

All India Aakash Test Series for NEET - 2027

OPEN MOCK TEST - 2[Click here for Code-J Sol.](#)

Test Date : 29/03/2026

ANSWERS

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

HINTS & SOLUTIONS

[PHYSICS]

1. Answer (2)

Hint: Gravitational potential inside due to spherical shell is $V = \frac{-GM}{R}$.

Sol.: Mass remains constant.

By decreasing radius, potential V decreases.

2. Answer (3)

Hint: Maximum horizontal distance (R_{\max}) = $\frac{u^2}{a_p}$

Sol.: $R_{\max} = \frac{u^2}{a_p}$

$$\Rightarrow 18 = \frac{12 \times 12}{a_p}$$

$$\Rightarrow a_p = \frac{144}{18} = 8 \text{ m s}^{-2}$$

3. Answer (3)

Hint & Sol.: Greater is the mass, greater is the inertia. Hence a greater force is required to change the state of the body.

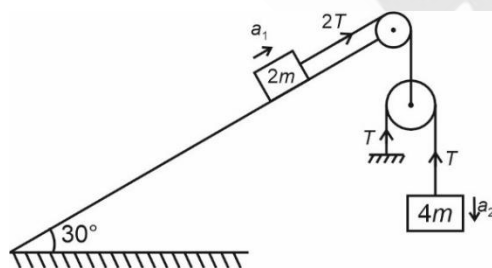
According to Newton's second law,

$$\vec{F} = \frac{d\vec{P}}{dt} \text{ or } \vec{F} = m\vec{a}$$

4. Answer (3)

Hint: Draw FBD of both blocks and apply Newton's second law.

Sol.:



By string constraint

$$2Ta_1 - Ta_2 = 0$$

$$a_2 = 2a_1$$

Apply NLM equation on $2m$ mass.

$$\Rightarrow 2T - 2mg \sin 30^\circ = 2ma_1$$

$$\Rightarrow 2T - 2mg \times \frac{1}{2} = 2ma_1$$

$$\Rightarrow 2T - mg = 2ma_1 \quad \dots(1)$$

Apply NLM equation on $4m$ mass.

$$\Rightarrow 4mg - T = 4ma_2$$

$$\Rightarrow 4mg - T = 4m(2a_1)$$

$$\Rightarrow 4mg - T = 8ma_1$$

$$\Rightarrow 8mg - 2T = 16ma_1 \quad \dots(2)$$

Add equation (1) and (2), we get

$$7mg = 18ma_1$$

$$\Rightarrow a_1 = \frac{7}{18}g$$

5. Answer (3)

Hint: Breaking stress depends on material and is independent of shape and size.

Sol.: Since wire is cut into 4 equal parts and cross-sectional area of each part is same,

Therefore, each part is able to support maximum load W .

Now, all parts connected in parallel, therefore maximum load that can be supported is $4W$.

6. Answer (2)

Hint: Use equation of motion, $\vec{v} = \vec{u} + \vec{a}t$

Sol.: $\vec{u} = (\hat{i} - 2\hat{j}) \text{ m s}^{-1}$ and

$$\vec{a} = (-\hat{i} + 2\hat{j}) \text{ m s}^{-2}$$

$$\vec{v} = \vec{u} + \vec{a}t$$

$$\vec{v} = (\hat{i} - 2\hat{j}) + (-\hat{i} + 2\hat{j}) \times 2$$

$$\vec{v} = (\hat{i} - 2\hat{j}) + (-2\hat{i} + 4\hat{j})$$

$$\vec{v} = (-\hat{i} + 2\hat{j}) \text{ m s}^{-1}$$

7. Answer (2)

Hint: Velocity of transverse wave on string,

$$v = \sqrt{\frac{T}{\mu}}$$

Sol.: $\mu = \frac{M}{L} = \frac{5}{2 \times 10} = 0.25 \text{ kg/m}$

$$v = \sqrt{\frac{100 \times 100}{25}} = \frac{100}{5} = 20 \text{ m s}^{-1}$$

$$\Rightarrow t = \frac{l}{v} = \frac{10}{20} = 0.5 \text{ s}$$

8. Answer (3)

Hint: Limitations of dimensional analysis.

Sol.: Work and torque have same dimension $[ML^2T^{-2}]$ but physically both are different

→ Addition of two different physical quantities is meaningless

→ Dimensional analysis cannot be used to derive formula containing exponential term because the term itself is inherently dimensionless.

→ Dimensional analysis gives no information about dimensionless constants.

9. Answer (4)

Hint: In uniform circular motion, only centripetal acceleration is present.

Sol.: Equation of circle is given

$$x^2 + y^2 = 16$$

By comparing this with standard equation of circle $x^2 + y^2 = r^2$, we get $r = 4$ m

$$\text{So, } |\vec{a}_c| = \frac{v^2}{r}$$

$$= \frac{8 \times 8}{4} = 16 \text{ m s}^{-2}$$

10. Answer (3)

Hint: Least count of vernier scale (LC) = 1 MSD – 1 VSD

Sol.: 20 VSD = 18 MSD

LC = 1 MSD – 1 VSD

$$0.2 \text{ mm} = 1 \text{ MSD} - \frac{18}{20} \text{ MSD}$$

$$0.2 \text{ mm} = \frac{1}{10} \text{ MSD}$$

1 MSD = 2 mm

11. Answer (4)

Hint: $|\hat{a} + \hat{b}| = 2 \cos \frac{\theta}{2}$, $|\hat{a} - \hat{b}| = 2 \sin \frac{\theta}{2}$

Sol.: $|\hat{a} + \hat{b}| = 2 \cos \frac{120^\circ}{2}$

$$= 2 \cos 60^\circ$$

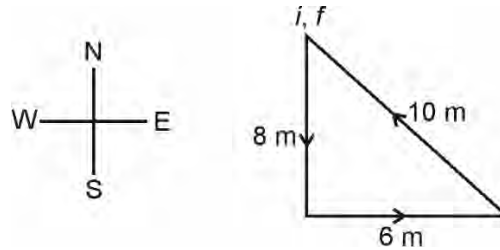
$$= 2 \left(\frac{1}{2} \right) = 1$$

$$\therefore |\hat{a} + \hat{b}| = 1$$

12. Answer (4)

Hint: Displacement $\vec{S} = \vec{x}_f - \vec{x}_i$

Sol.:



since $x_i = x_f$

\therefore Displacement = 0

13. Answer (3)

Hint: Moment of inertia of a hollow sphere is minimum about its COM

Sol.: I_{\min} for hollow sphere = $\frac{2}{3} MR^2$

$$I \geq \frac{2}{3} MR^2$$

14. Answer (3)

Hint & Sol.: For calculating moment of inertia, we cannot assume whole mass to be concentrated at centre of mass. Moment of inertia depends on the distribution of mass relative to the axis of rotation and not just total mass.

15. Answer (4)

Hint & Sol.: In case of uniform circular motion, speed is constant but both velocity and acceleration are variable.

16. Answer (4)

Hint: If \vec{u}_{com} and \vec{a}_{com} are parallel, then path is straight line.

Sol.:

$$\vec{u}_{\text{com}} = \frac{m\vec{v}_1 + m\vec{v}_2}{2m} = \frac{4\hat{i} + 4\hat{j}}{2} = (2\hat{i} + 2\hat{j}) \text{ m s}^{-1}$$

$$\vec{a}_{\text{com}} = \frac{m\vec{a}_1 + m\vec{a}_2}{2m} = \frac{\vec{a}_1}{2} = \frac{(\hat{i} + \hat{j})}{2} \text{ m s}^{-2}$$

\vec{u}_{com} is parallel to \vec{a}_{com}

17. Answer (1)

Hint & Sol.: Work done by static friction/kinetic friction on an object may be positive, negative or zero.

The work done by internal forces during a bomb's explosion is positive

18. Answer (2)

Hint: Use, $F = \frac{mdv}{dt}$ and W.D. = $\int F dx$

$$\text{Sol.: } F = \frac{mdv}{dt} = \frac{K}{v^2}$$

$$\Rightarrow \int v^2 dv = \frac{K}{m} \int dt$$

$$\Rightarrow \frac{v^3}{3} = \frac{K}{m} t$$

$$\Rightarrow v^3 = \frac{K}{m} 3t$$

$$\Rightarrow v^2 = \left(\frac{3Kt}{m}\right)^{2/3}$$

$$W = \Delta K \propto v^2 \propto t^{2/3}$$

19. Answer (4)

Hint & Sol.: Since there is no opposition to prevent free expansion, so no longitudinal strain is developed.

20. Answer (1)

Hint: Use Newtons' third law

Sol.: Since liquid is at rest, therefore force exerted by flask on liquid is equal to its weight.

21. Answer (4)

Hint: For isothermal process, temperature is constant.

$$\text{Sol.: } PV = nRT$$

$$T = \text{constant}$$

$$\therefore PV = \text{constant}$$

22. Answer (3)

Hint: Apply internal energy conservation

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

$$\Rightarrow \frac{f_1}{2} n_1 RT + \frac{f_2}{2} n_2 RT = \frac{f_{\text{mix}}}{2} (n_1 + n_2) RT$$

$$\Rightarrow \frac{3}{2} \times 2RT + \frac{5}{2} \times 4RT = \frac{f_{\text{mix}}}{2} (6) RT$$

$$\Rightarrow 13 = f_{\text{mix}} \times 3$$

$$f_{\text{mix}} = \frac{13}{3}$$

$$\therefore \gamma_{\text{mix}} = 1 + \frac{2}{f_{\text{mix}}} = 1 + \frac{2 \times 3}{13} = \frac{19}{13}$$

23. Answer (4)

Hint and Sol.: When you touch two bodies, the body which is felt warmer need not to be at higher temperature, it depends on the rate of heat flow.

24. Answer (3)

Hint: For monoatomic gas, $C_p = \frac{5}{2}R$ and

$$C_v = \frac{3}{2}R$$

$$\text{Sol.: } Q_A = nC_p(\Delta T)_A \text{ for A}$$

$$Q_B = nC_v(\Delta T)_B \text{ for B}$$

Since $Q_A = Q_B$

$$\Rightarrow C_p(\Delta T)_A = C_v(\Delta T)_B$$

$$\Rightarrow \frac{5}{2}R \times 60 = \frac{3}{2}R \times (\Delta T)_B$$

$$\Rightarrow 100 \text{ K} = (\Delta T)_B$$

25. Answer (2)

Hint: Slope of tangent to a curve is given by

$$m = \tan \theta = \frac{dy}{dx}$$

$$\text{Sol.: } y = x^4 - 2x$$

$$\tan \theta = \frac{dy}{dx} = 4x^3 - 2$$

$$\left. \frac{dy}{dx} \right|_{x=2} = 4 \times 2^3 - 2$$

$$= 32 - 2 = 30$$

26. Answer (4)

Hint: Thermal strain $\frac{\Delta l}{l} = \alpha \Delta T$

$$\text{Sol.: } \text{Stress} = \frac{T}{A} = \frac{Y \Delta l}{l} = Y \alpha \Delta T$$

$$T = YA \alpha \Delta T$$

\therefore Both B and D are correct

27. Answer (3)

Hint: Compare given equation with standard travelling wave equation $y = A \sin(\omega t - kx)$

$$\text{Sol.: } y = 0.4 \sin 2\pi(20t - 2x)$$

on comparing with standard equation

$$A = 0.4 \text{ m}$$

$$\text{Speed of wave } v = \frac{\omega}{k} = \frac{40\pi}{4\pi} = 10 \text{ m/s}$$

$$\Rightarrow k = 4\pi = \frac{2\pi}{\lambda}$$

$$\Rightarrow \lambda = \frac{1}{2} = 0.5 \text{ m}$$

$$\Rightarrow \text{maximum particle speed } v_{\text{max}} = A\omega$$

$$= 0.4 \times 40\pi = 16\pi$$

$$\Rightarrow \omega = 2\pi f = 40\pi$$

$$f = 20 \text{ Hz}$$

28. Answer (2)

Hint and Sol.: Since $a_c = a_t$

$$\begin{aligned} \therefore \omega^2 R &= \frac{R d\omega}{dt} \Rightarrow \int \frac{d\omega}{\omega^2} = \int dt \\ \Rightarrow \left[\frac{-1}{\omega} \right]_{\frac{v_0}{R}}^{\omega} &= t \Rightarrow \frac{-1}{\omega} + \frac{R}{v_0} = t \Rightarrow \omega = \frac{v_0}{R - v_0 t} \\ \Rightarrow \frac{d\theta}{dt} &= \frac{v_0}{R - v_0 t} \Rightarrow \int_0^\pi d\theta = \int_0^t \frac{v_0}{R - v_0 t} dt \\ \Rightarrow \pi &= \frac{-v_0}{v_0} [\log(R - v_0 t)]_0^t = -\log\left(\frac{R - v_0 t}{R}\right) \\ \Rightarrow t &= \frac{R}{v_0} (1 - e^{-\pi}) \end{aligned}$$

29. Answer (2)

Hint: Velocity of sound in liquid is given by,

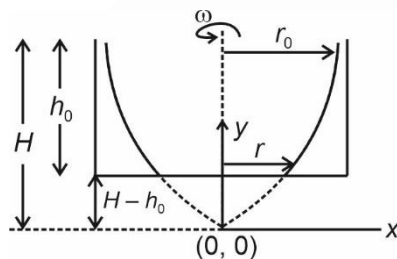
$$v = \sqrt{\frac{B}{\rho}}$$

Sol.: $B = \frac{-\Delta P}{\frac{\Delta V}{V}} = \frac{50 \times 10^3}{\frac{2.5 \times 10^{-3}}{100}} = 2 \times 10^9 \text{ Pa}$

$$v = \sqrt{\frac{B}{\rho}} = \sqrt{\frac{2 \times 10^9}{10^3}} = \sqrt{2 \times 10^6} \approx 1.414 \times 10^3 \approx 1414 \text{ m s}^{-1}$$

30. Answer (4)

Hint & Sol.:



Since half of the bottom is exposed

$$\therefore \pi r^2 = \frac{1}{2} \pi r_0^2 \Rightarrow r = \frac{r_0}{\sqrt{2}}$$

Equation of profile: $y = \frac{\omega^2 x^2}{2g}$

$$H - h_0 = \frac{1}{2} \frac{\omega^2 r^2}{g} \quad \dots(i)$$

$$H = \frac{1}{2} \frac{\omega^2 r_0^2}{g} \quad \dots(ii)$$

$$\omega = \frac{\sqrt{4h_0g}}{r_0} = \frac{\sqrt{4 \times 40 \times 10^{-2} \times 10}}{4 \times 10^{-2}}$$

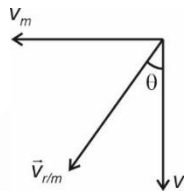
$$\omega = 100 \text{ rad/s}$$

31. Answer (1)

Hint: Rain appears to man with velocity $= \vec{v}_r - \vec{v}_m$

Sol.: With respect to man,

$$\vec{v}_{r/m} = \vec{v}_r - \vec{v}_m$$



$$\tan \theta = \frac{v_m}{v_r} = \frac{3}{5}$$

$$\theta = \tan^{-1}\left(\frac{3}{5}\right)$$

32. Answer (4)

Hint: First law of thermodynamics, $dQ = dU + dW$

Sol.: Isobaric $\rightarrow P = \text{Constant}$

Isothermal $\rightarrow T = \text{Constant}, dU = 0$

Isochoric $\rightarrow dW = 0, dQ = dU$

Adiabatic $\rightarrow dQ = 0, dW = -dU$

33. Answer (2)

Hint: Energy required $E = m(V_s - V_c)$

Sol.: $V_s = -\frac{GM}{R}$ and $V_c = -\frac{3GM}{2R}$

$$E = m \left[-\frac{GM}{R} + \frac{3GM}{2R} \right]$$

$$E = \frac{GMm}{2R} = \frac{gmR}{2}$$

$$= \frac{10 \times 2 \times 6400 \times 10^3}{2}$$

$$= 64 \times 10^6 \text{ J}$$

$$= 6.4 \times 10^7 \text{ J}$$

34. Answer (3)

Hint: At displacement x from mean position,

$$P.E. = \frac{1}{2} kx^2 \text{ and } K.E. = \frac{1}{2} k(A^2 - x^2)$$

Sol.: Given $K.E. = \frac{1}{2} (PE)$

$$\Rightarrow \frac{1}{2} K(A^2 - x^2) = \frac{1}{2} \left(\frac{1}{2} Kx^2 \right)$$

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

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

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

35. Answer (3)

Hint: All the zeros between two non-zero digits are significant, no matter where the decimal point is, if at all.

Sol.: All digits in given number are significant.

36. Answer (2)

Hint: $f_b = (f_1 - f_2)$ and $f = \frac{v}{\lambda}$

Sol.: $6 = \frac{v}{1} - \frac{v}{1.02}$

$$6 = v \left(\frac{0.02}{1.02} \right)$$

$$\Rightarrow v = \frac{6 \times 1.02}{0.02}$$

$$= 306 \text{ m s}^{-1}$$

37. Answer (2)

Hint: Use, $C_p = \left(1 + \frac{f}{2}\right) R$

Sol.: $\frac{C_p}{R} = 1 + \frac{f}{2}$, where f is degree of freedom.

$$\Rightarrow \frac{7}{2} = 1 + \frac{f}{2}$$

$$\Rightarrow \frac{5}{2} = \frac{f}{2}$$

$$f = 5$$

\therefore Diatomic

38. Answer (3)

Hint: Since block is moving upward, so friction is acting down the inclined plane.

