All India Aakash Test Series for NEET - 2025

TEST – 4 (Code-I)

Test Date : 03/03/2024

ANSWERS

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

Hints & Solutions

PHYSICS

SECTION - A

1. Answer (2)

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

Torque = Rate of change of angular momentum.

2. Answer (1)

Hint: Magnitude of vector product = $\left|\vec{A}\times\vec{B}\right|$

Sol.: $\hat{i}(-2+6)-\hat{j}(-3+2)+\hat{k}(9-2)$

$\vec{A}\times\vec{B} = 4\hat{i}+\hat{j}+7\hat{k}$

$\left|\vec{A}\times\vec{B}\right| = \sqrt{(4)^2+(1)^2+(7)^2} = \sqrt{16+1+49}$

$\left|\vec{A}\times\vec{B}\right| = \sqrt{66}$

3. Answer (4)

Hint: Use $\alpha = \frac{\Delta\omega}{\Delta t}$

Sol.: $\alpha = \frac{\omega_2-\omega_1}{t}$

$$\alpha = \frac{\frac{1800}{60}\times 2\pi - \frac{480}{60}\times 2\pi}{11}$$

$$= \frac{2\pi(30-8)}{11}$$

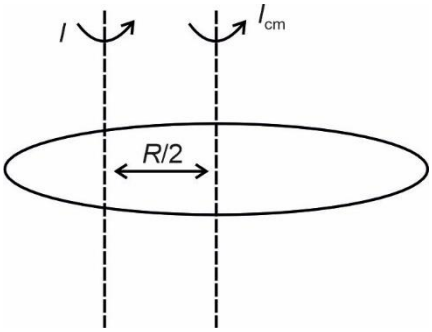
$\alpha = 4\pi$ rad/s^2

4. Answer (2)

Hint: From parallel axis theorem

$I = I_{cm} + md^2$

Sol.:



$I = I_{cm} + m\left(\frac{R}{2}\right)^2$

$I = mR^2 + \frac{mR^2}{4}$

$I = \frac{5}{4}mR^2$

5. Answer (1)

Hint: $I = mK^2$

$K \rightarrow$ radius of gyration

Sol.: $I_{H\cdot S} = \frac{2}{3}mR^2 \Rightarrow mK_{H\cdot S}^2 = \frac{2}{3}mR^2$

$K_{H\cdot S} = \sqrt{\frac{2}{3}}R$

$I_{S\cdot S} = \frac{2}{5}mR^2 \Rightarrow mK_{S\cdot S}^2 = \frac{2}{5}mR^2$

$K_{S\cdot S} = \sqrt{\frac{2}{5}}R$

$\frac{K_{H\cdot S}}{K_{S\cdot S}} = \sqrt{\frac{5}{3}}$

6. Answer (2)

Hint: Distance of C.O.M. from m_2 = $\frac{m_1 r}{m_1+m_2}$

Sol.: Distance of C.O.M. from 40 kg = $\frac{20\times 15}{20+40}$

$= \frac{20}{60}\times 15$

= 5 m

7. Answer (4)

Hint: $W_{net} = K.E_f - K.E_i = 0 - K.E_i$

Sol.: $W = -\frac{1}{2}mv^2\left(1+\frac{K^2}{R^2}\right)$

$= -\frac{1}{2}\times 10\times(2)^2\left(1+\frac{2}{5}\right)$

$= -\frac{1}{2}\times 10\times 4\times\frac{7}{5}$

W = –28 J

8. Answer (3)

Hint: $\tau = I\,\alpha \Rightarrow \alpha = \frac{\tau}{I}$

Sol.: M.O.I. of solid cylinder = $\frac{mR^2}{2}$

$= \frac{5\times(0.5)^2}{2} = \frac{1.25}{2}\text{kg m}^2$

$\tau = I\alpha \Rightarrow \alpha = \frac{\tau}{I}$

$\alpha = \frac{F\cdot R}{I} = \frac{50\times 0.5}{\left(\frac{1.25}{2}\right)}$

α = 40 rad/s^2

9. Answer (2)

Hint & Sol.: A couple consists of two equal and opposite forces whose lines of action are parallel and laterally separated by some distance. Therefore net force of a couple is zero vector, hence there is no translational motion, only rotational motion will be there.

10. Answer (3)

Hint & Sol.: Acceleration of C.O.M. may be zero

Hence, the C.O.M. of body in pure rotation may remain steady.

11. Answer (1)

Hint: Use conservation of mechanical energy $v_e = \sqrt{2gR}$

Sol.: Expression of escape velocity is obtained by conservation of mechanical energy and doesn't involve in which direction the body is projected. Escape velocity of the body from earth surface is a constant irrespective of direction of projection.

