All India Aakash Test Series for NEET - 2025

TEST - 3 (Code-E)

Click here for Code-F Sol.

Test Date : 22/12/2024

ANSWERS

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

HINTS & SOLUTIONS

[PHYSICS]

SECTION - A

1. Answer (3)

Hint and Sol.:

$m_1x_1 = m_2x_2$

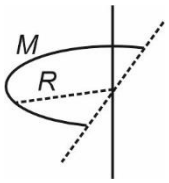
$m_1 > m_2$

$x_1 < x_2$

2. Answer (1)

Hint: Use, $I = \int R^2 dm$

Sol.:



$I = R^2 \int dm = MR^2$

3. Answer (4)

Hint: For a particle in uniform circular motion, only a centripetal force acts on it.

Sol.: $\vec{\tau} = \frac{d\vec{L}}{dt} = 0$

Because torque of central force is zero.

4. Answer (3)

Hint: In an elliptical orbit angular momentum of a satellite is conserved.

Sol.: $m_0v_1r_1 = m_0v_2r_2$, so the speed of satellite changes with position and its potential energy also changes. The total energy remains constant, because only conservative force (gravitational force) is acting.

5. Answer (4)

Hint: The gravitational force on pendulum is balanced by centrifugal force.

Sol.: $T = 2\pi\sqrt{\frac{l}{g_{eff}}}$

$g_{eff} = 0$

$T = 2\pi\sqrt{\frac{l}{0}} \to \infty$

6. Answer (3)

Hint: A particle will leave the earth's surface when its total energy is either zero or positive.

Sol.: $\frac{1}{2}mv_e^2 = \frac{GMm}{R}$

$v_e = \sqrt{\frac{2GM}{R}}$

$v_e \propto \sqrt{M}$

7. Answer (3)

Hint: Use, $T^2 \propto r^3$

Sol.: $\left(\frac{T_2}{T_1}\right)^2 = \left(\frac{R_2}{R_1}\right)^3 = \left(\frac{4r}{r}\right)^3 = 64$

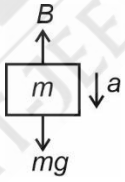
$\left(\frac{T_2}{T}\right) = \sqrt{64} \Rightarrow T_2 = 8T$

= 8 × 4 = 32 hours

8. Answer (1)

Hint: Buoyant force is equal to apparent weight of the block.

Sol.: When the beaker was at rest, then $B = mg$. While falling:



$ma = mg - B$

$B = mg - ma$

$B = m(g - a)$

9. Answer (1)

Hint: Work done = change in surface energy

Sol.: $W = S\Delta A$

$W = (S)\ 2 \times 4\pi(4^2 - 2^2) \times 10^{-4}$

$= 0.03 \times 2 \times 4\pi\ (16 - 4) \times 10^{-4}$

$= 0.03 \times 8\pi \times 12 \times 10^{-4}$

$= 24 \times 12\pi \times 10^{-6} = 288\pi \times 10^{-6}$

$= 0.3\pi$ mJ

10. Answer (3)

Hint and Sol.: Young's modulus is a material property and it is independent of shape and size.

11. Answer (4)

Hint: Use, $\frac{\Delta V}{V}=\frac{3\Delta r}{r}$

$\frac{\Delta A}{A}=\frac{2\Delta r}{r}=\frac{2}{3}\frac{\Delta V}{V}$

Sol.: $B=\frac{P}{\frac{\Delta V}{V}}$

$\frac{\Delta V}{V}=\frac{P}{B}$

$\frac{\Delta A}{A}=\frac{2}{3}\frac{P}{B}$

12. Answer (4)

Hint: Use, $Y=\frac{\text{Load}}{\text{Area}}\frac{l}{\Delta l}$

Sol.: $\text{Area} \propto \frac{\text{Load}}{\text{Elongation}}$

$\text{Area} \propto \frac{1}{\text{Slope of graph}}$

The slope for S is maximum, so its area is minimum.

13. Answer (2)

Hint: $\vec{v}_{com}=\frac{m_1\vec{v}_1+m_2\vec{v}_2}{m_1+m_2}$

Sol.: $\vec{v}_{com}=\left(\frac{1}{2}\right)\left[v\hat{i}+\sqrt{3}v\hat{j}\right]$

$|\vec{v}_{com}|=\frac{1}{2}(2v)=v$

14. Answer (2)

Hint: Use conversation of energy

Sol.: Loss in KE = Gain in PE

$\frac{1}{2}I\omega^2=mg\frac{l}{4}$

$\frac{1}{2}\frac{ml^2\omega^2}{3}=mg\frac{l}{4}$

$\omega^2=\frac{3g}{2l} \Rightarrow \omega=\sqrt{\frac{3g}{2l}}$

15. Answer (1)

Hint: $I\omega$ = constant

Sol.: $I_1\omega_1 = I_2\omega_2$

As the insect moves away from centre to rim, moment of inertia of the system increases which decreases the angular speed.

16. Answer (4)

Hint: Use parallel axis theorem

Sol.: $2400=\frac{ML^2}{12}$

$I=\frac{ML^2}{3}=4\left(\frac{ML^2}{12}\right)=4\times 2400$

I = 9600 kg m^2

17. Answer (2)

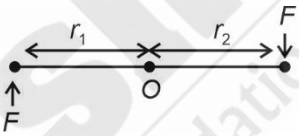
Hint: Kinetic energy of rotation $=\frac{1}{2}I\omega^2$

Sol.: $KE_R=\frac{1}{4}MR^2\omega^2, \quad I=\frac{MR^2}{2}$

18. Answer (1)

Hint: Set of equal and opposite forces acting on an object is called couple

Sol.:



$a_{cm}=\frac{\vec{F}_1+\vec{F}_2}{m}$

$\vec{a}_{cm}=\frac{\vec{F}-\vec{F}}{m}=0$

$I\alpha=\vec{r}_1\times\vec{F}_1+\vec{r}_2\times\vec{F}_2 \Rightarrow$ Non zero and constant

19. Answer (4)

Hint and Sol.: $L = I\omega$

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

$L=I\omega=\sqrt{2KI}=\frac{2K}{\omega}$

20. Answer (3)

Hint: Use, $g'=\frac{GM}{(R+h)^2}$

Sol.: $g'=\frac{GM}{\left(R+\frac{R}{2}\right)^2}=\frac{GM}{\left(\frac{3}{R}R\right)^2}=\frac{4}{9}\frac{GM}{R^2}=\frac{4}{9}g$

21. Answer (2)

Hint: Total energy = $KE + PE = \frac{PE}{2}$

Sol.: $PE = \frac{-GMm}{2R}$

$TE = \frac{-GMm}{4R}$

22. Answer (1)

Hint: Potential inside earth is $-\frac{GM}{R}\left[\frac{3}{2}-\frac{1}{2}\frac{r^2}{R^2}\right]$, where r is the distance from centre.

Sol.: Conservation of total energy

$-\frac{GMm}{R} = \frac{-3GMm}{2R} + \frac{1}{2}mv^2$

$\frac{3}{2}\frac{GMm}{R} - \frac{GMm}{R} = \frac{1}{2}mv^2$

$\frac{1}{2}\frac{GMm}{R} = \frac{1}{2}mv^2$

$\sqrt{\frac{GM}{R}} = v$

23. Answer (4)

Hint: Use, $F = \frac{GM_1M_2}{d^2}$

Sol.: $F = \frac{GM_1M_2}{d^2}$

$F' = \frac{(G)(2M_1)(2M_2)}{\left(\frac{d}{2}\right)^2}$

$F' = 4 \times 4\frac{GM_1M_2}{d^2}$

$F' = 16F$

24. Answer (4)

Hint and Sol.: $g = \frac{GMr}{R^3}$ when $r \le R$

For $r = 0 \Rightarrow g = 0$

$g = \frac{GM}{r^2}$ when $r > R$

25. Answer (2)

Hint: Pressure difference = ρgh

Sol.: $10^3 \times 10 \times h = \frac{200}{400} \times 10^4$

$h = \frac{1}{2}$ m $\Rightarrow h = 50$ cm

26. Answer (4)

Hint: Use equation of continuity

Sol.: $A_1v_1 = A_2v_2$

$(\pi)(5)^2 \times \frac{1}{2} = \pi \times 20 \times (10^{-1})^2 \times v_2$

$\pi\frac{25}{2} = \pi \times 20 \times 10^{-2} \times v_2$

$\frac{25}{40} \times 100 = v_2$

62.5 cm s^{-1} = v_2

27. Answer (2)

Hint: $\rho = \frac{\text{total mass}}{\text{total volume}}$

Sol.: $\rho = \frac{\rho_1V_1 + \rho_2V_2}{V_1 + V_2}$

$= \frac{1V + 2V}{V + V} = \frac{3}{2}$ g cm^{-3}

28. Answer (3)

Hint: Weight of block = Buoyant force

Sol.: Volume, $AL = \frac{100}{600} = \frac{1}{6}$ m^3

Weight of block = Buoyant force

$600 \times A \times L \times g = 1000 \times A \times h \times g$

h = depth of block inside water

$0.6L = h$

Volume outside = $0.4AL$

$= 0.4 \times \frac{1}{6}$

$= \frac{4}{60} = \frac{1}{15}$ m^3

29. Answer (4)

Hint & Sol.: Longitudinal strain $= \frac{\Delta L}{L}$ is a unitless quantity.

30. Answer (4)

Hint: Young's modulus is equal to slope of stress-strain graph.

Sol.: $\frac{Y_A}{Y_B} = \frac{\tan 30^\circ}{\tan 60^\circ}$

$\frac{Y_A}{Y_B} = \frac{1}{\sqrt{3} \times \sqrt{3}} = \frac{1}{3}$

$Y_B = 3Y_A$

31. Answer (3)

Hint: Breaking stress remains same

Sol.: $\frac{F}{\pi r^2} = \frac{F'}{\pi(2r)^2} \Rightarrow F' = 4F$

32. Answer (1)

Hint: Use, $g = \frac{4}{3}G\pi\rho r$

Sol.: $\frac{g_P}{g_Q} = \frac{\frac{4}{3}G\pi\rho r}{\frac{4}{3}G\pi(2\rho)\left(\frac{r}{2}\right)} = 1:1$

33. Answer (3)

Hint: The gravitational potential of shell is constant inside it.

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

34. Answer (4)

Hint: They will collide at their COM

Sol.: Position of COM from mass m,

$x = \frac{m_1 0 + 2md}{2m + m}$

$x = \frac{2}{3}d$

35. Answer (2)

Hint and Sol.: The centre of mass will shift toward the heavier side opposite to the section removed.

SECTION - B

36. Answer (2)

Hint: Use conservation of energy

Sol.: $-\frac{GMm}{R} + \frac{1}{2}mv^2 = \frac{-GMm}{R+h}$

$-\frac{GMm}{R} + \frac{1}{2}m\left(\frac{GM}{R}\right) = \frac{-GMm}{R+h}$

$-\frac{1}{R} + \frac{1}{2R} = \frac{-1}{R+h}$

$-\frac{1}{2R} = \frac{-1}{R+h}$

$2R = R + h \Rightarrow h = R$

37. Answer (1)

Hint: Use parallel axis theorem

Sol.: $MK^2 = \frac{MR^2}{2} + M(R^2)$

$MK^2 = \frac{MR^2}{2} + MR^2$

$MK^2 = \frac{3}{2}MR^2$

$K = \sqrt{\frac{3}{2}}R$

38. Answer (3)

Hint: $I = mx^2$, where x is perpendicular distance from axis.

Sol.: $I = ml^2 + m\left(\sqrt{2}l\right)^2 + ml^2$

$I = ml^2 + 2ml^2 + ml^2$

$I = 4ml^2$

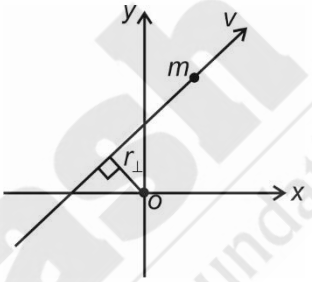
39. Answer (1)

Hint: Use, $\vec{L} = \vec{r} \times (\vec{P})$

Sol.: $|\vec{L}| = rmv\sin\theta$.

$= r\sin\theta mv$

$= r_\perp mv = \text{constant}$



40. Answer (1)

Hint: Use principle of moments

Sol.: $N_A + N_B = Mg$ ...(i)

$N_A \times \frac{L}{4} = N_B \times \frac{L}{2}$

$N_A = 2N_B$ ...(ii)

From (i) and (ii),

$3N_B = Mg$

$N_B = \frac{Mg}{3}$

41. Answer (2)

Hint and Sol.: (A) $\Rightarrow g_a = \frac{GM \cdot r}{R^3}$

(B) $\Rightarrow g_b = \frac{GM}{r^2}$

(C) $\Rightarrow g_c = \frac{GM}{(R+r)^2} = \frac{GM}{R^2\left(1+\frac{r}{R}\right)^2}$

$g_c = \frac{GM}{R^2}\left(1+\frac{r}{R}\right)^{-2}$

given $r << R$

$$g_c = \frac{GM}{R^2}\left(1-\frac{2r}{R}\right)$$

(D) $\Rightarrow g_d = \frac{GM}{R^2}\left(1-\frac{r}{R}\right)$

42. Answer (2)

Hint & Sol.: Viscous force acting on spherical object.

$F_v = 6\pi\eta av$

$\Rightarrow F_v = 6\pi\eta \times \frac{d}{2} \times v = 3\pi\eta dv$

43. Answer (4)

Hint and Sol.: Law of orbit and law of areas are the Kepler's laws.

44. Answer (2)

Hint: Work done = change in potential energy

Sol.: $\Delta W = \frac{-Gm^2}{2d} + \frac{Gm^2}{d} = +\frac{Gm^2}{2d}$

45. Answer (3)

Hint: Assume the whole mass to be concentrated at centre of mass.

Sol.: COM at distance $\frac{L}{2}$ from bottom

$\Rightarrow \Delta L = \frac{Mg \times \frac{L}{2}}{AY}$

$\Rightarrow$ elongation $= \frac{MgL}{2AY}$

46. Answer (2)

Hint: Compressibility is defined as reciprocal of Bulk modulus.

Sol.:

$[K] = \frac{1}{[B]} \Rightarrow [K] = \frac{1}{[ML^{-1}T^{-2}]} \Rightarrow [K] = [M^{-1}L^{1}T^{2}]$

47. Answer (1)

Hint: Use velocity of efflux

Sol.: $v = \sqrt{2g(H-h)} = \sqrt{2\times10\times2} = \sqrt{40}$ m s^{-1}

time $t = \sqrt{\frac{2h}{g}} = \sqrt{\frac{4}{10}}$

Range(x) = vt

$= \sqrt{40} \times \sqrt{\frac{4}{10}}$

$= \sqrt{\frac{40}{10}}\sqrt{4}$

= 2 × 2 = 4 m

48. Answer (1)

Hint: Use, $h = \frac{2s\cos\theta}{\rho gr}$

Sol.: $h' = \frac{2s\cos\theta}{\rho(g+a)r}$

$h' < h$

49. Answer (1)

Hint and Sol.: $\vec{a}_{cm} = \frac{\vec{F}_{ext}}{M_1+M_2+M_3} = 0$ as $\vec{F}_{ext} = 0$. So the v_{cm} = 0 or v_{cm} = constant

50. Answer (4)

Hint and Sol.: Gravitational force is a conservative force because the work done by gravitational force between two points depends upon initial and final position.

[CHEMISTRY]

SECTION - A

51. Answer (3)

Hint: Relationship between K_P and K_C for any gaseous equilibrium can be derived by using ideal gas equation.

Sol.: $\because \quad K_P = K_C(RT)^{\Delta n_g}$

for $\Delta n_g = 0$

$K_P = K_C$

52. Answer (2)

Hint: pH = –log [H$^+$]

Where [H$^+$] $\Rightarrow$ concentration of H$^+$ ion

Sol.: pH = –log [H$^+$] = 2.7

[H$^+$] = $10^{-2.7}$

= 2×10^{-3} M

Number of mole of H$^+$ ion in 1 ml = $2 \times 10^{-3} \times 10^{-3}$

= 2×10^{-6} mol

= $2 \times 10^{-6} \times 6.02 \times 10^{23}$ H$^+$ ions

= 1.204×10^{18}

53. Answer (4)

Hint: For a neutral solution concentration of $[H^+]$ and $[OH^-]$ are equal.