Sol.: Retardation, $a = g \sin \theta + \mu g \cos \theta$

$$= 10 \left[\frac{3}{5} + \frac{1}{2} \times \frac{4}{5} \right]$$

$$= 6 + 4$$

$$= 10 \text{ m s}^{-2}$$

39. Answer (1)

Hint: $\vec{v}_{\text{avg}} = \frac{\vec{X}_f - \vec{X}_i}{\Delta t}$

Sol.: From $t = 0$ to $t = 6$ s

$$X_f = X_i = 0$$

$$\therefore \vec{v}_{\text{avg}} = 0$$

40. Answer (2)

Hint: Energy loss in collision

$$E = \frac{1}{2} \frac{m_1 m_2}{m_1 + m_2} (u_1 - u_2)^2 (1 - e^2)$$

Sol.: $e = 0$ for perfectly inelastic collision

$$E = \frac{1}{2} \frac{m_1 m_2}{m_1 + m_2} (2 - (-6))^2$$

$$= \frac{1}{2} \times \frac{3 \times 2}{3 + 2} (8)^2$$

$$= \frac{3}{5} \times 64 = 38.4 \text{ J}$$

41. Answer (2)

Hint: $\omega_{BA} = \frac{(V_{BA})_{\perp}}{d}$

Sol.:



$$(V_{BA})_{\perp} = 16 - 6 = 10 \text{ ms}^{-1}$$

$$\omega = \frac{(V_{BA})_{\perp}}{d} = \frac{10}{5} = 2 \text{ rad/s}$$

42. Answer (3)

Hint & Sol.: By Stoke's law, the terminal velocity of water drop of radius r is given by

$$v = \frac{2}{9} r^2 \frac{(\rho - \sigma) g}{\eta}$$

Neglecting density of air $\Rightarrow \sigma = 0$

$$\therefore v = \frac{2 r^2 \rho g}{9 \eta}$$

43. Answer (3)

Hint: Compare given equation with standard

equation of SHM, $\frac{d^2 y}{dt^2} + \omega^2 y = 0$

Sol.: By comparing with standard equation,

$$\omega^2 = \frac{12}{3} = 4$$

$$\omega = 2 \text{ rad/s}$$

44. Answer (2)

Hint: About fixed axis, use $\tau = I\alpha$ **Sol.:** $\tau_{axis} = I\alpha$

$$mg \cos 60^\circ \times \frac{l}{2} = \frac{ml^2}{3} \alpha$$

$$\Rightarrow g \times \frac{l}{2} \times \frac{l}{2} = \frac{l}{3} \alpha$$

$$\Rightarrow \alpha = \frac{3g}{4l}$$

45. Answer (3)

Hint: Use principle of calorimetry $Q_{\text{absorb}} = Q_{\text{release}}$ **Sol.:** Heat required to convert 10 g of ice at -10°C to ice at 0°C .

$$Q_r = m_{\text{ice}} \Delta T = 10 \times \frac{1}{2} \times 10 = 50 \text{ cal}$$

Heat released due to temperature change of water from 20°C to 0°C

$$Q_{\text{release}} = m_{\text{sw}} \Delta T = 10 \times 1 \times 20 = 200 \text{ cal}$$

Let m be the mass of ice which melts

$$Q_{\text{remaining}} = mL$$

$$m = \frac{150}{80} = \frac{15}{8} = 1.875 \text{ g}$$

 \therefore Mass of water = $10 + 1.875 = 11.875 \text{ g}$ Mass of ice left = 8.125 g

[CHEMISTRY]

46. Answer (2)

Hint: Basic buffer can be obtained by mixing weak base and its salt made with strong acid**Sol.:** Number of mmoles ($t = 0$)

$$100 \times 0.1 \quad 50 \times 0.1 \\ = 10 \text{ mmoles} \quad = 5 \text{ mmoles}$$

$$5 \text{ mmoles} \quad - \quad 5 \text{ mmoles}$$

The solution contains equimolar mixture of NH_4OH and NH_4Cl

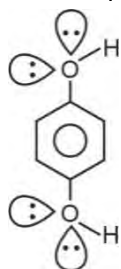
47. Answer (1)

Hint: More polarisation, more covalent character.**Sol.:** Iodide ion being largest anion among all would have greater polarisation, so, more covalent character and less ionic character.

48. Answer (3)

Hint: Ne has maximum electron gain enthalpy among group 18 elements.**Sol.:** Removal of electron from isolated gaseous atom is an endothermic process.

49. Answer (4)

Hint: Symmetrical molecules usually have zero dipole moment and are non-polar.**Sol.:** A, B, D and E have zero dipole moment and are non-polar moleculesDue to the presence of lone pair of electrons, bond dipoles do not cancel each other as the angle between them is not 180°

50. Answer (4)

Hint: Ag is less reactive than H_2 .**Sol.:** More reactive metal than H_2 gives hydrogen gas with dilute acid.Mg is more reactive than H_2 .

51. Answer (1)

Hint: Electronic configuration of element decides its position in periodic table**Sol.:**

Atomic number	Electronic configuration	Block
64	$4f^1 5d^1 6s^2$	f
57	$5d^1 6s^2$	d
38	$5s^2$	s
83	$6s^2 6p^3$	p

52. Answer (3)

Hint: $h\nu = h\nu_0 + \text{kinetic energy}$

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

$$\lambda = \frac{h}{\sqrt{2m \text{KE}}}$$

$$\lambda^2 = \frac{h^2}{2m \text{KE}}$$

$$\text{KE} = \frac{h^2}{2m\lambda^2}$$

$$h(v - v_0) = \frac{h^2}{2m\lambda^2}$$

$$\lambda = \sqrt{\frac{h}{2m(v - v_0)}}$$

53. Answer (4)

Hint: PbI_4 does not exist.

Sol.: Fullerenes are pure form due to absence of dangling bonds.

54. Answer (4)

Hint: 0.5 moles of $Ba(N_3)_2$ is decomposed

Sol.: Number of moles of $Ba(N_3)_2 = \frac{110.7}{221.37} = 0.5$

Moles of N_2 produced in 1st reaction = 0.5×3

Moles of NO produced in 2nd reaction = 3

Moles of NO_2 produced in 3rd reaction = 3

Mass of NO_2 produced = $3 \times 46 = 138$ g

55. Answer (1)

Hint: Effect of temperature on equilibrium constant can be given as

$$\log\left(\frac{K_2}{K_1}\right) = \frac{\Delta H}{2.303R} \left(\frac{1}{T_1} - \frac{1}{T_2}\right)$$

Sol.: $\log 2 = \frac{\Delta H}{2.303 \times 8.314} \left(\frac{1}{300} - \frac{1}{400}\right)$

$$\Delta_r H = 2.303 \times 8.314 \times (\log 2) \times 1200$$

$$= 6.9 \text{ kJ}$$

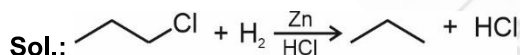
56. Answer (1)

Hint: cis-But-2-ene has high boiling point than trans-But-2-ene.

Sol.: trans-But-2-ene is non-polar.

57. Answer (1)

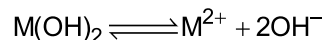
Hint: Zn with H_2 in acidic medium reduces haloalkanes to alkanes with same number of carbon atoms



58. Answer (1)

Hint: Precipitation starts when $Q_{ip} = K_{sp}$

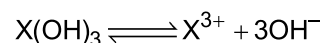
Sol.: For $M(OH)_2$



$$K_{sp} = 4 \times 10^{-10} = 1 \times [OH^-]^2$$

$$[OH^-] = 2 \times 10^{-5} \text{ M}$$

For $X(OH)_3$



$$K_{sp} = 2.7 \times 10^{-14} = 1 \times [OH^-]^3$$

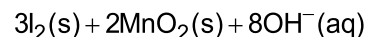
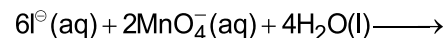
$$[OH^-] = 3 \times 10^{-5} \text{ M}$$

Since $M(OH)_2$ requires less $[OH^-]$ for precipitation, it will precipitate first.

59. Answer (3)

Hint: Balancing of redox reaction can be done by oxidation number method or ion electron method.

Sol.: The balanced chemical reaction is



$$a = 6$$

$$c = 4$$

$$d = 3$$

$$f = 8$$

60. Answer (3)

Hint: For given value of n,

$$l = 0, 1, 2, \dots, n-1$$

Sol.: For a given value of l

$$m_l = -l, \dots, 0, \dots, +l$$

61. Answer (1)

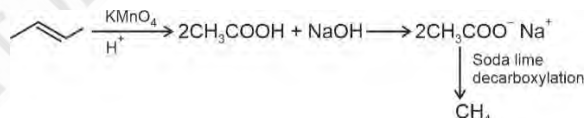
Hint: In general enthalpy of neutralization becomes less than 57.1 kJ/mol if either weak acid or weak base or both weak acid and weak base are taken.

Sol.: HF and NaOH when combine releases energy more than 57.1 kJ/mol because of a very high negative hydration energy of F^- ion.

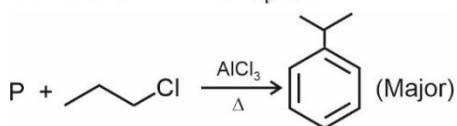
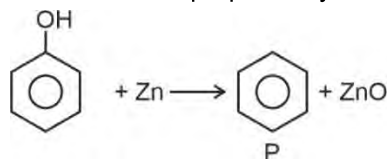
62. Answer (3)

Hint: B is methane and P is benzene

Sol.:



CH_4 cannot be prepared by using Kolbe's method



63. Answer (2)

Hint: Steam distillation is applied to separate substances which are steam volatile and are immiscible with water.

Sol.: Aniline and water are separated using steam distillation.

64. Answer (1)

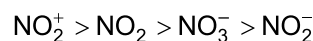
Hint: XeO₃ is pyramidal in shape.**Sol.:** Xe in XeO₃ is sp³ hybridised.

65. Answer (3)

Hint: Bond angle depends upon hybridisation, lone pair on central atom, size of central and side atom etc.**Sol.:** In N(SiH₃)₃ the lone pair of electrons of N is back donated to vacant orbital of Si, so, this is a weaker Lewis base

	Bond order
N ₂	3
N ₂ ⁻	2.5
N ₂ ²⁻	2

Correct order of bond angle is

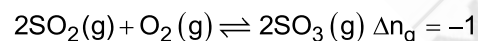
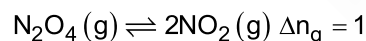
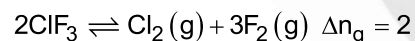
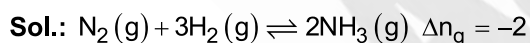


Lesser the strength of back bonding from X (halogen) to B greater will be Lewis acid nature.

66. Answer (2)

Hint: Molecule with sp³d hybridisation and trigonal bipyramidal shape has 90°, 120° and 180° bond angle.**Sol.:** PCl₅ : 90°, 120° and 180° bond angleIF₇ : 90°, 72° and 180° bond angleSF₆ : 90° and 180° bond angleClF₃ : Less than 90° and less than 180°

67. Answer (1)

Hint: Δn_g = n_p - n_r

68. Answer (2)

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

Sol.: Li²⁺ ion

$$n_1 = 1$$

$$n_2 = \infty \quad \frac{1}{\lambda_1} = R_H \times 9 \left(1 - \frac{1}{\infty} \right) = 9 \times R_H$$

Be³⁺ ion

$$n_1 = 3 \quad \frac{1}{\lambda_2} = R_H \times 16 \left(\frac{1}{9} - \frac{1}{16} \right)$$

$$n_2 = 4 \quad \frac{1}{\lambda_2} = R_H \times 16 \left(\frac{7}{9 \times 16} \right) = \frac{7R_H}{9}$$

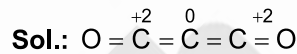
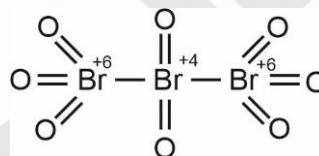
$$\frac{\lambda_2}{\lambda_1} = \frac{9 \times R_H \times 9}{7R_H} = \frac{81}{7}$$

$$\therefore \frac{\lambda_1}{\lambda_2} = \frac{7}{81}$$

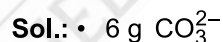
69. Answer (3)

Hint: Δ_{eg}H of O is -141 kJ/mol**Sol.:** When an electron is added to O, the added electron goes to 2p subshell and suffers significant repulsion.

70. Answer (2)

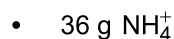
Hint: Structure of C₃O₂: O = C = C = C = Ocarbon suboxide (C₃O₂)tribromooctaoxide (Br₃O₈)

71. Answer (1)

Hint: Number of moles × N_A × Number of electron in single species.

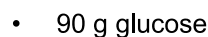
$$\text{Number of electrons} = \frac{6}{60} \times N_A \times (6 + 24 + 2)$$

$$= 3.2 N_A$$



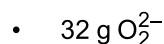
$$\text{Number of electrons} = \frac{36}{18} \times N_A \times (7 + 4 - 1)$$

$$= 20 N_A$$



Number of electrons

$$= \frac{90}{180} \times N_A \times (6 \times 6 + 12 + 6 \times 8) = 48 N_A$$



$$\text{Number of electrons} = \frac{32}{32} \times N_A \times (2 \times 8 + 2) = 18 N_A$$

$$= 18 N_A$$

72. Answer (3)

Hint: $\Delta H = \Delta U + \Delta(PV)$ **Sol.:** $\Delta U = nC_v \Delta T$

$$= 5 \times 28 \times 100 = 14 \text{ kJ}$$

$$\Delta H = 14 + \Delta(PV)$$

For ideal gas $PV = nRT$

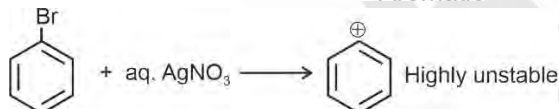
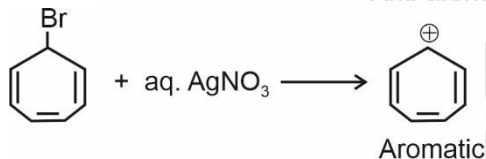
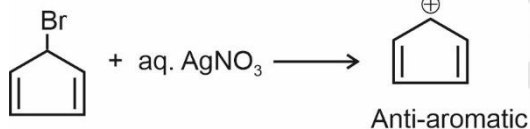
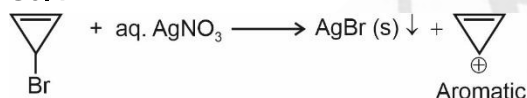
$$\Delta H = 14 + \Delta(nRT)$$

$$= 14 + \frac{5 \times 8.314 \times 100}{1000} = 18.157 \text{ kJ}$$

73. Answer (1)

Hint: Electrons present in d and f subshell show poor screening effect which can change the general order of properties like size and ionization enthalpy.**Sol.:** $\text{Si} \approx \text{Ge} \approx \text{Sn} < \text{Pb} < \text{C}$: Electronegativity $\text{B} < \text{Ga} < \text{Al} < \text{In} < \text{Tl}$: Atomic radius $\text{C} > \text{Si} > \text{Ge} > \text{Pb} > \text{Sn}$: Ionization enthalpy

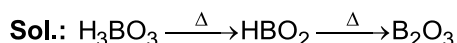
74. Answer (1)

Hint: Species which form stable carbocation can form precipitate with aq. AgNO_3 **Sol.:**

75. Answer (1)

Hint: Carbanion can be stabilised by back donation of electron from carbon to adjacent atom.**Sol.:** In $\text{C}^{\ominus}\text{Cl}_3$, electron pair of carbon is back donated to vacant orbital of Cl, increasing its stability than $\text{C}^{\ominus}\text{F}_3$

76. Answer (2)

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

77. Answer (3)

Hint: Amphoteric oxides behave as acid with bases and as base with acids.**Sol.:** The amphoteric oxides are SnO , PbO , SnO_2 , PbO_2 and Al_2O_3

78. Answer (4)

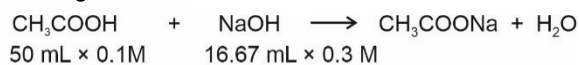
Hint: pH for weak acid strong base salt

$$= 7 + \frac{1}{2} pK_a + \frac{1}{2} \log C$$

Sol.: Number of equivalents of acid = Number of equivalents of base

$$50 \times 0.1 \times 1 = V \times 0.3 \times 1$$

$$V = \frac{50}{3} \text{ mL} = 16.67 \text{ mL}$$



$$50 \text{ mL} \times 0.1 \text{ M} \quad 16.67 \text{ mL} \times 0.3 \text{ M}$$

$$= 5 \text{ mmoles} \quad = 5 \text{ mmoles} \quad 5 \text{ mmoles}$$

$$[\text{CH}_3\text{COONa}] = \frac{5 \text{ mmoles}}{(50 + 16.67) \text{ mL}} = 0.075 \text{ M}$$

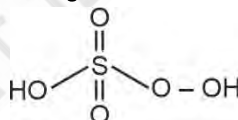
For salt hydrolysis

$$\text{pH} = 7 + \frac{1}{2} (\text{p}K_a + \log C)$$

$$= 7 + \frac{1}{2} [5 + \log(0.075)]$$

$$= 7 + \frac{1}{2} (5 - 1.125) = 8.9$$

79. Answer (2)

Hint: H_2SO_5 is Caro's acid and has 1 peroxide linkage,**Sol.:** KClO_3

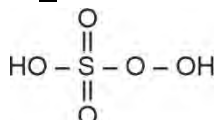
$$+1 + x + 3(-2) = 0$$

$$x = +5$$

 OF_2

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

$$x = +2$$

 H_2SO_5 

S exists in +6 oxidation number

 NaH

$$x + 1 = 0$$

$$x = -1$$

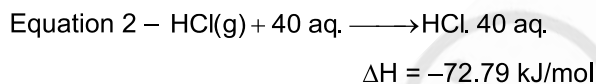
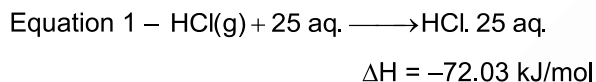
80. Answer (2)

Hint: Possible amines having molecular formula C_3H_9N could be 1° , 2° or 3° .

