During normal expiration	–	Diaphragm and external intercostal muscles relax.
During forceful expiration	–	Internal intercostal muscles and abdominal muscles contract.

159. Answer (3)

Hint: It includes expiratory reserve volume and residual volume

Sol.:

Tidal Volume (TV)	=	500 mL
Inspiratory Reserve Volume (IRV)	=	2500–3000 mL
Expiratory Reserve Volume (ERV)	=	1000–1100 mL
Residual Volume (RV)	=	1100–1200 mL
Inspiratory Capacity (IC)	=	TV + IRV
	=	3000–3500 mL
Functional residual Capacity (FRC)	=	ERV + RV = 2100 – 2300 mL
Vital Capacity (VC)	=	ERV + TV + IRV
	=	4000 – 4600 mL

160. Answer (2)

Hint: Their percentage is more than that of eosinophils

Sol.: Monocytes – 6–8 percent

Basophils – 0.5–1 percent

Eosinophils – 2–3 percent

Lymphocytes – 20–25 percent

161. Answer (3)

Hint: In these network of threads, dead and damaged formed elements of blood are trapped

Sol.: During an injury, platelets get activated and alongwith tissue at the site of injury release certain factors, which *via* a cascade process helps in the formation of enzyme complex *i.e.*, thrombokinase.

$$\text{Prothrombin} \xrightarrow[\text{Ca}^{2+}]{\text{Thrombokinase}} \text{Thrombin}$$

$$\text{Fibrinogen} \xrightarrow[\text{Ca}^{2+}]{\text{Thrombin}} \text{Fibrin}$$

Fibrins form a network of threads which traps dead and damaged formed elements of blood to form the blood clot.

162. Answer (4)

Hint: Human beings have closed circulatory system

Sol.: Open circulatory system: The blood pumped by the heart passes through large vessels into open spaces or body cavities called sinuses. It is present in arthropods and molluscs.

Closed circulatory system: The blood pumped by the heart is always circulated through a closed network of blood vessels. It is present in most annelids and most chordates.

163. Answer (3)

Hint: *Ophiura* belongs to same phylum

Sol.: *Obelia* is a cnidarian which exhibits alternation of generation (metagenesis).

Saccoglossus is a hemichordate having proboscis gland as an excretory organ.

Asterias (Star fish) is an echinoderm having indirect development with free-swimming larva.

Hippocampus (Sea horse) belongs to class Osteichthyes, in which air bladder is present that regulates buoyancy.

164. Answer (4)

Hint: Individual with blood group 'O' is an universal donor

Sol.:

Blood group	Donor's blood group
A	O, A
B	O, B
O	O
AB	O, A, B and AB

165. Answer (2)

Hint: Thrombus means clot

Sol.: Heart failure: It is the state of heart when it is not pumping blood effectively enough to meet the needs of the body.

Coronary thrombosis: Occurs due to formation of clot in coronary artery.

Heart attack: When the heart muscle is suddenly damaged by an inadequate blood supply.

Heart murmur: Due to defective or damaged heart valves, the improper closure leads to leakage of blood which produces an abnormal sound referred to as heart murmur.

166. Answer (3)

Hint: Terrestrial molluscs live in crisis of water

Sol.:

Ammonotelic – *e.g.*, many bony fishes, aquatic amphibians and aquatic insects.

Ureotelic – *e.g.*, mammals, terrestrial amphibians and marine fishes.

Uricotelic – *e.g.*, reptiles, birds, land snails and insects.

167. Answer (3)

Hint: Aldosterone causes reabsorption of Na^+ and water from the distal parts of the tubule

Sol.: Ascending limb of Henle's loop allows transport of electrolytes actively or passively and is impermeable to water. PCT helps in maintaining the pH and ionic balance of the body fluids by selective secretion of hydrogen ions, ammonia and potassium ions into filtrate and by reabsorption of HCO_3^- from it.

168. Answer (2)

Hint: Also known as macula adherens

Sol.: Tight junctions help to stop substances from leaking across a tissue. Gap junctions connect the cytoplasm of adjoining cells for rapid transfer of ions, small molecules and sometimes bigger molecules.

169. Answer (3)

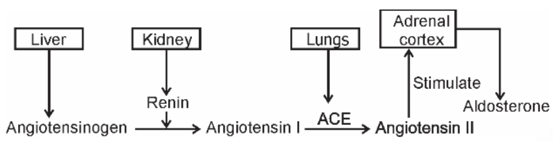
Hint: It is eliminated out of the body by sweat glands

Sol.: Sebaceous glands eliminate certain substances like sterols, hydrocarbons and waxes through sebum. Sweat glands also help in elimination of certain substances in the form of sweat which contains NaCl, small amounts of urea, lactic acid etc.

170. Answer (4)

Hint: Largest gland of the body situated in the abdominal cavity

Sol.: Angiotensinogen is synthesised in liver and released in blood.



171. Answer (4)

Hint: It is a type of specialised connective tissue

Sol.: Dense regular connective tissue like tendon and ligament, areolar tissue (a type of loose connective tissue) and cartilage (a type of specialised connective tissue), all have cells that secrete fibres of structural proteins called collagen or elastin.

172. Answer (2)

Hint: It is also present in ducts of glands

Sol.: Squamous epithelium: Found in the walls of blood vessels and air sacs of lungs.

Ciliated epithelium: Found in the inner surface of bronchioles and fallopian tubes.

Columnar epithelium: Found in lining of stomach and intestine.

173. Answer (3)

Hint: High amount of calcium ions will help in faster rate of contraction

Sol.: Red muscle fibres have more myoglobin and plenty of mitochondria. They have slow rate of contraction for long periods. White muscle fibres have less amount of myoglobin and mitochondria. They carry out anaerobic oxidation for energy production and have a fast rate of contraction for short periods.

174. Answer (1)

Hint: Disorder caused by decreased level of estrogen is an age-related disorder

Sol.

Tetany	–	Rapid spasm in muscles due to low calcium ions in body fluid.
Myasthenia gravis	–	Autoimmune disorder affecting neuromuscular junction leading to fatigue, weakening and paralysis of skeletal muscle.
Osteoporosis	–	Age-related disorder characterised by decreased bone mass and increased chances of fractures. Decreased levels of estrogen is a common cause.
Osteoarthritis	–	Degenerative joint disease characterised by the degeneration of articular cartilage and proliferation of new bones.
Arthritis	–	Inflammation of joints, characterised by pain, swelling, redness and heat.

175. Answer (1)

Hint: In gliding joint, the articulating ends of both the bones can easily glide over each other

Sol.:

Joint		**Examples**
Hinge joint	–	Elbow joint and knee joint
Pivot joint	–	Joint between radius and ulna just below the elbow
Gliding joint	–	Between the carpals
Saddle joint	–	Between carpal and metacarpal of thumb side
Ellipsoid joint	–	Joint between radius and carpal

176. Answer (3)

Hint: It is located in pelvic region

Sol.:

Cervical vertebrae	–	7
Thoracic vertebrae	–	12
Lumbar vertebrae	–	5
Sacrum	–	1 (formed by fusion of 5 bones)
Coccyx	–	1 (formed by fusion of 4 bones)

177. Answer (4)

Hint: It is amphipathic in nature

Sol.: The given figure is of lecithin, a phospholipid commonly found in cell membrane.

178. Answer (4)

Hint: K_m increases when inhibitor resembles with substrate

Sol.: In competitive inhibition, the value of K_m increases as it takes a higher concentration of the substrate to reach the $\frac{1}{2}$ of V_{max}.

179. Answer (3)

Hint: Respiratory rhythm centre is also present in the same region

Sol.: Vomit centre is located in medulla oblongata. Hippocampus along with other structures like amygdala form limbic system. Hypothalamus contains a number of centres which control body temperature, eating, drinking, etc.

180. Answer (4)

Hint: Association areas are neither clearly sensory nor motor in function

Sol.: Association areas are responsible for intersensory associations, memory and communication. In Parkinson's disease, there is decrease in level of dopamine.

181. Answer (4)

Hint: They are mainly involved in protein synthesis

Sol.: Ribosomes are involved in protein synthesis and RER in post-translational modifications.

182. Answer (3)

Hint: Neurohypophysis does not produce any hormone

Sol.: Pituitary gland produces GH, PRL, TSH, ACTH, LH, FSH and MSH. Posterior pituitary do not produce any hormone, rather stores and releases oxytocin and vasopressin (ADH) which are produced by hypothalamus.

183. Answer (3)

Hint: Other options are part of female reproductive tract

Sol.: The two lobes of thyroid gland are connected by a thin flap of connective tissue called isthmus. Ampulla, fimbriae and infundibulum are regions of fallopian tube present in female reproductive tract.

184. Answer (3)

Hint: Thymosins play a major role in differentiation of T-lymphocytes

Sol.: After puberty, the thymus starts to shrink, thereby producing less thymosins. B cells produce antigen specific antibodies and T cells can recognise processed pathogenic antigens even in older persons, but due to degenerating thymus, production of thymosins is decreased which are essential for T lymphocytes differentiation and production of antibodies by plasma cells.

185. Answer (1)

Hint: Inhibits the production of lymphocytes in the lymphoid tissues

Sol.: Cortisol produces anti-inflammatory reactions and suppresses the immune response. Cortisol also suppresses the synthesis of antibodies by inhibiting the production of lymphocytes in the lymphoid tissues and is therefore also called an immunosuppressor.

SECTION - B

186. Answer (4)

Hint: Erythropoiesis means formation of RBCs

Sol.: Progesterone does not stimulate RBC production. Aldosterone acts on renal tubules and stimulates reabsorption of Na^+ and water and secretion of K^+ and phosphate ions.

187. Answer (2)

Hint: Conn's syndrome is characterised by high plasma Na^+ and low plasma K^+

Sol.: Conn's syndrome: Caused by excessive secretion of aldosterone from an adrenal cortical tumour. It is characterised by high plasma Na^+, low plasma K^+, rise in blood volume and high B.P.

Myxedema: Caused by deficiency of thyroid hormones in adults. Its symptoms include puffy appearance, decrease in alertness and intelligence, low metabolic rate, slow heart rate.

Gynaecomastia: It is the development of breasts in males, and is usually due to perturbation of estrogen to androgen ratio.

Precocious puberty: Early maturation of ovaries and testes with production of ova before the age of 9 years in girls, and production of sperms before the age of 10 years in boys.

188. Answer (3)

Hint: Bioluminescence is well marked in ctenophores

Sol.:

Taenia (Tapeworm)	– Belongs to phylum Platyhelminthes.
Ascaris	– Belongs to phylum Aschelminthes.
Echinus	– Belongs to phylum Echinodermata.

189. Answer (2)

Hint: It is present at the end of oesophagus

Sol.:

Pyloric sphincter	– Controls the passage of chyme into duodenum.
Sphincter of Oddi	– Controls the opening of hepatopancreatic duct into duodenum.

Sphincter of Boyden – Controls the opening of common bile duct into pancreatic duct.

190. Answer (4)

Hint: Other respiratory regulatory centres give signal to the specialised centre for remedial actions

Sol.: Oxygen does not play a significant role in regulation of respiratory rhythm. Receptors associated with aortic arch and carotid artery can recognise changes in CO_2 and H^+ concentration and send signals to the respiratory rhythm centre for remedial actions.