12. Answer (4)

Hint: Angular momentum of planet w.r.t. centre of sun is conserved

mvr = constant

Sol.: Since the planet is revolving in elliptical orbit, its distance from the planet changes. So the speed of the planet changes.

It is minimum at farthest point and maximum at nearest point.

13. Answer (1)

Hint & Sol.: $v_o = \sqrt{\frac{GM}{R}} = \sqrt{gR}$

$M \rightarrow$ Mass of earth

So orbital velocity is independent of satellite's mass.

14. Answer (2)

Hint: $T = \frac{2\pi R}{v_0}$

Sol.: $T = \frac{2\pi R}{\sqrt{\frac{Gm}{R}}}$

$T = \frac{2\pi R}{\sqrt{\frac{G\frac{4}{3}\pi R^3\rho}{R}}} \Rightarrow T = \sqrt{\frac{3\pi}{G\rho}}$

$T^2 = \frac{3\pi}{G\rho} \Rightarrow \frac{G\rho}{3\pi} = \frac{1}{T^2}$

15. Answer (3)

Hint: Gravitational potential due to mass $= -\frac{Gm}{r}$

Sol.: 9 m — P — 16 m; x; $R - x$; R

Let at a distance x from 9m mass intensity is zero.

$G\frac{9\text{ m}}{x^2} = G\frac{16\text{ m}}{(R-x)^2}$

$\frac{R-x}{x} = \frac{4}{3} \Rightarrow 3R - 3x = 4x$

$x = \frac{3R}{7}$

Potential at point P

$= -\frac{G(9\text{ m})}{\left(\frac{3R}{7}\right)} + \left(-\frac{G(16\text{ m})}{\frac{4R}{7}}\right)$

$= -\frac{21Gm}{R} - \frac{28Gm}{R}$

$= -\frac{49\,Gm}{R}$

16. Answer (2)

Hint: $E = \frac{-dV}{dr}$

Sol.: $E = -\frac{d}{dx}\left(\frac{-3}{x^2}\right)$

$= 3\left(-\frac{2}{x^3}\right)$

$E = \frac{-6}{x^3}$

$E_{(1,2,3)} = \frac{6}{(1)^3} = 6$ N/kg

17. Answer (1)

Hint: g' at a depth d

$$g' = g\left(1-\frac{d}{R}\right)$$

Sol.: $W = mg = 300$

$$W' = mg' = mg\left(1-\frac{2R}{3R}\right)$$

$$= 300\times\frac{1}{3}$$

$W' = 100$ N

18. Answer (3)

Hint: $E = \frac{F}{m}$

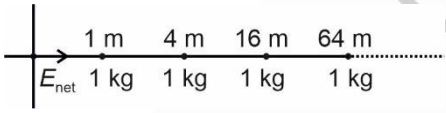
Sol.: $E = \frac{4}{\left(\frac{100}{1000}\right)}$

$E = 40$ N/kg

19. Answer (3)

Hint: $\therefore$ Intensity $E = \frac{Gm}{r^2}$

Sol.:



$$E_{net} = \frac{G(1)}{(1)^2}+\frac{G(1)}{(4)^2}+\frac{G(1)}{(16)^2}+...$$

$$= G\left(1+\frac{1}{16}+\frac{1}{256}+...\right)$$

$$= G\left(\frac{1}{1-\frac{1}{16}}\right) = \frac{16G}{15}$$

20. Answer (3)

Hint: $v_e = \sqrt{\frac{2Gm}{R}} = \sqrt{\frac{2}{R}G\frac{4}{3}\pi R^3\rho}$

$$v_e = R\sqrt{\frac{8}{3}\pi G\rho}$$

Sol.: $v_e \propto R\sqrt{\rho}$

$$\frac{v_e}{v_p} = \frac{R\sqrt{\rho}}{2R\sqrt{4\rho}} = \frac{1}{4}$$

21. Answer (3)

Hint & Sol.: According to Hooke's law within proportional limit

Stress $\propto$ strain

So graph is straight line.