Sol.:

81. Answer (2)

Hint: Enthalpy of dilution is the heat change when additional solvent is added to the solution

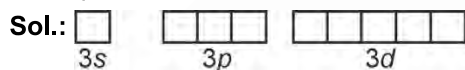
Sol.:

Subtracting equation (1) from equation (2)

$$\Delta H = -72.79 + 72.03 = -0.76 \text{ kJ/mol}$$

82. Answer (3)

Hint: For single electron species, energy of $3s = 3p = 3d$



9 orbitals have same energy i.e., degenerate

83. Answer (2)

Hint: Total node(s) = $(n - 1)$

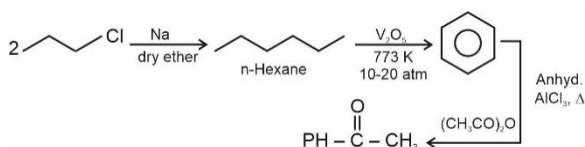
Angular node(s) = l

Sol.:

	Angular node(s)	Total nodes
$5d$	2	4
$4f$	3	3
$7s$	0	6
$5p$	1	4

84. Answer (4)

Hint: Wurtz reaction is involved in step number I.

Sol.:

85. Answer (3)

Hint: Molarity of mixture = $\frac{n_1 + n_2}{\text{Total volume}}$

Sol.: 1500 mL of 2M HCl

Number of mmoles of HCl

$$= 1500 \times 2 = 3000 \text{ mmol} = 3 \text{ mol}$$

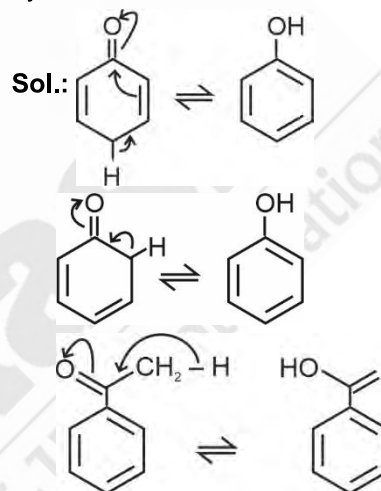
$$\text{Number of moles of HCl} = \frac{3.65}{36.5} = 0.1$$

$$\text{Concentration of mixture} = \frac{(3 + 0.1) \times 1000}{1500}$$

$$= \frac{3.1 \times 10}{15} = 2.06 \text{ mol/L}$$

86. Answer (1)

Hint: Molecules that have the presence of alpha hydrogen connected to carbon which is sp^3 hybridised show tautomerism.



87. Answer (3)

Hint: 5 mol/L means that 5 mol of H_2SO_4 is dissolved in 1 L solution

Sol.: 29% w/w of solution means 100 g solution would have 29 g of solute

5 mol/L means that 1 L of solution would have 5 moles of H_2SO_4

$$\text{Mass of } H_2SO_4 = 5 \times 98 = 490 \text{ g}$$

29 g of H_2SO_4 is present in 100 g solution

490 g of H_2SO_4 is present in

$$\frac{490 \times 100}{29} = 1.69 \times 10^3 \text{ g}$$

$$\text{Density of solution} = \frac{\text{Mass of solution}}{\text{Volume of solution}}$$

$$= \frac{1.69 \times 10^3}{1000 \text{ mL}} = 1.69 \text{ g/mL}$$

88. Answer (2)

$$\text{Hint: } T_{\text{eq}} = \frac{\Delta H}{\Delta S}$$

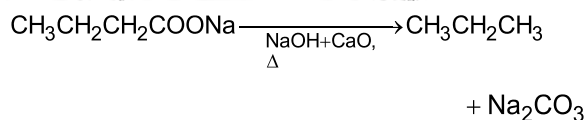
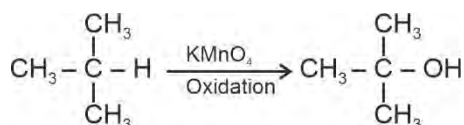
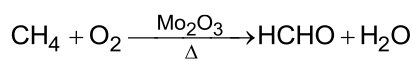
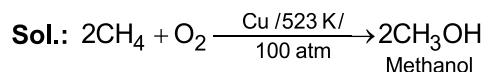
$$\text{Sol.: } T_{\text{eq}} = \frac{30 \times 10^3}{50}$$

$$= 600 \text{ K}$$

$$= 327^\circ\text{C}$$

89. Answer (4)

Hint: Soda lime decarboxylation produces alkane with one carbon atom less than starting reactant.



90. Answer (3)

Hint: F is more electronegative than H.

Sol.: NH_3 has more dipole moment than NF_3 because of orbital dipole due to lone pair in the same direction of resultant dipole moment of N-H bonds.

[BIOLOGY]

91. Answer (2)

Hint: He was an evolutionary biologist from the Harvard university.

Sol.: Ernst Mayr is known as the Darwin of the 20th century.

92. Answer (4)

Hint: Brinjal belongs to the family, Solanaceae.

Sol.: Brinjal belongs to the class, Dicotyledonae.

93. Answer (2)

Hint: Lion and leopard are two different species but both belong to the genus, *Panthera*.

Sol.: Plant family Convolvulaceae is included in the order Polymoniales, mainly on the basis of floral characters.

94. Answer (2)

Hint: Nuclear membrane is absent in monerans.

Sol.: All the members of the kingdom Monera are prokaryotic and have cellular body organisation.

95. Answer (3)

Hint: Dinoflagellates comprise of two flagella.

Sol.: Diatoms are the chief producers in the oceans.

96. Answer (3)

Hint: Asexual spores are generally not found in the members of Basidiomycetes.

Sol.: Presence of conidia is a common characteristic of the members of the class Ascomycetes and Deuteromycetes.

97. Answer (4)

Hint: In euglenoids, there is the presence of protein rich layer called pellicle, instead of a cell wall.

Sol.: A viroid was found to be a free RNA and is smaller than virus in size.

98. Answer (2)

Hint: *Mucor* belongs to the class Phycomycetes, whereas, *Ustilago* belongs to the class Basidiomycetes.

Sol.: Dikaryophase is absent in *Mucor*. Biological classification of plants and animals was first proposed by Aristotle.

99. Answer (2)

Hint: *Volvox* shows oogamous type of sexual reproduction.

Sol.: In *Ulothrix*, gametes are flagellated and similar in size.

100. Answer (3)

Hint: Protonema is the first stage in the life cycle of a moss.

Sol.: Protonema is a creeping, green, branched and frequently filamentous stage.

101. Answer (4)

Hint: Bentham and Hooker gave the natural system of classification.

Sol.: Natural system of classification were based on natural affinities among the organisms and considered, not only the external features, but also internal features, like ultra-structure, anatomy, embryology and phytochemistry.

102. Answer (1)

Hint: The given figure is of brown alga, *Laminaria*.

Sol.: *Laminaria* is a marine alga used as food.

103. Answer (2)

Hint: *Equisetum* is a homosporous pteridophyte.

Sol.: In *Equisetum*, gametophyte is not retained on the parent sporophyte. Sporophyte in *Riccia* (liverwort) is less developed than that in *Sphagnum* (moss).

104. Answer (2)

Hint: A few millimetres above the root cap is the region of meristematic activity.

Sol.: Rapid elongation is evident in the cells of the elongation zone, which is present above the region of meristematic activity.

105. Answer (1)

Hint: The given characteristics are of the members of the family, Solanaceae.

Sol.: *Makoi* has bisexual flowers with radial symmetry, valvate aestivation in calyx and corolla and superior ovary.

106. Answer (2)

Hint: An endocrine gland

Sol.: The prominent endocrine glands found in frog are pituitary, thyroid, parathyroid, thymus, etc. In humans, four parathyroid glands are present on the back side of the thyroid gland, one pair each in the two lobes of the thyroid gland.

Eyes in a frog are a pair of spherical structures situated in the orbit in skull. These are simple eyes (possessing only one unit).

In frogs, salivary glands are absent.

In the frog's brain, pons is absent.

In humans, pons and salivary glands are present.

107. Answer (4)

Hint: One of the additional chambers present in the heart of frog.

Sol.: In frogs, the right atrium receives deoxygenated blood through sinus venosus which in turn receives blood from the major veins called vena cava, while the left atrium receives oxygenated blood from the pulmonary veins. Conus arteriosus is present on the ventral side of heart; it receives the blood which is ejected from the ventricle of the heart. Both right and left atrium pump blood into a single ventricle.

108. Answer (2)

Hint: Their skin is moist and slimy.

Sol.: Frogs have the ability to change their colour to hide them from their enemies (camouflage). This protective coloration is called mimicry.

Frogs never drink water but absorb it through the skin.

Frogs have a thick, pigmented and almost immovable upper eyelid and a thin semi-transparent and freely movable lower eyelid.

In harsh weather conditions, the frogs exhibit the state of dormancy called hibernation (winter sleep) and aestivation (summer sleep).

109. Answer (4)

Hint: 'Amphi' means both

Sol.: Tadpole requires thyroxine for its metamorphosis into an adult frog.

In adult frogs, the alimentary canal is short because they are carnivores and hence the length of intestine gets reduced; tadpoles are herbivores.

Tadpoles exhibit branchial respiration as well as cutaneous respiration whereas adult frogs exhibit buccopharyngeal, pulmonary and cutaneous respiration.

Tadpoles are free-swimming aquatic larvae whereas adult frogs live on both land and water.

110. Answer (3)

Hint: Male cockroaches can be differentiated from female cockroaches morphologically.

Sol.: Anal styles are a paired thread like structures. These small unjointed outgrowths, project backwardly from the sides of the 9th sternum of the male cockroach only. They are sensitive to touch.

111. Answer (1)

Hint: True for the initial part of the digestive system.

Sol.: The entire foregut of cockroaches is lined by cuticle.

Their hindgut is broader than the midgut and is differentiated into ileum, colon and rectum. They contain a paired but bilobed salivary glands.

Gizzard/proventriculus is used for grinding the food. It contains an outer layer of thick circular muscles and thick inner cuticle forming six highly chitinous plate called teeth, which are needed for grinding.

Crop is the largest part of foregut where food is stored.

112. Answer (2)

Hint: Structure possessing myocardium

Sol.: Smooth muscle fibres exhibit uninucleated condition with no striations. They are found in the walls of stomach and blood vessels. Biceps contain skeletal muscle fibres. These fibres are multinucleated and striated and they get easily fatigued. Myocardium is composed of cardiac muscle fibres. These fibres are striated, uninucleated and resistant to fatigue.

Wall of oesophagus is lined by

- (i) Smooth muscles in its lower portion
- (ii) Skeletal muscles in its upper portion

113. Answer (4)

Hint: Equal to the number of bones present in pectoral girdle of humans

Sol.: Adipocytes are found in both areolar and adipose tissues in variable number. It is not exclusive to adipose tissues.

Epithelial tissue is avascular. Lamellae are found in bones, not in cartilages. Chondrocytes are the cells of cartilage. Chondrocytes occur singly or in groups in the lacunae. Collagen fibres are structural proteins. They are not present in the matrix of blood.

114. Answer (4)

Hint: Protein molecule.

Sol.: Dehydration synthesis, also known as condensation reaction, is a chemical process where two molecules combine to form a larger molecule, with a water molecule being removed as a by-product. Formation of glycosidic bonds (present in carbohydrates), peptide bonds (present in proteins) and ester bond (present in lipids) involve condensation reaction.

Palmitic acid has 16 carbons including the carboxyl carbon.

Glycine is an amino acid. It has a symmetric carbon. Inulin is a storage homopolymer. Trypsin is a proteinaceous enzyme.

115. Answer (2)

Hint: Hydrolysis of glycosidic bond

Sol.: Enzymes are divided into 6 classes, each with 4-13 sub-classes and named accordingly by a four digit number.

- Oxidoreductases – Class I
- Transferases – Class II
- Hydrolases – Class III
- Lyases – Class IV
- Isomerases – Class V
- Ligases – Class VI

Lactose is a disaccharide that will hydrolyse into galactose and glucose in the presence of lactase.

Hydrolases perform hydrolysis.

116. Answer (3)

Hint: More than two leaves arise at a node and form a whorl in *Alstonia*.

Sol.: China rose and sunflower have alternate phyllotaxy. In guava, opposite phyllotaxy is seen.

117. Answer (2)

Hint: Carpels are fused in mustard and cotton.

Sol.: In pea, diadelphous androecium is found.

118. Answer (3)

Hint: Legume fruit is a characteristic of the members of the family, Fabaceae.

Sol.: Members of the family Solanaceae and Liliaceae show the presence of actinomorphic flowers, endospermous seeds and axile placentation.

119. Answer (1)

Hint: Polyarch xylem bundles are observed in monocot roots.

Sol.: Maize is a monocot plant in which polyarch xylem bundles are observed and the pith is large and well-developed.

120. Answer (4)

Hint: Hypodermis of a monocot stem is sclerenchymatous.

Sol.: Cortical layers below hypodermis, consists of round, thin-walled parenchymatous cells with conspicuous intercellular spaces.

121. Answer (2)

Hint: Endodermis of the root cortex comprises of water-impermeable, barrel-shaped cells with waxy coating.

Sol.: The tangential as well as radial walls of the endodermal cells have a deposition of water-impermeable, waxy material suberin, in the form of casparian strips.

122. Answer (4)

Hint: 'a' represents medullary rays and 'b' represents endodermis of a dicot stem.

Sol.: 'c' represents pericycle and 'd' represents hypodermis of a dicot stem.

Hypodermis consists of 3 to 5 layers of collenchymatous cells having no intercellular spaces.

123. Answer (3)

Hint: Bulliform cells help in rolling of leaves.

Sol.: Bulliform cells are present in the adaxial epidermis.

124. Answer (3)

Hint: Sclereids are found in the fruit walls of nuts and guava pulp.

Sol.: Tracheids are found in all the categories of vascular plants.

125. Answer (4)

Hint: The organelles included in the endomembrane system, function in a coordinated manner.

Sol.: Lysosomes, endoplasmic reticulum, Golgi body and vacuoles constitute the endomembrane system.

126. Answer (3)

Hint: Peripheral proteins lie on the surface of the membrane while the integral proteins are partially or totally buried in the membrane.

Sol.: Depending on the ease of extraction, membrane proteins can be classified as integral and peripheral.

127. Answer (3)

Hint: Leucoplasts are devoid of pigments.

Sol.: Microtubules are hollow, unbranched and cylindrical structures.

128. Answer (3)

Hint: Length of the two arms is equal in a metacentric chromosome.

Sol.: Flagella show 9 + 2 arrangement of microtubules.

129. Answer (4)

Hint: Endomembrane system includes ER, Golgi complex, lysosomes and vacuoles.

Sol.: Smooth Endoplasmic Reticulum (SER) helps in the synthesis of steroidal hormones.

Golgi body helps in the formation of glycoproteins and glycolipids and digestion of proteins and lipids is done by lysosomes.

130. Answer (2)

Hint: A tetrad comprises of a pair of synapsed homologous chromosomes.

Sol.: Tetrad/bivalent formation takes place during the zygotene stage.

131. Answer (4)

Hint: Exclusive to RNA.

Sol.: Uridylic acid is also known as uridine monophosphate. It is a nucleotide that is a unique component of RNA and is not found in the structure of DNA. Humans have DNA as their genetic material.

Nucleotides contain both glycosidic and ester bonds.

Nitrogen bases contain heterocyclic rings.

Upon chemical analysis of a living tissue, acid-soluble pool/filtrate and acid-insoluble pool/retentate is obtained. The molecules found in the acid-soluble pool have molecular weights

ranging from 18 to 800 daltons (Da) approximately. The acid-insoluble pool has molecular weights in the range of 10,000 daltons and above.

132. Answer (4)

Hint: True for a prosthetic group.

Sol.: Co-factors are the non-protein constituents of enzymes.

NADP acts as the co-enzyme. NAD and NADP contain the vitamin niacin.

Prosthetic groups are organic compounds and are distinguished from other co-factors as they are tightly bound to the apoenzyme.

In peroxidase and catalase, haem acts as the prosthetic group. These enzymes catalyse the breakdown of H_2O_2 .

Haem is a part of the active site of the enzyme.

133. Answer (4)

Hint: 'X' and 'Y' are carbohydrates.

Sol.: Cotton fibre is cellulosic.

So, 'X' here is cellulose. Starch ('Y') acts as the storehouse of energy in plant tissues.

Cellulose is a polymeric secondary metabolite. Starch forms helical secondary structures and thus, it can hold I_2 molecules in the helical portion.

Cellulose is the most abundant carbohydrate. The two functional groups that are present in sugars are carbonyl and hydroxyl.

134. Answer (2)

Hint: Hyperventilation reduces blood pCO_2 .

Sol.:

- Hyperventilation causes excess CO_2 exhalation, reducing $[H^+]$ concentration \rightarrow respiratory alkalosis.
- Elevated pH causes a leftward shift in the oxygen-hemoglobin dissociation curve \rightarrow hemoglobin holds O_2 more tightly.

135. Answer (2)

Hint: An arthropod

Sol.: The neural organisation is very simple in lower invertebrates.

In *Hydra*, it is composed of a network of neurons.

The neural system is better organised in insects, where a brain is present along with a number of ganglia and neural tissues. In cockroaches, brain is represented by supra-oesophageal ganglion. The vertebrates (*Macaca*) have a more developed neural system.

In *Sycon*, nervous system is absent.

136. Answer (2)

Hint: Na^+/K^+ pump transports 3Na^+ outwards for 2K^+ into the cell.