191. Answer (1)

Hint: Ventricular repolarisation

Sol.: P-wave represents atrial depolarisation.

QRS complex represents depolarisation of the ventricles.

T-wave represents the repolarisation of ventricles. The end of the T-wave marks the end of systole.

192. Answer (1)

Hint: *Peripatus* is a primitive arthropod

Sol.: *Peripatus* is a connecting link between annelids and arthropods. Tadpole of frog is ammonotelic, whereas adult frog is ureotelic. *Limulus* (King crab) is a living fossil.

193. Answer (2)

Hint: Blood is present in urine

Sol.: Haematuria: Presence of blood in urine

Pyuria: Presence of pus in urine

Cystitis: Inflammation of urinary bladder

194. Answer (2)

Hint: They are phagocytic cells

Sol.: Macrophages and leucocytes in blood exhibit amoeboid movement, effected by pseudopodia, formed by the streaming of protoplasm. Cytoskeletal elements like microfilaments are also involved in amoeboid movement.

Sperm cells show flagellar movement. The inner lining of bronchioles and fallopian tubes are lined by ciliated epithelium.

195. Answer (3)

Hint: It has ATP binding sites

Sol.: Tropomyosin is a part of thin filament. At rest, it covers the myosin binding site on actin filament and hence prevents the formation of cross bridges.

Many meromyosin constitute one thick filament. Each meromyosin has 2 parts: a globular head with a short arm (heavy meromyosin) and a tail (light meromyosin). The globular head is an active ATPase enzyme and has binding sites for ATP and active sites for actin.

196. Answer (4)

Hint: They are secreted directly into the fluid bathing the structure

Sol.: Exocrine glands secrete saliva, mucus, earwax, milk, digestive enzymes etc., but not hormones. Hormones are secreted by endocrine glands directly into the fluid bathing the glands.

197. Answer (3)

Hint: Ootheca

Sol.: Malpighian tubules, urecose glands, nephrocytes and fat body are associated with excretion in cockroach. Mushroom shaped gland is a part of male reproductive system and collaterial glands are a part of female reproductive system in cockroach.

198. Answer (3)

Hint: Electrical current can flow directly from one neuron to other through electrical synapses

Sol.: At electrical synapses, the pre-synaptic and post-synaptic membranes are in very close proximity and transmission of impulse across electrical synapse is very similar to impulse conduction along a single axon.

199. Answer (3)

Hint: Nerve impulse travels from one neuron to other *via* electrical or chemical synapses

Sol.: Myelin sheath protects the axons of a neuron and acts as an insulating layer. Only the axon terminals (synaptic knobs) can release neurotransmitters which travel *via* synaptic cleft and reach post-synaptic membrane (dendrite of the next neuron) to transmit nerve impulses.

200. Answer (3)

Hint: Haem is an organic compound

Sol.: Prosthetic groups and co-enzymes, both are organic compounds. Haem is a prosthetic group for enzyme peroxidase and catalase, and it is a part of the active site of the enzyme.

❑ ❑ ❑

All India Aakash Test Series for NEET-2023

TEST - 7 (Code-D)

Test Date : 27/03/2022

ANSWERS

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

HINTS & SOLUTIONS

[PHYSICS]

SECTION - A

1. Answer (4)

Hint: $\widehat{PQ} = \dfrac{\overrightarrow{PQ}}{|\overrightarrow{PQ}|}$

Sol.: $\overrightarrow{PQ} = \overrightarrow{OQ} - \overrightarrow{OP}$

$= (5\hat{i} + 4\hat{j} - 3\hat{k}) - (2\hat{i} + 3\hat{j} - 4\hat{k})$

$= 3\hat{i} + \hat{j} + \hat{k}$

$|\overrightarrow{PQ}| = \sqrt{3^2 + 1^2 + 1^2}$

$= \sqrt{11}$

$\widehat{PQ} = \dfrac{3\hat{i} + \hat{j} + \hat{k}}{\sqrt{11}}$

2. Answer (3)

Hint & Sol.: $v = \sqrt{\dfrac{\gamma RT}{M}}$

$v_{\text{rms}} = \sqrt{\dfrac{3RT}{M}}$

$\dfrac{v}{v_{\text{rms}}} = \sqrt{\dfrac{\gamma}{3}}$

$v \propto v_{\text{rms}}$

3. Answer (4)

Hint: $f = f_0\left(\dfrac{v \pm v_0}{v \pm v_s}\right)$

Sol.: $f_1 = f_0\left(\dfrac{340}{340-34}\right)$

$f_2 = f_0\left(\dfrac{340}{340-17}\right)$

$\dfrac{f_1}{f_2} = \dfrac{340-17}{340-34}$

$= \dfrac{19}{18}$

4. Answer (3)

Hint: $f = \dfrac{(2n+1)v}{4l}$

Sol.: $f_0 = \dfrac{v}{4l}$

$f_2 = \dfrac{5v}{4l}$

$\dfrac{f_0}{f_2} = \dfrac{1}{5}$

$f_2 = 5 \times 40$

$= 200$ Hz

5. Answer (2)

Hint: Beats frequency = $|f_1 - f_2|$

Sol.: $\dfrac{1}{2l}\dfrac{10}{\sqrt{\mu}} - f = 5$ ...(i)

$f - \dfrac{9}{2l\sqrt{\mu}} = 5$ ...(ii)

(i) + (ii)

$\dfrac{1}{2l\sqrt{\mu}} = 10$

On putting $\dfrac{1}{2l\sqrt{\mu}} = 10$

$100 - f = 5$

$f = 95$ Hz

6. Answer (3)

Hint & Sol.: In stationary waves energy is minimum at nodes and maximum at antinodes.

7. Answer (1)

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

Sol.: $v_{\max} = A\omega$

$\dfrac{A\omega}{2} = \omega\sqrt{A^2 - x^2}$

$\dfrac{A^2}{4} = A^2 - x^2$

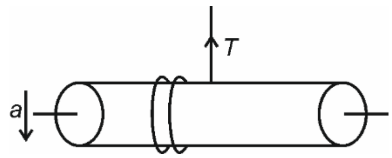
$x^2 = \dfrac{3A^2}{4}$

$x = \dfrac{\sqrt{3}A}{2}$

8. Answer (2)

Hint: $\tau = I\alpha$ and $F = ma$

Sol.:



$Mg - T = Ma$ ...(i)

$T \times R = I\alpha$

$T \times R = \frac{MR^2}{2}\frac{a}{R}$

$T = \frac{Ma}{2}$ ...(ii)

(i) + (ii)

$Mg = \frac{3Ma}{2}$

$a = \frac{2g}{3}$

9. Answer (1)

Hint: $W = \vec{F} \cdot \vec{d}$

Sol.: $a = \frac{F}{m}$

$= \frac{5}{20}$

$= \frac{1}{4}$ m/s^2

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

$= \frac{1}{2} \times \frac{1}{4}(2 \times 3 - 1)$

$= \frac{5}{8}$ m

$W = 5 \times \frac{5}{8}$

$= \frac{25}{8}$ J

10. Answer (4)

Hint & Sol.: For perfectly elastic collision, $e = 1$

For inelastic collision, $0 < e < 1$

For perfectly inelastic collision, $e = 0$

In explosion final kinetic energy is greater than initial kinetic energy.

11. Answer (4)

Hint & Sol.: Direction of acceleration is continuously changing and is always towards the centre for uniform circular motion.

12. Answer (2)

Hint & Sol.: $T - 2mg = 2ma$

$\Rightarrow T = 2ma + 2mg$

$2ma + 2mg \le 6mg$

$2ma \le 4mg$

$\Rightarrow a \le 2g$

13. Answer (2)

Hint: For stable equilibrium, $\frac{dF}{dx} < 0$

Sol.: $F = x^2 - 5x + 6$

Now, $F = 0$

$\Rightarrow x^2 - 5x + 6 = 0$

$\Rightarrow x = 3, 2$

$\frac{dF}{dx} = 2x - 5 \Rightarrow \left.\frac{dF}{dx}\right|_{x=2} < 0$

$\left.\frac{dF}{dx}\right|_{x=3} > 0$

$x = 2$ is position of stable equilibrium

14. Answer (3)

Hint: Area under acceleration time graph gives change in velocity.

Sol.: $v_f - v_i = \int a\,dt$

$v_f - 2 = \frac{1}{2} \times 8 \times 4$

$v_f = 16 + 2$

$v_f = 18$ m/s

15. Answer (2)

Hint: $\vec{v}_{RC} = \vec{v}_{RG} - \vec{v}_{CG}$

Sol.: $(V_{RC})^2 = (V_{RG})^2 + (V_{CG})^2$

$(20)^2 = (10)^2 + (V_{CG})^2$

$\Rightarrow V_{CG} = 10\sqrt{3}$ m/s

16. Answer (2)

Hint: On heating all the dimensions increases.

Sol.: Fractional change in radius is $\frac{\Delta R}{R}$

$\Rightarrow$ Fractional change area $\frac{\Delta A}{A} = \frac{2\Delta R}{R}$

$\Rightarrow$ Fractional change in volume $\frac{\Delta V}{V} = \frac{3\Delta R}{R}$

17. Answer (3)

Hint & Sol.: The heating of glass bulb due to filament occurs by radiation.

18. Answer (1)

Hint & Sol.: $P = \frac{1}{3} \times \frac{N}{V} \times m \times (V_{\text{rms}})^2$

$P \propto m(V_{\text{rms}})^2$

M is halved and v_{rms} is doubled

$\therefore$ P will become two times

19. Answer (2)

Hint: $\Delta U = nC_v\Delta T = \frac{n \times 5R \times \Delta T}{2}$ ...(i)

Sol.: From first law of thermodynamics

$\Delta U = \Delta Q - \Delta W$

$= Q - \frac{Q}{3}$

$\Delta U = Q - \frac{Q}{3} = \frac{2Q}{3}$ ...(ii)

$\frac{n \times 5R}{2} \times \Delta T = \frac{2Q}{3} \Rightarrow \frac{15R}{4} = \frac{Q}{n\Delta T}$ ...(iii)

Using equations,

Molar heat capacity $C = \frac{Q}{n\Delta T}$ ...(iv)

Using equations (iii) and (iv)

$\Rightarrow$ $C = \frac{15R}{4}$

20. Answer (4)

Hint: $Q_1 = mC\Delta\theta$,

$Q_2 = mL$

Sol.: Mass of ice melted $= \frac{Q}{L}$

$= \frac{mC\theta}{L}$

21. Answer (1)

Hint & Sol.:

$Y = \frac{FL}{A\Delta L}$

$F = \frac{YA}{L}\Delta L$ ...(i)

$F = kx$ ...(ii)

On comparing (i) and (ii), $K = \frac{YA}{L}$

22. Answer (3)

Hint: Force exerted on the side = $\frac{\rho g h A_1}{2}$

Sol.: Force exerted on the bottom = $\rho g h A_2$

Force exerted on sides = Average pressure × area

$= \frac{\rho g h}{2} \times 2\pi r h$

$\Rightarrow$ $\frac{\rho g h}{2} \times 2\pi r h = \rho g h \times \pi r^2$

$\Rightarrow$ $h = r$

23. Answer (3)

Hint: $M = \rho V$

Sol.: $V_1 = \frac{m}{2\rho}$

$V_2 = \frac{m}{4\rho}$

$V_1 + V_2 = \frac{2m}{\rho'}$

$\frac{m}{2\rho} + \frac{m}{4\rho} = \frac{2m}{\rho'}$

$\frac{2+1}{4\rho} = \frac{2}{\rho'}$

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

24. Answer (3)

Hint: Energy of a satellite around earth in radius r is $= \frac{-GMm}{2r}$

Sol.: $U_i = \frac{-GMm}{6R}$

$U_f = \frac{-GMm}{8R}$

$W = U_f - U_i$

$= \frac{-GMm}{8R} + \frac{GMm}{6R}$

$= \frac{-3GMm + 4GMm}{24R}$

$= \frac{GMm}{24R}$

25. Answer (1)

Hint: $V = \frac{-GM}{R}$

Sol.: $V = \frac{-GM}{R}$

On decreasing R gravitational potential V decreases.