- Ionic product of water can be defined as $K_w = [H^+]\,[OH^-]$

Sol.: At T°C, $[H^+]\,[OH^-] = 10^{-13}$

For neutral liquid $\Rightarrow [H^+] = [OH^-]$

$[H^+]^2 = 10^{-13}$

$[H^+] = 10^{-6.5}$, pH = 6.5

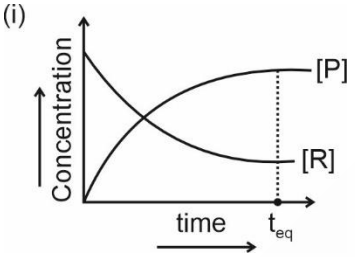
54. Answer (3)

Hint: At equilibrium state, rate of forward and backward reaction becomes equal.

Sol.: At equilibrium, concentration of reactant and product becomes constant.

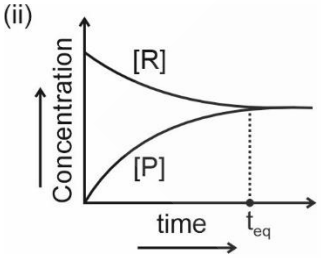
Concentrations of reactant and product may be equal or unequal.

(i)



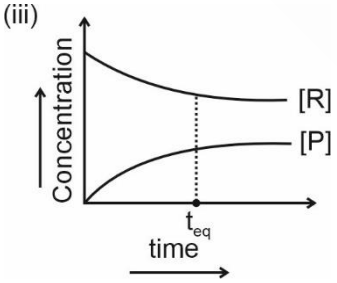
In this graph [P] > [R] at equilibrium

(ii)



In this graph [P] = [R] at equilibrium

(iii)



In this graph [P] < [R] at equilibrium

55. Answer (2)

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

Sol.: $\because\ 2SO_2 + O_2 \rightleftharpoons 2SO_3$, $K = 9\ mol^{-1}L$

$$\therefore\ 2SO_3 \rightleftharpoons 2SO_2 + O_2, \quad K' = \frac{1}{K} = \frac{1}{9}\ mol\,L^{-1}$$

$$SO_3 \rightleftharpoons SO_2 + \frac{1}{2}O_2, \quad K'' = \sqrt{\frac{1}{K}} = \frac{1}{3}\ mol^{1/2}L^{-1/2}$$

56. Answer (4)

Hint: On mixing multiple acids resultant normally of H^+ can be calculated as following.

$$\left[H^+\right] = \frac{N_1V_1 + N_2V_2 + \ldots}{V_1 + V_2 \ldots}$$

Sol.: If pH = 2 then $N_1 = 10^{-2}$

pH = 3 then $N_2 = 10^{-3}$

$$\left[H^+\right] = \frac{N_1V + N_2V}{2V}$$

$$= \frac{10^{-2} \times V + 10^{-3}V}{2V} = \frac{1.1 \times 10^{-2}}{2} = 5.5 \times 10^{-3}$$

$pH = -\log [H^+] = -\log (5.5 \times 10^{-3})$

$\simeq 2.26$

57. Answer (2)

Hint: During neutralisation of weak electrolyte with strong electrolyte if weak electrolyte is in excess then buffer solution will be formed.

Sol.: (1) 10 mmol CH_3COOH + 10 mmol NaOH will result into salt solution.

	$CH_3COOH_{(aq)}$ +	$NaOH_{(aq)}$ →	$CH_3COONa_{(aq)}$ +	$H_2O_{(l)}$
t = 0	10 mmol	10 mmol	0	0
t = t	0	0	10 mmol	

(2)

	$CH_3COOH_{(aq)}$ +	$NaOH_{(aq)}$ →	$CH_3COONa_{(aq)}$ +	$H_2O_{(l)}$
t = 0	10mmol	5mmol	0	0
t = t	5mmol	0	5mmol	

It is acidic buffer solution.

58. Answer (1)

Hint: During neutralisation of WA + SB buffer solution is formed if weak electrolyte is in excess.

Sol.: Since millimole of weak acid is more than strong base it will form an acidic buffer solution

	$CH_3COOH_{(aq)}$ +	$NaOH_{(aq)}$ →	$CH_3COONa_{(aq)}$ +	$H_2O_{(l)}$
t = 0,	20mmol	5mmol	0	
t = t,	15mmol	0	5mmol	

$$pH = pK_a + \log\frac{[Salt]}{[Acid]}$$

$$= 4.76 + \log\left(\frac{5}{15}\right)$$

= 4.76 – log3 = 4.28

59. Answer (3)

Hint: Common ion effect decreases solubility of sparingly soluble salt.

Sol.: $BaCl_2$, Na_2SO_4, H_2SO_4 will provide common ion due to presence of $Ba^{2+}(aq)$, $SO_4^{2-}(aq)$ and $SO_4^{2-}(aq)$ respectively.

NaCl will not give any common ion effect hence solubility will be maximum in 0.1 M NaCl solution.

60. Answer (2)

Hint: For reversible isothermal expansion

$$w = -2.303\, nRT \log\left(\frac{V_2}{V_1}\right)$$

Sol.: $w = -2.303\, nRT \log\left(\frac{V_2}{V_1}\right)$

$$= -2.303 \times 2 \times 2 \times 300 \log\left(\frac{1}{0.1}\right)$$

= – 2763.6 cal

= –2.76 kcal

61. Answer (1)

Hint: For any reversible process; $\Delta S = \frac{q_{rev}}{T}$

Sol.: For reversible adiabatic process, q = 0

Hence $\Delta S = 0$

During Isothermal process; $\Delta U = 0$

62. Answer (1)

Hint: For an ideal gas $\Delta U = nC_v\Delta T$

Sol.: Isothermal $\Rightarrow \Delta T = 0$ hence $\Delta U = 0$, $q = -w$

Isobaric $\Rightarrow q_p = \Delta H$

Adiabatic $\Rightarrow q = 0$ hence $\Delta U = w$

Isochoric $\Rightarrow w = 0$ hence $\Delta U = q$

63. Answer (2)

Hint: $\Delta_C H^{\ominus}$ is amount of heat evolved on combustion of 1 mol substance.

Sol.: Heat evolved on combustion of 1 mol that is 180 g glucose = 2802 kJ

Hence heat evolved on combustion of $6g = \frac{2802}{180} \times 6$

= 93.4 kJ

64. Answer (2)

Hint: At equilibrium $\Delta G = 0$

Hence $\Delta G° = -2.303\, RT \log K_C$

Sol.: $-9.2 \times 10^3 = -2.303 \times 2 \times 400 \log K_C$

$$\log K_C = \frac{9.2 \times 1000}{2.303 \times 2 \times 400}$$

= 5

$K_C = 10^5$

65. Answer (3)

Hint: Electrolysis of Brine will give H_2 at cathode and Cl_2 at anode

Sol.: Charge supplied = $\frac{965 \times 2}{96500}$ F

= 2×10^{-2} F

n_{eq} of Cl_2 evolved at anode = 0.02

number of mole of $Cl_2 = \frac{0.02}{2} = 0.01$ mol

n_{eq} H_2 evolved at cathode = 0.02

mole of H_2 evolved = 0.01

total mole of gas evolved = 0.02

Total volume evolved at STP = 0.02 × 22.4 L

= 0.448 L

n_{eq} of OH^- produced in solution = 0.02

pOH of solution = $-\log(2 \times 10^{-2})$

= 1.6990

pH = 12.3

66. Answer (3)

Hint: For reduction of 1 gram equivalent substance, 1 F charge is required

Sol.: Charge on faraday = no. of equivalent deposited

= mole × n-factor

= 0.1 × 6

= 0.6 F

67. Answer (3)

Hint & Sol.: For free expansion, w = 0

For adiabatic process, q = 0

68. Answer (4)

Hint: For saturated solution $Q_{sp} = K_{sp}$

Sol.: If $Q_{sp} > K_{sp}$ precipitation will take place

Since ice is less denser than water melting of ice increases with pressure.

69. Answer (3)

Hint: During adiabatic process, q = 0

Sol.: For expansion, w < 0

Hence for adiabatic expansion, $\Delta U < 0$

$\Delta T < 0$

Cooling will take place

70. Answer (2)

Hint: Oxidation state of some elements changes during a redox reaction

Sol.: For reaction $CaCO_3 \rightleftharpoons CaO + CO_2$ oxidation state of each and every element is constant hence it is not redox reaction.

71. Answer (3)

Hint: Metal with positive SRP does not give H_2 on reaction with dil H_2SO_4

Sol.: SRP of Pt is positive hence it will not given H_2 with H_2SO_4.

72. Answer (2)

Hint: $q_P = q_V + \Delta n_g RT$

Δn_g = change in gaseous number of moles

Sol.: Combustion of CH_4 at 127°C is

$CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(g)$

$\Delta n_g = 0$

$\Delta U = \Delta H$

73. Answer (2)

Hint: For any redox reaction $(n_{eq})_{OA} = (n_{eq})_{RA}$

Sol.:

$(\text{mole} \times \text{n} - \text{factor})_{KMnO_4} = (\text{mole} \times \text{n} - \text{factor})_{FeC_2O_4}$

$n \times 5 = 0.1 \times 3$

$n = 0.06$ mole

74. Answer (2)

Hint: On adding two reaction, their ΔH will also be added

Sol.:

$$A \rightarrow B; \quad \Delta H = 200$$
$$+B \rightarrow C + D; \Delta H = -150$$
$$\overline{A \rightarrow C + D; \Delta H = 50 \text{ kJ}}$$

75. Answer (2)

Hint: pH + pOH = 14

Sol.: For saturated solution of $Ba(OH)_2$

$$Ba(OH)_2(s) \rightleftharpoons \underset{S}{Ba^{2+}}(aq) + \underset{2S+10^{-2}}{2OH^-}(aq)$$

$K_{sp} = [Ba^{2+}] [OH^-]^2$

Since pH = 12

pOH = 2

$[OH^-] = 10^{-2}$

$K_{sp} = (S) \times (2S + 10^{-2})^2$

$10^{-12} = S \times 10^{-4}$

$S = 10^{-8}$ M

76. Answer (1)

Hint: Given reaction is disproportionation

Sol.: $3Br_2 + 6NaOH \rightarrow 5NaBr + NaBrO_3 + 3H_2O$

a = 3

b = 6

c = 5

d = 1

77. Answer (3)

Hint: Reversible reaction could be reversed by infinitesimal change in opposite direction.

Sol.: Reversible reaction are very slow and are at equilibrium.

78. Answer (3)

Hint: Value of intensive properties does not depend on quantity of substance.

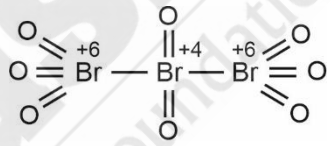
Sol.: Volume, number of mole and surface area are extensive properties.

Pressure is an intensive property.

79. Answer (2)

Hint: For covalent bond, high electronegative element gets –1 oxidation state and less electronegative element gets +1 oxidation state

Sol.:



Average oxidation state of $Br = \frac{+16}{3}$

80. Answer (4)

Hint: Halogen attached with more electronegative atom exhibit positive oxidation state, while halogen attached with less electronegative atom exhibit negative oxidation state.

Sol.: $CsI_3 \rightarrow$ O.S of I is $\frac{"-1"}{3}$

$NaBr \rightarrow$ O.S of Br is "–1"

$KClO_4 \rightarrow$ O.S of Cl is "+7"

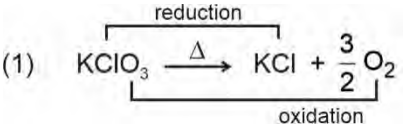
$Ca(OCl)_2 \rightarrow$ O.S of Cl is "+1"

$O_2F_2 \rightarrow$ O.S of F is "–1"

81. Answer (3)

Hint: In disproportionation reaction, reduction and oxidation of same element takes place

Sol.:



(2) $2H_2 + O_2 \longrightarrow 2H_2O$ (reduction: O_2; oxidation: H_2)

(3) $Cl_2 + 2NaOH \longrightarrow NaOCl + NaCl + H_2O$ (oxidation: Cl_2 to $NaOCl$; reduction: Cl_2 to $NaCl$)

Hence (3) is disproportionation reaction.

82. Answer (2)

Hint: Element with high value at SRP are good oxidising agent.

Sol.: Since $E_{A^{2+}/A} > E_{B^{2+}/B}$, A will be insoluble in BSO_4

- Since $E_{A^{2+}/A} > E_{C^{2+}/C}$, C will be soluble in $A(NO_3)_2$
- C^{2+} has least SRP hence it will be weakest oxidising agent.
- $B(s) + CSO_4 \rightarrow BSO_4 + C(s)$, is non-spontaneous hence will have negative EMF.

83. Answer (4)

Hint: Conductivity depends on charge and movability of ion in aqueous medium.

Sol.:

Ion	$\lambda°/(S\ cm^2 mol^{-1})$
H^+	349.6
Na^+	50.1
K^+	73.5
Ca^{2+}	119.0
Mg^{2+}	106.0

84. Answer (4)

Hint: $E^\circ_{cell} = E^\circ_{cathode} - E^\circ_{anode}$

Sol.: This is concentration cell in which both cathode and anode are same, hence

$E^\circ_{cell} = 0$

85. Answer (2)

Hint: On electrolysis of $CuSO_4(aq)$ using inert electrode, Cu^{2+} will get reduced at cathode and H_2O will get oxidised at anode.

Sol.: At cathode

$Cu^{2+} + 2e^- \rightarrow Cu(s)$

At anode

$$H_2O \rightarrow \frac{1}{2}O_2(g) + 2e^-$$

By passing 1F charge 1eq of O_2 will be evolved.

mole of $O_2 = \frac{1}{4} \times n_{eq}$ of O_2

$= \frac{1}{4}$

Volume at STP $= \frac{1}{4} \times 22.4$

= 5.6 L

SECTION - B

86. Answer (4)

Hint: At equilibrium, $E^\circ_{cell} = 0$

Sol.: $E^\circ_{cell} = \frac{0.0591}{n} \log K_{eq}$

$E^\circ_{cell} = 1.18\ V$

$1.18 = \frac{0.0591}{2} \log K_{eq}$

$\log K_{eq} = \frac{2 \times 1.18}{0.0591}$

$= 40$

$K = 10^{40}$

87. Answer (3)

Hint: Value of intensive properties do not depend on quantity of substance.

Sol.: Since electrode potential is an intensive property it will not be affected by size of metal electrode used.

88. Answer (1)

Hint: As SRP of metal increases its reactivity decreases.

Sol.: Since for Li^+/Li SRP value is minimum it will have maximum reactivity in aqueous medium.

89. Answer (4)

Hint & Sol.: Ionisation of Hg_2Cl_2 in water is as

$$Hg_2Cl_2(s) \rightleftharpoons Hg_2^{2+}(aq) + 2\overline{Cl}(q)$$

Solubility S 2 S

Therefore, K_{sp} of $Hg_2Cl_2 = S(2\ S)^2 = 4\ S^3$

90. Answer (2)

Hint: On passing same amount of charge through different electrolytic solution, equal number of gram equivalent gets deposited.

Sol.: $(n_{eq})_{Ag} = (n_{eq})_{Al}$

$= \frac{18 \times 10^3 \times 3}{27}$

$w_{Ag} = (n_{eq} \times E)_{Ag}$

$= \frac{18 \times 10^3 \times 3}{27} \times \frac{108}{1}$

$= 216 \times 10^3$ g

= 216 kg

91. Answer (3)

Hint: For gases volume % = mole %

Sol.: $X_{PCl_5} = \frac{40}{100} = \frac{2}{5}$

equilibrium $n_{PCl_3} = n_{Cl_2}$

$X_{PCl_3} = X_{Cl_2} = \frac{3}{10}$

$p_{PCl_5} = 5 \times \frac{2}{5} = 2$ atm

$p_{PCl_3} = 5 \times \frac{3}{10} = 1.5$ atm

$p_{Cl_2} = 5 \times \frac{3}{10} = 1.5$ atm

$K_p = \frac{p_{PCl_3} \times p_{Cl_2}}{p_{PCl_5}} = \frac{1.5 \times 1.5}{2}$

= 1.125 atm

92. Answer (2)

Hint: Algebraic sum of oxidation state of all the element for a neutral compound is zero.