22. Answer (3)

Hint: Stress = $\frac{\text{Normal Restoring Force}}{\text{Area}}$

Sol.: Stress = $\frac{25\times10}{5\times10^{-6}}$

Stress = 5×10^7 N/m^2

23. Answer (3)

Hint & Sol.: Strain and Poisson's ratios are dimensionless

Volumetric stress $= \frac{-\Delta P}{\frac{\Delta v}{v}}$

24. Answer (4)

Hint & Sol.: Energy/volume $= \frac{1}{2}\times\text{stress}\times\text{strain}$

$$= \frac{1}{2}\times(\text{strain})\times Y\times\text{strain}$$

$$= \frac{1}{2}\times(\text{strain})^2\times Y \quad \left[Y = \frac{\text{stress}}{\text{strain}}\right]$$

25. Answer (2)

Hint: $\Delta L = \frac{FL}{AY}$

Sol.: $\Delta L = \frac{FL}{AY} \Rightarrow \Delta L \propto \frac{F}{Y}$

$$\frac{\Delta L_1}{\Delta L_2} = \frac{3mg}{Y_1}\times\frac{Y_2}{2mg} = \frac{1}{2}$$

26. Answer (4)

Hint & Sol.: Young's modulus is the property of material it is independent of dimension of material.

27. Answer (1)

Hint: $E = T(2\Delta A)$

Sol.: $E = 2T(4\pi r^2)$

$= 2 \times 3 \times 10^{-2} \times 4 \times 3.14\ (4 \times 10^{-2})^2$

$E = 12.06 \times 10^{-4}$ J

28. Answer (3)

Hint & Sol.: Equation of continuity is based on conservation of mass.

29. Answer (3)

Hint: Rate of flow of water $= A\sqrt{2gh}$

Sol.: Rate of flow of water

$= 1\times10^{-6}\sqrt{2\times10\times5}$

$= 1 \times 10^{-6} \times 10$

$= 10^{-5}$ m^3/s

30. Answer (3)

Hint: $v_T \propto r^2$

Sol.: Volume = constant

$$n\frac{4}{3}\pi r^3 = \frac{4}{3}\pi R^3$$

$R = n^{1/3} r$

$v_T' = n^{2/3} v_T$

$= (27)^{2/3}10$

$= 9 \times 10 = 90$ cm s^{-1}

31. Answer (3)

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

Sol.: $\sigma = 0$

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

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

$$\eta = \frac{2}{9}\frac{\left(3\times10^{-2}\right)^2\times\left(1.5\times10^3\right)\times10}{2\times10^{-3}}$$

$$\eta = \frac{2}{9}\times\frac{9\times10^{-4}\times1.5\times10^4}{2\times10^{-3}}$$

$\eta = 1.5 \times 10^3 = 1500$ units

32. Answer (2)

Hint: Use Bernoulli's theorem

Sol.: $P_1 = P_2 + \frac{1}{2}\rho v^2$

$$4.5\times10^5 = 4\times10^5 + \frac{1}{2}\rho v^2$$

$$v^2 = \frac{0.5\times10^5\times2}{10^3} = 10^2$$

$v = 10$ m/s

33. Answer (1)

Hint: Velocity head $= \frac{v^2}{2g}$

Sol.: $\frac{v^2}{2g} = 50$ cm

$v^2 = 50 \times 2 \times 1000$

$v = \sqrt{10^5}$

$v = 100\sqrt{10}$ cm/s

34. Answer (4)

Hint: $v_T \propto r^2$

Sol.: $\frac{v_1}{v_2} = \left(\frac{r_1}{r_2}\right)^2$

$$\frac{v_1}{v_2} = \left(\frac{2}{3}\right)^2$$

$$\frac{v_1}{v_2} = \frac{4}{9}$$

35. Answer (4)

Hint: $Y = \frac{\text{stress}}{\text{strain}}$

Sol.: $Y = \frac{\frac{F}{A}}{\frac{\Delta\ell}{\ell}} = \frac{F\ell}{A\Delta\ell}\left[\begin{matrix}\Delta\ell = 2\ell - \ell \\ \Delta\ell = \ell\end{matrix}\right]$

$$F = \frac{AY}{\ell}\Delta\ell$$

$$= \frac{AY}{\ell}\ell$$

$F = AY = 4 \times 10^{-5} \times 2 \times 10^{11}$

$F = 8 \times 10^6$ N

SECTION - B

36. Answer (3)

Hint: $\vec{\tau} = \frac{d\vec{L}}{dt}$

Sol.: $\tau = \frac{9-3}{3}$ N m

$\tau = 2$ N m

37. Answer (2)

Hint: Parallel axis theorem

Sol.: According to parallel axis theorem:

$I_P = I_{cm} + Md^2$

It means, MOI will be maximum about the axis which is at maximum distance from the COM.