26. Answer (1)

Hint: $W_{\text{isothermal}} = nRT_0 \ln\left(\frac{V_2}{V_1}\right)$

Sol.: $W_{\text{isobaric}} = nRT_0$

$W_1 = nRT_0$ (for isobaric process)

$W_2 = nRT_0 \ln\left(\frac{2V}{V}\right)$ (for isothermal process)

$W_2 = nRT_0 \ln 2$

$W_2 = W_1 \ln 2$

27. Answer (2)

Hint: At constant volume $C_V = \frac{R}{\gamma - 1}$

Sol.: For diatomic gas $\gamma = \left(\frac{7}{5}\right)$

$$C_v = \frac{R}{\left(\frac{7}{5} - 1\right)}$$

$$C_v = \frac{R}{\frac{2}{5}}$$

$$R = \frac{2}{5}C_v$$

$n = 0.4$

28. Answer (1)

Hint: $g = g_P - R\omega^2 \cos^2 \phi$

Sol.: At $\phi = 37°$, $g = 0$

$$0 = g_P - R\omega^2 \cos^2 37°$$

$$\omega = \frac{1}{\cos 37°}\sqrt{\frac{g_P}{R}}$$

$$\omega = \frac{5}{4}\sqrt{\frac{g_P}{R}}$$

29. Answer (1)

Hint: $T = 2\pi\sqrt{\frac{m}{k}}$

Sol.: $T = 2\pi\sqrt{\frac{m}{k}}$

$$2\pi = 2\pi\sqrt{\frac{m}{k}}$$

$k = m$

$kx = mg$

$x = 10$ m

30. Answer (4)

Hint: Area under force-displacement curve gives work done

Sol.: $W = \Delta K$ [From work-energy theorem]

$$\frac{1}{2}Mv^2 - 0 = 10 \times 10 + \frac{1}{2} \times 10 \times 25$$

$v^2 = 100 + 125$

$v^2 = 225$

$v = 15$ m/s

31. Answer (1)

Hint: $\tau = I\alpha$

Sol.: For solid cylinder $I_C = \frac{MR^2}{2}$

for solid sphere $I_S = \frac{2}{5}MR^2$

$I_C > I_S$

$\alpha_C < \alpha_S$

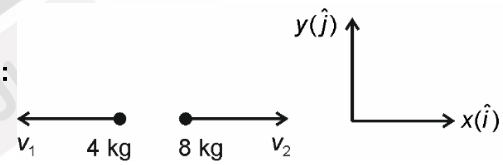
$\omega = \omega_0 + \alpha t$

$\omega_C < \omega_S$

32. Answer (3)

Hint: $\vec{v}_{cm} = \frac{M_1\vec{v}_1 + M_2\vec{v}_2}{M_1 + M_2}$

Sol.:



$$\vec{v}_{cm} = \frac{-2 \times 4\hat{i} + 8 \times 3\hat{i}}{4 + 8}$$

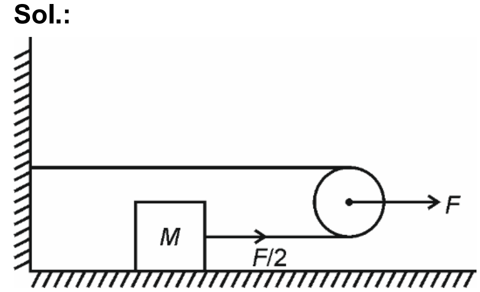
$$\vec{v}_{cm} = \frac{-8\hat{i} + 24\hat{i}}{12}$$

$$= \frac{16\hat{i}}{12} = \frac{4\hat{i}}{3} \text{ m/s}$$

33. Answer (3)

Hint: $F - f = ma$

Sol.:



$\frac{F}{2} - f = Ma$

12 – $\mu Mg = Ma$

12 – 0.2 × 10M = M

12 = 3M

M = 4 kg

34. Answer (3)

Hint: $\tan\alpha = \frac{u\sin\theta - gt}{u\cos\theta}$

Sol.: $\tan 37^\circ = \frac{u\sin 53^\circ - gt}{u\cos 53^\circ}$

$\frac{3}{4} = \frac{\frac{4u}{5} - gt}{\frac{3}{5}u}$

$\frac{9u}{20} = \frac{4u}{5} - gt$

$gt = \frac{4u}{5} - \frac{9u}{20}$

$gt = \frac{16u - 9u}{20}$

$t = \frac{7u}{20g}$

35. Answer (1)

Hint: $A = l \times b$

$\frac{\Delta A}{A} = \frac{\Delta l}{l} + \frac{\Delta b}{b}$

Sol.: $A = l \times b$

= 40 × 30

= 1200 cm^2

$\frac{\Delta A}{A} = \frac{0.2}{40} + \frac{0.1}{30}$

$\Delta A = \frac{0.2}{40} \times 1200 + \frac{0.1}{30} \times 1200$

ΔA = 6 + 4 = 10 cm^2

SECTION - B

36. Answer (3)

Hint: $v = \frac{\omega}{k}$ and $K = \frac{2\pi}{\lambda}$

Sol.: $v = \frac{\omega}{k}$

$= \frac{50\pi}{10\pi}$

= 5 m/s

37. Answer (3)

Hint: $v = \frac{dx}{dt}$

Sol.: $v = \frac{d}{dt}(t^2 - 3t + 4)$

$v = 2t - 3$

$v = 0$

t = 1.5 s

38. Answer (2)

Hint: L.C = 1MSD – 1 VSD

Sol.: (N)VSD = 10 MSD

1VSD=$\frac{10}{N}$ MSD

$L.C = 1\text{MSD} - \frac{10}{\text{N}}\text{MSD}$

$0.05\text{ cm} = \left(1 - \frac{10}{\text{N}}\right)\frac{1\text{ cm}}{10}$

N = 20 division

39. Answer (2)

Hint: $-\sqrt{a^2 + b^2} \le a\sin\theta + b\cos\theta \le \sqrt{a^2 + b^2}$

Sol.: $-\sqrt{3^2 + 4^2} \le 3\sin\omega t + 4\cos\omega t \le \sqrt{3^2 + 4^2}$

$-5 \le 3\sin\omega t + 4\cos\omega t \le 5$

$y_{\min} = 6 - 5$

$= 1$

40. Answer (3)

Hint & Sol.: $\left[\frac{\text{T}}{\eta}\right] = \left[\frac{\text{MT}^{-2}}{\text{ML}^{-1}\text{T}^{-1}}\right]$

= [LT^{-1}]

41. Answer (1)

Hint: Use conservation of linear momentum

Sol.: $Mv_1 = 2Mv_2$

$v_1 = 2v_2$

By conservation of linear momentum

$Mv_1 + Mv_2 = 2Mv$

$v = \frac{3v_2}{2}$

$\frac{1}{2}2M(v)^2 = M\left(\frac{3v_2}{2}\right)^2$

$= \frac{9Mv_2^2}{4}$

$\frac{Mv_2^2}{2} \times \frac{9}{2} = 9$

$\frac{Mv_2^2}{2} = 2\text{ J}$

42. Answer (4)

Hint & Sol.: $\tau = I\alpha$

Rotational K.E $= \frac{1}{2}I\omega^2$

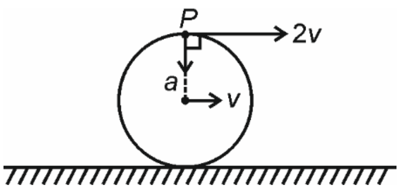
$L = I\omega$

work done by centripetal force is zero.

43. Answer (3)

Hint: Acceleration at point $P = \frac{v^2}{R}$ towards the centre

Sol.:



Since the body is having constant angular velocity hence only centripetal acceleration would be there. Hence angle between acceleration and velocity at point P is 90°.

44. Answer (2)

Hint & Sol.: Due to weight of the rope, the tension will increase along the rope from the lower end to the upper end. Hence, the pulse will travel with increasing speed of $v = \sqrt{\frac{T}{\mu}}$

45. Answer (2)

Hint & Sol.: Inside the water, weight = upthrust

$\therefore$ apparent weight = 0

46. Answer (4)

Hint: $\frac{T - \text{ice point}}{\text{Steam point} - \text{ice point}} = \frac{F-32}{180}$

Sol.: $\frac{52° - 5°}{99° - 5°} = \frac{F-32}{180°}$

$\frac{47°}{94°} = \frac{F-32°}{180°}$

$\frac{1}{2} = \frac{F-32°}{180°}$

$F = 122°\text{F}$

47. Answer (3)

Hint: $\frac{T_1 - T_2}{t} = k\left(\frac{T_1+T_2}{2} - T_0\right)$

Sol.: $\frac{75° - 65°}{2} = k\left(\frac{75°+65°}{2} - 30°\right)$

$5 = k(40)$

$k = \frac{1}{8}$

$\frac{55° - 45°}{t} = k\left(\frac{55°+45°}{2} - 30°\right)$

$\frac{10°}{t} = \frac{1}{8}(50° - 30°)$

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

= 4 min

48. Answer (2)

Hint: $F_{\text{applied}} < f_{s_{\max}}$ then friction force acting on the block will be equal to applied force.

Sol.: $f_{s_{\max}} = \mu_s N$

$= \frac{1}{2} \times 4 \times 10$

= 20 N

$F_{\text{applied}} < f_{s_{\max}}$

f = 16 N

49. Answer (3)

Hint: $\tan\theta = \frac{u_y}{u_x}$

Sol.: $v^2 = u^2 + 2as$ (along y direction)

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

$2^2 = u^2 - 2 \times 0.4 \times 10$

$u^2 = 12$

$u_y = 2\sqrt{3}$ m/s

$\tan\theta = \frac{2\sqrt{3}}{6}$

$\theta = 30°$

50. Answer (4)

Hint: The quantity $\left(\frac{t}{a} - 1\right)$ should be dimensionless

Sol.: $\frac{dt}{\sqrt{2at - t^2}}$

$\Rightarrow$ a should have the dimension of 't' so the term on LHS is dimensionless.

The argument of sine function is dimensionless. So the power of a should be zero to make RHS dimensionless.