Sol.: The ionic gradient across a resting neuronal membrane is maintained by the active transport of ions by the Na^+-K^+ pump which transports 3Na^+ outwards for 2K^+ into the cell.

Depolarization of a nerve fibre occurs due to influx of Na^+ via voltage gated Na^+ channels.

So, if Na^+ voltage gated channels are blocked, there will be no influx of Na^+ in axon

No influx \rightarrow No depolarization \rightarrow No action potential

Thus, the neurons cannot send or receive signals (motor loss) or sensory receptors (sensory loss).

If Na^+ channels are blocked, there will be no contraction at all.

In a resting neuron, K^+ concentration is higher inside the cell.

Resting potential is around -70 mV.

137. Answer (3)

Hint: May have a role in cognition

Sol.: Cerebellum is a part of human hindbrain. It has very convoluted surface in order to provide the additional space for many more neurons.

The cerebellum integrates information received from the semi-circular canals of the ear and the auditory system.

Midbrain, pons and medulla oblongata constitute the brain stem.

Cerebellum coordinates contractions of skeletal muscles. It does not initiate the movements of the body but modulates or reorganises the motor commands. Cerebellum's unconscious directions and cerebrum's conscious instructions determine when and how to move body parts.

138. Answer (4)

Hint: Nodes of Ranvier is absent

Sol.: Unmyelinated nerve fibre is enclosed by a Schwann cell that does not form a myelin sheath around the axon and is commonly found in autonomous and the somatic neural systems. Axolemma is also present around these nerve fibres.

Impulse transmission across an electrical synapse is significantly faster than that across a chemical synapse. The membranes of pre-synaptic and post-synaptic neurons are in close proximity in an electrical synapse. Dendrites receive and integrate signals from other neurons or from sensory stimuli and conduct nerve impulses towards the axon or the cell body.

139. Answer (3)

Hint: Negative intra-pleural pressure is seen in humans.

Sol.: Air flows in as long as intra-pulmonary pressure is lower than the atmospheric pressure. Once they equalize, inspiration stops.

Intra-pleural pressure is always lower than the atmospheric pressure, even at the end of inspiration. If it ever equals the atmospheric pressure, the lungs would collapse. Hence, the mechanism halts due to pressure equalization between alveoli and outside air, not due to intrapleural pressure reaching the atmospheric pressure.

140. Answer (3)

Hint: The role of O_2 in the regulation of respiratory rhythm is quite insignificant.

Sol.: A specialised centre present in the medulla region of the brain, called respiratory rhythm centre, is primarily responsible for regulation of breathing.

A chemosensitive area is situated adjacent to the rhythm centre which in turn is sensitive to CO_2 and H^+ . Increase in these substances can activate this centre, which in turn can signal the rhythm centre to make necessary adjustments in the respiratory process by which these substances can be eliminated.

141. Answer (1)

Hint: Value of 'X' is somewhere close to ERV.

Sol.: The volume of air remaining in the lungs even after a forcible expiration is called residual volume. This averages around 1100 mL to 1200 mL.

RV cannot be measured by a simple spirometer. The residual volume maintains the alveolar patency even after maximal forced expiration. In healthy lungs, the air that makes up the residual volume is utilized for continual gas exchange between breaths. Inspiration then draws atmospheric O_2 into the lungs to replenish the O_2 -depleted residual air for gas exchange in the alveoli.

FRC (Functional Residual Capacity) is the volume of air that will remain in the lungs after a normal expiration. This includes ERV + RV.

142. Answer (1)

Hint: Accelerates the reaction

Sol.: Enzymes catalyse the reaction by lowering the activation energy (E_a).

- The overall gibbs free energy change (ΔG) between reactants and products remains unchanged.

- They increase the rate of reaction without affecting spontaneity.
- Graphically, the catalyzed reaction curve has a smaller energy peak, but start and end points are the same.

143. Answer (2)

Hint: Less than 1 sec

Sol.: The cardiac cycle is the sequence of events that occur during one complete heartbeat, from the start of one contraction to the next one.

Thus, cardiac cycle = Time for one heart beat

If the heart beats 75 times in one minute

Time for one beat = 60 seconds ÷ 75

= 0.8 seconds

This is the duration of one complete cardiac cycle, including atrial systole, ventricular systole and joint diastole.

144. Answer (4)

Hint: Contains the SA node

Sol.: Pulmonary circulation leads to transport of deoxygenated blood from the right ventricle to the lungs, then, there is return of the oxygenated blood to the left atrium.

The pulmonary circuit begins when deoxygenated blood is returned from the body to the right atrium of the heart, where it is pumped out from the right ventricle to the lungs.

145. Answer (3)

Hint: One less than the number of ear ossicles you have in one ear.

Sol.: Although events on the two sides of the heart are similar, they are somewhat a little asynchronous. Right atrial systole proceeds left atrial systole.

Cardiac muscle fibres have gap junctions. Presence of gap junctions allow the cardiac muscle fibres to contract as a unit.

The first heart sound (called 'lub') is caused by closure of the AV valves ventricular systole begins.

Second heart sound (dub) is caused by the closure of semilunar valves.

146. Answer (4)

Hint: Cells that constitute 2-3% of all the WBCs

Sol.: RBCs are the most abundant of all the cells in blood. A healthy adult man has, on an average, 5 millions to 5.5 millions of RBCs per mm^{-3} of blood. Platelets can release a variety of substances most of which are involved in the coagulation or clotting of blood. Eosinophils are

granulocytes. They resist infections and are also associated with allergic reactions.

T-P gap represents the period in which heart muscles are electrically silent, indicating the heart's relaxation phase.

147. Answer (1)

Hint: Location of blood pumping organ.

Sol.: Human heart is mesodermal in origin. The heart is located in the mediastinum, with two third of its mass to the left of the midline. The exchange of substances between the blood and interstitial fluid occurs only in capillaries because capillaries have thin walls that permit exchange of substances.

Hardening of arteries by accumulation of fatty deposits leads to atherosclerosis.

Acetylcholine is a neurotransmitter released by the parasympathetic nervous system, which is responsible for slowing down the heart rate.

148. Answer (4)

Hint: Water retention is important.

Sol.: Dehydration increases the plasma osmolarity. Angiotensin-I is an inactive precursor molecule that plays a crucial role in the RAAS. Angiotensin-I is converted into angiotensin-II by the ACE (angiotensin-converting enzyme). Angiotensin-II acts on the adrenal cortex (zona glomerulosa) to release aldosterone.

Aldosterone acts on the distal tubules and collecting ducts, promoting Na^+ reabsorption and thus water retention.

149. Answer (3)

Hint: Nearly 99% of the filtrate is reabsorbed by the renal tubules.

Sol.: The amount of the filtrate formed by the kidneys per minute is called GFR. In a healthy individual, GFR is approximately 125 mL/min, i.e., 180 L/day. An adult human excretes, on an average, 1 to 1.5 L of urine per day. Our lungs remove large amounts of CO_2 (approximately 200 mL/minute) and also significant quantities of water every day. Stroke volume, the amount of blood ejected by the heart with each beat, is generally about 70 mL per beat in a healthy adult.

150. Answer (2)

Hint: Dialysing fluid has the same composition as that of blood plasma, except some substance.

Sol.: During the process of haemodialysis, the blood drained from a convenient artery is pumped into a dialysing unit called artificial kidney.

Nitrogenous wastes (urea) is absent in the dialysing fluid.

The dialysing unit contains a coiled cellophane tube surrounded by a dialysing fluid.

Haemodialysis can replace some, but not all of our kidney functions. e.g., secretion by renal tubules.

151. Answer (4)

Hint: Low blood pressure

Sol.: Constriction of the afferent arteriole reduces blood flow into the glomerulus, decreasing glomerular hydrostatic pressure and thus reducing GFR.

Urine output will decrease in the given case.

152. Answer (2)

Hint: Forms the lower jawline.

Sol.: Ethmoid is an unpaired cranial bone.

Temporal is a paired cranial bone.

Maxilla is a paired facial bone.

Mandible is an unpaired facial bone.

Mandible is a movable bone in the skull.

153. Answer (3)

Hint: The myosin head rotates to break the cross-bridge by utilising energy.

Sol.: In the absence of ATP, myosin remains attached to actin after the power stroke.

When a new ATP molecule binds, the cross-bridge is broken. The ATP is again hydrolysed by the myosin head and bridge formation and breakage is repeated causing further sliding.

154. Answer (2)

Hint: Equal to the number of fingers in one hand

Sol.: Last 2 pairs (11th and 12th) of ribs are not connected ventrally and are therefore called floating ribs.

Facial bones = 14

The 8th, 9th and 10th pairs of ribs are called vertebrochondral (false) ribs.

Metatarsals = 5 in each limb

Cervical vertebrae = 7

Tibia = 1 in each limb

Phalanges = 14 in each limb

First seven pairs of ribs are called true ribs (vertebrosternal ribs).

Lumbar vertebrae = 5

155. Answer (3)

Hint: It articulates with pelvic girdle.

Sol.: The femur (thigh bone) is the longest bone in the human body.

Its proximal end articulates with the acetabulum of the hip bone. Its distal end articulates with the tibia.

The end of the femur contains the red bone marrow which participates in blood cell production.

The bones of the limbs along with their girdles constitute the appendicular skeleton.

156. Answer (4)

Sol.: The correct sequence of the stages of cell cycle is:

$G_1 \rightarrow S \rightarrow G_2 \rightarrow M$

157. Answer (1)

Hint: Most of the cell organelles duplicate during the first stage of interphase.

Sol.: Most of the cell organelles duplicate during the G_1 phase of cell cycle.

158. Answer (3)

Hint: During anaphase II, sister chromatids separate and move towards the opposite poles.

Sol.: During reductional division, replication of DNA occurs only before meiosis I.

159. Answer (1)

Hint: T.W. Engelmann observed that bacteria accumulated mainly in the region of blue and red light of the split spectrum.

Sol.: Jan Ingenhousz, through his experiments, showed that sunlight is essential for plant process (photosynthesis) that somehow purifies the air fouled by burning candles.

160. Answer (3)

Hint: Both PS I and PS II are involved in the non-cyclic photophosphorylation.

Sol.: PS II is found in grana lamellae only.

161. Answer (3)

Hint: In tomato, RuBisCO can act as oxygenase.

Sol.: In C_4 plants, RuBisCO acts as carboxylase, minimising the oxygenase activity and hence preventing photorespiration.

162. Answer (1)

Hint: Conversion of glucose to glucose-6-phosphate is the first irreversible step of glycolysis.

Sol.: Hexokinase catalyses the conversion of glucose to glucose-6-phosphate.

163. Answer (3)

Hint: Citrate synthase catalyses the formation of citric acid in Krebs' cycle.

Sol.: Cytochrome bc_1 (complex III) accepts electrons from ubiquinol.

164. Answer (1)

Hint: RQ value of tripalmitin is 0.7.

Sol.: Fatty acids are degraded to acetyl CoA and enter the respiratory pathway.

165. Answer (2)

Hint: Castor seed is albuminous.

Sol.: In monocots, seed coat is membranous and generally fused with the fruit wall.

166. Answer (1)

Hint: Ethylene is called as the fruit ripening hormone.

Sol.: Ethylene accelerates thinning of fruits in plants like, cotton, cherry and walnut *etc.*

167. Answer (3)

Hint: Gibberellin was discovered from the extract of a fungus that causes the foolish seedling disease.

Sol.: Cytokinin was discovered from the degraded product of autoclaved herring sperm DNA.

168. Answer (2)

Hint: Absolute growth rate is the measurement and comparison of total growth per unit time.

Sol.: The absolute growth rate of both the leaf A and B is same.

- **Relative growth rate of leaf A.**

$$\frac{\text{Growth per unit time}}{\text{Initial size}} \times 100$$

$$\frac{15}{15} \times 100 = 100\%$$

- **Relative growth rate of leaf B**

$$\frac{\text{Growth per unit time}}{\text{Initial size}} \times 100$$

$$\frac{15}{25} \times 100 = 60\%$$

169. Answer (2)

Sol.: Arithmetic growth rate is represented by the equation, $L_t = L_0 + rt$

170. Answer (1)

Hint: One of the most widely used PGR is a gaseous hormone.

Sol.: Plants show open form of growth due to the presence of different types of meristems at specific locations in their body.

Cytokinins delay leaf senescence by promoting nutrient mobilization.

171. Answer (2)

Hint: True for gland whose lobes are found on either sides of trachea

Sol.: Anterior pituitary secretes growth hormone, not hypothalamus.

Hypothalamus secretes oxytocin which is stored and released by posterior pituitary.

Pineal gland secretes melatonin.

Thyroxine is derived from tyrosine and its deficiency cause cretinism.

172. Answer (3)

Hint: Released by the anterior pituitary.

Sol.: Prolactin regulates the growth of the mammary glands and formation of milk in them.

Estrogen and progesterone contribute in the development of mammary glands but they are steroidal (lipid-soluble) in nature. GnRH is a proteinaceous hormone released from the hypothalamus. It regulates the secretion of FSH and LH.

173. Answer (1)

Hint: TCT is released by the thyroid gland

Sol.: PTH is a hypercalcemic hormone, *i.e.*, it increases the blood Ca^{+2} levels. PTH acts on bones and stimulates the process of bone resorption. It also stimulates reabsorption of Ca^{+2} by the renal tubules and increases Ca^{+2} absorption from the digested food.

TCT is a hypocalcemic hormone.

When blood calcium levels are high, PTH secretion is suppressed and calcitonin secretion is stimulated. Conversely, when blood Ca^{+2} levels are low, PTH secretion is stimulated and calcitonin secretion is suppressed.

Parathyroid and thyroid cells can directly sense the changes in levels of Ca^{+2} in blood.

174. Answer (4)

Hint: Storage of glucose

Sol.: Adrenaline is an emergency hormone secreted from the adrenal medulla.

Cortisol is a glucocorticoid secreted from the adrenal cortex.

Catecholamines stimulate the breakdown of glycogen resulting in an increased concentration of glucose in blood.

In addition, they also stimulate the breakdown of lipids and proteins.

Glucocorticoids stimulate gluconeogenesis, lipolysis and proteolysis.

Both the hormones aim to increase the blood glucose level; thus, they inhibit glycogenesis.

175. Answer (1)

Hint: Marine cartilaginous fishes

Sol.: *Scolidon* and *Carcharodon* are cartilaginous fishes. They possess a heterocercal tail. This means that their tail has two lobes that are unequal in size, with the upper lobe being large and more developed than the lower lobe.

They are marine fishes with streamlined body. Notochord is persistent throughout life in them.

These animals are predaceous.

In males, pelvic fins bear claspers (copulatory organs).

They contain paired pectoral and pelvic fins.

Catla and *Pterophyllum* are bony fishes. They contain ctenoid scales.

Petromyzon is a cyclostome and its body is devoid of scales and paired fins.

176. Answer (2)

Hint: *Repere* or *reptum* means to creep or crawl.

Sol.: Amphibians can live in aquatic as well as terrestrial habitats. Most of them have two pairs of limbs, not all. *Ichthyophis* is a limbless amphibian.

The class name of reptiles refers to their creeping or crawling mode of locomotion. They are mostly terrestrial. Sea turtles, sea snakes, crocodiles and alligators live in water.

Not all reptiles show crawling mode of locomotion.

Planaria is a flatworm; it shows direct development.

177. Answer (1)

Hint: Recall the characteristics of a mammal and a bird.

Sol.: *Columba* is pigeon (bird).

Canis is cat (mammal).

Both exhibit pulmonary respiration.

Birds are oviparous whereas most mammals are viviparous (except *Ornithorhyncus*).

Birds do not have teeth. Birds have ossified endoskeleton and the long bones are hollow with air cavities (pneumatic).

Delphinus is also a mammal.

178. Answer (3)

Hint: Less than three

Sol.: *Sycon* is a porifer. It is monoecious and shows indirect development but it does not show bilateral symmetry.

Aurelia is a coelenterate. It is radially symmetrical.

Fasciola is a platyhelminth and it is bilaterally symmetrical. Sexes are not separate in them. Development is through many larval stages.

Ascaris is an aschelminth. It is dioecious.

Nereis is an annelid. It is dioecious.

Pila is a mollusc. It becomes asymmetrical in the adult stage due to torsion.

Ophiura is an echinoderm. Sexes are separate in them, but they show radial symmetry in the adult form.

179. Answer (2)

Hint: Alternation of generation

Sol.: Sea hare (*Aplysia*) is a mollusc. Molluscs have sensory tentacles and radula.

Sea anemone (*Adamsia*) is a coelenterate. Coelenterates contain cnidoblasts (which contain the stinging capsules or nematocysts).

Adamsia is sessile and cylindrical in shape.

Sea lily (*Antedon*) is an echinoderm. Echinoderms have a complete digestive system with mouth on the lower (ventral) side and anus on the upper (dorsal) side.

Sea horse (*Hippocampus*) is a bony fish. Male sea horses have a brood pouch, a specialized structure where they incubate fertilized eggs until they hatch.

180. Answer (3)

Hint: Look for a gregarious pest

Sol.: *Loligo* is a mollusc. Molluscs are unsegmented.

Ancylostoma is an aschelminth. It is a pseudocoelomate.

Pleurobrachia is a ctenophore. It is diploblastic.

Locusta is an arthropod. Arthropods are triploblastic, segmented and coelomate animals.

Pheretima is an annelid.

Meandrina is also a coelenterate.

Saccoglossus is not segmented.