Sol.: x + 2(+1) + 4(–2) = 0

x = +6

93. Answer (3)

Hint: Conjugate acid-base pair has difference of one H^+ or OH^-.

Sol.: $\underset{(\text{base})}{H_2PO_4^-} + H^+ \rightarrow \underset{(\text{conjugate acid})}{H_3PO_4}$

$\underset{(\text{acid})}{H_2PO_4^-} \rightarrow \underset{(\text{conjugate base})}{HPO_4^{2-}} + H^+$

94. Answer (3)

Hint: K_C for a particular equilibrium changes with temperature only.

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

If $T_2 > T_1$ (rise in temperature)

Then $K_2 > K_1$

If $\Delta H > 0$ (endothermic)

But $K_2 < K_1$

If $\Delta H < 0$ (exothermic)

95. Answer (4)

Hint: For reaction

$AB_2(s) \rightleftharpoons A(g) + 2B(g)$

$K_p = p_A \times p_B^2$

	$AB_2(s)$	$\rightleftharpoons$	$A(g)$	+	$2B(g)$
Sol.: $t = 0$	a		0		0
$t = t$	a – x		x		2x

If total pressure = P

$p_A = \frac{P}{3}, p_B = \frac{2P}{3}$

$\frac{P}{3} \times \left(\frac{2P}{3}\right)^2 = K_P$

$\frac{P}{3} \times \frac{4P^2}{9} = 108$

$P^3 = \frac{108 \times 9 \times 3}{4}$

P = 9 atm

96. Answer (3)

Hint: At equilibrium state $\Delta G = 0$

Sol.: $\Delta G = \Delta H - T\Delta S = 0$

$\Delta H - T\Delta S = 0$

$T = \frac{\Delta H}{\Delta S} = \frac{20 \times 10^3}{40} = 500$ K

= 227°C

97. Answer (2)

Hint: Slope of PV graph is higher for adiabatic process.

Sol.: Magnitude of work done in adiabatic expansion is less than work done in isothermal expansion.

98. Answer (2)

Hint: Neutralisation of 1 gram equivalent strong acid with 1 gram equivalent strong base gives 13.7 kcal of heat.

Sol.: 1 mol HCl = 1 gram eqivalent HCl

1 mol H_2SO_4 = 2 gram equivalent H_2SO_4

1 mol CH_3COOH = 1 gram equivalent CH_3COOH

1 mol HF = 1 gram equivalent HF

99. Answer (3)

Hint: Reducing agent causes reduction of other species by providing them electrons.

Sol.: Oxidising agent causes oxidation of other species by accepting electrons.

100. Answer (4)

Hint: Oxidation and reduction of same species takes place during disproportionation

Sol.: Since sulphur is present at lowest oxidation state in S^{2-}, it cannot get further reduced.

[BOTANY]

SECTION - A

101. Answer (2)

Hint: Endodermis have a deposition of waxy material suberin in the form of casparian strips.

Sol.: In dicot roots, the innermost layer of the cortex is endodermis. 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.

102. Answer (2)

Hint: Epidermis of roots is also called epiblema.

Sol.: In dicot leaf, the epidermis covers both the upper surface (adaxial) and lower surface (abaxial) of the leaf has a conspicuous cuticle.

103. Answer (2)

Hint: Abaxial epidermis is the lower surface of leaf.

Sol.: Vascular bundles are conjoint and closed in leaf. Mesophyll is differentiated into palisade and spongy parenchyma in dicot leaf and the size of vascular bundles are dependent on the size of veins.

104. Answer (2)

Hint: Sclereids are commonly found in the fruit walls of nuts.

Sol.: Xylem parenchyma – Stores food in the form of starch or fat and tannins.

Phloem parenchyma – Absent in most of the monocots.

Tracheids – Water transporting elements of xylem.

105. Answer (1)

Hint: Phloem fibres have lignified cell wall.

Sol.: Phloem fibres are made up of sclerenchymatous cells and these are generally absent in the primary phloem but are found in the secondary phloem.

106. Answer (2)

Hint: It is a part of stomatal apparatus.

Sol.: The specialised epidermal cells present in the vicinity of guard cells are called subsidiary cells. On the stem the epidermal hairs are called trichomes.

107. Answer (2)

Hint: These cells lies next to endodermis and are few layers thick.

Sol.: Next to endodermis lies a few layers of thick-walled parenchymatous cells referred to as pericycle. Initiation of lateral roots and vascular cambium during the secondary growth takes place in these cells.

108. Answer (3)

Hint: Ground tissues consist of simple tissues.

Sol.: All tissues except epidermis and vascular bundles constitute the ground tissue. It consists of simple tissues such as parenchyma, collenchyma and sclerenchyma.

109. Answer (3)

Hint: Starch sheath is absent in monocot stem.

Sol.: In dicot stem, the cells of the endodermis are rich in starch grains and the layer is also referred to as the starch sheath.

110. Answer (3)

Hint: Endodermis is not a part of stele.

Sol.: Pericycle is the outermost part of the stele.

111. Answer (4)

Hint: Guard cells possess chloroplast and regulate stomatal opening and closing.

Sol.: The outer walls of the guard cells are thin while the inner walls are highly thickened.

112. Answer (4)

Hint: Except intrafasicular cambium, lateral meristems are secondary meristems.

Sol.: Lateral meristems are responsible for producing the secondary tissues. The cells that becomes structurally and functionally specialised and lose the ability to divide such cells are termed as permanent or mature cells.

113. Answer (3)

Hint: Lateral roots originate from the outermost part of the stele.

Sol.: In the dicot root, the lateral roots originates from the pericycle.

114. Answer (1)

Hint: Parenchyma forms the major component within various organs of plants.

Sol.: Parenchyma are thin-walled and performs the function of photosynthesis, storage and secretion.

115. Answer (3)

Sol.: The radial conduction of water takes place by the ray parenchyma cells.

116. Answer (3)

Hint: Cambium is absent in monocots.

Sol.: In both dicot and monocot roots, xylem and phloem within a vascular bundle are arranged in an alternate manner along the different radii and protoxylem lies towards the periphery.

117. Answer (2)

Hint: Water-containing cavities are present within the vascular bundles in monocot stem.

Sol.: In monocot stem, each vascular bundle is surrounded by a sheath made up of sclerenchymatous tissue. It is called as bundle sheath.

118. Answer (2)

Hint: Artificial classification system were given by Aristotle and Linnaeus

Sol.: Natural system of classification was given by George Bentham and Joseph Dalton Hooker.

119. Answer (3)

Hint: Fusion of two gametes which are similar in size, either flagellated or non-flagellated is termed as isogamous.

Sol.: *Ulothrix* shows isogamous type of sexual reproduction. *Eudorina* shows anisogamous type of sexual reproduction, while *Fucus* shows oogamous reproductions.

120. Answer (1)

Hint: Red algae do not produce motile gametes

Sol.: *Polysiphonia* being red alga shows oogamous type of sexual reproduction where both gametes are non-motile.

121. Answer (3)

Sol.: Some unicellular algae like *Chlorella* and *Spirullina* are rich in proteins and are used as food supplements even by space travellers.

122. Answer (2)

Hint: Major pigment of phaeophyceae is fucoxanthin.

Sol.: In red algae, complex post-fertilisation development occurs. Cell wall is made up of cellulose and pectose in green algae. Gametes are pyriform in brown algae.

123. Answer (3)

Hint: Gemmae are green, multicellular asexual buds.

Sol.: Sex organs in bryophytes are multicellular

124. Answer (3)

Hint: *Ginkgo* has fan shaped leaves.

Sol.: In conifers, the needle-like leaves reduce the surface area. Thick cuticle and sunken stomata also help to reduce water loss in gymnosperms.

125. Answer (2)

Hint: In gymnosperms male and female gametophytes do not have an independent free-living existence.

Sol.: The leaves in pteridophyte are small (microphylls) as in *Selaginella* or large (Macrophylls) as in ferns. *Marchantia* is a dioecious plant.

126. Answer (3)

Hint: *Selaginella* produce two kinds of spores.

Sol.: Heterosporous vascular cryptogams like *Selaginella* fail to develop seeds because:

- They have no protective structure like the integuments surrounding the megasporangia.
- The retention of megaspores permanently within the megasporangia have not become established.

127. Answer (4)

Hint: A decoction of *Polytrichum* was employed in removing kidney stones.

Sol.: Species of *Sphagnum*, a moss, provide peat that have long been used as fuel and as packing material for trans-shipment of living material.

128. Answer (1)

Hint: *Dryopteris* belongs to Pteropsida

Sol.:

Psilopsida	–	*Psilotum*
Sphenopsida	–	*Equisetum*
Pteropsida	–	*Dryopteris*
Lycopsida	–	*Selaginella*

129. Answer (4)

Hint: Bryophytes produce only one type of spores.

Sol.: In both, pteridophyte and bryophytes, spores germinate to give rise to free-living photosynthetic gametophyte.

130. Answer (3)

Hint: Evolutionarily, pteridophytes are the first terrestrial plant to possess vascular tissues.

Sol.: In pteridophytes, the sporangia contain sporogenous tissue, where spore mother cells

undergoes meiosis to produce spores. The spores germinate to give rise to inconspicuous small but multicellular free living, mostly photosynthetic thalloid gametophyte called prothallus.

131. Answer (4)

Hint: They bear the integumented megasporangium.

Sol.: Gymnosperms are the vascular plants with an exposed ovule. As the ovule is not covered by an ovary wall, after fertilization the seeds are exposed to the environment forming naked seeds.

132. Answer (3)

Hint: Prothallus is free-living multicellular gametophyte.

Sol.: In pteridophyte, the spores germinate to give rise to inconspicuous, small but multicellular free-living, mostly photosynthetic thalloid gametophyte called prothallus.

133. Answer (3)

Hint: *Laminaria* is multicellular alga.

Sol.: *Chlamydomonas* is an unicellular alga.

134. Answer (3)

Hint: *Ginkgo* is a gymnosperm.

Sol.: C represent seed. Fruit is absent in gymnosperms.

135. Answer (2)

Hint: Bryophytes lack true roots, stem or leaves.

Sol.: Bryophytes and pteridophytes both have diploid sporophyte, jacketed sex organs, motile male gametes and they produce embryo.

SECTION - B

136. Answer (2)

Hint: Lateral meristem are responsible for producing the secondary tissues.

Sol.: Intercalary meristem is the primary meristem and involved in formation of primary plant body.

137. Answer (4)

Hint: Root hairs can be seen in outermost layer of root.

Sol.: The outermost layer in root is epiblema

138. Answer (1)

Hint: In grasses, certain adaxial epidermal cells along the veins modify into bulliform cells.

Sol.: Bulliform cells make the leaves curl inward to minimise water loss.

139. Answer (4)

Hint: Epidermis forms a continuous layer.

Sol.: Epidermis is made up of elongated compactly arranged cells, which form a continuous layer.

140. Answer (3)

Hint: The root hairs are unicellular epidermal outgrowth.

Sol.: Cortical layers below hypodermis of dicot stem consists of round thin walled parenchymatous cells with conspicuous intercellular spaces. Epidermal cells are parenchymatous with a small amount of cytoplasm lining the cell wall and a large vacuole.

141. Answer (2)

Hint: In monocots stem vascular bundles are scattered.

Sol.: A large number of vascular bundles are arranged in a ring; the 'ring' arrangement of vascular bundles is a characteristic of dicot stem.

142. Answer (2)

Hint: A mature sieve tube element possesses a peripheral cytoplasm and a large vacuole but lacks nucleus.

Sol.: The functions of sieve tubes are controlled by nucleus of companion cells.

143. Answer (1)

Hint: Stoma is composed of two guard cells.

Sol.: Presence of vessels is a characteristic feature of angiosperms. Interfascicular and cork cambium are dedifferentiated cells. Mature sieve tube element possesses a peripheral cytoplasm and a large central vacuole but lack a nucleus.

144. Answer (3)

Hint: Aromatic compounds are chemical constituents of the plant.

Sol.: Karyotaxonomy is based on cytological information like chromosome number, structure, behaviour etc.

145. Answer (3)

Hint: The development of pollen grains take place within the microsporangia.

Sol.: The microspores develop into a male gametophytic generation which is highly reduced. This reduced gametophyte is called a pollen grain.

146. Answer (4)

Hint: In *Cycas* stems are unbranched.

Sol.: The stems are unbranched (*Cycas*) or branched (*Pinus, Cedrus*). The leaves may be simple or compound. In *Cycas*, the pinnate leaves persist for a few years.

147. Answer (1)

Sol.: Agar, one of the commercial products obtained from *Gelidium* and *Gracilaria* are used to grow microbes and in preparation of ice-creams and jellies.

148. Answer (3)

Hint: Sexual reproduction occur by non-motile gametes in Rhodophyceae.

Sol.: *Gracilaria* and *Porphyra* are red algae and they reproduce sexually by non-motile gametes.

149. Answer (3)

Hint: Winged pollen grain are found in gymnosperms.

Sol.: In *Pinus* winged pollen grains are present. It is extended outer exine on two lateral sides to form the wing of pollen.

150. Answer (2)

Hint: *Pinus* is monoecious.

Sol.:

Cycas – Male cone and megasporophylls are borne on different trees.

Dictyota – Presence of laminarin and fucoxanthin

Sequoia – Is a giant red wood tree

[ZOOLOGY]

SECTION - A

151. Answer (1)

Hint: It is an unpaired bone.

Sol.: In human body, hyoid bone does not articulate with any other bone. It is U-shaped and is present at the base of the buccal cavity.

Lacrimal and maxillae are paired facial bones. Sphenoid is an unpaired cranial bone.

152. Answer (4)

Hint: Insects have tracheal tubes for respiration.

Sol.: Malpighian tubules are the excretory structures of most insects including cockroaches. Malpighian tubules help in the removal of nitrogenous wastes and osmoregulation. Statocysts are balancing organs in aquatic arthropods. Respiration occurs by gills, book gills, book lungs and tracheal system in arthropods.

153. Answer (1)

Hint: Branch that includes sympathetic neural system.

Sol.: The CNS (Central Neural System) includes the brain and the spinal cord. The PNS (Peripheral Neural System) is divided into two divisions called somatic neural system and autonomic neural system.

The autonomic neural system is further classified into sympathetic and parasympathetic neural system.

154. Answer (3)

Hint: Synapse is made up of pre-synaptic membrane, synaptic cleft and post-synaptic membrane.

Sol.: Synaptic vesicles contain chemicals called neurotransmitters. The receptors to which neurotransmitters bind to, are present on the post-synaptic membrane. Binding of neurotransmitters open ion channels, allowing the entry of ions which can generate a new action potential in the post-synaptic neuron.

155. Answer (2)

Hint: Keeps a check on the renin-angiotensin mechanism.

Sol.: ADH, also called vasopressin, affects the kidney functions by its constrictory effect on blood vessels.

Angiotensin II is a powerful vasoconstrictor.

Vasoconstriction increases the blood pressure and thereby GFR.

ANF released from atria of the heart can cause vasodilation and thereby decreases the blood pressure.

156. Answer (3)

Hint: Dura mater is the outermost meninx.

Sol.: The human brain is well protected by the skull. Inside the skull, the brain is covered by the cranial meninges consisting of an outer layer called dura mater, a very thin middle layer called arachnoid and an inner layer (which is in contact with the brain tissue) called pia mater.

The cerebral cortex is referred to as grey matter.

157. Answer (4)

Hint: Facilitated by structures that help in the passage of ovum through fallopian tubes.

Sol.: *Paramoecium* has cilia that help in the movement of food through cytopharynx and in locomotion as well.

Flagellar movement helps in the swimming of human spermatozoa, maintenance of water current in the canal system of sponges and in locomotion of *Euglena*.

158. Answer (3)

Hint: Locomotion involves change of place.

Sol.: All locomotions are movements but all movements are not locomotions.

Movements that result in change of place or location are called locomotions.

Some specialised cells in our body like macrophages in tissue, monocytes and leucocytes in blood exhibit amoeboid movement.

159. Answer (3)

Hint: Neurotransmitters are chemicals involved in impulse conduction across chemical synapses.