[CHEMISTRY]

SECTION - A

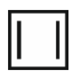
51. Answer (2)

Hint and Sol.: The maximum limit of nitrate in drinking water is 50 ppm. Excess of nitrate in drinking water causes disease such as methemoglobinemia ('blue baby' syndrome).

52. Answer (3)

Hint: Cyclic planar species which follows Huckel rule with complete delocalisation of π electrons in the ring are aromatic in nature.

Sol.:

-  : Cyclic, planar, 4π electrons: anti-aromatic
-  : Cyclic, non-planar (Tub like structure): non-Aromatic
-  : Cyclic, planar, 6π electrons: aromatic
-  : Cyclic, planar, 4π electron: anti-aromatic

53. Answer (1)

Hint: Addition of water takes place according to Markovnikov's addition.

Sol.:

$$CH_3-C\equiv CH + H_2O \xrightarrow[333\ K]{Hg^{2+}/H^+} CH_3-\underset{(A)}{\overset{OH}{\overset{|}{C}}}=CH_2$$

$$\Big\Updownarrow \text{Tautomerises}$$

$$CH_3-\underset{(B)}{\overset{O}{\overset{\|}{C}}}-CH_3$$

54. Answer (2)

Hint: Equilibrium constant for the reverse reaction is the inverse of the equilibrium constant for the reaction in the forward direction.

Sol.:

- $A_2(g)+B_2(g) \rightleftharpoons 2AB(g) \qquad K = K_C$
- $2AB(g) \rightleftharpoons A_2(g)+B_2(g) \qquad K' = \dfrac{1}{K_C}$
- $AB(g) \rightleftharpoons \dfrac{1}{2}A_2(g)+\dfrac{1}{2}B_2(g) \quad K'' = \dfrac{1}{\sqrt{K_C}}$

55. Answer (1)

Hint: % of bromine $= \dfrac{80\times W_{AgBr}\times 100}{188\times W_{Organic\ comp}}$

Sol.: Molar Mass of AgBr = 108 + 80 = 188 g

188 g of AgBr contains 80 g of bromine

0.15 g of AgBr contains $\dfrac{80}{188}\times 0.15$ g of bromine

% of bromine $= \dfrac{80\times 0.15\times 100}{188\times 0.2}$

$= 31.9\% \simeq 32\%$

56. Answer (4)

Hint: Hybridization depends upon number of σ bonds and lone pairs of electrons.

Sol.:

$$\underset{sp^3}{H_3C}-\underset{sp^2}{CH}=\underset{sp^2}{CH}-\underset{sp^2}{\overset{:\ddot{O}}{\overset{\|}{C}}}-\underset{sp^3}{CH_2}-\underset{sp}{C}\equiv N$$

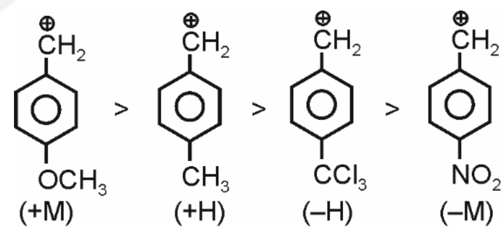
Number of *sp* hybridized carbon atom = 1

Number of sp^2 hybridized carbon atoms = 3

57. Answer (4)

Hint: Electron donating group increases the stability of the carbocation.

Sol.: Correct order of stability of carbocation is



58. Answer (2)

Hint: In 13th group, down the group, the stability of lower oxidation state increases because of inert pair effect.

Sol.: Down the group, due to poor shielding effect of intervening *d* and *f* orbitals, the increased effective nuclear charge holds n*s* electrons tightly and thereby, restricting their participation in bonding.

$\therefore$ The relative stability of +1 oxidation state progressively increases for heavier elements: i.e., Al < Ga < In < Tl

59. Answer (3)

Hint: In pyrosilicates, one oxygen atom is shared between two SiO_4^{4-} tetrahedron.

Sol.:

- Orthosilicates : SiO_4^{4-}
- Chain silicates : $\left(SiO_3^{2-}\right)_n$
- Pyrosilicates : $Si_2O_7^{6-}$
- Sheet silicates : $\left(Si_2O_5^{2-}\right)_n$

60. Answer (2)

Hint: All alkaline earth metal nitrates decompose on heating to give the corresponding oxides.

Sol.:

- Among alkali metal nitrates, only lithium nitrate on heating gives oxide whereas, other alkali metal nitrates give corresponding nitrites.
- $4LiNO_3 \rightarrow 2Li_2O + 4NO_2 + O_2$
- $2NaNO_3 \rightarrow 2NaNO_2 + O_2$
- $2Mg(NO_3)_2 \rightarrow 2MgO + 4NO_2 + O_2$
- $2Ba(NO_3)_2 \rightarrow 2BaO + 4NO_2 + O_2$

61. Answer (4)

Hint: In acidic medium, H_2O_2 oxidises PbS into $PbSO_4$

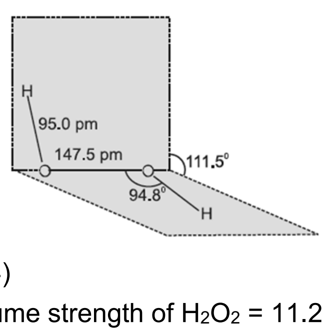
$PbS(s) + 4H_2O_2(aq) \rightarrow PbSO_4(s) + 4H_2O(l)$

Sol.:

- H_2O_2 decomposes slowly on exposure to light

  $2H_2O_2(l) \rightarrow 2H_2O(l) + O_2(g)$

  It is therefore, stored in wax lined glass or plastic vessels in dark.
- Dihedral angle of H_2O_2 in gas phase is 111.5°



62. Answer (4)

Hint: Volume strength of H_2O_2 = 11.2 × molarity

Sol.: Volume strength of H_2O_2 = 11.2 × 0.5 = 5.6 V

63. Answer (3)

Hint: Presence of soluble salts of magnesium and calcium in the form of chlorides and sulphate in water causes permanent hardness of water.

Sol.: Temporary hardness of water is due to the presence of magnesium and calcium hydrogen carbonates.

64. Answer (2)

Hint: Lower is the value of standard reduction potential, higher will be the reducing power of the metal.

Sol.: Correct order of reducing power of the metals is

Cu < Fe < Al < K

65. Answer (1)

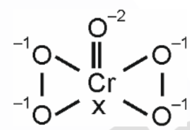
Hint and Sol.: Balance equation is

$$Cr_2O_7^{2-}(aq) + 3SO_3^{2-}(aq) + 8H^+(aq) \rightarrow 2Cr^{3+}(aq) + 3SO_4^{2-}(aq) + 4H_2O(l)$$

66. Answer (4)

Hint: CrO_5 contains 2 peroxide bonds.

Sol.:



$x + 4(-1) + 1(-2) = 0$

$x = +6$

67. Answer (4)

Hint: For endothermic reaction, increase in temperature shifts the equilibrium in the forward direction.

Sol.:

- Increasing the concentration of products, will shift the equilibrium in the backward direction.
- Decreasing the temperature of endothermic reaction, will shift the equilibrium in the backward direction.
- Addition of inert gas at constant volume, will not change the state of equilibrium.
- Addition of inert gas at constant pressure, will shift the equilibrium towards more number of gaseous mole *i.e.*, in forward direction.

68. Answer (3)

Hint:

- Bronsted acid $-H^+ \rightarrow$ Conjugate base
- Bronsted base $+H^+ \rightarrow$ Conjugate acid

Sol.:

- $HCO_3^- + H^+ \rightarrow H_2CO_3$

Bronsted base   Conjugate acid

- $HCO_3^- - H^+ \rightarrow CO_3^{2-}$

Bronsted acid   Conjugate base

69. Answer (2)

Hint: $pOH = -\log[OH^-]$

Sol.:

- $[OH^-] = 0.1 = 10^{-1}$ M
- $pOH = -\log(10^{-1})$
  $= 1$
- $pH + pOH = 14$
- $pH = 14 - 1$
  $= 13$

70. Answer (2)

Hint: Enthalpy of combustion is the amount of heat released when 1 mole of the substance is completely burnt.

Sol.: $C(s) + O_2(g) \rightarrow CO_2(g)$

When 12 g of C, undergoes combustion, heat released is 393.5 kJ

When 1.2 g of C, undergoes combustion, heat released will be 39.35 kJ.

71. Answer (1)

Hint: $\Delta_r H = \Sigma(BE)_{Reactants} - \Sigma(BE)_{Products}$

Sol.: $\frac{1}{2}A_2(g) + \frac{1}{2}B_2(g) \rightarrow AB(g)$

$$\Delta_f H = \Delta_r H = \frac{1}{2} \times BE_{A_2} + \frac{1}{2} \times BE_{B_2} - BE_{A-B}$$

$$= \frac{1}{2}a + \frac{1}{2}b - c$$

72. Answer (2)

Hint: For irreversible process, P_{ext} is constant

$\therefore$ $w = -P_{ext}\Delta V$

According to first law of thermodynamics.

- $\Delta U = q + w$

Sol.: Work done $= -10^5(10^{-2} - 10^{-4})$

$= -10^5(9.9 \times 10^{-3})$

$= -9.9 \times 10^2$ J

$= -990$ J

According to first law of thermodynamics

$\Delta U = q + w$

$\because$ $\Delta U = 0$ (isothermal process)

$\therefore$ $q = -w$

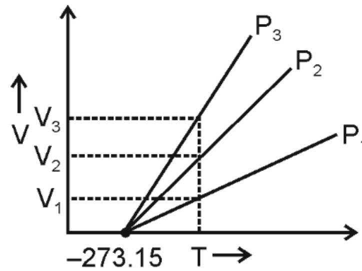
$= -(-990 \text{ J})$

$= 990$ J

73. Answer (3)

Hint: At constant temperature, $P \propto \frac{1}{V}$

Sol.:



At constant temperature, $P \propto \frac{1}{V}$

$\because$ $V_3 > V_2 > V_1$

$\therefore$ $P_1 > P_2 > P_3$

74. Answer (3)

Hint: Stronger is the intermolecular forces of attraction, more easily the gas will be liquified.

Sol.: Hydrogen bonding exist in NH_3. So, it will be most easily liquified.

75. Answer (4)

Hint: According to Graham's Law of diffusion.

$$\frac{r_1}{r_2} = \frac{(V/t)_1}{(V/t)_2} = \sqrt{\frac{M_2}{M_1}}$$

Sol.: $\frac{r_x}{r_{He}} = \frac{t_{He}}{t_x} = \sqrt{\frac{M_{He}}{M_x}}$

or $\frac{1}{4} = \sqrt{\frac{4}{M_x}} \Rightarrow \frac{1}{16} = \frac{4}{M_x}$

$M_x = 64$ u

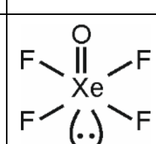
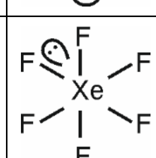
$\therefore$ The gas could be SO_2

76. Answer (3)

Hint:

- Hybridization depends upon number of hybrid orbitals.
- Number of hybrid orbitals = number of σ bonds + number of lone pairs of electrons on central atom.