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ANSWERS

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

HINTS & SOLUTIONS

[PHYSICS]

1. Answer (3)

Hint: Use principle of calorimetry $Q_{\text{absorb}} = Q_{\text{release}}$

Sol.: Heat required to convert 10 g of ice at -10°C to ice at 0°C .

$$Q_r = m_{\text{ice}} \Delta T = 10 \times \frac{1}{2} \times 10 = 50 \text{ cal}$$

Heat released due to temperature change of water from 20°C to 0°C

$$Q_{\text{release}} = m_{\text{w}} \Delta T = 10 \times 1 \times 20 = 200 \text{ cal}$$

Let m be the mass of ice which melts

$$Q_{\text{remaining}} = mL$$

$$m = \frac{150}{80} = \frac{15}{8} = 1.875 \text{ g}$$

$$\therefore \text{Mass of water} = 10 + 1.875 = 11.875 \text{ g}$$

$$\text{Mass of ice left} = 8.125 \text{ g}$$

2. Answer (2)

Hint: About fixed axis, use $\tau = I\alpha$

Sol.: $\tau_{\text{axis}} = I\alpha$

$$mg \cos 60^\circ \times \frac{l}{2} = \frac{ml^2}{3} \alpha$$

$$\Rightarrow g \times \frac{l}{2} \times \frac{l}{2} = \frac{l}{3} \alpha$$

$$\Rightarrow \alpha = \frac{3g}{4l}$$

3. Answer (3)

Hint: Compare given equation with standard

equation of SHM, $\frac{d^2y}{dt^2} + \omega^2 y = 0$

Sol.: By comparing with standard equation,

$$\omega^2 = \frac{12}{3} = 4$$

$$\omega = 2 \text{ rad/s}$$

4. Answer (3)

Hint & Sol.: By Stoke's law, the terminal velocity of water drop of radius r is given by

$$v = \frac{2}{9} r^2 \frac{(\rho - \sigma)g}{\eta}$$

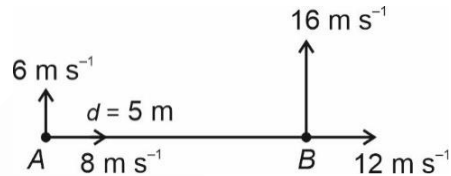
Neglecting density of air $\Rightarrow \sigma = 0$

$$\therefore v = \frac{2}{9} \frac{r^2 \rho g}{\eta}$$

5. Answer (2)

$$\text{Hint: } \omega_{BA} = \frac{(V_{BA})_{\perp}}{d}$$

Sol.:



$$(V_{BA})_{\perp} = 16 - 6 = 10 \text{ ms}^{-1}$$

$$\omega = \frac{(V_{BA})_{\perp}}{d} = \frac{10}{5} = 2 \text{ rad/s}$$

6. Answer (2)

Hint: Energy loss in collision

$$E = \frac{1}{2} \frac{m_1 m_2}{m_1 + m_2} (u_1 - u_2)^2 (1 - e^2)$$

Sol.: $e = 0$ for perfectly inelastic collision

$$E = \frac{1}{2} \frac{m_1 m_2}{m_1 + m_2} (2 - (-6))^2$$

$$= \frac{1}{2} \times \frac{3 \times 2}{3 + 2} (8)^2$$

$$= \frac{3}{5} \times 64 = 38.4 \text{ J}$$

7. Answer (1)

$$\text{Hint: } \vec{v}_{\text{avg}} = \frac{\vec{X}_f - \vec{X}_i}{\Delta t}$$

Sol.: From $t = 0$ to $t = 6 \text{ s}$

$$X_f = X_i = 0$$

$$\therefore \vec{v}_{\text{avg}} = 0$$

8. Answer (3)

Hint: Since block is moving upward, so friction is acting down the inclined plane.

Sol.: Retardation, $a = g \sin \theta + \mu g \cos \theta$

$$= 10 \left[\frac{3}{5} + \frac{1}{2} \times \frac{4}{5} \right]$$

$$= 6 + 4$$

$$= 10 \text{ m s}^{-2}$$

9. Answer (2)

Hint: Use, $C_p = \left(1 + \frac{f}{2}\right)R$

Sol.: $\frac{C_p}{R} = 1 + \frac{f}{2}$, where f is degree of freedom.

$$\Rightarrow \frac{7}{2} = 1 + \frac{f}{2}$$

$$\Rightarrow \frac{5}{2} = \frac{f}{2}$$

$$f = 5$$

∴ Diatomic

10. Answer (2)

Hint: $f_b = (f_1 - f_2)$ and $f = \frac{v}{\lambda}$

$$\text{Sol.: } 6 = \frac{v}{1} - \frac{v}{1.02}$$

$$6 = v \left(\frac{0.02}{1.02} \right)$$

$$\Rightarrow v = \frac{6 \times 1.02}{0.02}$$

$$= 306 \text{ m s}^{-1}$$

11. Answer (3)

Hint: All the zeros between two non-zero digits are significant, no matter where the decimal point is, if at all.

Sol.: All digits in given number are significant.

12. Answer (3)

Hint: At displacement x from mean position,

$$P.E. = \frac{1}{2}kx^2 \text{ and } K.E. = \frac{1}{2}k(A^2 - x^2)$$

Sol.: Given $K.E. = \frac{1}{2}(PE)$

$$\Rightarrow \frac{1}{2}k(A^2 - x^2) = \frac{1}{2} \left(\frac{1}{2}kx^2 \right)$$

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

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

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

13. Answer (2)

Hint: Energy required $E = m(V_s - V_c)$

$$\text{Sol.: } V_s = -\frac{GM}{R} \text{ and } V_c = -\frac{3GM}{2R}$$

$$E = m \left[-\frac{GM}{R} + \frac{3GM}{2R} \right]$$

$$E = \frac{GMm}{2R} = \frac{gmR}{2}$$

$$= \frac{10 \times 2 \times 6400 \times 10^3}{2}$$

$$= 64 \times 10^6 \text{ J}$$

$$= 6.4 \times 10^7 \text{ J}$$

14. Answer (4)

Hint: First law of thermodynamics, $dQ = dU + dW$

Sol.: Isobaric $\rightarrow P = \text{Constant}$

Isothermal $\rightarrow T = \text{Constant}, dU = 0$

Isochoric $\rightarrow dW = 0, dQ = dU$

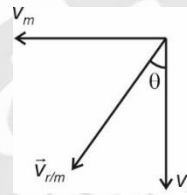
Adiabatic $\rightarrow dQ = 0, dW = -dU$

15. Answer (1)

Hint: Rain appears to man with velocity $= \vec{v}_r - \vec{v}_m$

Sol.: With respect to man,

$$\vec{v}_{r/m} = \vec{v}_r - \vec{v}_m$$

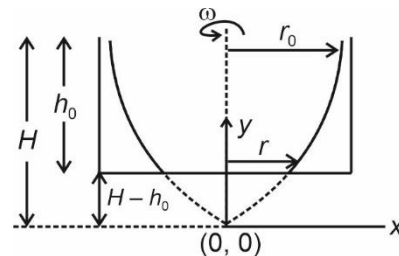


$$\tan \theta = \frac{v_m}{v_r} = \frac{3}{5}$$

$$\theta = \tan^{-1} \left(\frac{3}{5} \right)$$

16. Answer (4)

Hint & Sol.:



Since half of the bottom is exposed

$$\therefore \pi r^2 = \frac{1}{2} \pi r_0^2 \Rightarrow r = \frac{r_0}{\sqrt{2}}$$

$$\text{Equation of profile: } y = \frac{\omega^2 x^2}{2g}$$

$$H - h_0 = \frac{1}{2} \frac{\omega^2 r^2}{g} \quad \dots(i)$$

$$H = \frac{1}{2} \frac{\omega^2 r_0^2}{g} \quad \dots(ii)$$

$$\omega = \frac{\sqrt{4h_0g}}{r_0} = \frac{\sqrt{4 \times 40 \times 10^{-2} \times 10}}{4 \times 10^{-2}}$$

$$\omega = 100 \text{ rad/s}$$

17. Answer (2)

Hint: Velocity of sound in liquid is given by,

$$v = \sqrt{\frac{B}{\rho}}$$

$$\text{Sol.: } B = \frac{-\Delta P}{\frac{\Delta V}{V}} = \frac{50 \times 10^3}{\frac{2.5 \times 10^{-3}}{100}} = 2 \times 10^9 \text{ Pa}$$

$$v = \sqrt{\frac{B}{\rho}} = \sqrt{\frac{2 \times 10^9}{10^3}} = \sqrt{2 \times 10^6} \approx 1.414 \times 10^3$$

$$\approx 1414 \text{ m s}^{-1}$$

18. Answer (2)

Hint and Sol.: Since $a_c = a_t$

$$\therefore \omega^2 R = \frac{R d\omega}{dt} \Rightarrow \int \frac{d\omega}{\omega^2} = \int dt$$

$$\Rightarrow \left[\frac{-1}{\omega} \right]_{\frac{v_0}{R}}^{\omega} = t \Rightarrow \frac{-1}{\omega} + \frac{R}{v_0} = t \Rightarrow \omega = \frac{v_0}{R - v_0 t}$$

$$\Rightarrow \frac{d\theta}{dt} = \frac{v_0}{R - v_0 t} \Rightarrow \int_0^{\pi} d\theta = \int_0^t \frac{v_0}{R - v_0 t} dt$$

$$\Rightarrow \pi = \frac{-v_0}{v_0} \left[\log(R - v_0 t) \right]_0^t = -\log\left(\frac{R - v_0 t}{R}\right)$$

$$\Rightarrow t = \frac{R}{v_0} (1 - e^{-\pi})$$

19. Answer (3)

Hint: Compare given equation with standard travelling wave equation $y = A \sin(\omega t - kx)$

$$\text{Sol.: } y = 0.4 \sin 2\pi(20t - 2x)$$

on comparing with standard equation

$$A = 0.4 \text{ m}$$

$$\text{Speed of wave } v = \frac{\omega}{k} = \frac{40\pi}{4\pi} = 10 \text{ m/s}$$

$$\Rightarrow k = 4\pi = \frac{2\pi}{\lambda}$$

$$\Rightarrow \lambda = \frac{1}{2} = 0.5 \text{ m}$$

$$\Rightarrow \text{maximum particle speed } v_{\max} = A\omega$$

$$= 0.4 \times 40\pi = 16\pi$$

$$\Rightarrow \omega = 2\pi f = 40\pi$$

$$f = 20 \text{ Hz}$$

20. Answer (4)

$$\text{Hint: Thermal strain } \frac{\Delta l}{l} = \alpha \Delta T$$

$$\text{Sol.: Stress} = \frac{T}{A} = \frac{Y \Delta l}{l} = Y \alpha \Delta T$$

$$T = YA \alpha \Delta T$$

\therefore Both B and D are correct

21. Answer (2)

Hint: Slope of tangent to a curve is given by

$$m = \tan \theta = \frac{dy}{dx}$$

$$\text{Sol.: } y = x^4 - 2x$$

$$\tan \theta = \frac{dy}{dx} = 4x^3 - 2$$

$$\left[\frac{dy}{dx} \right]_{x=2} = 4 \times 2^3 - 2$$

$$= 32 - 2 = 30$$

22. Answer (3)

Hint: For monoatomic gas, $C_p = \frac{5}{2}R$ and

$$C_v = \frac{3}{2}R$$

$$\text{Sol.: } Q_A = n C_p (\Delta T)_A \text{ for A}$$

$$Q_B = n C_v (\Delta T)_B \text{ for B}$$

$$\text{Since } Q_A = Q_B$$

$$\Rightarrow C_p (\Delta T)_A = C_v (\Delta T)_B$$

$$\Rightarrow \frac{5}{2}R \times 60 = \frac{3}{2}R \times (\Delta T)_B$$

$$\Rightarrow 100 \text{ K} = (\Delta T)_B$$

23. Answer (4)

Hint and Sol.: When you touch two bodies, the body which is felt warmer need not to be at higher temperature, it depends on the rate of heat flow.

24. Answer (3)

Hint: Apply internal energy conservation

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

$$\Rightarrow \frac{f_1}{2} n_1 RT + \frac{f_2}{2} n_2 RT = \frac{f_{\text{mix}}}{2} (n_1 + n_2) RT$$

$$\Rightarrow \frac{3}{2} \times 2RT + \frac{5}{2} \times 4RT = \frac{f_{\text{mix}}}{2} (6)RT$$

$$\Rightarrow 13 = f_{\text{mix}} \times 3$$

$$f_{\text{mix}} = \frac{13}{3}$$

$$\therefore \gamma_{\text{mix}} = 1 + \frac{2}{f_{\text{mix}}} = 1 + \frac{2 \times 3}{13} = \frac{19}{13}$$

25. Answer (4)

Hint: For isothermal process, temperature is constant.

Sol.: $PV = nRT$

$T = \text{constant}$

$\therefore PV = \text{constant}$

26. Answer (1)

Hint: Use Newtons' third law

Sol.: Since liquid is at rest, therefore force exerted by flask on liquid is equal to its weight.

27. Answer (4)

Hint & Sol.: Since there is no opposition to prevent free expansion, so no longitudinal strain is developed.

28. Answer (2)

Hint: Use, $F = \frac{mdv}{dt}$ and W.D. = $\int Fdx$

Sol.: $F = \frac{mdv}{dt} = \frac{K}{v^2}$

$$\Rightarrow \int v^2 dv = \frac{K}{m} \int dt$$

$$\Rightarrow \frac{v^3}{3} = \frac{K}{m} t$$

$$\Rightarrow v^3 = \frac{K}{m} 3t$$

$$\Rightarrow v^2 = \left(\frac{3Kt}{m}\right)^{2/3}$$

$$W = \Delta K \propto v^2 \propto t^{2/3}$$

29. Answer (1)

Hint & Sol.: Work done by static friction/kinetic friction on an object may be positive, negative or zero.

The work done by internal forces during a bomb's explosion is positive

30. Answer (4)

Hint: If \vec{u}_{com} and \vec{a}_{com} are parallel, then path is straight line.

Sol.:

$$\vec{u}_{\text{com}} = \frac{m\vec{v}_1 + m\vec{v}_2}{2m} = \frac{4\hat{i} + 4\hat{j}}{2} = (2\hat{i} + 2\hat{j}) \text{ m s}^{-1}$$

$$\vec{a}_{\text{com}} = \frac{m\vec{a}_1 + m\vec{a}_2}{2m} = \frac{\vec{a}_1}{2} = \frac{(\hat{i} + \hat{j})}{2} \text{ m s}^{-2}$$

\vec{u}_{com} is parallel to \vec{a}_{com}

31. Answer (4)

Hint & Sol.: In case of uniform circular motion, speed is constant but both velocity and acceleration are variable.

32. Answer (3)

Hint & Sol.: For calculating moment of inertia, we cannot assume whole mass to be concentrated at centre of mass. Moment of inertia depends on the distribution of mass relative to the axis of rotation and not just total mass.

33. Answer (3)

Hint: Moment of inertia of a hollow sphere is minimum about its COM

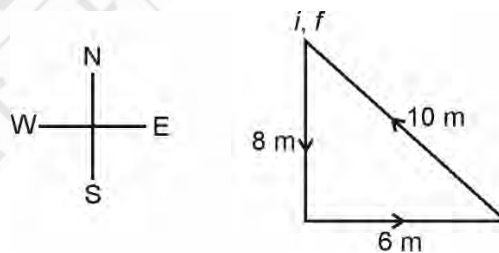
Sol.: I_{min} for hollow sphere = $\frac{2}{3}MR^2$

$$I \geq \frac{2}{3}MR^2$$

34. Answer (4)

Hint: Displacement $\vec{S} = \vec{x}_f - \vec{x}_i$

Sol.:



since $x_i = x_f$

\therefore Displacement = 0

35. Answer (4)

Hint: $|\hat{a} + \hat{b}| = 2 \cos \frac{\theta}{2}$, $|\hat{a} - \hat{b}| = 2 \sin \frac{\theta}{2}$

Sol.: $|\hat{a} + \hat{b}| = 2 \cos \frac{120^\circ}{2}$

$$= 2 \cos 60^\circ$$

$$= 2 \left(\frac{1}{2}\right) = 1$$

$$\therefore |\hat{a} + \hat{b}| = 1$$

36. Answer (3)

Hint: Least count of vernier scale (LC) = 1 MSD – 1 VSD

Sol.: 20 VSD = 18 MSD

LC = 1 MSD – 1 VSD

$$0.2 \text{ mm} = 1 \text{ MSD} - \frac{18}{20} \text{ MSD}$$

$$0.2 \text{ mm} = \frac{1}{10} \text{ MSD}$$

1 MSD = 2 mm

37. Answer (4)

Hint: In uniform circular motion, only centripetal acceleration is present.

Sol.: Equation of circle is given

$$x^2 + y^2 = 16$$

By comparing this with standard equation of circle

$$x^2 + y^2 = r^2, \text{ we get } r = 4 \text{ m}$$

$$\text{So, } |\vec{a}_c| = \frac{v^2}{r}$$

$$= \frac{8 \times 8}{4} = 16 \text{ m s}^{-2}$$

38. Answer (3)

Hint: Limitations of dimensional analysis.

Sol.: Work and torque have same dimension [ML²T⁻²] but physically both are different

→ Addition of two different physical quantities is meaningless

→ Dimensional analysis cannot be used to derive formula containing exponential term because the term itself is inherently dimensionless.

→ Dimensional analysis gives no information about dimensionless constants.

39. Answer (2)

Hint: Velocity of transverse wave on string,

$$v = \sqrt{\frac{T}{\mu}}$$

$$\text{Sol.} \mu = \frac{M}{L} = \frac{5}{2 \times 10} = 0.25 \text{ kg/m}$$

$$v = \sqrt{\frac{100 \times 100}{25}} = \frac{100}{5} = 20 \text{ m s}^{-1}$$

$$\Rightarrow t = \frac{l}{v} = \frac{10}{20} = 0.5 \text{ s}$$

40. Answer (2)

Hint: Use equation of motion, $\vec{v} = \vec{u} + \vec{a}t$

Sol.: $\vec{u} = (\hat{i} - 2\hat{j}) \text{ m s}^{-1}$ and

$\vec{a} = (-\hat{i} + 2\hat{j}) \text{ m s}^{-2}$

$\vec{v} = \vec{u} + \vec{a}t$

$\vec{v} = (\hat{i} - 2\hat{j}) + (-\hat{i} + 2\hat{j}) \times 2$

$\vec{v} = (\hat{i} - 2\hat{j}) + (-2\hat{i} + 4\hat{j})$

$\vec{v} = (-\hat{i} + 2\hat{j}) \text{ m s}^{-1}$

41. Answer (3)

Hint: Breaking stress depends on material and is independent of shape and size.