Sol.: Impulse conduction across an electrical synapse is always faster than that across a chemical synapse. The membranes of pre and post-synaptic neurons are in very close proximity.

Electrical current can flow directly from one neuron into the other across these synapses.

Electrical synapses are rare in our body.

160. Answer (1)

Hint: Sarcolemma is the plasma membrane of a muscle fibre.

Sol.: A muscle is covered by a sheath of connective tissue called epimysium. Inside epimysium, a muscle has many fibres arranged in bundles called fasciculi (fascicles). The muscle bundles are held together by a common collagenous sheath of connective tissue called fascia.

161. Answer (3)

Hint: Exclude 26-serially arranged units in human body.

Sol.: Our vertebral column is formed by 26-serially arranged units called vertebrae and is dorsally placed.

Clavicle and scapula are the parts of pectoral girdle.

Patella is a cup-shaped bone, covering the knee ventrally.

162. Answer (4)

Hint: A nitrogenous waste

Sol.: The tubular epithelial cells in different segments of nephron perform reabsorption by either active or passive mechanisms. Substances like glucose, amino acids, Na^+, *etc.,* in the filtrate are reabsorbed actively whereas nitrogenous wastes are absorbed by the passive transport.

163. Answer (3)

Hint: In resting condition, the axoplasm contains high concentration of K^+.

Sol.: The ionic gradients across the resting neuronal membrane are maintained by the active transport of ions by sodium-potassium pump which transports 3 Na^+ outwards for 2 K^+ into the cell. As a result, the outer surface of the axonal membrane possesses a positive charge while its inner surface becomes negatively charged.

164. Answer (2)

Hint: Each myofibril contains many serially arranged units called sarcomere.

Sol.: Muscle fibre is the anatomical unit of muscles. Each muscle fibre has many parallelly arranged filaments in the sarcoplasm called myofilaments or myofibrils. Each myofibril contains many serially arranged units called sarcomere which are the functional units of muscles.

165. Answer (2)

Hint: It has a slightly elevated ridge called spine.

Sol.: Scapula is a large triangular flat bone situated in the dorsal part of thorax between the second and the seventh ribs. Each half of pectoral girdle consists of a clavicle and a scapula.

The dorsal, flat, triangular body of scapula has a slightly elevated ridge called the spine which projects as a flat, expanded process called the acromion.

Clavicle is commonly called the collar bone.

166. Answer (4)

Hint: Counter current mechanism leads to concentration of urine.

Sol.: The proximity between the Henle's loop and vasa recta, as well as the counter current in them help in maintaining an increasing osmolarity towards the inner medullary interstitium *i.e.*, from 300 $mOsmolL^{-1}$ in the cortex to about 1200 $mOsmolL^{-1}$ in the inner medulla. The flow of filtrate in the two limbs of Henle's loop is in the opposite direction and thus, forms a counter current.

167. Answer (3)

Hint: Neurons are polarised during the resting state.

Sol.: When a neuron is not conducting any impulse *i.e.,* resting, the axonal membrane is comparatively more permeable to K^+ and nearly impermeable to Na^+. Similarly, the membrane is impermeable to negatively charged proteins present in the axoplasm.

168. Answer (4)

Hint: Exclude the functions of medulla oblongata

Sol.: Hypothalamus is a part of forebrain and contains a number of centres which control body temperature, urge for eating and drinking. It also contains several groups of neurosecretory cells, which secrete hormones called hypothalamic hormones.

The medulla oblongata contains centres which control respiration, cardiovascular reflexes and gastric secretions.

Cerebellum maintains balance and posture of the body.

169. Answer (4)

Hint: This hormone acts as a vasodilator.

Sol.:

JG cells of kidneys release renin which converts angiotensinogen in blood to angiotensin I, which further changes to angiotensin II that increases GFR.

Angiotensin II also activates the adrenal cortex to release aldosterone.

Aldosterone causes reabsorption of Na^+ and water from the distal parts of the renal tubules. This also causes increase in blood pressure and thereby GFR.

This complex mechanism is known as the Renin-Angiotensin mechanism.

An increase in the blood flow to atria of the heart can cause the release of Atrial Natriuretic Factor (ANF).

ANF causes vasodilation (dilation of blood vessels) and thereby decreases the blood pressure. ANF mechanism, therefore, acts as a check on the renin-angiotensin mechanism.

170. Answer (1)

Hint: Antennal glands are called green glands.

Sol.: Neurons can detect, receive and transmit different kinds of stimuli; they cannot produce them.

The cortex extends in between the medullary pyramids as renal columns called Columns of Bertini.

On an average, 25 – 30 gm of urea is excreted out through urine per day.

Protonephridia are the excretory structures of *Amphioxus*.

Antennal glands or green glands perform the excretory function in prawns.

171. Answer (2)

Hint: A part of brain stem

Sol.: The hindbrain comprises pons, cerebellum and medulla.

Hypothalamus and thalamus are the parts of forebrain.

The medulla of the brain is connected to the spinal cord. The medulla contains centres which control respiration, cardiovascular reflexes and gastric secretions.

172. Answer (4)

Hint: Muscle fibres that perform aerobic respiration have plenty of mitochondria.

Sol.: Red muscle fibres have plenty of mitochondria which can utilise the large amount of oxygen stored in them for ATP production.

Therefore, they can also be called aerobic muscles.

On the other hand, white muscle fibres depend on anaerobic process for energy.

173. Answer (1)

Hint: Includes DCT

Sol.: JGA is a special sensitive region formed by the cellular modifications in distal convoluted tubule (DCT) and the afferent arteriole at the location of their contact. Conditional reabsorption of Na^+ and water takes place in DCT. Maximum reabsorption of electrolytes and nutrients occurs in PCT (Proximal Convoluted Tubule).

Blood from the glomerulus is carried away by an efferent arteriole.

174. Answer (1)

Hint: First 7 pairs of ribs are true ribs.

Sol.: Vertebrochondral ribs (false ribs) are 8^{th}, 9^{th} and 10^{th} pairs of ribs. These do not articulate directly with the sternum but join the 7^{th} rib with the help of hyaline cartilage.

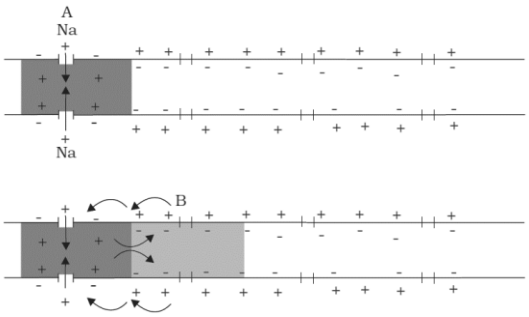
Floating ribs *i.e.*, 11^{th} and 12^{th} pairs of ribs are not connected ventrally and are therefore called floating ribs.

175. Answer (2)

Hint: During depolarisation of an axonal membrane, the polarity gets reversed at the site where impulse is applied.

Sol.: After depolarisation of a segment of axon, the inner surface becomes positively charged and the outer surface becomes negatively charged.

Impulse conduction through an axon:



176. Answer (4)

Hint: Multipolar neurons are neurons with one axon and two or more dendrites.

Sol.: Based on the number of axon and dendrites, the neurons are of 3 types:

- Multipolar – 1 axon and 2 or more dendrites (found in the cerebral cortex)
- Bipolar – 1 axon and 1 dendrite (found in retina of eye)
- Unipolar – Cell body with 1 axon only (found in the embryonic stage)

177. Answer (4)

Hint: Longest bone in the human body

Sol.: Pelvic girdle consists of two coxal bones. Each coxal bone is formed by the fusion of three bones – ilium, ischium and pubis. At the point of the fusion of above bones is a cavity called acetabulum to which the thigh bone articulates. The two halves of the pelvic girdle meet ventrally to form the pubic symphysis.

178. Answer (1)

Hint: Malpighian body is made up of glomerulus alongwith Bowman's capsule.

Sol.: The renal tubule begins with a double walled cup-like structure called Bowman's capsule, which encloses the glomerulus. The Malpighian body, PCT and DCT of the nephron are situated in the cortical region of the kidney whereas the loop of Henle dips into the medulla.

Glomerulus is a part of nephron, but not renal tubules.

179. Answer (3)

Hint: Exclude the convoluted region of hind brain.

Sol.: Three major regions make up the brain stem; midbrain, pons and medulla oblongata. Brain stem forms the connections between the brain and the spinal cord.

The hindbrain comprises pons, cerebellum and medulla. Hypothalamus, cerebrum and thalamus are the parts of forebrain.

180. Answer (3)

Hint: Aldosterone is released by the outer part of adrenal gland.

Sol.:

- Human kidneys can produce urine nearly four times concentrated than the initial filtrate formed. Thus, it is hypertonic.
- JG cells release renin which converts angiotensinogen in blood to angiotensin I.
- Angiotensin II activates the adrenal cortex to release aldosterone.
- Each kidney of an adult human has an average weight of 120 – 170 g.

181. Answer (4)

Hint: Include the site of filtration

Sol.: Glomerulus is a tuft of capillaries formed by the afferent arteriole-a fine branch of renal artery. Blood from the glomerulus is carried away by an efferent arteriole.

The glomerular capillary blood pressure causes filtration of blood through three layers *i.e.*, the endothelium of blood vessels, the epithelium of Bowman's capsule and a basement membrane between these two layers. The epithelial cells of Bowman's capsule, called podocytes, are arranged in an intricate manner so as to leave some minute spaces called filtration slits or slit pores.

182. Answer (2)

Hint: Eliminate the substance removed by the largest gland in the human body.

Sol.: Sweat contains NaCl, small amounts of urea, lactic acid, *etc*.

Sebaceous glands eliminate certain substances like sterols, hydrocarbons and waxes through sebum.

183. Answer (4)

Hint: Biceps are skeletal muscle fibres.

Sol.:

Skeletal muscle fibres	**Smooth muscle fibres**
Multinucleated with peripheral nuclei	Uninucleated with central nucleus
Cylindrical shaped	Fusiform shaped
Striated	Non-striated

Both are unbranched fibres.

184. Answer (1)

Hint: Each myofibril has alternate dark and light bands on it.

Sol.: The light band contains actin and is called I-band or Isotropic band whereas the dark band is called 'A' or Anisotropic band, which contains myosin. The striated/striped appearance of muscle fibres is due to the distribution of actin and myosin filaments.

185. Answer (1)

Hint: Part of the brain located between hypothalamus/thalamus and pons.

Sol.: The midbrain is located between the thalamus/hypothalamus of the forebrain and pons of the hindbrain. The dorsal portion of the midbrain consists mainly of four round swellings (lobes) called corpora quadrigemina. Pons, cerebellum and medulla are the parts of hindbrain.

SECTION - B

186. Answer (4)

Hint: Recall the function associated with the cerebellum.

Sol.: The cerebral cortex contains motor areas, sensory areas and large regions that are neither clearly sensory nor motor in function.

These regions are called association areas and are responsible for complex functions like intersensory associations, memory and communication.

187. Answer (3)

Hint: Divides longitudinally.

Sol.: Cerebrum forms the major part of the human brain. A deep cleft divides the cerebrum longitudinally into two halves, called the left and right cerebral hemispheres. The hemispheres are connected by a tract of nerve fibres called corpus callosum.

Cerebral aqueduct is a canal that passes through the midbrain.

188. Answer (1)

Hint: Urinary bladder contains muscles that have spindle-shaped muscle fibres.

Sol.: The CNS passes on motor messages to initiate the contraction of smooth muscles of the urinary bladder and simultaneous relaxation of the urethral sphincters causing the release of urine. The process of release of urine is called micturition.

189. Answer (1)

Hint: Function of renin-angiotensin mechanism

Sol.: Osmoreceptors in the body are activated by changes in blood volume, that leads to release of ADH. Angiotensin II is a powerful vasoconstrictor that increases the glomerular blood pressure and thereby GFR.

Angiotensin II also activates the adrenal cortex to release aldosterone that causes reabsorption of Na^+ and water from the distal parts of the renal tubules.

190. Answer (3)

Hint: Contractile proteins slide over each other for muscle contraction.

Sol.: Tropomyosin and troponin are regulatory proteins whereas actin and myosin are contractile proteins.

Troponin and tropomyosin are associated with the structure of actin filament.

191. Answer (1)

Hint: More than the volume (in mL) of GFR formed by a healthy man per minute.

Sol.: Our lungs remove large amounts of CO_2 (approximately 200 mL/min) and also significant quantities of water every day.

192. Answer (4)

Hint: Equal to the number of phalanges in one upper limb of humans

Sol.: Vertebrosternal ribs also known as true ribs. First seven pairs of ribs are called true ribs. Dorsally, they are attached to the thoracic vertebrae and ventrally connected with the sternum with the help of hyaline cartilage.

193. Answer (1)

Hint: Part of PNS

Sol.: The peripheral neural system is divided into two divisions:

(a) Somatic neural system

(b) Autonomic neural system

The somatic neural system relays impulses from CNS to the skeletal muscles (voluntary muscles such as triceps) of the body. While the autonomic neural system transmits impulses from the CNS to the involuntary organs and smooth muscles of the body. Visceral nervous system transmits impulses from CNS to the viscera and from the viscera to CNS.

Sympathetic neural system is a part of autonomic neural system.

194. Answer (2)

Hint: Action potential

Sol.: The electrical potential difference that develops across the plasma membrane of a neuron where stimulus is applied, is termed as nerve impulse.

The electrical potential difference across the resting plasma membrane is called the resting potential. The nerve impulse is conducted along the axonal membrane in the form of a wave of depolarisation and repolarisation.

The synapse is the junction through which a nerve impulse is transmitted from one neuron to the other.

195. Answer (3)

Hint: Not a part of nephron

Sol.: Collecting duct allows passage of small amounts of urea into the medullary interstitium to keep up the osmolarity. It also plays a role in the maintenance of pH and ionic balance of blood by the selective secretion of H^+ and K^+.

PCT selectively secretes H^+ and ammonia into the filtrate.

Glomerulus performs filtration of blood.

DCT performs selective secretion of H^+, K^+ and NH_3 to maintain the pH and sodium-potassium balance in blood.

196. Answer (4)

Hint: Between atlas and axis

Sol.: Joints have been classified into three major structural forms, namely, fibrous, cartilaginous and synovial.

Synovial joints are of different types, for example, ball and socket joint, hinge joint, pivot joint, gliding joint (between carpals) and saddle joint (between carpal and metacarpal of thumb).

Atlas is the vertebra that articulates with the occipital condyles. Axis is the second vertebra. The joint present between the atlas and the axis is pivot joint.

Flat skull bones show fibrous joints.

197. Answer (3)

Hint: Myasthenia gravis affects neuromuscular junction.

Sol.:

- Myasthenia gravis is an auto-immune disorder that affects neuromuscular junctions leading to fatigue, weakening and paralysis of skeletal muscles.
- In muscular dystrophy, there is a progressive degeneration of skeletal muscles mostly due to genetic disorder.
- Tetany is characterised by rapid spasms in muscles due to low Ca^{2+} in body fluid.
- In gout, inflammation of joints occur due to accumulation of uric acid crystals.

198. Answer (1)

Hint: Central part of thick filament, not overlapped by thin filaments

Sol.: When a skeletal muscle is fully contracted,

- Length of sarcomere decreases
- H-zone disappears
- Length of A-band remains unchanged
- Length of I-band gets reduced

199. Answer (3)

Hint: Members of class Osteichthyes are ammonotelic in nature.

Sol.: Order of toxicity = Ammonia > Urea > Uric acid.

Many bony fishes, aquatic amphibians and aquatic insects are ammonotelic in nature.

Mammals, many terrestrial amphibians and marine fishes mainly excrete urea and are called ureotelic animals.

Reptiles, birds, land snails, and terrestrial insects are uricotelic animals.

200. Answer (2)

Hint: Present in perikaryon

Sol.: Nissl's granules are made up of RER and ribosomes. Thus, they participate in protein synthesis.

They are absent in axons of neurons.

They are found in dendrites and cyton.

❑ ❑ ❑

All India Aakash Test Series for NEET - 2025

TEST - 3 (Code-F)

Click here for Code-E Sol.

Test Date : 22/12/2024

ANSWERS

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

HINTS & SOLUTIONS

[PHYSICS]

SECTION - A

1. Answer (2)

Hint and Sol.: The centre of mass will shift toward the heavier side opposite to the section removed.