Sol.:

	Structure	Number of hybrid orbitals	Hybridization of Xe
$XeOF_4$		5 + 1 = 6	sp^3d^2
XeF_6		6 + 1 = 7	sp^3d^3

77. Answer (4)

Hint:

- Species which contains unpaired electrons are paramagnetic in nature.
- Species which contains no unpaired electrons are diamagnetic in nature.
- $B.O. = \frac{1}{2}(N_b - N_a)$

Sol.:

Molecular orbital configurations

- $H_2(2e^-) : \sigma 1s^2$

B.O. = 1, (Diamagnetic)

- $H_2^-(3e^-) : \sigma 1s^2 \sigma^* 1s^1$

$B.O. = \frac{1}{2}$, (Paramagnetic)

- $N_2(14e^-) : \sigma 1s^2 \sigma^* 1s^2 \sigma 2s^2 \sigma^* 2s^2 \begin{cases} \pi 2p_x^2 \\ \pi 2p_y^2 \end{cases} \sigma 2p_z^2$

B.O. = 3, (Diamagnetic)

- $N_2^-(15e^-) : \sigma 1s^2 \sigma^* 1s^2 \sigma 2s^2 \sigma^* 2s^2 \begin{cases} \pi 2p_x^2 \\ \pi 2p_y^2 \end{cases} \sigma 2p_z^2 \begin{cases} \pi^* 2p_x^1 \\ \pi^* 2p_y \end{cases}$

B.O. = 2.5, (Paramagnetic)

- $O_2(16e^-) : \sigma 1s^2 \sigma^* 1s^2 \sigma 2s^2 \sigma^* 2s^2 \sigma 2p_z^2 \begin{cases} \pi 2p_x^2 \\ \pi 2p_y^2 \end{cases} \begin{cases} \pi^* 2p_x^1 \\ \pi^* 2p_y^1 \end{cases}$

B.O. = 2, (Paramagnetic)

- $O_2^+(15e^-) : \sigma 1s^2 \sigma^* 1s^2 \sigma 2s^2 \sigma^* 2s^2 \sigma 2p_z^2 \begin{cases} \pi 2p_x^2 \\ \pi 2p_y^2 \end{cases} \begin{cases} \pi^* 2p_x^1 \\ \pi^* 2p_y \end{cases}$

B.O. = 2.5, (Paramagnetic)

- $C_2(12e^-) : \sigma 1s^2 \sigma^* 1s^2 \sigma 2s^2 \sigma^* 2s^2 \begin{cases} \pi 2p_x^2 \\ \pi 2p_y^2 \end{cases}$

B.O. = 2, (Diamagnetic)

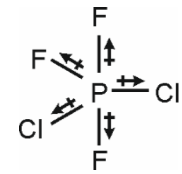
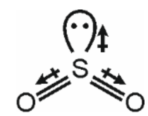
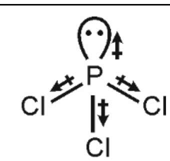
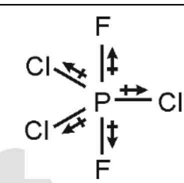
- $C_2^-(13e^-) : \sigma 1s^2 \sigma^* 1s^2 \sigma 2s^2 \sigma^* 2s^2 \begin{cases} \pi 2p_x^2 \\ \pi 2p_y^2 \end{cases} \sigma 2p_z^1$

B.O. = 2.5, (paramagnetic)

78. Answer (4)

Hint: Species for which $\mu_{net} = 0$, are non-polar

Sol.:

	Structure	
• PCl_2F_3		$\mu_{net} \neq 0$
• SO_2		$\mu_{net} \neq 0$
• PCl_3		$\mu_{net} \neq 0$
• PCl_3F_2	 (All bond dipoles cancel out each other)	$\mu_{net} = 0$

79. Answer (4)

Hint: Volume of n mole of a gas at (STP) = n × 22.4 L

Sol.:

$$C_2H_6(g) + \frac{7}{2}O_2(g) \rightarrow 2CO_2 + 3H_2O(l)$$

1 mol	$\frac{7}{2}$ mol	
$\frac{4.5}{30}$ mol	$\frac{7}{2} \times 0.15$ mol	
0.15 mol	0.525 mol	

∴ Volume of O_2 required at STP = 0.525 × 22.4

= 11.76 L

80. Answer (4)

Hint: The electron gain enthalpy of O and F (i.e., second period element) is less negative than those of the succeeding elements as when electron adds to n = 2 quantum level, it suffers significant electronic repulsion from the other electrons.

Sol.:

- Down the group, in the Modern Periodic Table, the metallic character increases.
- On moving left to right in periodic table, the electronegativity increases.

- Generally, on moving left to right, IE increases but IE of N is more than that of O because of the stable electronic configuration of N.

Element	$\Delta_{eg}H$ (kJ mol^{-1})
O	–141
S	–200
Se	–195
Te	–190

81. Answer (3)

Hint and Sol.:

Atomic Number	IUPAC official Name
101	Mendelevium
107	Bohrium
102	Nobelium
106	Seaborgium
105	Dubnium

82. Answer (4)

Hint: For any value of l, the value of m_l ranges from –l to + l.

Sol.:

- Energy of the orbitals in the same subshell decreases with increase in the atomic number ($Z_{eff.}$)

  $\therefore$ $E_{2s}(H) > E_{2s}(Li) > E_{2s}(Na) > E_{2s}(K)$

- For hydrogen atom, the energy of the orbital depends only upon the principal quantum number

  $\therefore$ $E_{3s} = E_{3p} = E_{3d}$

So, total 9 degenerate orbitals in the third energy level.

- For any value of l, maximum possible value of m_l is 2l + 1.

83. Answer (3)

Hint: Number of angular nodes = l

Number of radial nodes = n – l – 1

Sol.:

- For 5*d*, angular nodes = 2

  radial nodes = 5 – 2 – 1 = 2
- For 5*p*, angular node = 1

  radial nodes = 5 – 1 – 1 = 3
- For 4*p*, angular node = 1

  radial nodes = 4 – 1 – 1 = 2
- For 4*d*, angular nodes = 2

  radial node = 4 – 2 – 1 = 1

84. Answer (4)

Hint: Number of atoms = Number of moles × Avogadro's Number × Atomicity

Sol.:

- 2 mol of H_2 = 2 × 2 N_A atoms = 4 N_A atoms
- 22 g of CO_2 = $\frac{22}{44}$ mol of CO_2 = 0.5 × 3 N_A atoms = 1.5 N_A atoms
- 44.8 L of O_2 at STP = $\frac{44.8}{22.4}$ mole of O_2 = 2 × 2 N_A atoms = 4 N_A atoms
- 27 ml of H_2O =27 g of H_2O = $\frac{27}{18}$ mol = 1.5 × 3 N_A atoms = 4.5 N_A atoms

85. Answer (2)

Hint: Empirical formula is the simplest whole number ratio of atoms of the various elements present in the molecule of the compound.

Sol.:

Element	Percentage	Atomic Mass	Number of moles	Simple ratio
C	26.67	12	$\frac{26.67}{12} = 2.22$	$\frac{2.22}{2.22} = 1$
H	2.22	1	$\frac{2.22}{1} = 2.22$	$\frac{2.22}{2.22} = 1$
O	71.11	16	$\frac{71.11}{16} = 4.44$	$\frac{4.44}{2.22} = 2$

$\therefore$ Empirical formula of the compound is CHO_2

SECTION - B

86. Answer (1)

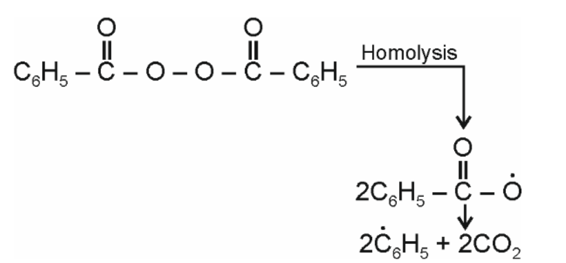
Hint: The common components of photochemical smog are ozone, nitric oxide, acrolein, formaldehyde and peroxyacetyl nitrate (PAN)

Sol.: Both ozone and PAN act as powerful eye irritants.

87. Answer (4)

Hint: In the presence of peroxide, free radical mechanism takes place.

Sol.: Mechanism: Free radical addition reaction.

(i) 

(ii) $\dot{C}_6H_5 + H-Br \xrightarrow{\text{Homolysis}} C_6H_6 + \dot{B}r$

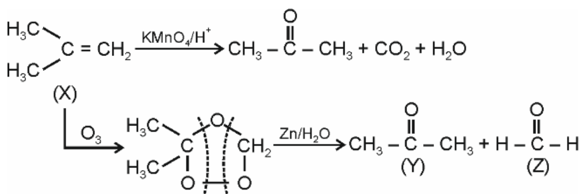
(iii) $CH_3-CH=CH_2+\dot{B}r \xrightarrow{\text{Homolysis}} \underset{\text{(Minor)}}{CH_3-\underset{|}{\overset{}{CH}}\!\!\underset{Br}{}-\dot{C}H_2} + \underset{\text{(Major)}}{CH_3-\dot{C}H-\underset{Br}{CH_2}}$

(iv) $CH_3-\dot{C}H-CH_2Br+H-Br \xrightarrow{\text{Homolysis}} \underset{\text{(Major)}}{CH_3-CH_2-CH_2Br}+\dot{B}r$

88. Answer (3)

Hint: Acidic potassium permanganate oxidises alkenes to ketones and/or acids depending upon the nature of the alkene.

Sol.:



89. Answer (2)

Hint: Two or more compounds having the same molecular formula but different functional groups are called functional group isomers.

Sol.:

- $CH_3CH_2CH_2CH_3$ and $CH_3-\overset{\overset{CH_3}{|}}{CH}-CH_3$: Chain isomers
- $CH_3-\overset{\overset{O}{||}}{C}-OH$ and $H-\overset{\overset{O}{||}}{C}-OCH_3$: Functional group isomers
- $CH_3CH_2CH_2\overset{\overset{OH}{|}}{CH_2}$ and $CH_3-\overset{\overset{OH}{|}}{CH}-CH_2CH_3$: Position isomers
- $CH_3CH_2CH_2OCH_3$ and $CH_3CH_2OCH_2CH_3$: Metamers

90. Answer (3)

Hint: On heating, orthoboric acid above 370 K forms metaboric acid, HBO_2 which on further heating yields boric oxide, B_2O_3.

$$H_3BO_3 \xrightarrow{\Delta} HBO_2 \xrightarrow{\Delta} B_2O_3$$

Sol.:

- Borax dissolves in water to give an alkaline solution.

  $Na_2B_4O_7 + 7H_2O \rightarrow 2NaOH + \underset{\text{Orthoboric acid}}{4H_3BO_3}$

- Boric acid can be prepared by acidifying an aqueous solution of borax

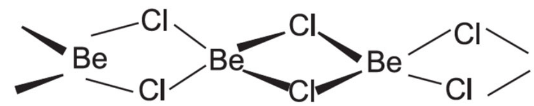
$Na_2B_4O_7 + 2HCl + 5H_2O \rightarrow 2NaCl + 4B(OH)_3$

91. Answer (2)

Hint: Smaller the cations, more will be the covalent character in ionic compound.