Sol.: Since wire is cut into 4 equal parts and cross-sectional area of each part is same,

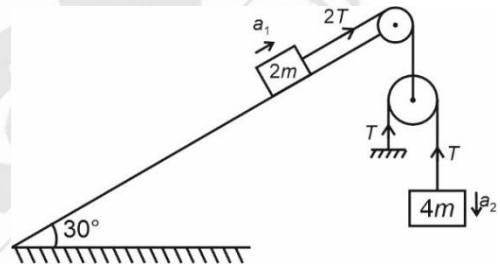
Therefore, each part is able to support maximum load W .

Now, all parts connected in parallel, therefore maximum load that can be supported is $4W$.

42. Answer (3)

Hint: Draw FBD of both blocks and apply Newton's second law.

Sol.:



By string constraint

$$2Ta_1 - Ta_2 = 0$$

$$a_2 = 2a_1$$

Apply NLM equation on $2m$ mass.

$$\Rightarrow 2T - 2mg \sin 30^\circ = 2ma_1$$

$$\Rightarrow 2T - 2mg \times \frac{1}{2} = 2ma_1$$

$$\Rightarrow 2T - mg = 2ma_1 \quad \dots(1)$$

Apply NLM equation on $4m$ mass.

$$\Rightarrow 4mg - T = 4ma_2$$

$$\Rightarrow 4mg - T = 4m(2a_1)$$

$$\Rightarrow 4mg - T = 8ma_1$$

$$\Rightarrow 8mg - 2T = 16ma_1 \quad \dots(2)$$

Add equation (1) and (2), we get

$$7mg = 18ma_1$$

$$\Rightarrow a_1 = \frac{7}{18}g$$

43. Answer (3)

Hint & Sol.: Greater is the mass, greater is the inertia. Hence a greater force is required to change the state of the body.

According to Newton's second law,

$$\vec{F} = \frac{d\vec{P}}{dt} \text{ or } \vec{F} = m\vec{a}$$

44. Answer (3)

Hint: Maximum horizontal distance (R_{\max}) = $\frac{u^2}{a_p}$

Sol.: $R_{\max} = \frac{u^2}{a_p}$

$$\Rightarrow 18 = \frac{12 \times 12}{a_p}$$

$$\Rightarrow a_p = \frac{144}{18} = 8 \text{ m s}^{-2}$$

45. Answer (2)

Hint: Gravitational potential inside due to spherical shell is $V = \frac{-GM}{R}$.

Sol.: Mass remains constant.

By decreasing radius, potential V decreases.

[CHEMISTRY]

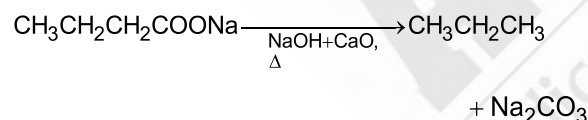
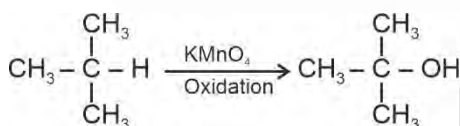
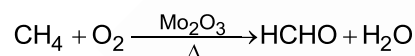
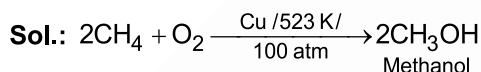
46. Answer (3)

Hint: F is more electronegative than H.

Sol.: NH_3 has more dipole moment than NF_3 because of orbital dipole due to lone pair in the same direction of resultant dipole moment of N-H bonds.

47. Answer (4)

Hint: Soda lime decarboxylation produces alkane with one carbon atom less than starting reactant.



48. Answer (2)

Hint: $T_{\text{eq}} = \frac{\Delta H}{\Delta S}$

Sol.: $T_{\text{eq}} = \frac{30 \times 10^3}{50}$

$$= 600 \text{ K}$$

$$= 327^\circ\text{C}$$

49. Answer (3)

Hint: 5 mol/L means that 5 mol of H_2SO_4 is dissolved in 1 L solution

Sol.: 29% w/w of solution means 100 g solution would have 29 g of solute

5 mol/L means that 1 L of solution would have 5 moles of H_2SO_4

$$\text{Mass of } \text{H}_2\text{SO}_4 = 5 \times 98 = 490 \text{ g}$$

29 g of H_2SO_4 is present in 100 g solution

490 g of H_2SO_4 is present in

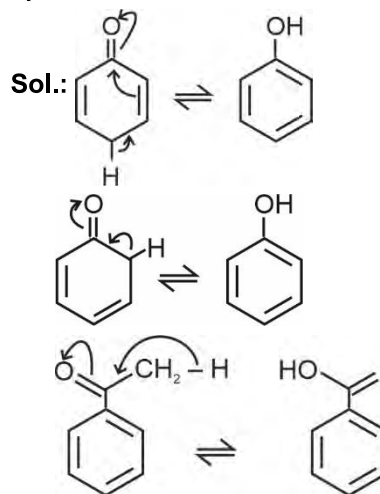
$$\frac{490 \times 100}{29} = 1.69 \times 10^3 \text{ g}$$

$$\text{Density of solution} = \frac{\text{Mass of solution}}{\text{Volume of solution}}$$

$$= \frac{1.69 \times 10^3}{1000 \text{ mL}} = 1.69 \text{ g/mL}$$

50. Answer (1)

Hint: Molecules that have the presence of alpha hydrogen connected to carbon which is sp^3 hybridised show tautomerism.



51. Answer (3)

$$\text{Hint: Molarity of mixture} = \frac{n_1 + n_2}{\text{Total volume}}$$

Sol.: 1500 mL of 2M HCl

Number of mmoles of HCl

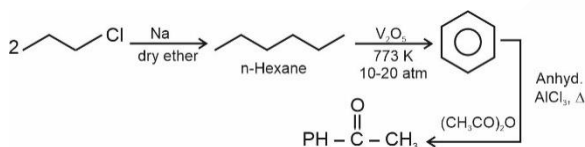
$$= 1500 \times 2 = 3000 \text{ mmol} = 3 \text{ mol}$$

$$\text{Number of moles of HCl} = \frac{3.65}{36.5} = 0.1$$

$$\text{Concentration of mixture} = \frac{(3 + 0.1) \times 1000}{1500}$$

$$= \frac{3.1 \times 10}{15} = 2.06 \text{ mol/L}$$

52. Answer (4)

Hint: Wurtz reaction is involved in step number I.**Sol.:**

53. Answer (2)

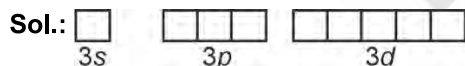
Hint: Total node(s) = (n - 1)

Angular node(s) = l

Sol.:

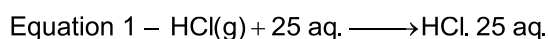
	Angular node(s)	Total nodes
5d	2	4
4f	3	3
7s	0	6
5p	1	4

54. Answer (3)

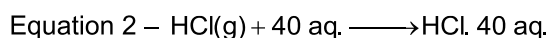
Hint: For single electron species, energy of $3s = 3p = 3d$ 

9 orbitals have same energy i.e., degenerate

55. Answer (2)

Hint: Enthalpy of dilution is the heat change when additional solvent is added to the solution**Sol.:**

$$\Delta H = -72.03 \text{ kJ/mol}$$



$$\Delta H = -72.79 \text{ kJ/mol}$$

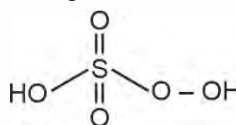
Subtracting equation (1) from equation (2)

$$\Delta H = -72.79 + 72.03 = -0.76 \text{ kJ/mol}$$

56. Answer (2)

Hint: Possible amines having molecular formula $\text{C}_3\text{H}_9\text{N}$ could be 1° , 2° or 3° .**Sol.:**

57. Answer (2)

Hint: H_2SO_5 is Caro's acid and has 1 peroxide linkage,**Sol.:** KClO_3

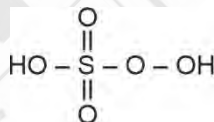
$$+1 + x + 3(-2) = 0$$

$$x = +5$$



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

$$x = +2$$



S exists in +6 oxidation number



$$x + 1 = 0$$

$$x = -1$$

58. Answer (4)

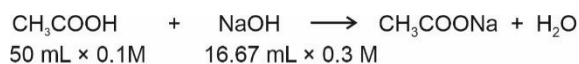
Hint: pH for weak acid strong base salt

$$= 7 + \frac{1}{2} \text{p}K_a + \frac{1}{2} \log C$$

Sol.: Number of equivalents of acid = Number of equivalents of base

$$50 \times 0.1 \times 1 = V \times 0.3 \times 1$$

$$V = \frac{50}{3} \text{ mL} = 16.67 \text{ mL}$$



$$= 5 \text{ mmoles} \qquad = 5 \text{ mmoles} \qquad 5 \text{ mmoles}$$

$$[\text{CH}_3\text{COONa}] = \frac{5 \text{ mmoles}}{(50 + 16.67) \text{ mL}} = 0.075 \text{ M}$$

For salt hydrolysis

$$\text{pH} = 7 + \frac{1}{2}(\text{pK}_a + \log C)$$

$$= 7 + \frac{1}{2}[5 + \log(0.075)]$$

$$= 7 + \frac{1}{2}(5 - 1.125) = 8.9$$

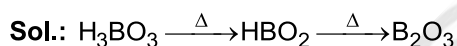
59. Answer (3)

Hint: Amphoteric oxides behave as acid with bases and as base with acids.

Sol.: The amphoteric oxides are SnO , PbO , SnO_2 , PbO_2 and Al_2O_3

60. Answer (2)

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



61. Answer (1)

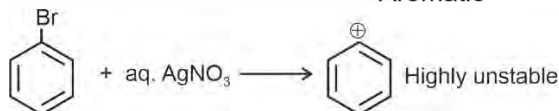
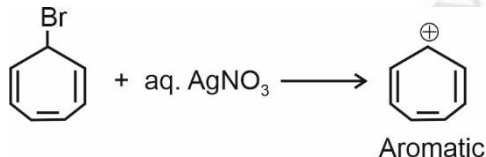
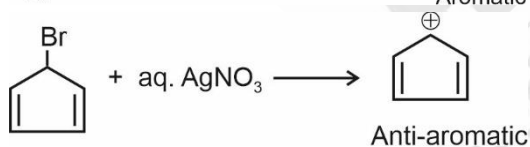
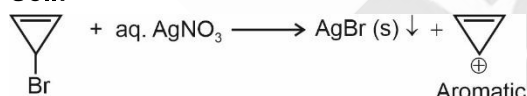
Hint: Carbanion can be stabilised by back donation of electron from carbon to adjacent atom.

Sol.: In $\overset{\ominus}{\text{C}}\text{Cl}_3$, electron pair of carbon is back donated to vacant orbital of Cl, increasing its stability than $\overset{\ominus}{\text{C}}\text{F}_3$

62. Answer (1)

Hint: Species which form stable carbocation can form precipitate with aq. AgNO_3

Sol.:



63. Answer (1)

Hint: Electrons present in d and f subshell show poor screening effect which can change the

general order of properties like size and ionization enthalpy.

Sol.: $\text{Si} \approx \text{Ge} \approx \text{Sn} < \text{Pb} < \text{C}$: Electronegativity

$\text{B} < \text{Ga} < \text{Al} < \text{In} < \text{Tl}$: Atomic radius

$\text{C} > \text{Si} > \text{Ge} > \text{Pb} > \text{Sn}$: Ionization enthalpy

64. Answer (3)

Hint: $\Delta H = \Delta U + \Delta(PV)$

Sol.: $\Delta U = nC_v \Delta T$

$$= 5 \times 28 \times 100 = 14 \text{ kJ}$$

$\Delta H = 14 + \Delta(PV)$

For ideal gas $PV = nRT$

$\Delta H = 14 + \Delta(nRT)$

$$= 14 + \frac{5 \times 8.314 \times 100}{1000} = 18.157 \text{ kJ}$$

65. Answer (1)

Hint: Number of moles $\times N_A \times$ Number of electron in single species.

Sol.: • 6 g CO_3^{2-}

$$\text{Number of electrons} = \frac{6}{60} \times N_A \times (6 + 24 + 2)$$

$$= 3.2 N_A$$

• 36 g NH_4^+

$$\text{Number of electrons} = \frac{36}{18} \times N_A \times (7 + 4 - 1)$$

$$= 20 N_A$$

• 90 g glucose

Number of electrons

$$= \frac{90}{180} \times N_A \times (6 \times 6 + 12 + 6 \times 8) = 48 N_A$$

• 32 g O_2^{2-}

$$\text{Number of electrons} = \frac{32}{32} \times N_A \times (2 \times 8 + 2) = 18 N_A$$

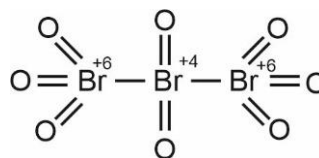
$$= 18 N_A$$

66. Answer (2)

Hint: Structure of C_3O_2 : $\text{O} = \text{C} = \text{C} = \text{C} = \text{O}$

Sol.: $\overset{+2}{\text{O}} = \overset{0}{\text{C}} = \overset{+2}{\text{C}} = \overset{+2}{\text{C}} = \overset{+2}{\text{O}}$

carbon suboxide (C_3O_2)



tribromo-octaoxide (Br_3O_8)

67. Answer (3)

Hint: Δ_{egH} of O is -141 kJ/mol**Sol.:** When an electron is added to O, the added electron goes to $2p$ subshell and suffers significant repulsion.

68. Answer (2)

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

Sol.: Li^{2+} ion

$$n_1 = 1$$

$$n_2 = \infty \quad \frac{1}{\lambda_1} = R_H \times 9 \left(1 - \frac{1}{\infty} \right) = 9 \times R_H$$

 Be^{3+} ion

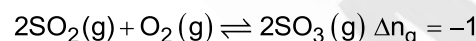
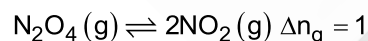
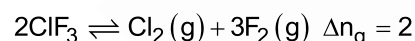
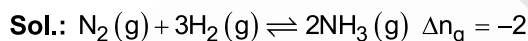
$$n_1 = 3 \quad \frac{1}{\lambda_2} = R_H \times 16 \left(\frac{1}{9} - \frac{1}{16} \right)$$

$$n_2 = 4 \quad \frac{1}{\lambda_2} = R_H \times 16 \left(\frac{7}{9 \times 16} \right) = \frac{7R_H}{9}$$

$$\frac{\lambda_2}{\lambda_1} = \frac{9 \times R_H \times 9}{7R_H} = \frac{81}{7}$$

$$\therefore \frac{\lambda_1}{\lambda_2} = \frac{7}{81}$$

69. Answer (1)

Hint: $\Delta n_g = n_p - n_r$ 

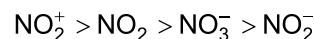
70. Answer (2)

Hint: Molecule with sp^3d hybridisation and trigonal bipyramidal shape has 90° , 120° and 180° bond angle.**Sol.:** PCl_5 : 90° , 120° and 180° bond angle IF_7 : 90° , 72° and 180° bond angle SF_6 : 90° and 180° bond angle ClF_3 : Less than 90° and less than 180°

71. Answer (3)

Hint: Bond angle depends upon hybridisation, lone pair on central atom, size of central and side atom etc.**Sol.:** In $\text{N}(\text{SiH}_3)_3$ the lone pair of electrons of N is back donated to vacant orbital of Si, so, this is a weaker Lewis base**Bond order** N_2 3 N_2^- 2.5 N_2^{2-} 2

Correct order of bond angle is



Lesser the strength of back bonding from X (halogen) to B greater will be Lewis acid nature.

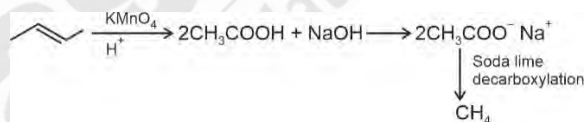
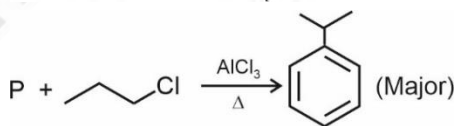
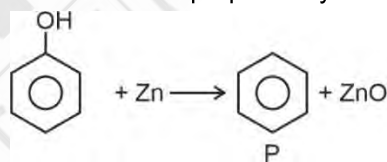
72. Answer (1)

Hint: XeO_3 is pyramidal in shape.**Sol.:** Xe in XeO_3 is sp^3 hybridised.

73. Answer (2)

Hint: Steam distillation is applied to separate substances which are steam volatile and are immiscible with water.**Sol.:** Aniline and water are separated using steam distillation.

74. Answer (3)

Hint: B is methane and P is benzene**Sol.:** CH_4 cannot be prepared by using Kolbe's method

75. Answer (1)

Hint: In general enthalpy of neutralization becomes less than 57.1 kJ/mol if either weak acid or weak base or both weak acid and weak base are taken.**Sol.:** HF and NaOH when combine releases energy more than 57.1 kJ/mol because of a very high negative hydration energy of F^- ion.