2. Answer (4)

Hint: They will collide at their COM

Sol.: Position of COM from mass m,

$$x = \frac{m_1 0 + 2md}{2m + m}$$

$$x = \frac{2}{3}d$$

3. Answer (3)

Hint: The gravitational potential of shell is constant inside it.

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

4. Answer (1)

Hint: Use, $g = \frac{4}{3}G\pi\rho r$

Sol.: $\frac{g_P}{g_Q} = \frac{\frac{4}{3}G\pi\rho r}{\frac{4}{3}G\pi(2\rho)\left(\frac{r}{2}\right)} = 1:1$

5. Answer (3)

Hint: Breaking stress remains same

Sol.: $\frac{F}{\pi r^2} = \frac{F'}{\pi(2r)^2} \Rightarrow F' = 4F$

6. Answer (4)

Hint: Young's modulus is equal to slope of stress-strain graph.

Sol.: $\frac{Y_A}{Y_B} = \frac{\tan 30^\circ}{\tan 60^\circ}$

$$\frac{Y_A}{Y_B} = \frac{1}{\sqrt{3}\times\sqrt{3}} = \frac{1}{3}$$

$Y_B = 3Y_A$

7. Answer (4)

Hint & Sol.: Longitudinal strain $= \frac{\Delta L}{L}$ is a unitless quantity.

8. Answer (3)

Hint: Weight of block = Buoyant force

Sol.: Volume, $AL = \frac{100}{600} = \frac{1}{6}$ m^3

Weight of block = Buoyant force

$600 \times A \times L \times g = 1000 \times A \times h \times g$

h = depth of block inside water

$0.6L = h$

Volume outside = $0.4AL$

$$= 0.4 \times \frac{1}{6}$$

$$= \frac{4}{60} = \frac{1}{15} \text{ m}^3$$

9. Answer (2)

Hint: $\rho = \frac{\text{total mass}}{\text{total volume}}$

Sol.: $\rho = \frac{\rho_1 V_1 + \rho_2 V_2}{V_1 + V_2}$

$$= \frac{1V + 2V}{V + V} = \frac{3}{2} \text{ g cm}^{-3}$$

10. Answer (4)

Hint: Use equation of continuity

Sol.: $A_1 v_1 = A_2 v_2$

$$(\pi)(5)^2 \times \frac{1}{2} = \pi \times 20 \times (10^{-1})^2 \times v_2$$

$$\pi\frac{25}{2} = \pi \times 20 \times 10^{-2} \times v_2$$

$$\frac{25}{40} \times 100 = v_2$$

62.5 cm s^{-1} = v_2

11. Answer (2)

Hint: Pressure difference = ρgh

Sol.: $10^3 \times 10 \times h = \frac{200}{400} \times 10^4$

$h = \frac{1}{2}$ m $\Rightarrow h = 50$ cm

12. Answer (4)

Hint and Sol.: $g = \frac{GMr}{R^3}$ when $r \le R$

For $r = 0 \Rightarrow g = 0$

$g = \frac{GM}{r^2}$ when $r > R$

13. Answer (4)

Hint: Use, $F = \frac{GM_1M_2}{d^2}$

Sol.: $F = \frac{GM_1M_2}{d^2}$

$F' = \frac{(G)(2M_1)(2M_2)}{\left(\frac{d}{2}\right)^2}$

$F' = 4 \times 4\frac{GM_1M_2}{d^2}$

$F' = 16F$

14. Answer (1)

Hint: Potential inside earth is $-\frac{GM}{R}\left[\frac{3}{2} - \frac{1}{2}\frac{r^2}{R^2}\right]$, where r is the distance from centre.

Sol.: Conservation of total energy

$-\frac{GMm}{R} = \frac{-3GMm}{2R} + \frac{1}{2}mv^2$

$\frac{3}{2}\frac{GMm}{R} - \frac{GMm}{R} = \frac{1}{2}mv^2$

$\frac{1}{2}\frac{GMm}{R} = \frac{1}{2}mv^2$

$\sqrt{\frac{GM}{R}} = v$

15. Answer (2)

Hint: Total energy = $KE + PE = \frac{PE}{2}$

Sol.: $PE = \frac{-GMm}{2R}$

$TE = \frac{-GMm}{4R}$

16. Answer (3)

Hint: Use, $g' = \frac{GM}{(R+h)^2}$

Sol.: $g' = \frac{GM}{\left(R + \frac{R}{2}\right)^2} = \frac{GM}{\left(\frac{3}{R}R\right)^2} = \frac{4}{9}\frac{GM}{R^2} = \frac{4}{9}g$

17. Answer (4)

Hint and Sol.: $L = I\omega$

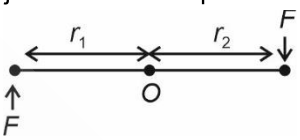
$K = \frac{1}{2}I\omega^2 = \frac{1}{2}\frac{I^2\omega^2}{I}$

$L = I\omega = \sqrt{2KI} = \frac{2K}{\omega}$

18. Answer (1)

Hint: Set of equal and opposite forces acting on an object is called couple

Sol.:



$a_{cm} = \frac{\vec{F}_1 + \vec{F}_2}{m}$

$\vec{a}_{cm} = \frac{\vec{F} - \vec{F}}{m} = 0$

$I\alpha = \vec{r}_1 \times \vec{F}_1 + \vec{r}_2 \times \vec{F}_2 \Rightarrow$ Non zero and constant

19. Answer (2)

Hint: Kinetic energy of rotation $= \frac{1}{2}I\omega^2$

Sol.: $KE_R = \frac{1}{4}MR^2\omega^2$, $I = \frac{MR^2}{2}$

20. Answer (4)

Hint: Use parallel axis theorem

Sol.: $2400 = \frac{ML^2}{12}$

$I = \frac{ML^2}{3} = 4\left(\frac{ML^2}{12}\right) = 4 \times 2400$

$I = 9600$ kg m^2

21. Answer (1)

Hint: $I\omega$ = constant

Sol.: $I_1\omega_1 = I_2\omega_2$

As the insect moves away from centre to rim, moment of inertia of the system increases which decreases the angular speed.

22. Answer (2)

Hint: Use conversation of energy

Sol.: Loss in KE = Gain in PE

$\frac{1}{2}I\omega^2 = mg\frac{l}{4}$

$\frac{1}{2}\frac{ml^2\omega^2}{3} = mg\frac{l}{4}$

$\omega^2 = \frac{3g}{2l} \Rightarrow \omega = \sqrt{\frac{3g}{2l}}$

23. Answer (2)

Hint: $\vec{v}_{com} = \frac{m_1\vec{v}_1 + m_2\vec{v}_2}{m_1 + m_2}$

Sol.: $\vec{v}_{com} = \left(\frac{1}{2}\right)\left[v\hat{i} + \sqrt{3}v\hat{j}\right]$

$|\vec{v}_{com}| = \frac{1}{2}(2v) = v$

24. Answer (4)

Hint: Use, $Y = \frac{\text{Load}}{\text{Area}}\frac{l}{\Delta l}$

Sol.: Area $\propto$ $\frac{\text{Load}}{\text{Elongation}}$

Area $\propto \frac{1}{\text{Slope of graph}}$

The slope for S is maximum, so its area is minimum.

25. Answer (4)

Hint: Use, $\frac{\Delta V}{V} = \frac{3\Delta r}{r}$

$\frac{\Delta A}{A} = \frac{2\Delta r}{r} = \frac{2}{3}\frac{\Delta V}{V}$

Sol.: $B = \frac{P}{\frac{\Delta V}{V}}$

$\frac{\Delta V}{V} = \frac{P}{B}$

$\frac{\Delta A}{A} = \frac{2}{3}\frac{P}{B}$

26. Answer (3)

Hint and Sol.: Young's modulus is a material property and it is independent of shape and size.

27. Answer (1)

Hint: Work done = change in surface energy

Sol.: $W = S\Delta A$

$W = (S)\ 2 \times 4\pi(4^2 - 2^2) \times 10^{-4}$

$= 0.03 \times 2 \times 4\pi\ (16 - 4) \times 10^{-4}$

$= 0.03 \times 8\pi \times 12 \times 10^{-4}$

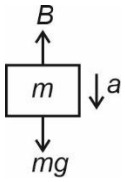
$= 24 \times 12\pi \times 10^{-6} = 288\pi \times 10^{-6}$

$= 0.3\pi$ mJ

28. Answer (1)

Hint: Buoyant force is equal to apparent weight of the block.

Sol.: When the beaker was at rest, then $B = mg$. While falling:



$ma = mg - B$

$B = mg - ma$

$B = m(g - a)$

29. Answer (3)

Hint: Use, $T^2 \propto r^3$

Sol.: $\left(\frac{T_2}{T_1}\right)^2 = \left(\frac{R_2}{R_1}\right)^3 = \left(\frac{4r}{r}\right)^3 = 64$

$\left(\frac{T_2}{T}\right) = \sqrt{64} \Rightarrow T_2 = 8T$

$= 8 \times 4 = 32$ hours

30. Answer (3)

Hint: A particle will leave the earth's surface when its total energy is either zero or positive.

Sol.: $\frac{1}{2}mv_e^2 = \frac{GMm}{R}$

$v_e = \sqrt{\frac{2GM}{R}}$

$v_e \propto \sqrt{M}$

31. Answer (4)

Hint: The gravitational force on pendulum is balanced by centrifugal force.

Sol.: $T = 2\pi\sqrt{\frac{l}{g_{eff}}}$

$g_{eff} = 0$

$T = 2\pi\sqrt{\frac{l}{0}} \to \infty$

32. Answer (3)

Hint: In an elliptical orbit angular momentum of a satellite is conserved.

Sol.: $m_0v_1r_1 = m_0v_2r_2$, so the speed of satellite changes with position and its potential energy also changes. The total energy remains constant, because only conservative force (gravitational force) is acting.

33. Answer (4)

Hint: For a particle in uniform circular motion, only a centripetal force acts on it.

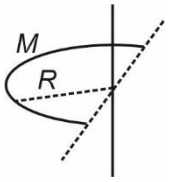
Sol.: $\vec{\tau} = \frac{d\vec{L}}{dt} = 0$

Because torque of central force is zero.

34. Answer (1)

Hint: Use, $I = \int R^2 dm$

Sol.:



$I = R^2 \int dm = MR^2$

35. Answer (3)

Hint and Sol.:

$m_1x_1 = m_2x_2$

$m_1 > m_2$

$x_1 < x_2$

SECTION - B

36. Answer (4)

Hint and Sol.: Gravitational force is a conservative force because the work done by gravitational force between two points depends upon initial and final position.

37. Answer (1)

Hint and Sol.: $\vec{a}_{cm} = \frac{\vec{F}_{ext}}{M_1 + M_2 + M_3} = 0$ as

$\vec{F}_{ext} = 0$. So the $v_{cm} = 0$ or v_{cm} = constant

38. Answer (1)

Hint: Use, $h = \frac{2s\cos\theta}{\rho g r}$

Sol.: $h' = \frac{2s\cos\theta}{\rho(g+a)r}$

$h' < h$

39. Answer (1)

Hint: Use velocity of efflux

Sol.: $v = \sqrt{2g(H-h)} = \sqrt{2\times10\times2} = \sqrt{40}$ m s^{-1}

time $t = \sqrt{\frac{2h}{g}} = \sqrt{\frac{4}{10}}$

Range(x) = vt

$= \sqrt{40} \times \sqrt{\frac{4}{10}}$

$= \sqrt{\frac{40}{10}}\sqrt{4}$

= 2 × 2 = 4 m

40. Answer (2)

Hint: Compressibility is defined as reciprocal of Bulk modulus.

Sol.:

$[K] = \frac{1}{[B]} \Rightarrow [K] = \frac{1}{[ML^{-1}T^{-2}]} \Rightarrow [K] = [M^{-1}L^1T^2]$

41. Answer (3)

Hint: Assume the whole mass to be concentrated at centre of mass.

Sol.: COM at distance $\frac{L}{2}$ from bottom

$\Rightarrow \Delta L = \frac{Mg \times \frac{L}{2}}{AY}$

$\Rightarrow$ elongation $= \frac{MgL}{2AY}$

42. Answer (2)

Hint: Work done = change in potential energy

Sol.: $\Delta W = \frac{-Gm^2}{2d} + \frac{Gm^2}{d} = +\frac{Gm^2}{2d}$

43. Answer (4)

Hint and Sol.: Law of orbit and law of areas are the Kepler's laws.

44. Answer (2)

Hint & Sol.: Viscous force acting on spherical object.

$F_v = 6\pi\eta a v$

$\Rightarrow F_v = 6\pi\eta \times \frac{d}{2} \times v = 3\pi\eta d v$

45. Answer (2)

Hint and Sol.: (A) $\Rightarrow g_a = \frac{GM \cdot r}{R^3}$

(B) $\Rightarrow g_b = \frac{GM}{r^2}$

(C) $\Rightarrow g_c = \frac{GM}{(R+r)^2} = \frac{GM}{R^2\left(1+\frac{r}{R}\right)^2}$

$$g_c = \frac{GM}{R^2}\left(1+\frac{r}{R}\right)^{-2}$$

given $r << R$

$$g_c = \frac{GM}{R^2}\left(1-\frac{2r}{R}\right)$$

(D) $\Rightarrow g_d = \frac{GM}{R^2}\left(1-\frac{r}{R}\right)$

46. Answer (1)

Hint: Use principle of moments

Sol.: $N_A + N_B = Mg$ ...(i)

$$N_A \times \frac{L}{4} = N_B \times \frac{L}{2}$$

$N_A = 2N_B$ ...(ii)

From (i) and (ii),

$3N_B = Mg$

$$N_B = \frac{Mg}{3}$$

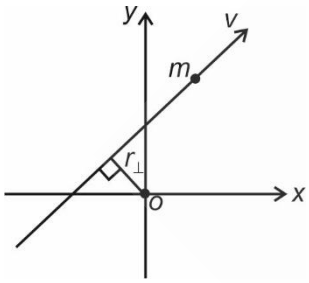
47. Answer (1)

Hint: Use, $\vec{L} = \vec{r} \times (\vec{P})$

Sol.: $|\vec{L}| = rmv\sin\theta$.

$= r\sin\theta mv$

$= r_\perp mv = \text{constant}$



48. Answer (3)

Hint: $I = mx^2$, where x is perpendicular distance from axis.

Sol.: $I = ml^2 + m\left(\sqrt{2}l\right)^2 + ml^2$

$I = ml^2 + 2ml^2 + ml^2$

$I = 4ml^2$

49. Answer (1)

Hint: Use parallel axis theorem

Sol.: $MK^2 = \frac{MR^2}{2} + M(R^2)$

$$MK^2 = \frac{MR^2}{2} + MR^2$$

$$MK^2 = \frac{3}{2}MR^2$$

$$K = \sqrt{\frac{3}{2}}\,R$$

50. Answer (2)

Hint: Use conservation of energy

Sol.: $-\frac{GMm}{R} + \frac{1}{2}mv^2 = \frac{-GMm}{R+h}$

$$-\frac{GMm}{R} + \frac{1}{2}m\left(\frac{GM}{R}\right) = \frac{-GMm}{R+h}$$

$$-\frac{1}{R} + \frac{1}{2R} = \frac{-1}{R+h}$$

$$-\frac{1}{2R} = \frac{-1}{R+h}$$

$2R = R + h \Rightarrow h = R$

[CHEMISTRY]

SECTION - A

51. Answer (2)

Hint: On electrolysis of $CuSO_4$(aq) using inert electrode, Cu^{2+} will get reduced at cathode and H_2O will get oxidised at anode.

Sol.: At cathode

$Cu^{2+} + 2e^- \rightarrow Cu(s)$

At anode

$$H_2O \rightarrow \frac{1}{2}O_2(g) + 2e^-$$

By passing 1F charge 1eq of O_2 will be evolved.

mole of $O_2 = \frac{1}{4} \times n_{eq}$ of O_2

$= \frac{1}{4}$

Volume at STP $= \frac{1}{4} \times 22.4$

= 5.6 L

52. Answer (4)

Hint: $E^\circ_{cell} = E^\circ_{cathode} - E^\circ_{anode}$

Sol.: This is concentration cell in which both cathode and anode are same, hence

$E^\circ_{cell} = 0$

53. Answer (4)

Hint: Conductivity depends on charge and movability of ion in aqueous medium.