Sol.:

- Because of small size of Be, its halides are essentially covalent in nature and are soluble in organic solvent.
- In solid state, $BeCl_2$ has a chain structure.



92. Answer (1)

Hint: Among alkaline earth metals, as the atomic number of the metal increases, the basic character of their hydroxides also increases.

Sol.: Correct order of basic character of hydroxides is

$Ba(OH)_2 > Sr(OH)_2 > Ca(OH)_2 > Mg(OH)_2$

93. Answer (2)

Hint: In a disproportionation reaction, an element in one oxidation state is simultaneously oxidised and reduced

Sol.:

Reduction

$$\overset{0}{S_8}(s) + 12OH^-(aq) \rightarrow 4S^{2-}(aq) + 2\overset{+2}{S_2}O_3^{2-}(aq) + 6H_2O$$

Oxidation

Disproportionation reaction

94. Answer (3)

Hint: A salt of strong acid and weak base undergoes cationic hydrolysis only.

Sol.:

- CH_3COONH_4 : Salt of weak acid and weak base.

  It undergoes both cationic and anionic hydrolysis.

- CH_3COONa : Salt of weak acid and strong base

  It undergoes only anionic hydrolysis

- NH_4Cl : Salt of strong acid and weak base

  It undergoes cationic hydrolysis only

- $NaCl$: Salt of strong acid and strong base

  It does not undergo hydrolysis

95. Answer (3)

Hint: An intensive property is a property whose value does not depends on the quantity or size of matter present in the system.

Sol.:

- Density is an intensive property
- Heat capacity, Internal energy and volume are extensive properties.

96. Answer (2)

Hint: van der Waals equation for n mole of a real gas is

$$\left(P+\frac{an^2}{V^2}\right)(V-nb)=nRT$$

Sol.: At high pressure, $P+\frac{an^2}{V^2}\simeq P$

So, van der Waals equation for 1 mol gas becomes,

P(V – b) = RT

or, PV – Pb = RT

Dividing by RT

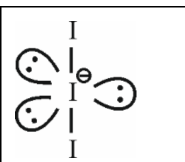
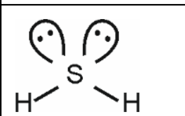
$$\frac{PV}{RT}-\frac{Pb}{RT}=\frac{RT}{RT}=1$$

$$Z=1+\frac{Pb}{RT}\quad\left(\because \frac{PV}{RT}=Z\right)$$

97. Answer (4)

Hint: *sp* hybridized molecule is linear in shape

Sol.:

I_3^-		Linear
CO_2	O = C = O	Linear
C_2H_2	$H-C\equiv C-H$	Linear
H_2S		Bent

98. Answer (2)

Hint: Alkali and Alkaline earth metal oxides are generally basic in nature.

Sol.:

- N_2O : Neutral
- MgO : Basic
- As_2O_3 : Amphoteric
- CO_2 : Acidic

99. Answer (3)

Hint: $\frac{1}{\lambda}=R_HZ^2\left(\frac{1}{n_1^2}-\frac{1}{n_2^2}\right)$

Sol.: For first line of Paschen series, n_1 = 3 and n_2 = 4

$$\therefore\quad \frac{1}{\lambda_1}=R_H2^2\left(\frac{1}{(3)^2}-\frac{1}{(4)^2}\right)\qquad ...(i)$$

For second line of Balmer series, n_1 = 2 and n_2 = 4

$$\therefore\quad \frac{1}{\lambda_2}=R_H2^2\left(\frac{1}{(2)^2}-\frac{1}{(4)^2}\right)\qquad ...(ii)$$

Dividing (ii) by (i)

$$\frac{\lambda_1}{\lambda_2}=\frac{R_H(2)^2\left(\frac{(4)^2-(2)^2}{(2)^2(4)^2}\right)}{R_H(2)^2\left(\frac{(4)^2-(3)^2}{(3)^2(4)^2}\right)}$$

$$=\frac{12\times144}{64\times7}=\frac{27}{7}$$

100. Answer (2)

Hint:

$\because$ Number of equivalents of metal = Number of equivalents of oxygen.

$$\therefore\quad \frac{\text{Mass of metal}}{\text{Equivalent weight of metal}}=\frac{\text{Mass of oxygen}}{\text{Equivalent weight of oxygen}}$$

Sol.:

- Mass of metal oxide = a g
- Mass of oxygen = b g
- $\therefore$ Mass of metal = (a – b) g

Now, $\frac{\text{Mass of metal}}{\text{Equivalent weight of metal}}=\frac{\text{Mass of oxygen}}{\text{Equivalent weight of oxygen}}$

$\frac{a-b}{E_M}=\frac{b}{8}$ ($\because$ Equivalent mass of oxygen = 8 g)

$$E_M=\frac{8(a-b)}{b}$$

[BOTANY]

SECTION - A

101. Answer (1)

Sol.: In C_3 plant during photorespiration the RuBP binds to oxygen to form one molecule of phosphoglycerate (3-carbon) and phosphoglycolate (2-carbon).

102. Answer (3)

Hint: Members of Rhodophyceae show oogamy and accompanied by post fertilisation development.

Sol.: *Gracilaria, Gelidium* and *Porphyra* are members of Rhodophyceae.

103. Answer (2)

Hint: The arrangement of ovules within the ovary is known as placentation. Parietal placentation is found in mustard and *Argemone.*

Sol.:

- Axile placentation - Lemon.
- Basal placentation - Marigold.
- Free central placentation - *Primrose.*

104. Answer (3)

Hint: Lower the taxa more common are the characteristics that the members within the taxon share.

Sol.: When we move from kingdom to the species the number of common characteristics will increase.

105. Answer (1)

Hint: During final stage of prophase I, the chromosomes become fully condensed.

Sol.: Final stage of prophase-I is diakinesis. During this stage, meiotic spindle is assembled for separation of homologous chromosomes.

106. Answer (4)

Hint: This element is an activator of RuBisCO and PEPcase.

Sol.: When concentration of Mg^{2+} reduces below critical level both ribosomal subunits get separated. By raising the concentration of Mg^{2+} ion in the matrix, the two ribosome sub units become associated with each other.

107. Answer (2)

Hint: Ribosomes are not surrounded by any membrane.

Sol.: Lysosome and Golgi apparatus are single membrane bound cell organelles.

The chloroplast and mitochondria are double membrane bound structures.

108. Answer (4)

Hint: All tissues inner to the endodermis constitute stele.

Sol.: Stele comprises of pericycle, vascular bundles and pith.

109. Answer (1)

Hint: Cruciform corolla is found in family Brassicaceae.

Sol.: Floral formula for members of Brassicaceae is $\oplus ⚥ K_{2+2}C_{x4}A_{2+4}\underline{G}_{(2)}$

110. Answer (3)

Hint: They are pathogenic in both plants and animals.

Sol.: The Mycoplasma completely lacks cell wall. It is smallest living cell known so far and can survive without oxygen.

111. Answer (4)

Hint: This reaction is one of the steps in nitrification.

Sol.: Ammonia is first oxidised to nitrite by the bacteria *Nitrosomonas* and *Nitrococcus.*

Denitrification is carried out by bacteria *Pseudomonas* and *Thiobacillus*.

112. Answer (2)

Hint: Water moves from its higher water potential to lower water potential. Pure water has maximum ψ_w.

Sol.: By mixing salt into the water, water potential decreases.

Therefore, water will move from higher water potential *i.e.*, from container A to lower water potential *i.e.*, container B.

113. Answer (3)

Sol.: *Psilotum*-Psilopsida.

Selaginella-Lycopsida.

Equisetum-Sphenopsida.

Dryopteris-Pteropsida.

114. Answer (2)

Hint: In vexillary aestivation, largest posterior petal overlaps lateral petals.

Sol.: In bean and pea flower, vexillary or papilionaceous aestivation is found.

- China rose and cotton have twisted aestivation.
- *Calotropis* has valvate aestivation.

115. Answer (3)

Hint: Pneumatophores are respiratory roots.

Sol.: In *Rhizophora* or plants growing in swampy areas, many roots come out of the ground and grow vertically upwards. Such roots are called pneumatophores that help to get oxygen for respiration.

116. Answer (3)

Hint: This hormone is also known as stress hormone.

Sol.: Abscisic acid can be used as anti transpirant and induce dormancy of buds, seeds and storage organ.

117. Answer (4)

Hint: The complex is called cytochrome *c* oxidase complex.

Sol.: In ETS, complex IV or cytochrome *c* oxidase complex contains cytochrome a and a_3 and two copper centres.

118. Answer (2)

Hint: For complete oxidation of each glucose molecule, 2 turns of TCA cycle are required.

Sol.: From 1 glucose molecule

Glycolysis yields – 2 ATP (Net gain)

TCA yields – 2 ATP

$\therefore$ From two molecules of glucose

4 × 2 = 8 ATP is the net gain.

119. Answer (3)

Hint: The given figure is of Golgi apparatus, a densely stained reticular structure near the nucleus.

Sol.: Golgi apparatus was first observed by Camillo Golgi.

- These structures principally perform the function of packaging of materials.
- It is the important site for the formation of glycoproteins and glycolipids.

120. Answer (2)

Hint: During S phase, DNA synthesis or replication takes place.

Sol.: There is no increase in chromosome number, if the cell had diploid or 2n number of chromosome at G_1 phase, even after S phase the number of chromosome remains the same *i.e.*, 2n.

121. Answer (4)

Hint: Characteristic features which are exclusively present in all living organisms are defining features.

Sol.: Cellular organisation, consciousness and metabolism are regarded as defining features of all living organisms.

122. Answer (1)

Hint: Dikaryophase is observed in members of ascomycetes and basidiomycetes.

Sol.: *Agaricus* is a member of basidiomycetes shows dikaryophase. Members of Deuteromycetes reproduce only by asexual spores.

Basidiospores are exogenously produced on basidium.

Deuteromycetes help in mineral cycling.

123. Answer (1)

Hint: Phycomycetes have aseptate and coenocytic mycelium.

Sol.: In phycomycetes asexual spores, *i.e.*, sporangiospores are produced endogenously in sporangium. These spores are mitospores.

124. Answer (3)

Hint: An activator of alcohol dehydrogenase is also required for synthesis of auxin.

Sol.: Zinc is an essential element which is an activator of enzyme alcohol dehydrogenase. It activates various enzymes and also needed in the synthesis of auxin.

125. Answer (3)

Hint: In a cross section of old wood, the greater part of it is darker region called heartwood and peripheral region is light in colour called sapwood.

Sol.: Sapwood differs from heartwood as former is involved in conduction of water and minerals from the root to leaf.

126. Answer (3)

Hint: Stomata regulate the process of transpiration.

Sol.: Palisade parenchyma are adaxially placed which is made up of elongated cells arranged vertically and parallel to each other.

Spongy parenchyma are loosely arranged oval or round cells situated below the palisade cells.

Bulliform cells are large, empty, colourless cells on adaxial epidermis in grasses.

127. Answer (1)

Sol.: *Trypanosoma* is flagellated protozoan.

128. Answer (2)

Hint: Euglenoids have pigments identical to those present in higher plants.