76. Answer (3)

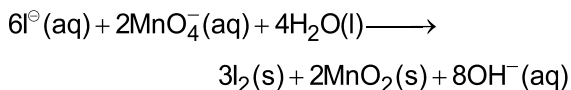
Hint: For given value of n ,

$$l = 0, 1, 2, \dots, n-1$$

Sol.: For a given value of l

$$m_l = -l, \dots, 0, \dots, +l$$

77. Answer (3)

Hint: Balancing of redox reaction can be done by oxidation number method or ion electron method.**Sol.:** The balanced chemical reaction is

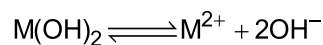
a = 6

c = 4

d = 3

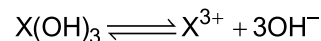
f = 8

78. Answer (1)

Hint: Precipitation starts when $Q_{\text{ip}} = K_{\text{sp}}$ **Sol.:** For $\text{M}(\text{OH})_2$ 

$$K_{\text{sp}} = 4 \times 10^{-10} = 1 \times [\text{OH}^-]^2$$

$$[\text{OH}^-] = 2 \times 10^{-5} \text{ M}$$

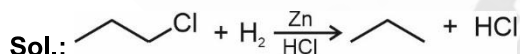
For $\text{X}(\text{OH})_3$ 

$$K_{\text{sp}} = 2.7 \times 10^{-14} = 1 \times [\text{OH}^-]^3$$

$$[\text{OH}^-] = 3 \times 10^{-5} \text{ M}$$

Since $\text{M}(\text{OH})_2$ requires less $[\text{OH}^-]$ for precipitation, it will precipitate first.

79. Answer (1)

Hint: Zn with H_2 in acidic medium reduces haloalkanes to alkanes with same number of carbon atoms

80. Answer (1)

Hint: cis-But-2-ene has high boiling point than trans-But-2-ene.**Sol.:** trans-But-2-ene is non-polar.

81. Answer (1)

Hint: Effect of temperature on equilibrium constant can be given as

$$\log\left(\frac{K_2}{K_1}\right) = \frac{\Delta H}{2.303R} \left(\frac{1}{T_1} - \frac{1}{T_2}\right)$$

$$\text{Sol.}:$$

$$\log 2 = \frac{\Delta H}{2.303 \times 8.314} \left(\frac{1}{300} - \frac{1}{400}\right)$$

$$\Delta_r H = 2.303 \times 8.314 \times (\log 2) \times 1200$$

$$= 6.9 \text{ kJ}$$

82. Answer (4)

Hint: 0.5 moles of $\text{Ba}(\text{N}_3)_2$ is decomposed

$$\text{Sol.}:$$
 Number of moles of $\text{Ba}(\text{N}_3)_2 = \frac{110.7}{221.37} = 0.5$

Moles of N_2 produced in 1st reaction = 0.5×3 Moles of NO produced in 2nd reaction = 3Moles of NO_2 produced in 3rd reaction = 3Mass of NO_2 produced = $3 \times 46 = 138 \text{ g}$

83. Answer (4)

Hint: PbI_4 does not exist.**Sol.:** Fullerenes are pure form due to absence of dangling bonds.

84. Answer (3)

Hint: $h\nu = h\nu_0 + \text{kinetic energy}$

$$\text{Sol.}:$$

$$\lambda = \frac{h}{mv}$$

$$\lambda = \frac{h}{\sqrt{2m \text{KE}}}$$

$$\lambda^2 = \frac{h^2}{2m \text{KE}}$$

$$\text{KE} = \frac{h^2}{2m\lambda^2}$$

$$h(\nu - \nu_0) = \frac{h^2}{2m\lambda^2}$$

$$\lambda = \sqrt{\frac{h}{2m(\nu - \nu_0)}}$$

85. Answer (1)

Hint: Electronic configuration of element decides its position in periodic table**Sol.:**

Atomic number	Electronic configuration	Block
64	$4f^7 5d^1 6s^2$	f
57	$5d^1 6s^2$	d
38	$5s^2$	s
83	$6s^2 6p^3$	p

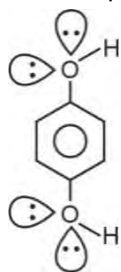
86. Answer (4)

Hint: Ag is less reactive than H_2 .**Sol.:** More reactive metal than H_2 gives hydrogen gas with dilute acid.Mg is more reactive than H_2 .

87. Answer (4)

Hint: Symmetrical molecules usually have zero dipole moment and are non-polar.

Sol.: A, B, D and E have zero dipole moment and are non-polar molecules



Due to the presence of lone pair of electrons, bond dipoles do not cancel each other as the angle between them is not 180°

88. Answer (3)

Hint: Ne has maximum electron gain enthalpy among group 18 elements.

91. Answer (1)

Hint: The given characteristics are of the members of the family, Solanaceae.

Sol.: Makoi has bisexual flowers with radial symmetry, valvate aestivation in calyx and corolla and superior ovary.

92. Answer (2)

Hint: A few millimetres above the root cap is the region of meristematic activity.

Sol.: Rapid elongation is evident in the cells of the elongation zone, which is present above the region of meristematic activity.

93. Answer (2)

Hint: *Equisetum* is a homosporous pteridophyte.

Sol.: In *Equisetum*, gametophyte is not retained on the parent sporophyte. Sporophyte in *Riccia* (liverwort) is less developed than that in *Sphagnum* (moss).

94. Answer (1)

Hint: The given figure is of brown alga, *Laminaria*.

Sol.: *Laminaria* is a marine alga used as food.

95. Answer (4)

Hint: Bentham and Hooker gave the natural system of classification.

Sol.: Natural system of classification were based on natural affinities among the organisms and

Sol.: Removal of electron from isolated gaseous atom is an endothermic process.

89. Answer (1)

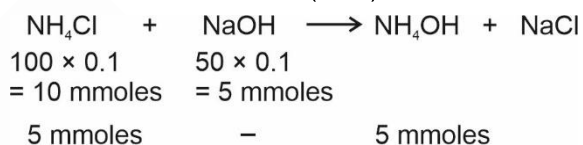
Hint: More polarisation, more covalent character.

Sol.: Iodide ion being largest anion among all would have greater polarisation, so, more covalent character and less ionic character.

90. Answer (2)

Hint: Basic buffer can be obtained by mixing weak base and its salt made with strong acid

Sol.: Number of mmoles ($t = 0$)



The solution contains equimolar mixture of NH_4OH and NH_4Cl

[BIOLOGY]

considered, not only the external features, but also internal features, like ultra-structure, anatomy, embryology and phytochemistry.

96. Answer (3)

Hint: Protonema is the first stage in the life cycle of a moss.

Sol.: Protonema is a creeping, green, branched and frequently filamentous stage.

97. Answer (2)

Hint: *Volvox* shows oogamous type of sexual reproduction.

Sol.: In *Ulothrix*, gametes are flagellated and similar in size.

98. Answer (2)

Hint: *Mucor* belongs to the class Phycomycetes, whereas, *Ustilago* belongs to the class Basidiomycetes.

Sol.: Dikaryophase is absent in *Mucor*. Biological classification of plants and animals was first proposed by Aristotle.

99. Answer (4)

Hint: In euglenoids, there is the presence of protein rich layer called pellicle, instead of a cell wall.

Sol.: A viroid was found to be a free RNA and is smaller than virus in size.

100. Answer (3)

Hint: Asexual spores are generally not found in the members of Basidiomycetes.

Sol.: Presence of conidia is a common characteristic of the members of the class Ascomycetes and Deuteromycetes.

101. Answer (3)

Hint: Dinoflagellates comprise of two flagella.

Sol.: Diatoms are the chief producers in the oceans.

102. Answer (2)

Hint: Nuclear membrane is absent in monerans.

Sol.: All the members of the kingdom Monera are prokaryotic and have cellular body organisation.

103. Answer (2)

Hint: Lion and leopard are two different species but both belong to the genus, *Panthera*.

Sol.: Plant family Convolvulaceae is included in the order Polymoniales, mainly on the basis of floral characters.

104. Answer (4)

Hint: Brinjal belongs to the family, Solanaceae.

Sol.: Brinjal belongs to the class, Dicotyledonae.

105. Answer (2)

Hint: He was an evolutionary biologist from the Harvard university.

Sol.: Ernst Mayr is known as the Darwin of the 20th century.

106. Answer (2)

Hint: An endocrine gland

Sol.: The prominent endocrine glands found in frog are pituitary, thyroid, parathyroid, thymus, etc. In humans, four parathyroid glands are present on the back side of the thyroid gland, one pair each in the two lobes of the thyroid gland.

Eyes in a frog are a pair of spherical structures situated in the orbit in skull. These are simple eyes (possessing only one unit).

In frogs, salivary glands are absent.

In the frog's brain, pons is absent.

In humans, pons and salivary glands are present.

107. Answer (4)

Hint: One of the additional chambers present in the heart of frog.

Sol.: In frogs, the right atrium receives deoxygenated blood through sinus venosus which in turn receives blood from the major veins called vena cava, while the left atrium receives oxygenated blood from the pulmonary veins. Conus arteriosus is present on the ventral side of heart; it receives the blood which is ejected from the ventricle of the heart. Both right and left atrium pump blood into a single ventricle.

108. Answer (2)

Hint: Their skin is moist and slimy.

Sol.: Frogs have the ability to change their colour to hide them from their enemies (camouflage). This protective coloration is called mimicry.

Frogs never drink water but absorb it through the skin.

Frogs have a thick, pigmented and almost immovable upper eyelid and a thin semi-transparent and freely movable lower eyelid.

In harsh weather conditions, the frogs exhibit the state of dormancy called hibernation (winter sleep) and aestivation (summer sleep).

109. Answer (4)

Hint: 'Amphi' means both

Sol.: Tadpole requires thyroxine for its metamorphosis into an adult frog.

In adult frogs, the alimentary canal is short because they are carnivores and hence the length of intestine gets reduced; tadpoles are herbivores.

Tadpoles exhibit branchial respiration as well as cutaneous respiration whereas adult frogs exhibit buccopharyngeal, pulmonary and cutaneous respiration.

Tadpoles are free-swimming aquatic larvae whereas adult frogs live on both land and water.

110. Answer (3)

Hint: Male cockroaches can be differentiated from female cockroaches morphologically.

Sol.: Anal styles are a paired thread like structures. These small unjointed outgrowths, project backwardly from the sides of the 9th sternum of the male cockroach only. They are sensitive to touch.

111. Answer (1)

Hint: True for the initial part of the digestive system.

Sol.: The entire foregut of cockroaches is lined by cuticle.

Their hindgut is broader than the midgut and is differentiated into ileum, colon and rectum. They contain a paired but bilobed salivary glands.

Gizzard/proventriculus is used for grinding the food. It contains an outer layer of thick circular muscles and thick inner cuticle forming six highly chitinous plate called teeth, which are needed for grinding.

Crop is the largest part of foregut where food is stored.

112. Answer (2)

Hint: Structure possessing myocardium

Sol.: Smooth muscle fibres exhibit uninucleated condition with no striations. They are found in the walls of stomach and blood vessels. Biceps contain skeletal muscle fibres. These fibres are multinucleated and striated and they get easily fatigued. Myocardium is composed of cardiac muscle fibres. These fibres are striated, uninucleated and resistant to fatigue.

Wall of oesophagus is lined by

- (i) Smooth muscles in its lower portion
- (ii) Skeletal muscles in its upper portion

113. Answer (4)

Hint: Equal to the number of bones present in pectoral girdle of humans

Sol.: Adipocytes are found in both areolar and adipose tissues in variable number. It is not exclusive to adipose tissues.

Epithelial tissue is avascular. Lamellae are found in bones, not in cartilages. Chondrocytes are the cells of cartilage. Chondrocytes occur singly or in groups in the lacunae. Collagen fibres are structural proteins. They are not present in the matrix of blood.

114. Answer (4)

Hint: Protein molecule.

Sol.: Dehydration synthesis, also known as condensation reaction, is a chemical process where two molecules combine to form a larger molecule, with a water molecule being removed as a by-product. Formation of glycosidic bonds (present in carbohydrates), peptide bonds (present in proteins) and ester bond (present in lipids) involve condensation reaction.

Palmitic acid has 16 carbons including the carboxyl carbon.

Glycine is an amino acid. It has a symmetric carbon. Inulin is a storage homopolymer. Trypsin is a proteinaceous enzyme.

115. Answer (2)

Hint: Hydrolysis of glycosidic bond

Sol.: Enzymes are divided into 6 classes, each with 4-13 sub-classes and named accordingly by a four digit number.

- Oxidoreductases – Class I
- Transferases – Class II
- Hydrolases – Class III
- Lyases – Class IV
- Isomerases – Class V
- Ligases – Class VI

Lactose is a disaccharide that will hydrolyse into galactose and glucose in the presence of lactase. Hydrolases perform hydrolysis.

116. Answer (2)

Hint: A tetrad comprises of a pair of synapsed homologous chromosomes.

Sol.: Tetrad/bivalent formation takes place during the zygotene stage.

117. Answer (4)

Hint: Endomembrane system includes ER, Golgi complex, lysosomes and vacuoles.

Sol.: Smooth Endoplasmic Reticulum (SER) helps in the synthesis of steroidal hormones.

Golgi body helps in the formation of glycoproteins and glycolipids and digestion of proteins and lipids is done by lysosomes.

118. Answer (3)

Hint: Length of the two arms is equal in a metacentric chromosome.

Sol.: Flagella show 9 + 2 arrangement of microtubules.

119. Answer (3)

Hint: Leucoplasts are devoid of pigments.

Sol.: Microtubules are hollow, unbranched and cylindrical structures.

120. Answer (3)

Hint: Peripheral proteins lie on the surface of the membrane while the integral proteins are partially or totally buried in the membrane.

Sol.: Depending on the ease of extraction, membrane proteins can be classified as integral and peripheral.

121. Answer (4)

Hint: The organelles included in the endomembrane system, function in a coordinated manner.

Sol.: Lysosomes, endoplasmic reticulum, Golgi body and vacuoles constitute the endomembrane system.

122. Answer (3)

Hint: Sclereids are found in the fruit walls of nuts and guava pulp.

Sol.: Tracheids are found in all the categories of vascular plants.

123. Answer (3)

Hint: Bulliform cells help in rolling of leaves.

Sol.: Bulliform cells are present in the adaxial epidermis.

124. Answer (4)

Hint: 'a' represents medullary rays and 'b' represents endodermis of a dicot stem.

Sol.: 'c' represents pericycle and 'd' represents hypodermis of a dicot stem.

Hypodermis consists of 3 to 5 layers of collenchymatous cells having no intercellular spaces.

125. Answer (2)

Hint: Endodermis of the root cortex comprises of water-impermeable, barrel-shaped cells with waxy coating.

Sol.: The tangential as well as radial walls of the endodermal cells have a deposition of water-impermeable, waxy material suberin, in the form of casparian strips.

126. Answer (4)

Hint: Hypodermis of a monocot stem is sclerenchymatous.

Sol.: Cortical layers below hypodermis, consists of round, thin-walled parenchymatous cells with conspicuous intercellular spaces.

127. Answer (1)

Hint: Polyarch xylem bundles are observed in monocot roots.

Sol.: Maize is a monocot plant in which polyarch xylem bundles are observed and the pith is large and well-developed.

128. Answer (3)

Hint: Legume fruit is a characteristic of the members of the family, Fabaceae.

Sol.: Members of the family Solanaceae and Liliaceae show the presence of actinomorphic flowers, endospermous seeds and axile placentation.

129. Answer (2)

Hint: Carpels are fused in mustard and cotton.

Sol.: In pea, diadelphous androecium is found.

130. Answer (3)

Hint: More than two leaves arise at a node and form a whorl in *Alstonia*.

Sol.: China rose and sunflower have alternate phyllotaxy. In guava, opposite phyllotaxy is seen.

131. Answer (3)

Hint: It articulates with pelvic girdle.

Sol.: The femur (thigh bone) is the longest bone in the human body.

Its proximal end articulates with the acetabulum of the hip bone. Its distal end articulates with the tibia.

The end of the femur contains the red bone marrow which participates in blood cell production.

The bones of the limbs along with their girdles constitute the appendicular skeleton.

132. Answer (2)

Hint: Equal to the number of fingers in one hand

Sol.: Last 2 pairs (11th and 12th) of ribs are not connected ventrally and are therefore called floating ribs.

Facial bones = 14

The 8th, 9th and 10th pairs of ribs are called vertebrochondral (false) ribs.

Metatarsals = 5 in each limb

Cervical vertebrae = 7

Tibia = 1 in each limb

Phalanges = 14 in each limb

First seven pairs of ribs are called true ribs (vertebrosternal ribs).

Lumbar vertebrae = 5

133. Answer (3)

Hint: The myosin head rotates to break the cross-bridge by utilising energy.

Sol.: In the absence of ATP, myosin remains attached to actin after the power stroke.

When a new ATP molecule binds, the cross-bridge is broken. The ATP is again hydrolysed by the myosin head and bridge formation and breakage is repeated causing further sliding.

134. Answer (2)

Hint: Forms the lower jawline.

Sol.: Ethmoid is an unpaired cranial bone.

Temporal is a paired cranial bone.

Maxilla is a paired facial bone.

Mandible is an unpaired facial bone.

Mandible is a movable bone in the skull.

135. Answer (4)

Hint: Low blood pressure

Sol.: Constriction of the afferent arteriole reduces blood flow into the glomerulus, decreasing glomerular hydrostatic pressure and thus reducing GFR.

Urine output will decrease in the given case.

136. Answer (2)

Hint: Dialysing fluid has the same composition as that of blood plasma, except some substance.

Sol.: During the process of haemodialysis, the blood drained from a convenient artery is pumped into a dialysing unit called artificial kidney.

Nitrogenous wastes (urea) is absent in the dialysing fluid.

The dialysing unit contains a coiled cellophane tube surrounded by a dialysing fluid.