Sol.:

Ion	$\lambda°/(S\ cm^2mol^{-1})$
H^+	349.6
Na^+	50.1
K^+	73.5
Ca^{2+}	119.0
Mg^{2+}	106.0

54. Answer (2)

Hint: Element with high value at SRP are good oxidising agent.

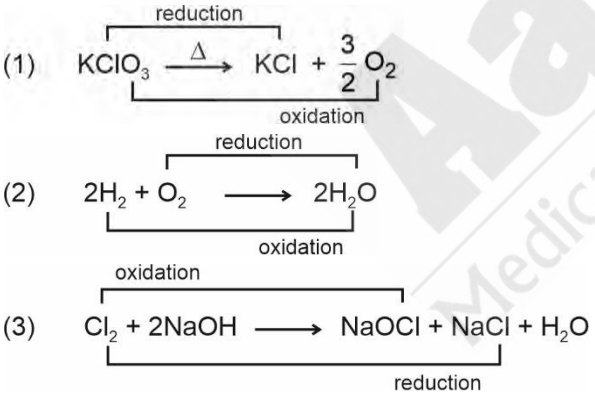
Sol.: Since $E_{A^{2+}/A} > E_{B^{2+}/B}$, A will be insoluble in BSO_4

- Since $E_{A^{2+}/A} > E_{C^{2+}/C}$, C will be soluble in $A(NO_3)_2$
- C^{2+} has least SRP hence it will be weakest oxidising agent.
- $B(s) + CSO_4 \rightarrow BSO_4 + C(s)$, is non-spontaneous hence will have negative EMF.

55. Answer (3)

Hint: In disproportionation reaction, reduction and oxidation of same element takes place

Sol.:



Hence (3) is disproportionation reaction.

56. Answer (4)

Hint: Halogen attached with more electronegative atom exhibit positive oxidation state, while halogen attached with less electronegative atom exhibit negative oxidation state.

Sol.: $CsI_3 \rightarrow$ O.S of I is $\frac{"-1"}{3}$

$NaBr \rightarrow$ O.S of Br is "–1"

$KClO_4 \rightarrow$ O.S of Cl is "+7"

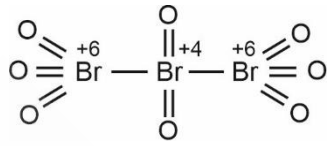
$Ca(OCl)_2 \rightarrow$ O.S of Cl is "+1"

$O_2F_2 \rightarrow$ O.S of F is "–1"

57. Answer (2)

Hint: For covalent bond, high electronegative element gets –1 oxidation state and less electronegative element gets +1 oxidation state

Sol.:



Average oxidation state of Br $= \frac{+16}{3}$

58. Answer (3)

Hint: Value of intensive properties does not depend on quantity of substance.

Sol.: Volume, number of mole and surface area are extensive properties.

Pressure is an intensive property.

59. Answer (3)

Hint: Reversible reaction could be reversed by infinitesimal change in opposite direction.

Sol.: Reversible reaction are very slow and are at equilibrium.

60. Answer (1)

Hint: Given reaction is disproportionation

Sol.: $3Br_2 + 6NaOH \rightarrow 5NaBr + NaBrO_3 + 3H_2O$

a = 3

b = 6

c = 5

d = 1

61. Answer (2)

Hint: pH + pOH = 14

Sol.: For saturated solution of $Ba(OH)_2$

$$Ba(OH)_2(s) \rightleftharpoons \underset{S}{Ba^{2+}}(aq) + \underset{2S+10^{-2}}{2OH^-}(aq)$$

$K_{sp} = [Ba^{2+}]\,[OH^-]^2$

Since pH = 12

pOH = 2

$[OH^-] = 10^{-2}$

$K_{sp} = (S) \times (2S + 10^{-2})^2$

$10^{-12} = S \times 10^{-4}$

$S = 10^{-8}$ M

62. Answer (2)

Hint: On adding two reaction, their ΔH will also be added

Sol.:

$$A \rightarrow B; \quad \Delta H = 200$$
$$+B \rightarrow C + D; \ \Delta H = -150$$
$$\overline{A \rightarrow C + D; \ \Delta H = 50 \text{ kJ}}$$

63. Answer (2)

Hint: For any redox reaction $(n_{eq})_{OA} = (n_{eq})_{RA}$

Sol.:

$$(\text{mole} \times \text{n} - \text{factor})_{KMnO_4} = (\text{mole} \times \text{n} - \text{factor})_{FeC_2O_4}$$

$n \times 5 = 0.1 \times 3$

$n = 0.06$ mole

64. Answer (2)

Hint: $q_P = q_V + \Delta n_g RT$

Δn_g = change in gaseous number of moles

Sol.: Combustion of CH_4 at 127°C is

$CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(g)$

$\Delta n_g = 0$

$\Delta U = \Delta H$

65. Answer (3)

Hint: Metal with positive SRP does not give H_2 on reaction with dil H_2SO_4

Sol.: SRP of Pt is positive hence it will not given H_2 with H_2SO_4.

66. Answer (2)

Hint: Oxidation state of some elements changes during a redox reaction

Sol.: For reaction $CaCO_3 \rightleftharpoons CaO + CO_2$ oxidation state of each and every element is constant hence it is not redox reaction.

67. Answer (3)

Hint: During adiabatic process, q = 0

Sol.: For expansion, w < 0

Hence for adiabatic expansion, $\Delta U < 0$

$\Delta T < 0$

Cooling will take place

68. Answer (4)

Hint: For saturated solution $Q_{sp} = K_{sp}$

Sol.: If $Q_{sp} > K_{sp}$ precipitation will take place

Since ice is less denser than water melting of ice increases with pressure.

69. Answer (3)

Hint & Sol.: For free expansion, w = 0

For adiabatic process, q = 0

70. Answer (3)

Hint: For reduction of 1 gram equivalent substance, 1 F charge is required

Sol.: Charge on faraday = no. of equivalent deposited

= mole × n-factor

= 0.1 × 6

= 0.6 F

71. Answer (3)

Hint: Electrolysis of Brine will give H_2 at cathode and Cl_2 at anode

Sol.: Charge supplied = $\frac{965 \times 2}{96500}$ F

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

n_{eq} of Cl_2 evolved at anode = 0.02

number of mole of $Cl_2 = \frac{0.02}{2} = 0.01$ mol

n_{eq} H_2 evolved at cathode = 0.02

mole of H_2 evolved = 0.01

total mole of gas evolved = 0.02

Total volume evolved at STP = 0.02 × 22.4 L

= 0.448 L

n_{eq} of OH^- produced in solution = 0.02

pOH of solution = $-\log(2 \times 10^{-2})$

= 1.6990

pH = 12.3

72. Answer (2)

Hint: At equilibrium $\Delta G = 0$

Hence $\Delta G° = -2.303 \text{ RT log } K_C$

Sol.: $-9.2 \times 10^3 = -2.303 \times 2 \times 400 \log K_C$

$$\log K_C = \frac{9.2 \times 1000}{2.303 \times 2 \times 400}$$

$= 5$

$K_C = 10^5$

73. Answer (2)

Hint: $\Delta_C H^{\ominus}$ is amount of heat evolved on combustion of 1 mol substance.

Sol.: Heat evolved on combustion of 1 mol that is 180 g glucose = 2802 kJ

Hence heat evolved on combustion of $6g = \frac{2802}{180} \times 6$

= 93.4 kJ

74. Answer (1)

Hint: For an ideal gas $\Delta U = nC_v\Delta T$

Sol.: Isothermal $\Rightarrow \Delta T = 0$ hence $\Delta U = 0$, $q = -w$

Isobaric $\Rightarrow q_p = \Delta H$

Adiabatic $\Rightarrow q = 0$ hence $\Delta U = w$

Isochoric $\Rightarrow w = 0$ hence $\Delta U = q$

75. Answer (1)

Hint: For any reversible process; $\Delta S = \frac{q_{rev}}{T}$

Sol.: For reversible adiabatic process, $q = 0$

Hence $\Delta S = 0$

During Isothermal process; $\Delta U = 0$

76. Answer (2)

Hint: For reversible isothermal expansion

$$w = -2.303\, nRT \log\left(\frac{V_2}{V_1}\right)$$

Sol.: $w = -2.303\, nRT \log\left(\frac{V_2}{V_1}\right)$

$$= -2.303 \times 2 \times 2 \times 300 \log\left(\frac{1}{0.1}\right)$$

= – 2763.6 cal

= –2.76 kcal

77. Answer (3)

Hint: Common ion effect decreases solubility of sparingly soluble salt.

Sol.: $BaCl_2$, Na_2SO_4, H_2SO_4 will provide common ion due to presence of $Ba^{2+}(aq)$, $SO_4^{2-}(aq)$ and $SO_4^{2-}(aq)$ respectively.

NaCl will not give any common ion effect hence solubility will be maximum in 0.1 M NaCl solution.

78. Answer (1)

Hint: During neutralisation of WA + SB buffer solution is formed if weak electrolyte is in excess.

Sol.: Since millimole of weak acid is more than strong base it will form an acidic buffer solution

	$CH_3COOH_{(aq)}$ +	$NaOH_{(aq)}$ →	$CH_3COONa_{(aq)}$ +	$H_2O_{(l)}$
t = 0,	20mmol	5mmol	0	
t = t,	15mmol	0	5mmol	

$$pH = pK_a + \log\frac{[Salt]}{[Acid]}$$

$$= 4.76 + \log\left(\frac{5}{15}\right)$$

= 4.76 – log3 = 4.28

79. Answer (2)

Hint: During neutralisation of weak electrolyte with strong electrolyte if weak electrolyte is in excess then buffer solution will be formed.

Sol.: (1) 10 mmol CH_3COOH + 10 mmol NaOH will result into salt solution.

	$CH_3COOH_{(aq)}$ +	$NaOH_{(aq)}$ →	$CH_3COONa_{(aq)}$ +	$H_2O_{(l)}$
t = 0	10 mmol	10 mmol	0	0
t = t	0	0	10 mmol	

(2)

	$CH_3COOH_{(aq)}$ +	$NaOH_{(aq)}$ →	$CH_3COONa_{(aq)}$ +	$H_2O_{(l)}$
t = 0	10mmol	5mmol	0	0
t = t	5mmol	0	5mmol	

It is acidic buffer solution.

80. Answer (4)

Hint: On mixing multiple acids resultant normally of H^+ can be calculated as following.

$$[H^+] = \frac{N_1V_1 + N_2V_2 + \ldots}{V_1 + V_2 \ldots}$$

Sol.: If pH = 2 then $N_1 = 10^{-2}$

pH = 3 then $N_2 = 10^{-3}$

$$[H^+] = \frac{N_1V + N_2V}{2V}$$

$$= \frac{10^{-2} \times V + 10^{-3}V}{2V} = \frac{1.1 \times 10^{-2}}{2} = 5.5 \times 10^{-3}$$

pH = –log $[H^+]$ = –log (5.5×10^{-3})

$\simeq 2.26$

81. Answer (2)

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

Sol.: $\because$ $2SO_2 + O_2 \rightleftharpoons 2SO_3$, K = 9 $mol^{-1}L$

$$\therefore\ 2SO_3 \rightleftharpoons 2SO_2 + O_2, \quad K' = \frac{1}{K} = \frac{1}{9}\ mol\,L^{-1}$$

$$SO_3 \rightleftharpoons SO_2 + \frac{1}{2}O_2, \quad K'' = \sqrt{\frac{1}{K}} = \frac{1}{3}\ mol^{1/2}L^{-1/2}$$

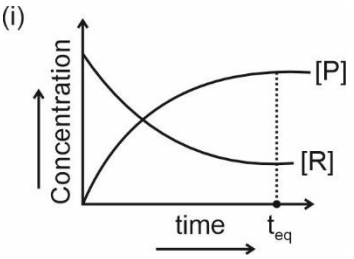
82. Answer (3)

Hint: At equilibrium state, rate of forward and backward reaction becomes equal.

Sol.: At equilibrium, concentration of reactant and product becomes constant.

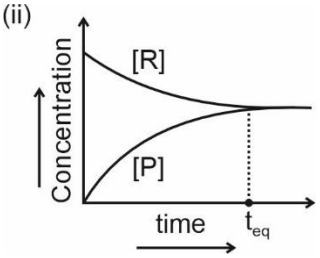
Concentrations of reactant and product may be equal or unequal.

(i)



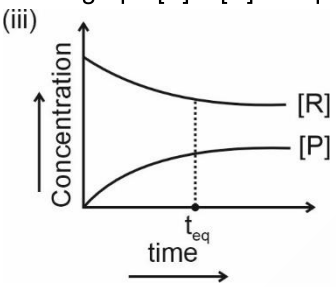
In this graph [P] > [R] at equilibrium

(ii)



In this graph [P] = [R] at equilibrium

(iii)



In this graph [P] < [R] at equilibrium

83. Answer (4)

Hint: For a neutral solution concentration of $[H^+]$ and $[OH^-]$ are equal.

- Ionic product of water can be defined as $K_w = [H^+][OH^-]$

Sol.: At T°C, $[H^+][OH^-] = 10^{-13}$

For neutral liquid $\Rightarrow [H^+] = [OH^-]$

$[H^+]^2 = 10^{-13}$

$[H^+] = 10^{-6.5}$, pH = 6.5

84. Answer (2)

Hint: $pH = -\log [H^+]$

Where $[H^+] \Rightarrow$ concentration of H^+ ion

Sol.: $pH = -\log [H^+] = 2.7$

$[H^+] = 10^{-2.7}$

$= 2 \times 10^{-3}$ M

Number of mole of H^+ ion in 1 ml $= 2 \times 10^{-3} \times 10^{-3}$

$= 2 \times 10^{-6}$ mol

$= 2 \times 10^{-6} \times 6.02 \times 10^{23}$ H^+ ions

$= 1.204 \times 10^{18}$

85. Answer (3)

Hint: Relationship between K_P and K_C for any gaseous equilibrium can be derived by using ideal gas equation.

Sol.: $\because \quad K_P = K_C (RT)^{\Delta n_g}$

for $\Delta n_g = 0$

$K_P = K_C$

SECTION - B

86. Answer (4)

Hint: Oxidation and reduction of same species takes place during disproportionation

Sol.: Since sulphur is present at lowest oxidation state in S^{2-}, it cannot get further reduced.

87. Answer (3)

Hint: Reducing agent causes reduction of other species by providing them electrons.

Sol.: Oxidising agent causes oxidation of other species by accepting electrons.

88. Answer (2)

Hint: Neutralisation of 1 gram equivalent strong acid with 1 gram equivalent strong base gives 13.7 kcal of heat.

Sol.: 1 mol HCl = 1 gram eqivalent HCl

1 mol H_2SO_4 = 2 gram equivalent H_2SO_4

1 mol CH_3COOH = 1 gram equivalent CH_3COOH

1 mol HF = 1 gram equivalent HF

89. Answer (2)

Hint: Slope of PV graph is higher for adiabatic process.

Sol.: Magnitude of work done in adiabatic expansion is less than work done in isothermal expansion.

90. Answer (3)

Hint: At equilibrium state $\Delta G = 0$

Sol.: $\Delta G = \Delta H - T\Delta S = 0$

$\Delta H - T\Delta S = 0$

$$T = \frac{\Delta H}{\Delta S} = \frac{20 \times 10^3}{40} = 500\ K$$

= 227°C

91. Answer (4)

Hint: For reaction

$AB_2(s) \rightleftharpoons A(g) + 2B(g)$

$K_p = p_A \times p_B^2$

Sol.:

	$AB_2(s) \rightleftharpoons$	$A(g)$	+	$2B(g)$
$t = 0$	a	0		0
$t = t$	a – x	x		2x

If total pressure = P

$p_A = \frac{P}{3}, p_B = \frac{2P}{3}$

$\frac{P}{3} \times \left(\frac{2P}{3}\right)^2 = K_P$

$\frac{P}{3} \times \frac{4P^2}{9} = 108$

$P^3 = \frac{108 \times 9 \times 3}{4}$

P = 9 atm

92. Answer (3)

Hint: K_C for a particular equilibrium changes with temperature only.