Sol.: Euglenoids are photosynthetic in the presence of sunlight and when they are deprived of sunlight they behave like heterotrophs by predating on other smaller organisms.

129. Answer (4)

Hint: PS I involves in both cyclic and non-cyclic photophosphorylation.

Sol.:

- PS I lies on the outer surface of the thylakoid.
- PS I is found in both grana and stroma lamellae. It participates in both cyclic as well as non-cyclic flow of electrons.
- PS I is not associated with splitting of water, only PS II is associated with splitting of water and release of O_2.

130. Answer (2)

Hint: Uphill transport of molecules requires energy.

Sol.: In facilitated diffusion, transfer of molecules occur from their high concentration to low concentration which do not require energy (ATP).

131. Answer (1)

Hint: Plastoquinone is small, lipid soluble molecule that can easily move in thylakoid membrane.

Sol.: Excited electrons from photosystem II are picked up by primary electron acceptor pheophytin, then it is transferred to cytochrome b_6f complex via plastoquinone and then transferred to PS I via plastocyanin.

132. Answer (3)

Hint: In bryophytes, both gametophyte and sporophyte phases are multicellular.

Sol.: Bryophyte show haplo-diplontic life cycle pattern.

133. Answer (4)

Hint: Ploidy is the number of sets of chromosomes in a cell of an organism.

Sol.: Pollen grains and cells of embryo sac have only one set of chromosomes inside the nucleus. So they are haploid.

- Zygote-diploid
- Endosperm-mostly triploid in angiosperms
- Seeds-diploid

134. Answer (2)

Hint: This region is few millimetres above the root cap.

Sol.: The cells of the region of meristem are very small, thin walled with dense protoplasm and divide repeatedly.

135. Answer (3)

Hint: Aloe belongs to a monocot family.

Sol.: *Aloe* belongs to family Liliaceae.

SECTION - B

136. Answer (3)

Sol.: In fungi, asexual reproduction is by spore called conidia, sporangiospores or zoospores.

Sexual reproduction takes place by oospores, ascospores and basidiospores

137. Answer (1)

Sol.: An embryo sac has one egg cell, two synergids, three antipodal cells and one central cell.

138. Answer (3)

Hint: Members of Basidiomycetes produce basidiospores exogenously on the basidium.

Sol.:

- *Ustilago,* is a member of basidiomycetes in which basidiospores are produced exogenously on the basidium.
- *Aspergillus, Claviceps* and *Neurospora* are members of Ascomycetes produce ascospores endogenously in sac like asci.

139. Answer (4)

Hint: Two molecules of ATP are used up in the activation phase of glycolysis.

Sol.: The net gain of ATP in the process of glycolysis from one molecule of glucose is two.

140. Answer (3)

Hint: In photosynthesis, ATP synthesis is linked to the development of proton gradient across a membrane.

Sol.: Splitting of water molecules takes place in the inner side of the thylakoid membrane. The protons or hydrogen ions that are produced by the splitting of water accumulate within the lumen of the thylakoids.

141. Answer (2)

Hint: When condensation of chromosomes is completed, they can be observed under microscope.

Sol.: At metaphase stage of M phase, morphology of chromosome is most easily studied.

142. Answer (1)

Hint: The pattern of arrangement of leaves on the stem or branch is called phyllotaxy.

Sol.: In *Alstonia*, more than two leaves arise at a node and form a whorl. It is called whorled phyllotaxy.

143. Answer (3)

Hint: Plant body of liverwort is thalloid.

Sol.: In *Marchantia*, thallus is dorsiventral and closely appressed to the substratum.

Funaria, Polytrichum and *Sphagnum* are mossess.

144. Answer (3)

Sol.: Key is taxonomical aid used for identification of plants and animal and they are generally analytical in nature.

145. Answer (4)

Hint: The large forms of brown algae possess air bladder for providing buoyancy.

Sol.: *Fucus* has air bladder which provides buoyancy.

146. Answer (1)

Hint: In racemose inflorescence, the main axis continues to grow and flower are borne laterally.

Sol.:

- In cymose type of inflorescence flowers are borne in a basipetal order.
- Flower *Cassia* can be divided into two similar halves only in one particular vertical plane. It has zygomorphic symmetry.
- Flowers of Guava, Cucumber and ray floret of sunflower have inferior ovary.

147. Answer (3)

Hint: Potato spindle tuber disease is caused by an infectious agent that was discovered by T.O. Diener.

Sol.: T.O. Diener discovered a new infectious agent viroid that was smaller than viruses and caused potato spindle tuber disease.

148. Answer (3)

Hint: Xylem and phloem fibres are infact sclerenchymatous.

Sol.: Tracheids, vessels and xylem fibres are dead elements of xylem. Xylem parenchyma cells are living cells.

Sieve tube element, companion cells and phloem parenchyma are living elements.

Phloem fibres/bast fibres are dead cells.

149. Answer (2)

Hint: Plant absorbs water from the root hairs and it is transported to leaves of plants through xylem.

Sol.: The correct sequence of tissue in the pathway of movement of water in the root is

Epidermis $\rightarrow$ Cortex $\rightarrow$ Endodermis $\rightarrow$ Pericycle $\rightarrow$ Xylem.

150. Answer (2)

Hint: During incomplete oxidation of glucose, the reducing agent NADH + H^+ is reoxidised to NAD^+.

Sol.: During fermentation, the incomplete oxidation of glucose is achieved under anaerobic condition and NADH + H^+ is reoxidised to NAD^+.

[ZOOLOGY]

SECTION - A

151. Answer (1)

Hint: Inhibits the production of lymphocytes in the lymphoid tissues

Sol.: Cortisol produces anti-inflammatory reactions and suppresses the immune response. Cortisol also suppresses the synthesis of antibodies by inhibiting the production of lymphocytes in the lymphoid tissues and is therefore also called an immunosuppressor.

152. Answer (3)

Hint: Thymosins play a major role in differentiation of T-lymphocytes

Sol.: After puberty, the thymus starts to shrink, thereby producing less thymosins. B cells produce antigen specific antibodies and T cells can recognise processed pathogenic antigens even in older persons, but due to degenerating thymus, production of thymosins is decreased which are essential for T lymphocytes differentiation and production of antibodies by plasma cells.

153. Answer (3)

Hint: Other options are part of female reproductive tract

Sol.: The two lobes of thyroid gland are connected by a thin flap of connective tissue called isthmus. Ampulla, fimbriae and infundibulum are regions of fallopian tube present in female reproductive tract.

154. Answer (3)

Hint: Neurohypophysis does not produce any hormone

Sol.: Pituitary gland produces GH, PRL, TSH, ACTH, LH, FSH and MSH. Posterior pituitary do not produce any hormone, rather stores and releases oxytocin and vasopressin (ADH) which are produced by hypothalamus.

155. Answer (4)

Hint: They are mainly involved in protein synthesis

Sol.: Ribosomes are involved in protein synthesis and RER in post-translational modifications.

156. Answer (4)

Hint: Association areas are neither clearly sensory nor motor in function

Sol.: Association areas are responsible for intersensory associations, memory and communication. In Parkinson's disease, there is decrease in level of dopamine.

157. Answer (3)

Hint: Respiratory rhythm centre is also present in the same region

Sol.: Vomit centre is located in medulla oblongata. Hippocampus along with other structures like amygdala form limbic system. Hypothalamus contains a number of centres which control body temperature, eating, drinking, etc.

158. Answer (4)

Hint: K_m increases when inhibitor resembles with substrate

Sol.: In competitive inhibition, the value of K_m increases as it takes a higher concentration of the substrate to reach the $\frac{1}{2}$ of V_{max}.

159. Answer (4)

Hint: It is amphipathic in nature

Sol.: The given figure is of lecithin, a phospholipid commonly found in cell membrane.

160. Answer (3)

Hint: It is located in pelvic region

Sol.:

Cervical vertebrae	–	7
Thoracic vertebrae	–	12
Lumbar vertebrae	–	5
Sacrum	–	1 (formed by fusion of 5 bones)
Coccyx	–	1 (formed by fusion of 4 bones)

161. Answer (1)

Hint: In gliding joint, the articulating ends of both the bones can easily glide over each other

Sol.:

Joint		**Examples**
Hinge joint	–	Elbow joint and knee joint
Pivot joint	–	Joint between radius and ulna just below the elbow
Gliding joint	–	Between the carpals
Saddle joint	–	Between carpal and metacarpal of thumb side
Ellipsoid joint	–	Joint between radius and carpal

162. Answer (1)

Hint: Disorder caused by decreased level of estrogen is an age-related disorder

Sol.

Tetany	–	Rapid spasm in muscles due to low calcium ions in body fluid.

Myasthenia gravis	–	Autoimmune disorder affecting neuromuscular junction leading to fatigue, weakening and paralysis of skeletal muscle.
Osteoporosis	–	Age-related disorder characterised by decreased bone mass and increased chances of fractures. Decreased levels of estrogen is a common cause.
Osteoarthritis	–	Degenerative joint disease characterised by the degeneration of articular cartilage and proliferation of new bones.
Arthritis	–	Inflammation of joints, characterised by pain, swelling, redness and heat.

163. Answer (3)

Hint: High amount of calcium ions will help in faster rate of contraction

Sol.: Red muscle fibres have more myoglobin and plenty of mitochondria. They have slow rate of contraction for long periods. White muscle fibres have less amount of myoglobin and mitochondria. They carry out anaerobic oxidation for energy production and have a fast rate of contraction for short periods.

164. Answer (2)

Hint: It is also present in ducts of glands

Sol.: Squamous epithelium: Found in the walls of blood vessels and air sacs of lungs.

Ciliated epithelium: Found in the inner surface of bronchioles and fallopian tubes.

Columnar epithelium: Found in lining of stomach and intestine.

165. Answer (4)

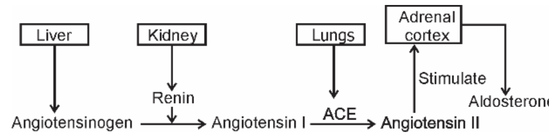
Hint: It is a type of specialised connective tissue

Sol.: Dense regular connective tissue like tendon and ligament, areolar tissue (a type of loose connective tissue) and cartilage (a type of specialised connective tissue), all have cells that secrete fibres of structural proteins called collagen or elastin.

166. Answer (4)

Hint: Largest gland of the body situated in the abdominal cavity

Sol.: Angiotensinogen is synthesised in liver and released in blood.



167. Answer (3)

Hint: It is eliminated out of the body by sweat glands

Sol.: Sebaceous glands eliminate certain substances like sterols, hydrocarbons and waxes through sebum. Sweat glands also help in elimination of certain substances in the form of sweat which contains NaCl, small amounts of urea, lactic acid etc.

168. Answer (2)

Hint: Also known as macula adherens

Sol.: Tight junctions help to stop substances from leaking across a tissue. Gap junctions connect the cytoplasm of adjoining cells for rapid transfer of ions, small molecules and sometimes bigger molecules.

169. Answer (3)

Hint: Aldosterone causes reabsorption of Na^+ and water from the distal parts of the tubule

Sol.: Ascending limb of Henle's loop allows transport of electrolytes actively or passively and is impermeable to water. PCT helps in maintaining the pH and ionic balance of the body fluids by selective secretion of hydrogen ions, ammonia and potassium ions into filtrate and by reabsorption of HCO_3^- from it.