Haemodialysis can replace some, but not all of our kidney functions. e.g., secretion by renal tubules.

137. Answer (3)

Hint: Nearly 99% of the filtrate is reabsorbed by the renal tubules.

Sol.: The amount of the filtrate formed by the kidneys per minute is called GFR. In a healthy individual, GFR is approximately 125 mL/min, i.e., 180 L/day. An adult human excretes, on an average, 1 to 1.5 L of urine per day. Our lungs remove large amounts of CO₂ (approximately

200 mL/minute) and also significant quantities of water every day. Stroke volume, the amount of blood ejected by the heart with each beat, is generally about 70 mL per beat in a healthy adult.

138. Answer (4)

Hint: Water retention is important.

Sol.: Dehydration increases the plasma osmolarity. Angiotensin-I is an inactive precursor molecule that plays a crucial role in the RAAS. Angiotensin-I is converted into angiotensin-II by the ACE (angiotensin-converting enzyme). Angiotensin-II acts on the adrenal cortex (zona glomerulosa) to release aldosterone.

Aldosterone acts on the distal tubules and collecting ducts, promoting Na⁺ reabsorption and thus water retention.

139. Answer (1)

Hint: Location of blood pumping organ.

Sol.: Human heart is mesodermal in origin. The heart is located in the mediastinum, with two third of its mass to the left of the midline. The exchange of substances between the blood and interstitial fluid occurs only in capillaries because capillaries have thin walls that permit exchange of substances.

Hardening of arteries by accumulation of fatty deposits leads to atherosclerosis.

Acetylcholine is a neurotransmitter released by the parasympathetic nervous system, which is responsible for slowing down the heart rate.

140. Answer (4)

Hint: Cells that constitute 2-3% of all the WBCs

Sol.: RBCs are the most abundant of all the cells in blood. A healthy adult man has, on an average, 5 millions to 5.5 millions of RBCs per mm⁻³ of blood. Platelets can release a variety of substances most of which are involved in the coagulation or clotting of blood. Eosinophils are granulocytes. They resist infections and are also associated with allergic reactions.

T-P gap represents the period in which heart muscles are electrically silent, indicating the heart's relaxation phase.

141. Answer (3)

Hint: One less than the number of ear ossicles you have in one ear.

Sol.: Although events on the two sides of the heart are similar, they are somewhat a little asynchronous. Right atrial systole proceeds left atrial systole.

Cardiac muscle fibres have gap junctions. Presence of gap junctions allow the cardiac muscle fibres to contract as a unit.

The first heart sound (called 'lub') is caused by closure of the AV valves ventricular systole begins.

Second heart sound (dub) is caused by the closure of semilunar valves.

142. Answer (4)

Hint: Contains the SA node

Sol.: Pulmonary circulation leads to transport of deoxygenated blood from the right ventricle to the lungs, then, there is return of the oxygenated blood to the left atrium.

The pulmonary circuit begins when deoxygenated blood is returned from the body to the right atrium of the heart, where it is pumped out from the right ventricle to the lungs.

143. Answer (2)

Hint: Less than 1 sec

Sol.: The cardiac cycle is the sequence of events that occur during one complete heartbeat, from the start of one contraction to the next one.

Thus, cardiac cycle = Time for one heart beat

If the heart beats 75 times in one minute

Time for one beat = $60 \text{ seconds} \div 75$

= 0.8 seconds

This is the duration of one complete cardiac cycle, including atrial systole, ventricular systole and joint diastole.

144. Answer (1)

Hint: Accelerates the reaction

Sol.: Enzymes catalyse the reaction by lowering the activation energy (E_a).

- The overall gibbs free energy change (ΔG) between reactants and products remains unchanged.
- They increase the rate of reaction without affecting spontaneity.
- Graphically, the catalyzed reaction curve has a smaller energy peak, but start and end points are the same.

145. Answer (1)

Hint: Value of 'X' is somewhere close to ERV.

Sol.: The volume of air remaining in the lungs even after a forcible expiration is called residual volume. This averages around 1100 mL to 1200 mL.

RV cannot be measured by a simple spirometer. The residual volume maintains the alveolar patency even after maximal forced expiration. In healthy lungs, the air that makes up the residual volume is utilized for continual gas exchange between breaths. Inspiration then draws atmospheric O_2 into the lungs to replenish the O_2 -depleted residual air for gas exchange in the alveoli.

FRC (Functional Residual Capacity) is the volume of air that will remain in the lungs after a normal expiration. This includes ERV + RV.

146. Answer (3)

Hint: The role of O_2 in the regulation of respiratory rhythm is quite insignificant.

Sol.: A specialised centre present in the medulla region of the brain, called respiratory rhythm centre, is primarily responsible for regulation of breathing.

A chemosensitive area is situated adjacent to the rhythm centre which in turn is sensitive to CO_2 and H^+ . Increase in these substances can activate this centre, which in turn can signal the rhythm centre to make necessary adjustments in the respiratory process by which these substances can be eliminated.

147. Answer (3)

Hint: Negative intra-pleural pressure is seen in humans.

Sol.: Air flows in as long as intra-pulmonary pressure is lower than the atmospheric pressure.

Once they equalize, inspiration stops.

Intra-pleural pressure is always lower than the atmospheric pressure, even at the end of inspiration. If it ever equals the atmospheric pressure, the lungs would collapse. Hence, the mechanism halts due to pressure equalization between alveoli and outside air, not due to intrapleural pressure reaching the atmospheric pressure.

148. Answer (4)

Hint: Nodes of Ranvier is absent

Sol.: Unmyelinated nerve fibre is enclosed by a Schwann cell that does not form a myelin sheath around the axon and is commonly found in autonomous and the somatic neural systems. Axolemma is also present around these nerve fibres.

Impulse transmission across an electrical synapse is significantly faster than that across a chemical synapse. The membranes of pre-synaptic and post-synaptic neurons are in close proximity in an electrical synapse. Dendrites receive and integrate signals from other neurons or from sensory stimuli and conduct nerve impulses towards the axon or the cell body.

149. Answer (3)

Hint: May have a role in cognition

Sol.: Cerebellum is a part of human hindbrain. It has very convoluted surface in order to provide the additional space for many more neurons.

The cerebellum integrates information received from the semi-circular canals of the ear and the auditory system.

Midbrain, pons and medulla oblongata constitute the brain stem.

Cerebellum coordinates contractions of skeletal muscles. It does not initiate the movements of the body but modulates or reorganises the motor commands. Cerebellum's unconscious directions and cerebrum's conscious instructions determine when and how to move body parts.

150. Answer (2)

Hint: Na^+/K^+ pump transports 3Na^+ outwards for 2K^+ into the cell.

Sol.: The ionic gradient across a resting neuronal membrane is maintained by the active transport of ions by the Na^+-K^+ pump which transports 3Na^+ outwards for 2K^+ into the cell.

Depolarization of a nerve fibre occurs due to influx of Na^+ via voltage gated Na^+ channels.

So, if Na^+ voltage gated channels are blocked, there will be no influx of Na^+ in axon

No influx \rightarrow No depolarization \rightarrow No action potential

Thus, the neurons cannot send or receive signals (motor loss) or sensory receptors (sensory loss).

If Na^+ channels are blocked, there will be no contraction at all.

In a resting neuron, K^+ concentration is higher inside the cell.

Resting potential is around -70 mV.

151. Answer (2)

Hint: An arthropod

Sol.: The neural organisation is very simple in lower invertebrates.

In *Hydra*, it is composed of a network of neurons.

The neural system is better organised in insects, where a brain is present along with a number of ganglia and neural tissues. In cockroaches, brain is represented by supra-oesophageal ganglion. The vertebrates (*Macaca*) have a more developed neural system.

In *Sycon*, nervous system is absent.

152. Answer (2)

Hint: Hyperventilation reduces blood pCO_2 .

Sol.:

- Hyperventilation causes excess CO_2 exhalation, reducing $[\text{H}^+]$ concentration \rightarrow respiratory alkalosis.
- Elevated pH causes a leftward shift in the oxygen-hemoglobin dissociation curve \rightarrow hemoglobin holds O_2 more tightly.

153. Answer (4)

Hint: 'X' and 'Y' are carbohydrates.

Sol.: Cotton fibre is cellulosic.

So, 'X' here is cellulose. Starch ('Y') acts as the storehouse of energy in plant tissues.

Cellulose is a polymeric secondary metabolite. Starch forms helical secondary structures and thus, it can hold I_2 molecules in the helical portion.

Cellulose is the most abundant carbohydrate. The two functional groups that are present in sugars are carbonyl and hydroxyl.

154. Answer (4)

Hint: True for a prosthetic group.

Sol.: Co-factors are the non-protein constituents of enzymes.

NADP acts as the co-enzyme. NAD and NADP contain the vitamin niacin.

Prosthetic groups are organic compounds and are distinguished from other co-factors as they are tightly bound to the apoenzyme.

In peroxidase and catalase, haem acts as the prosthetic group. These enzymes catalyse the breakdown of H_2O_2 .

Haem is a part of the active site of the enzyme.

155. Answer (4)

Hint: Exclusive to RNA.

Sol.: Uridylic acid is also known as uridine monophosphate. It is a nucleotide that is a unique component of RNA and is not found in the structure of DNA. Humans have DNA as their genetic material.

Nucleotides contain both glycosidic and ester bonds.

Nitrogen bases contain heterocyclic rings.

Upon chemical analysis of a living tissue, acid-soluble pool/filtrate and acid-insoluble pool/retentate is obtained. The molecules found in the acid-soluble pool have molecular weights ranging from 18 to 800 daltons (Da) approximately. The acid-insoluble pool has molecular weights in the range of 10,000 daltons and above.

156. Answer (1)

Hint: One of the most widely used PGR is a gaseous hormone.

Sol.: Plants show open form of growth due to the presence of different types of meristems at specific locations in their body.

Cytokinins delay leaf senescence by promoting nutrient mobilization.

157. Answer (2)

Sol.: Arithmetic growth rate is represented by the equation, $L_t = L_0 + rt$

158. Answer (2)

Hint: Absolute growth rate is the measurement and comparison of total growth per unit time.

Sol.: The absolute growth rate of both the leaf A and B is same.

• **Relative growth rate of leaf A.**

$$\frac{\text{Growth per unit time}}{\text{Initial size}} \times 100$$

$$\frac{15}{15} \times 100 = 100\%$$

• **Relative growth rate of leaf B**

$$\frac{\text{Growth per unit time}}{\text{Initial size}} \times 100$$

$$\frac{15}{25} \times 100 = 60\%$$

159. Answer (3)

Hint: Gibberellin was discovered from the extract of a fungus that causes the foolish seedling disease.

Sol.: Cytokinin was discovered from the degraded product of autoclaved herring sperm DNA.

160. Answer (1)

Hint: Ethylene is called as the fruit ripening hormone.

Sol.: Ethylene accelerates thinning of fruits in plants like, cotton, cherry and walnut *etc.*

161. Answer (2)

Hint: Castor seed is albuminous.

Sol.: In monocots, seed coat is membranous and generally fused with the fruit wall.

162. Answer (1)

Hint: RQ value of tripalmitin is 0.7.

Sol.: Fatty acids are degraded to acetyl CoA and enter the respiratory pathway.

163. Answer (3)

Hint: Citrate synthase catalyses the formation of citric acid in Krebs' cycle.

Sol.: Cytochrome bc_1 (complex III) accepts electrons from ubiquinol.

164. Answer (1)

Hint: Conversion of glucose to glucose-6-phosphate is the first irreversible step of glycolysis.

Sol.: Hexokinase catalyses the conversion of glucose to glucose-6-phosphate.

165. Answer (3)

Hint: In tomato, RuBisCO can act as oxygenase.

Sol.: In C_4 plants, RuBisCO acts as carboxylase, minimising the oxygenase activity and hence preventing photorespiration.

166. Answer (3)

Hint: Both PS I and PS II are involved in the non-cyclic photophosphorylation.

Sol.: PS II is found in grana lamellae only.

167. Answer (1)

Hint: T.W. Engelmann observed that bacteria accumulated mainly in the region of blue and red light of the split spectrum.

Sol.: Jan Ingenhousz, through his experiments, showed that sunlight is essential for plant process (photosynthesis) that somehow purifies the air fouled by burning candles.

168. Answer (3)

Hint: During anaphase II, sister chromatids separate and move towards the opposite poles.

Sol.: During reductional division, replication of DNA occurs only before meiosis I.

169. Answer (1)

Hint: Most of the cell organelles duplicate during the first stage of interphase.

Sol.: Most of the cell organelles duplicate during the G₁ phase of cell cycle.

170. Answer (4)

Sol.: The correct sequence of the stages of cell cycle is:

G₁ → S → G₂ → M

171. Answer (3)

Hint: Look for a gregarious pest

Sol.: *Loligo* is a mollusc. Molluscs are unsegmented.

Ancylostoma is an aschelminth. It is a pseudocoelomate.

Pleurobrachia is a ctenophore. It is diploblastic.

Locusta is an arthropod. Arthropods are triploblastic, segmented and coelomate animals.

Pheretima is an annelid.

Meandrina is also a coelenterate.

Saccoglossus is not segmented.

172. Answer (2)

Hint: Alternation of generation

Sol.: Sea hare (*Aplysia*) is a mollusc. Molluscs have sensory tentacles and radula.

Sea anemone (*Adamsia*) is a coelenterate. Coelenterates contain cnidoblasts (which contain the stinging capsules or nematocysts).

Adamsia is sessile and cylindrical in shape.

Sea lily (*Antedon*) is an echinoderm. Echinoderms have a complete digestive system with mouth on the lower (ventral) side and anus on the upper (dorsal) side.

Sea horse (*Hippocampus*) is a bony fish. Male sea horses have a brood pouch, a specialized structure where they incubate fertilized eggs until they hatch.

173. Answer (3)

Hint: Less than three

Sol.: *Sycon* is a porifer. It is monoecious and shows indirect development but it does not show bilateral symmetry.

Aurelia is a coelenterate. It is radially symmetrical.

Fasciola is a platyhelminth and it is bilaterally symmetrical. Sexes are not separate in them. Development is through many larval stages.

Ascaris is an aschelminth. It is dioecious.

Nereis is an annelid. It is dioecious.

Pila is a mollusc. It becomes asymmetrical in the adult stage due to torsion.

Ophiura is an echinoderm. Sexes are separate in them, but they show radial symmetry in the adult form.

174. Answer (1)

Hint: Recall the characteristics of a mammal and a bird.

Sol.: *Columba* is pigeon (bird).

Canis is cat (mammal).

Both exhibit pulmonary respiration.

Birds are oviparous whereas most mammals are viviparous (except *Ornithorhyncus*).

Birds do not have teeth. Birds have ossified endoskeleton and the long bones are hollow with air cavities (pneumatic).

Delphinus is also a mammal.

175. Answer (2)

Hint: *Repere* or *reptum* means to creep or crawl.

Sol.: Amphibians can live in aquatic as well as terrestrial habitats. Most of them have two pairs of limbs, not all. *Ichthyophis* is a limbless amphibian.

The class name of reptiles refers to their creeping or crawling mode of locomotion. They are mostly

terrestrial. Sea turtles, sea snakes, crocodiles and alligators live in water.

Not all reptiles show crawling mode of locomotion. *Planaria* is a flatworm; it shows direct development.

176. Answer (1)

Hint: Marine cartilaginous fishes

Sol.: *Scolidon* and *Carcharodon* are cartilaginous fishes. They possess a heterocercal tail. This means that their tail has two lobes that are unequal in size, with the upper lobe being large and more developed than the lower lobe.

They are marine fishes with streamlined body. Notochord is persistent throughout life in them.

These animals are predaceous.

In males, pelvic fins bear claspers (copulatory organs).

They contain paired pectoral and pelvic fins.

Catla and *Pterophyllum* are bony fishes. They contain ctenoid scales.

Petromyzon is a cyclostome and its body is devoid of scales and paired fins.

177. Answer (4)

Hint: Storage of glucose

Sol.: Adrenaline is an emergency hormone secreted from the adrenal medulla.

Cortisol is a glucocorticoid secreted from the adrenal cortex.

Catecholamines stimulate the breakdown of glycogen resulting in an increased concentration of glucose in blood.

In addition, they also stimulate the breakdown of lipids and proteins.

Glucocorticoids stimulate gluconeogenesis, lipolysis and proteolysis.

Both the hormones aim to increase the blood glucose level; thus, they inhibit glycogenesis.

178. Answer (1)

Hint: TCT is released by the thyroid gland

Sol.: PTH is a hypercalcemic hormone, i.e., it increases the blood Ca^{+2} levels. PTH acts on bones and stimulates the process of bone resorption. It also stimulates reabsorption of Ca^{+2} by the renal tubules and increases Ca^{+2} absorption from the digested food.

TCT is a hypocalcemic hormone.

When blood calcium levels are high, PTH secretion is suppressed and calcitonin secretion is stimulated. Conversely, when blood Ca^{+2} levels are low, PTH secretion is stimulated and calcitonin secretion is suppressed.

Parathyroid and thyroid cells can directly sense the changes in levels of Ca^{+2} in blood.

179. Answer (3)

Hint: Released by the anterior pituitary.

Sol.: Prolactin regulates the growth of the mammary glands and formation of milk in them.

Estrogen and progesterone contribute in the development of mammary glands but they are steroidal (lipid-soluble) in nature. GnRH is a proteinaceous hormone released from the hypothalamus. It regulates the secretion of FSH and LH.

180. Answer (2)

Hint: True for gland whose lobes are found on either sides of trachea

Sol.: Anterior pituitary secretes growth hormone, not hypothalamus.

Hypothalamus secretes oxytocin which is stored and released by posterior pituitary.

Pineal gland secretes melatonin.

Thyroxine is derived from tyrosine and its deficiency cause cretinism.