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

If $T_2 > T_1$ (rise in temperature)

Then $K_2 > K_1$

If $\Delta H > 0$ (endothermic)

But $K_2 < K_1$

If $\Delta H < 0$ (exothermic)

93. Answer (3)

Hint: Conjugate acid-base pair has difference of one H^+ or OH^-.

Sol.: $\underset{(base)}{H_2PO_4^-} + H^+ \rightarrow \underset{(conjugate\ acid)}{H_3PO_4}$

$\underset{(acid)}{H_2PO_4^-} \rightarrow \underset{(conjugate\ base)}{HPO_4^{2-}} + H^+$

94. Answer (2)

Hint: Algebraic sum of oxidation state of all the element for a neutral compound is zero.

Sol.: x + 2(+1) + 4(–2) = 0

x = +6

95. Answer (3)

Hint: For gases volume % = mole %

Sol.: $X_{PCl_5} = \frac{40}{100} = \frac{2}{5}$

equilibrium $n_{PCl_3} = n_{Cl_2}$

$X_{PCl_3} = X_{Cl_2} = \frac{3}{10}$

$p_{PCl_5} = 5 \times \frac{2}{5} = 2$ atm

$p_{PCl_3} = 5 \times \frac{3}{10} = 1.5$ atm

$p_{Cl_2} = 5 \times \frac{3}{10} = 1.5$ atm

$K_p = \frac{p_{PCl_3} \times p_{Cl_2}}{p_{PCl_5}} = \frac{1.5 \times 1.5}{2}$

= 1.125 atm

96. Answer (2)

Hint: On passing same amount of charge through different electrolytic solution, equal number of gram equivalent gets deposited.

Sol.: $(n_{eq})_{Ag} = (n_{eq})_{Al}$

$= \frac{18 \times 10^3 \times 3}{27}$

$w_{Ag} = (n_{eq} \times E)_{Ag}$

$= \frac{18 \times 10^3 \times 3}{27} \times \frac{108}{1}$

$= 216 \times 10^3$ g

= 216 kg

97. Answer (4)

Hint & Sol.: Ionisation of Hg_2Cl_2 in water is as

$Hg_2Cl_2(s) \rightleftharpoons Hg_2^{2+}(aq) + 2\overline{Cl}(q)$

Solubility S 2 S

Therefore, K_{sp} of $Hg_2Cl_2 = S(2\,S)^2 = 4\,S^3$

98. Answer (1)

Hint: As SRP of metal increases its reactivity decreases.

Sol.: Since for Li^+/Li SRP value is minimum it will have maximum reactivity in aqueous medium.

99. Answer (3)

Hint: Value of intensive properties do not depend on quantity of substance.

Sol.: Since electrode potential is an intensive property it will not be affected by size of metal electrode used.

100. Answer (4)

Hint: At equilibrium, $E^\circ_{cell} = 0$

Sol.: $E^\circ_{cell} = \frac{0.0591}{n} \log K_{eq}$

$E^\circ_{cell} = 1.18$ V

$1.18 = \frac{0.0591}{2} \log K_{eq}$

$\log K_{eq} = \frac{2 \times 1.18}{0.0591}$

= 40

$K = 10^{40}$

[BOTANY]

SECTION - A

101. Answer (2)

Hint: Endodermis have a deposition of waxy material suberin in the form of casparian strips.

Sol.: In dicot roots, the innermost layer of the cortex is endodermis. 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.

102. Answer (2)

Hint: Epidermis of roots is also called epiblema.

Sol.: In dicot leaf, the epidermis covers both the upper surface (adaxial) and lower surface (abaxial) of the leaf has a conspicuous cuticle.

103. Answer (2)

Hint: Abaxial epidermis is the lower surface of leaf.

Sol.: Vascular bundles are conjoint and closed in leaf. Mesophyll is differentiated into palisade and spongy parenchyma in dicot leaf and the size of vascular bundles are dependent on the size of veins.

104. Answer (2)

Hint: Sclereids are commonly found in the fruit walls of nuts.

Sol.: Xylem parenchyma – Stores food in the form of starch or fat and tannins.

Phloem parenchyma – Absent in most of the monocots.

Tracheids – Water transporting elements of xylem.

105. Answer (1)

Hint: Phloem fibres have lignified cell wall.

Sol.: Phloem fibres are made up of sclerenchymatous cells and these are generally absent in the primary phloem but are found in the secondary phloem.

106. Answer (2)

Hint: It is a part of stomatal apparatus.

Sol.: The specialised epidermal cells present in the vicinity of guard cells are called subsidiary cells. On the stem the epidermal hairs are called trichomes.

107. Answer (2)

Hint: These cells lies next to endodermis and are few layers thick.

Sol.: Next to endodermis lies a few layers of thick-walled parenchymatous cells referred to as pericycle. Initiation of lateral roots and vascular cambium during the secondary growth takes place in these cells.

108. Answer (3)

Hint: Ground tissues consist of simple tissues.

Sol.: All tissues except epidermis and vascular bundles constitute the ground tissue. It consists of simple tissues such as parenchyma, collenchyma and sclerenchyma.

109. Answer (3)

Hint: Starch sheath is absent in monocot stem.

Sol.: In dicot stem, the cells of the endodermis are rich in starch grains and the layer is also referred to as the starch sheath.

110. Answer (3)

Hint: Endodermis is not a part of stele.

Sol.: Pericycle is the outermost part of the stele.

111. Answer (4)

Hint: Guard cells possess chloroplast and regulate stomatal opening and closing.

Sol.: The outer walls of the guard cells are thin while the inner walls are highly thickened.

112. Answer (4)

Hint: Except intrafasicular cambium, lateral meristems are secondary meristems.

Sol.: Lateral meristems are responsible for producing the secondary tissues. The cells that becomes structurally and functionally specialised and lose the ability to divide such cells are termed as permanent or mature cells.

113. Answer (3)

Hint: Lateral roots originate from the outermost part of the stele.

Sol.: In the dicot root, the lateral roots originates from the pericycle.

114. Answer (1)

Hint: Parenchyma forms the major component within various organs of plants.

Sol.: Parenchyma are thin-walled and performs the function of photosynthesis, storage and secretion.

115. Answer (3)

Sol.: The radial conduction of water takes place by the ray parenchyma cells.

116. Answer (3)

Hint: Cambium is absent in monocots.

Sol.: In both dicot and monocot roots, xylem and phloem within a vascular bundle are arranged in an alternate manner along the different radii and protoxylem lies towards the periphery.

117. Answer (2)

Hint: Water-containing cavities are present within the vascular bundles in monocot stem.

Sol.: In monocot stem, each vascular bundle is surrounded by a sheath made up of sclerenchymatous tissue. It is called as bundle sheath.

118. Answer (2)

Hint: Artificial classification system were given by Aristotle and Linnaeus

Sol.: Natural system of classification was given by George Bentham and Joseph Dalton Hooker.

119. Answer (3)

Hint: Fusion of two gametes which are similar in size, either flagellated or non-flagellated is termed as isogamous.

Sol.: *Ulothrix* shows isogamous type of sexual reproduction. *Eudorina* shows anisogamous type of sexual reproduction, while *Fucus* shows oogamous reproductions.

120. Answer (1)

Hint: Red algae do not produce motile gametes

Sol.: *Polysiphonia* being red alga shows oogamous type of sexual reproduction where both gametes are non-motile.

121. Answer (2)

Hint: Bryophytes lack true roots, stem or leaves.

Sol.: Bryophytes and pteridophytes both have diploid sporophyte, jacketed sex organs, motile male gametes and they produce embryo.

122. Answer (3)

Hint: *Ginkgo* is a gymnosperm.

Sol.: C represent seed. Fruit is absent in gymnosperms.

123. Answer (3)

Hint: *Laminaria* is multicellular alga.

Sol.: *Chlamydomonas* is an unicellular alga.

124. Answer (3)

Hint: Prothallus is free-living multicellular gametophyte.

Sol.: In pteridophyte, the spores germinate to give rise to inconspicuous, small but multicellular free-living, mostly photosynthetic thalloid gametophyte called prothallus.

125. Answer (4)

Hint: They bear the integumented megasporangium.

Sol.: Gymnosperms are the vascular plants with an exposed ovule. As the ovule is not covered by an ovary wall, after fertilization the seeds are exposed to the environment forming naked seeds.

126. Answer (3)

Hint: Evolutionarily, pteridophytes are the first terrestrial plant to possess vascular tissues.

Sol.: In pteridophytes, the sporangia contain sporogenous tissue, where spore mother cells undergoes meiosis to produce spores. The spores germinate to give rise to inconspicuous small but multicellular free living, mostly photosynthetic thalloid gametophyte called prothallus.

127. Answer (4)

Hint: Bryophytes produce only one type of spores.

Sol.: In both, pteridophyte and bryophytes, spores germinate to give rise to free-living photosynthetic gametophyte.

128. Answer (1)

Hint: *Dryopteris* belongs to Pteropsida

Sol.:

Psilopsida	–	*Psilotum*
Sphenopsida	–	*Equisetum*
Pteropsida	–	*Dryopteris*
Lycopsida	–	*Selaginella*

129. Answer (4)

Hint: A decoction of *Polytrichum* was employed in removing kidney stones.

Sol.: Species of *Sphagnum*, a moss, provide peat that have long been used as fuel and as packing material for trans-shipment of living material.

130. Answer (3)

Hint: *Selaginella* produce two kinds of spores.

Sol.: Heterosporous vascular cryptogams like *Selaginella* fail to develop seeds because:

- They have no protective structure like the integuments surrounding the megasporangia.
- The retention of megaspores permanently within the megasporangia have not become established.

131. Answer (2)

Hint: In gymnosperms male and female gametophytes do not have an independent free-living existence.

Sol.: The leaves in pteridophyte are small (microphylls) as in *Selaginella* or large (Macrophylls) as in ferns. *Marchantia* is a dioecious plant.

132. Answer (3)

Hint: *Ginkgo* has fan shaped leaves.

Sol.: In conifers, the needle-like leaves reduce the surface area. Thick cuticle and sunken stomata also help to reduce water loss in gymnosperms.

133. Answer (3)

Hint: Gemmae are green, multicellular asexual buds.

Sol.: Sex organs in bryophytes are multicellular

134. Answer (2)

Hint: Major pigment of phaeophyceae is fucoxanthin.

Sol.: In red algae, complex post-fertilisation development occurs. Cell wall is made up of cellulose and pectose in green algae. Gametes are pyriform in brown algae.

135. Answer (3)

Sol.: Some unicellular algae like *Chlorella* and *Spirullina* are rich in proteins and are used as food supplements even by space travellers.

SECTION - B

136. Answer (2)

Hint: *Pinus* is monoecious.

Sol.:

Cycas – Male cone and megasporophylls are borne on different trees.

Dictyota – Presence of laminarin and fucoxanthin

Sequoia – Is a giant red wood tree

137. Answer (3)

Hint: Winged pollen grain are found in gymnosperms.

Sol.: In *Pinus* winged pollen grains are present. It is extended outer exine on two lateral sides to form the wing of pollen.

138. Answer (3)

Hint: Sexual reproduction occur by non-motile gametes in Rhodophyceae.

Sol.: *Gracilaria* and *Porphyra* are red algae and they reproduce sexually by non-motile gametes.

139. Answer (1)

Sol.: Agar, one of the commercial products obtained from *Gelidium* and *Gracilaria* are used to grow microbes and in preparation of ice-creams and jellies.

140. Answer (4)

Hint: In *Cycas* stems are unbranched.

Sol.: The stems are unbranched (*Cycas*) or branched (*Pinus, Cedrus*). The leaves may be simple or compound. In *Cycas*, the pinnate leaves persist for a few years.

141. Answer (3)

Hint: The development of pollen grains take place within the microsporangia.

Sol.: The microspores develop into a male gametophytic generation which is highly reduced. This reduced gametophyte is called a pollen grain.

142. Answer (3)

Hint: Aromatic compounds are chemical constituents of the plant.

Sol.: Karyotaxonomy is based on cytological information like chromosome number, structure, behaviour etc.

143. Answer (1)

Hint: Stoma is composed of two guard cells.

Sol.: Presence of vessels is a characteristic feature of angiosperms. Interfascicular and cork cambium are dedifferentiated cells. Mature sieve tube element possesses a peripheral cytoplasm and a large central vacuole but lack a nucleus.

144. Answer (2)

Hint: A mature sieve tube element possesses a peripheral cytoplasm and a large vacuole but lacks nucleus.

Sol.: The functions of sieve tubes are controlled by nucleus of companion cells.

145. Answer (2)

Hint: In monocots stem vascular bundles are scattered.

Sol.: A large number of vascular bundles are arranged in a ring; the 'ring' arrangement of vascular bundles is a characteristic of dicot stem.

146. Answer (3)

Hint: The root hairs are unicellular epidermal outgrowth.

Sol.: Cortical layers below hypodermis of dicot stem consists of round thin walled parenchymatous cells with conspicuous intercellular spaces. Epidermal cells are parenchymatous with a small amount of cytoplasm lining the cell wall and a large vacuole.

147. Answer (4)

Hint: Epidermis forms a continuous layer.

Sol.: Epidermis is made up of elongated compactly arranged cells, which form a continuous layer.

148. Answer (1)

Hint: In grasses, certain adaxial epidermal cells along the veins modify into bulliform cells.

Sol.: Bulliform cells make the leaves curl inward to minimise water loss.

149. Answer (4)

Hint: Root hairs can be seen in outermost layer of root.

Sol.: The outermost layer in root is epiblema

150. Answer (2)

Hint: Lateral meristem are responsible for producing the secondary tissues.

Sol.: Intercalary meristem is the primary meristem and involved in formation of primary plant body.

[ZOOLOGY]

SECTION - A

151. Answer (1)

Hint: Part of the brain located between hypothalamus/thalamus and pons.

Sol.: The midbrain is located between the thalamus/hypothalamus of the forebrain and pons of the hindbrain. The dorsal portion of the midbrain consists mainly of four round swellings (lobes) called corpora quadrigemina. Pons, cerebellum and medulla are the parts of hindbrain.

152. Answer (1)

Hint: Each myofibril has alternate dark and light bands on it.

Sol.: The light band contains actin and is called I-band or Isotropic band whereas the dark band is called 'A' or Anisotropic band, which contains myosin. The striated/striped appearance of muscle fibres is due to the distribution of actin and myosin filaments

153. Answer (4)

Hint: Biceps are skeletal muscle fibres.

Sol.:

Skeletal muscle fibres	Smooth muscle fibres
Multinucleated with peripheral nuclei	Uninucleated with central nucleus
Cylindrical shaped	Fusiform shaped
Striated	Non-striated

Both are unbranched fibres.

154. Answer (2)

Hint: Eliminate the substance removed by the largest gland in the human body.

Sol.: Sweat contains NaCl, small amounts of urea, lactic acid, *etc*.

Sebaceous glands eliminate certain substances like sterols, hydrocarbons and waxes through sebum.

155. Answer (4)

Hint: Include the site of filtration

Sol.: Glomerulus is a tuft of capillaries formed by the afferent arteriole-a fine branch of renal artery. Blood from the glomerulus is carried away by an efferent arteriole.

The glomerular capillary blood pressure causes filtration of blood through three layers *i.e*., the endothelium of blood vessels, the epithelium of Bowman's capsule and a basement membrane between these two layers. The epithelial cells of Bowman's capsule, called podocytes, are arranged in an intricate manner so as to leave some minute spaces called filtration slits or slit pores.

156. Answer (3)

Hint: Aldosterone is released by the outer part of adrenal gland.

Sol.:

- Human kidneys can produce urine nearly four times concentrated than the initial filtrate formed. Thus, it is hypertonic.
- JG cells release renin which converts angiotensinogen in blood to angiotensin I.
- Angiotensin II activates the adrenal cortex to release aldosterone.
- Each kidney of an adult human has an average weight of 120 – 170 g.

157. Answer (3)

Hint: Exclude the convoluted region of hind brain.

Sol.: Three major regions make up the brain stem; midbrain, pons and medulla oblongata. Brain stem forms the connections between the brain and the spinal cord.

The hindbrain comprises pons, cerebellum and medulla. Hypothalamus, cerebrum and thalamus are the parts of forebrain.