170. Answer (3)

Hint: Terrestrial molluscs live in crisis of water

Sol.:

Ammonotelic	–	*e.g.*, many bony fishes, aquatic amphibians and aquatic insects.
Ureotelic	–	*e.g.*, mammals, terrestrial amphibians and marine fishes.
Uricotelic	–	*e.g.*, reptiles, birds, land snails and insects.

171. Answer (2)

Hint: Thrombus means clot

Sol.: Heart failure: It is the state of heart when it is not pumping blood effectively enough to meet the needs of the body.

Coronary thrombosis: Occurs due to formation of clot in coronary artery.

Heart attack: When the heart muscle is suddenly damaged by an inadequate blood supply.

Heart murmur: Due to defective or damaged heart valves, the improper closure leads to leakage of blood which produces an abnormal sound referred to as heart murmur.

172. Answer (4)

Hint: Individual with blood group 'O' is an universal donor

Sol.:

Blood group	Donor's blood group
A	O, A
B	O, B
O	O
AB	O, A, B and AB

173. Answer (3)

Hint: *Ophiura* belongs to same phylum

Sol.: *Obelia* is a cnidarian which exhibits alternation of generation (metagenesis).

Saccoglossus is a hemichordate having proboscis gland as an excretory organ.

Asterias (Star fish) is an echinoderm having indirect development with free-swimming larva.

Hippocampus (Sea horse) belongs to class Osteichthyes, in which air bladder is present that regulates buoyancy.

174. Answer (4)

Hint: Human beings have closed circulatory system

Sol.: Open circulatory system: The blood pumped by the heart passes through large vessels into open spaces or body cavities called sinuses. It is present in arthropods and molluscs.

Closed circulatory system: The blood pumped by the heart is always circulated through a closed network of blood vessels. It is present in most annelids and most chordates.

175. Answer (3)

Hint: In these network of threads, dead and damaged formed elements of blood are trapped

Sol.: During an injury, platelets get activated and alongwith tissue at the site of injury release certain factors, which *via* a cascade process helps in the formation of enzyme complex *i.e.*, thrombokinase.

$$\text{Prothrombin} \xrightarrow[\text{Ca}^{2+}]{\text{Thrombokinase}} \text{Thrombin}$$

$$\text{Fibrinogen} \xrightarrow[\text{Ca}^{2+}]{\text{Thrombin}} \text{Fibrin}$$

Fibrins form a network of threads which traps dead and damaged formed elements of blood to form the blood clot.

176. Answer (2)

Hint: Their percentage is more than that of eosinophils

Sol.: Monocytes – 6–8 percent

Basophils – 0.5–1 percent

Eosinophils – 2–3 percent

Lymphocytes – 20–25 percent

177. Answer (3)

Hint: It includes expiratory reserve volume and residual volume

Sol.:

Tidal Volume (TV)	=	500 mL
Inspiratory Reserve Volume (IRV)	=	2500–3000 mL
Expiratory Reserve Volume (ERV)	=	1000–1100 mL
Residual Volume (RV)	=	1100–1200 mL
Inspiratory Capacity (IC)	=	TV + IRV
	=	3000–3500 mL
Functional residual Capacity (FRC)	=	ERV + RV = 2100 – 2300 mL
Vital Capacity (VC)	=	ERV + TV + IRV
	=	4000 – 4600 mL

178. Answer (3)

Hint: Abdominal muscles help in forceful expiration

Sol.:

During inspiration	–	Diaphragm and external intercostal muscles contract.
During normal expiration	–	Diaphragm and external intercostal muscles relax.
During forceful expiration	–	Internal intercostal muscles and abdominal muscles contract.

179. Answer (2)

Hint: It can alter the pH of blood

Sol.: High concentration of enzyme carbonic anhydrase is present in RBCs and minute quantities are also present in plasma. At the tissue level, CO_2 diffuses into blood (RBCs and plasma) and forms HCO_3^- and H^+. At the alveolar site where pCO_2 is low, the reaction proceeds in the opposite direction leading to formation of CO_2 and H_2O.

180. Answer (3)

Hint: *Ascidia* belongs to this sub-phylum

Sol.: Amphioxus (*Branchiostoma*) is a member of sub-phylum Cephalochordata. *Ascidia*, *Salpa* and *Doliolum* are members of sub-phylum Urochordata.

181. Answer (1)

Hint: Nucleic acids are digested by enzymes in pancreatic juice

Sol.: Lactase, sucrase, lipases, dipeptidases and nucleosidases are present in succus entericus.

Chymotrypsinogen and nucleases are present in pancreatic juice.

Chymotrypsin helps in digestion of proteins, peptones and proteoses into dipeptides, whereas nucleases help in digestion of nucleic acids into nucleotides.

182. Answer (2)

Hint: Acts as good antioxidant

Sol.: The deficiency of vitamin K causes faulty blood clotting and deficiency of vitamin E (Tocopherol) may cause reproductive failure.

183. Answer (2)

Hint: Invertase is also known as sucrase.

Sol.: $\text{Sucrose} \xrightarrow{\text{Sucrase/invertase}} \text{Glucose} + \text{Fructose}$

$\text{Lactose} \xrightarrow{\text{Lactase}} \text{Glucose} + \text{Galactose}$

$\text{Maltose} \xrightarrow{\text{Maltase}} \text{Glucose} + \text{Glucose}$

$\text{Proteins} \xrightarrow[\text{Carboxypeptidase}]{\text{Trypsin/Chymotrypsin}} \text{Dipeptides}$

184. Answer (2)

Hint: Human beings have different types of teeth

Sol.:

Monophyodont – Teeth which appear only once in the lifetime.

Diphyodont – Teeth which appear two times in the lifetime.

Acrodont – Teeth are superficially attached to the jaw bone, *e.g.*, in fishes.

Thecodont – Each tooth is embedded in a socket of jaw bone.

Homodont – All teeth are similar.

Heterodont – Teeth are of different types

185. Answer (1)

Hint: Member of phylum Aschelminthes

Sol.: Members of phylum Aschelminthes are pseudocoelomates and have bilateral symmetry e.g., *Wuchereria*. *Hirudinaria*, *Limulus* and *Fasciola* belongs to phylum Annelida, Arthropoda and Platyhelminthes respectively.

SECTION - B

186. Answer (3)

Hint: Haem is an organic compound

Sol.: Prosthetic groups and co-enzymes, both are organic compounds. Haem is a prosthetic group for enzyme peroxidase and catalase, and it is a part of the active site of the enzyme.

187. Answer (3)

Hint: Nerve impulse travels from one neuron to other *via* electrical or chemical synapses

Sol.: Myelin sheath protects the axons of a neuron and acts as an insulating layer. Only the axon terminals (synaptic knobs) can release neurotransmitters which travel *via* synaptic cleft and reach post-synaptic membrane (dendrite of the next neuron) to transmit nerve impulses.

188. Answer (3)

Hint: Electrical current can flow directly from one neuron to other through electrical synapses

Sol.: At electrical synapses, the pre-synaptic and post-synaptic membranes are in very close proximity and transmission of impulse across electrical synapse is very similar to impulse conduction along a single axon.

189. Answer (3)

Hint: Ootheca

Sol.: Malpighian tubules, urecose glands, nephrocytes and fat body are associated with excretion in cockroach. Mushroom shaped gland is a part of male reproductive system and collaterial glands are a part of female reproductive system in cockroach.

190. Answer (4)

Hint: They are secreted directly into the fluid bathing the structure

Sol.: Exocrine glands secrete saliva, mucus, earwax, milk, digestive enzymes etc., but not hormones. Hormones are secreted by endocrine glands directly into the fluid bathing the glands.

191. Answer (3)

Hint: It has ATP binding sites

Sol.: Tropomyosin is a part of thin filament. At rest, it covers the myosin binding site on actin filament and hence prevents the formation of cross bridges.

Many meromyosin constitute one thick filament. Each meromyosin has 2 parts: a globular head with a short arm (heavy meromyosin) and a tail (light meromyosin). The globular head is an active ATPase enzyme and has binding sites for ATP and active sites for actin.

192. Answer (2)

Hint: They are phagocytic cells

Sol.: Macrophages and leucocytes in blood exhibit amoeboid movement, effected by pseudopodia, formed by the streaming of protoplasm. Cytoskeletal elements like microfilaments are also involved in amoeboid movement.

Sperm cells show flagellar movement. The inner lining of bronchioles and fallopian tubes are lined by ciliated epithelium.

193. Answer (2)

Hint: Blood is present in urine

Sol.: Haematuria: Presence of blood in urine

Pyuria: Presence of pus in urine

Cystitis: Inflammation of urinary bladder

194. Answer (1)

Hint: *Peripatus* is a primitive arthropod

Sol.: *Peripatus* is a connecting link between annelids and arthropods. Tadpole of frog is ammonotelic, whereas adult frog is ureotelic. *Limulus* (King crab) is a living fossil.

195. Answer (1)

Hint: Ventricular repolarisation

Sol.: P-wave represents atrial depolarisation.

QRS complex represents depolarisation of the ventricles.

T-wave represents the repolarisation of ventricles. The end of the T-wave marks the end of systole.

196. Answer (4)

Hint: Other respiratory regulatory centres give signal to the specialised centre for remedial actions

Sol.: Oxygen does not play a significant role in regulation of respiratory rhythm. Receptors associated with aortic arch and carotid artery can recognise changes in CO_2 and H^+ concentration and send signals to the respiratory rhythm centre for remedial actions.

197. Answer (2)

Hint: It is present at the end of oesophagus

Sol.:

Pyloric sphincter	– Controls the passage of chyme into duodenum.
Sphincter of Oddi	– Controls the opening of hepatopancreatic duct into duodenum.
Sphincter of Boyden	– Controls the opening of common bile duct into pancreatic duct.

198. Answer (3)

Hint: Bioluminescence is well marked in ctenophores

Sol.:

Taenia (Tapeworm)	– Belongs to phylum Platyhelminthes.
Ascaris	– Belongs to phylum Aschelminthes.
Echinus	– Belongs to phylum Echinodermata.

199. Answer (2)

Hint: Conn's syndrome is characterised by high plasma Na^+ and low plasma K^+

Sol.: Conn's syndrome: Caused by excessive secretion of aldosterone from an adrenal cortical tumour. It is characterised by high plasma Na^+, low plasma K^+, rise in blood volume and high B.P.

Myxedema: Caused by deficiency of thyroid hormones in adults. Its symptoms include puffy appearance, decrease in alertness and intelligence, low metabolic rate, slow heart rate.

Gynaecomastia: It is the development of breasts in males, and is usually due to perturbation of estrogen to androgen ratio.

Precocious puberty: Early maturation of ovaries and testes with production of ova before the age of 9 years in girls, and production of sperms before the age of 10 years in boys.

200. Answer (4)

Hint: Erythropoiesis means formation of RBCs

Sol.: Progesterone does not stimulate RBC production. Aldosterone acts on renal tubules and stimulates reabsorption of Na^+ and water and secretion of K^+ and phosphate ions.

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