158. Answer (1)

Hint: Malpighian body is made up of glomerulus alongwith Bowman's capsule.

Sol.: The renal tubule begins with a double walled cup-like structure called Bowman's capsule, which encloses the glomerulus. The Malpighian body, PCT and DCT of the nephron are situated in the cortical region of the kidney whereas the loop of Henle dips into the medulla.

Glomerulus is a part of nephron, but not renal tubules.

159. Answer (4)

Hint: Longest bone in the human body

Sol.: Pelvic girdle consists of two coxal bones. Each coxal bone is formed by the fusion of three bones – ilium, ischium and pubis. At the point of the fusion of above bones is a cavity called acetabulum to which the thigh bone articulates. The two halves of the pelvic girdle meet ventrally to form the pubic symphysis.

160. Answer (4)

Hint: Multipolar neurons are neurons with one axon and two or more dendrites.

Sol.: Based on the number of axon and dendrites, the neurons are of 3 types:

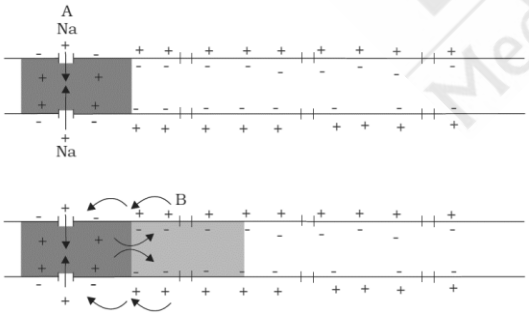
- Multipolar – 1 axon and 2 or more dendrites (found in the cerebral cortex)
- Bipolar – 1 axon and 1 dendrite (found in retina of eye)
- Unipolar – Cell body with 1 axon only (found in the embryonic stage)

161. Answer (2)

Hint: During depolarisation of an axonal membrane, the polarity gets reversed at the site where impulse is applied.

Sol.: After depolarisation of a segment of axon, the inner surface becomes positively charged and the outer surface becomes negatively charged.

Impulse conduction through an axon:



162. Answer (1)

Hint: First 7 pairs of ribs are true ribs.

Sol.: Vertebrochondral ribs (false ribs) are 8^{th}, 9^{th} and 10^{th} pairs of ribs. These do not articulate directly with the sternum but join the 7^{th} rib with the help of hyaline cartilage.

Floating ribs *i.e.*, 11^{th} and 12^{th} pairs of ribs are not connected ventrally and are therefore called floating ribs.

163. Answer (1)

Hint: Includes DCT

Sol.: JGA is a special sensitive region formed by the cellular modifications in distal convoluted tubule (DCT) and the afferent arteriole at the location of their contact. Conditional reabsorption of Na^+ and water takes place in DCT. Maximum reabsorption of electrolytes and nutrients occurs in PCT (Proximal Convoluted Tubule).

Blood from the glomerulus is carried away by an efferent arteriole.

164. Answer (4)

Hint: Muscle fibres that perform aerobic respiration have plenty of mitochondria.

Sol.: Red muscle fibres have plenty of mitochondria which can utilise the large amount of oxygen stored in them for ATP production.

Therefore, they can also be called aerobic muscles.

On the other hand, white muscle fibres depend on anaerobic process for energy.

165. Answer (2)

Hint: A part of brain stem

Sol.: The hindbrain comprises pons, cerebellum and medulla.

Hypothalamus and thalamus are the parts of forebrain.

The medulla of the brain is connected to the spinal cord. The medulla contains centres which control respiration, cardiovascular reflexes and gastric secretions.

166. Answer (1)

Hint: Antennal glands are called green glands.

Sol.: Neurons can detect, receive and transmit different kinds of stimuli; they cannot produce them.

The cortex extends in between the medullary pyramids as renal columns called Columns of Bertini.

On an average, 25 – 30 gm of urea is excreted out through urine per day.

Protonephridia are the excretory structures of *Amphioxus*.

Antennal glands or green glands perform the excretory function in prawns.

167. Answer (4)

Hint: This hormone acts as a vasodilator.

Sol.:

JG cells of kidneys release renin which converts angiotensinogen in blood to angiotensin I, which further changes to angiotensin II that increases GFR.

Angiotensin II also activates the adrenal cortex to release aldosterone.

Aldosterone causes reabsorption of Na^+ and water from the distal parts of the renal tubules. This also causes increase in blood pressure and thereby GFR.

This complex mechanism is known as the Renin-Angiotensin mechanism.

An increase in the blood flow to atria of the heart can cause the release of Atrial Natriuretic Factor (ANF).

ANF causes vasodilation (dilation of blood vessels) and thereby decreases the blood pressure. ANF mechanism, therefore, acts as a check on the renin-angiotensin mechanism.

168. Answer (4)

Hint: Exclude the functions of medulla oblongata

Sol.: Hypothalamus is a part of forebrain and contains a number of centres which control body temperature, urge for eating and drinking. It also contains several groups of neurosecretory cells, which secrete hormones called hypothalamic hormones.

The medulla oblongata contains centres which control respiration, cardiovascular reflexes and gastric secretions.

Cerebellum maintains balance and posture of the body.

169. Answer (3)

Hint: Neurons are polarised during the resting state.

Sol.: When a neuron is not conducting any impulse *i.e.,* resting, the axonal membrane is comparatively more permeable to K^+ and nearly impermeable to Na^+. Similarly, the membrane is impermeable to negatively charged proteins present in the axoplasm.

170. Answer (4)

Hint: Counter current mechanism leads to concentration of urine.

Sol.: The proximity between the Henle's loop and vasa recta, as well as the counter current in them help in maintaining an increasing osmolarity towards the inner medullary interstitium *i.e.*, from 300 $mOsmolL^{-1}$ in the cortex to about 1200 $mOsmolL^{-1}$ in the inner medulla. The flow of filtrate in the two limbs of Henle's loop is in the opposite direction and thus, forms a counter current.

171. Answer (2)

Hint: It has a slightly elevated ridge called spine.

Sol.: Scapula is a large triangular flat bone situated in the dorsal part of thorax between the second and the seventh ribs. Each half of pectoral girdle consists of a clavicle and a scapula.

The dorsal, flat, triangular body of scapula has a slightly elevated ridge called the spine which projects as a flat, expanded process called the acromion.

Clavicle is commonly called the collar bone.

172. Answer (2)

Hint: Each myofibril contains many serially arranged units called sarcomere.

Sol.: Muscle fibre is the anatomical unit of muscles. Each muscle fibre has many parallelly arranged filaments in the sarcoplasm called myofilaments or myofibrils. Each myofibril contains many serially arranged units called sarcomere which are the functional units of muscles.

173. Answer (3)

Hint: In resting condition, the axoplasm contains high concentration of K^+.

Sol.: The ionic gradients across the resting neuronal membrane are maintained by the active transport of ions by sodium-potassium pump which transports 3 Na^+ outwards for 2 K^+ into the cell. As a result, the outer surface of the axonal membrane possesses a positive charge while its inner surface becomes negatively charged.

174. Answer (4)

Hint: A nitrogenous waste

Sol.: The tubular epithelial cells in different segments of nephron perform reabsorption by either active or passive mechanisms. Substances like glucose, amino acids, Na^+, *etc.,* in the filtrate are reabsorbed actively whereas nitrogenous wastes are absorbed by the passive transport.

175. Answer (3)

Hint: Exclude 26-serially arranged units in human body.

Sol.: Our vertebral column is formed by 26-serially arranged units called vertebrae and is dorsally placed.

Clavicle and scapula are the parts of pectoral girdle.

Patella is a cup-shaped bone, covering the knee ventrally.

176. Answer (1)

Hint: Sarcolemma is the plasma membrane of a muscle fibre.

Sol.: A muscle is covered by a sheath of connective tissue called epimysium. Inside epimysium, a muscle has many fibres arranged in bundles called fasciculi (fascicles). The muscle bundles are held together by a common collagenous sheath of connective tissue called fascia.

177. Answer (3)

Hint: Neurotransmitters are chemicals involved in impulse conduction across chemical synapses.

Sol.: Impulse conduction across an electrical synapse is always faster than that across a chemical synapse. The membranes of pre and post-synaptic neurons are in very close proximity.

Electrical current can flow directly from one neuron into the other across these synapses.

Electrical synapses are rare in our body.

178. Answer (3)

Hint: Locomotion involves change of place.

Sol.: All locomotions are movements but all movements are not locomotions.

Movements that result in change of place or location are called locomotions.

Some specialised cells in our body like macrophages in tissue, monocytes and leucocytes in blood exhibit amoeboid movement.

179. Answer (4)

Hint: Facilitated by structures that help in the passage of ovum through fallopian tubes.

Sol.: *Paramoecium* has cilia that help in the movement of food through cytopharynx and in locomotion as well.

Flagellar movement helps in the swimming of human spermatozoa, maintenance of water current in the canal system of sponges and in locomotion of *Euglena*.

180. Answer (3)

Hint: Dura mater is the outermost meninx.

Sol.: The human brain is well protected by the skull. Inside the skull, the brain is covered by the cranial meninges consisting of an outer layer called dura mater, a very thin middle layer called arachnoid and an inner layer (which is in contact with the brain tissue) called pia mater.

The cerebral cortex is referred to as grey matter.

181. Answer (2)

Hint: Keeps a check on the renin-angiotensin mechanism.

Sol.: ADH, also called vasopressin, affects the kidney functions by its constrictory effect on blood vessels.

Angiotensin II is a powerful vasoconstrictor.

Vasoconstriction increases the blood pressure and thereby GFR.

ANF released from atria of the heart can cause vasodilation and thereby decreases the blood pressure.

182. Answer (3)

Hint: Synapse is made up of pre-synaptic membrane, synaptic cleft and post-synaptic membrane.

Sol.: Synaptic vesicles contain chemicals called neurotransmitters. The receptors to which neurotransmitters bind to, are present on the post-synaptic membrane. Binding of neurotransmitters open ion channels, allowing the entry of ions which can generate a new action potential in the post-synaptic neuron.

183. Answer (1)

Hint: Branch that includes sympathetic neural system.

Sol.: The CNS (Central Neural System) includes the brain and the spinal cord. The PNS (Peripheral Neural System) is divided into two divisions called somatic neural system and autonomic neural system.

The autonomic neural system is further classified into sympathetic and parasympathetic neural system.

184. Answer (4)

Hint: Insects have tracheal tubes for respiration.

Sol.: Malpighian tubules are the excretory structures of most insects including cockroaches. Malpighian tubules help in the removal of nitrogenous wastes and osmoregulation. Statocysts are balancing organs in aquatic arthropods. Respiration occurs by gills, book gills, book lungs and tracheal system in arthropods.

185. Answer (1)

Hint: It is an unpaired bone.

Sol.: In human body, hyoid bone does not articulate with any other bone. It is U-shaped and is present at the base of the buccal cavity.

Lacrimal and maxillae are paired facial bones. Sphenoid is an unpaired cranial bone.

SECTION - B

186. Answer (2)

Hint: Present in perikaryon

Sol.: Nissl's granules are made up of RER and ribosomes. Thus, they participate in protein synthesis.

They are absent in axons of neurons.

They are found in dendrites and cyton.

187. Answer (3)

Hint: Members of class Osteichthyes are ammonotelic in nature.

Sol.: Order of toxicity = Ammonia > Urea > Uric acid.

Many bony fishes, aquatic amphibians and aquatic insects are ammonotelic in nature.

Mammals, many terrestrial amphibians and marine fishes mainly excrete urea and are called ureotelic animals.

Reptiles, birds, land snails, and terrestrial insects are uricotelic animals.

188. Answer (1)

Hint: Central part of thick filament, not overlapped by thin filaments

Sol.: When a skeletal muscle is fully contracted,

- Length of sarcomere decreases
- H-zone disappears
- Length of A-band remains unchanged
- Length of I-band gets reduced

189. Answer (3)

Hint: Myasthenia gravis affects neuromuscular junction.

Sol.:

- Myasthenia gravis is an auto-immune disorder that affects neuromuscular junctions leading to fatigue, weakening and paralysis of skeletal muscles.
- In muscular dystrophy, there is a progressive degeneration of skeletal muscles mostly due to genetic disorder.
- Tetany is characterised by rapid spasms in muscles due to low Ca^{2+} in body fluid.
- In gout, inflammation of joints occur due to accumulation of uric acid crystals.

190. Answer (4)

Hint: Between atlas and axis

Sol.: Joints have been classified into three major structural forms, namely, fibrous, cartilaginous and synovial.

Synovial joints are of different types, for example, ball and socket joint, hinge joint, pivot joint, gliding joint (between carpals) and saddle joint (between carpal and metacarpal of thumb).

Atlas is the vertebra that articulates with the occipital condyles. Axis is the second vertebra. The joint present between the atlas and the axis is pivot joint.

Flat skull bones show fibrous joints.

191. Answer (3)

Hint: Not a part of nephron

Sol.: Collecting duct allows passage of small amounts of urea into the medullary interstitium to keep up the osmolarity. It also plays a role in the maintenance of pH and ionic balance of blood by the selective secretion of H^+ and K^+.

PCT selectively secretes H^+ and ammonia into the filtrate.

Glomerulus performs filtration of blood.

DCT performs selective secretion of H^+, K^+ and NH_3 to maintain the pH and sodium-potassium balance in blood.

192. Answer (2)

Hint: Action potential

Sol.: The electrical potential difference that develops across the plasma membrane of a neuron where stimulus is applied, is termed as nerve impulse.

The electrical potential difference across the resting plasma membrane is called the resting potential. The nerve impulse is conducted along the axonal membrane in the form of a wave of depolarisation and repolarisation.

The synapse is the junction through which a nerve impulse is transmitted from one neuron to the other.

193. Answer (1)

Hint: Part of PNS

Sol.: The peripheral neural system is divided into two divisions:

(a) Somatic neural system

(b) Autonomic neural system

The somatic neural system relays impulses from CNS to the skeletal muscles (voluntary muscles such as triceps) of the body. While the autonomic neural system transmits impulses from the CNS to the involuntary organs and smooth muscles of the body. Visceral nervous system transmits impulses from CNS to the viscera and from the viscera to CNS.

Sympathetic neural system is a part of autonomic neural system.

194. Answer (4)

Hint: Equal to the number of phalanges in one upper limb of humans

Sol.: Vertebrosternal ribs also known as true ribs. First seven pairs of ribs are called true ribs. Dorsally, they are attached to the thoracic vertebrae and ventrally connected with the sternum with the help of hyaline cartilage.

195. Answer (1)

Hint: More than the volume (in mL) of GFR formed by a healthy man per minute.

Sol.: Our lungs remove large amounts of CO_2 (approximately 200 mL/min) and also significant quantities of water every day.

196. Answer (3)

Hint: Contractile proteins slide over each other for muscle contraction.

Sol.: Tropomyosin and troponin are regulatory proteins whereas actin and myosin are contractile proteins.

Troponin and tropomyosin are associated with the structure of actin filament.

197. Answer (1)

Hint: Function of renin-angiotensin mechanism

Sol.: Osmoreceptors in the body are activated by changes in blood volume, that leads to release of ADH. Angiotensin II is a powerful vasoconstrictor that increases the glomerular blood pressure and thereby GFR.

Angiotensin II also activates the adrenal cortex to release aldosterone that causes reabsorption of Na^+ and water from the distal parts of the renal tubules.

198. Answer (1)

Hint: Urinary bladder contains muscles that have spindle-shaped muscle fibres.

Sol.: The CNS passes on motor messages to initiate the contraction of smooth muscles of the urinary bladder and simultaneous relaxation of the urethral sphincters causing the release of urine. The process of release of urine is called micturition.

199. Answer (3)

Hint: Divides longitudinally.

Sol.: Cerebrum forms the major part of the human brain. A deep cleft divides the cerebrum longitudinally into two halves, called the left and right cerebral hemispheres. The hemispheres are connected by a tract of nerve fibres called corpus callosum.

Cerebral aqueduct is a canal that passes through the midbrain.

200. Answer (4)

Hint: Recall the function associated with the cerebellum.

Sol.: The cerebral cortex contains motor areas, sensory areas and large regions that are neither clearly sensory nor motor in function.

These regions are called association areas and are responsible for complex functions like intersensory associations, memory and communication.

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