38. Answer (4)

Hint: M.O.I. of ring passing through C.O.M. & lying in the plane of ring $= \frac{mr^2}{2}$

Sol.: $I = 2\times\left(\frac{m\left(\frac{R}{2}\right)^2}{2}\right)+2\times\left(\frac{m\left(\frac{R}{2}\right)^2}{2}+m\left(\frac{R}{2}\right)^2\right)$

$I = mR^2$

39. Answer (3)

Hint: Use conservation of mechanical energy

Sol.: Loss in potential energy = Gain in kinetic energy

$$2mgR = \frac{1}{2}\left[\frac{mR^2}{2}+mR^2\right]\omega^2$$

$$2mgR = \frac{3}{4}mR^2\omega^2$$

$$\sqrt{\frac{8}{3}\frac{g}{R}} = \omega$$

$$\omega = \sqrt{\frac{8}{3}\times\frac{10}{\frac{5}{3}}}$$

$\omega = \sqrt{16}$ rad/s

ω = 4 rad/s

40. Answer (2)

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

Sol.: $\frac{G(m)(m)}{(2r)^2} = mr\omega^2$

$$\omega = \sqrt{\frac{Gm}{4r^3}}$$

$$T = \frac{2\pi}{\omega} = 2\pi\sqrt{\frac{4r^3}{Gm}}$$

41. Answer (3)

Hint: $V_{in} = -\frac{Gm}{R}\left(\frac{3}{2}-\frac{r^2}{2R^2}\right)$

at centre $r = 0$

$$V_{in} = -\frac{3}{2}\frac{Gm}{R}$$

Sol.: $V_{centre} = \frac{3}{2}V_{surface}$

$$V_{surface} = \frac{2}{3}V_{centre}$$

$$= \frac{2V}{3}$$

42. Answer (2)

Hint: $L = mvr = m\sqrt{\frac{GM}{r}}r$

$$L = m\sqrt{GMr}$$

Sol.: $L = m\sqrt{GM(R+3R)} = 2m\sqrt{GMR}$

$$L' = m\sqrt{GM(R+15R)} = 4m\sqrt{GMR}$$

L' = 2L

43. Answer (4)

Hint & Sol.: The net gravitational field is zero at the centre of a uniform ring.

44. Answer (2)

Hint: $B = -\frac{dP}{\left(\frac{dV}{V}\right)} = -V\frac{dP}{dV}$

Sol.: $P = \frac{\alpha}{V^2}$

$$\frac{dP}{dV} = -2\alpha V^{-3} = -\frac{2\alpha}{V^3}$$

$$B = -V\left(-\frac{2\alpha}{V^3}\right) = \frac{2\alpha}{V^2} = 2P$$

45. Answer (2)

Hint & Sol: For a satellite moving in circular orbit:

$$-TE = -\frac{PE}{2} = KE$$

$$\therefore \frac{KE}{|PE|} = \frac{1}{2}$$

46. Answer (3)

Hint: $Y = \frac{\frac{F}{A}}{\frac{\Delta\ell}{\ell}}$

Sol.: $Y = \frac{F\ell}{A\Delta\ell}$

$$\Delta\ell = \frac{F\ell}{AY}$$

$$\Delta\ell = \frac{mg'\ell}{AY}$$

$$= \frac{6\times\left(\frac{3}{4}g\right)\times 8}{4\times10^{-6}\times4\times10^{11}}$$

$$= \frac{6\times3\times10\times8}{64\times10^{5}}$$

$= 2.25 \times 10^{-4}$ m

$\Delta\ell = 0.225$ mm

47. Answer (3)

Hint: Horizontal range = vt

Sol.: Velocity of efflux at depth $v = \sqrt{2gx}$

Time of flight $= \sqrt{\frac{2(2.2+3.8-x)}{g}}$

$= \sqrt{\frac{2(6-x)}{g}}$

Range $= \sqrt{2gx}\sqrt{\frac{2(6-x)}{g}} = 2x\sqrt{x(6-x)}$

For maximum range $\frac{dR}{dx} = 0$

$x = \frac{6}{2} = 3$ m

48. Answer (1)

Hint: Use Bernoulli's theorem

Sol.: $P_1 + \frac{1}{2}\rho v_1^2 = P_2$

$P_2 - P_1 = \frac{1}{2}\rho v_1^2 = \frac{1}{2}\times1.2\times(25)^2$

$P_2 - P_1 = 375$ N/m^2

Magnitude of aerodynamic lift = Pressure × Area

= 375 × 50

= 18750

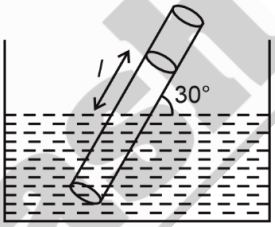
= 1.875×10^4 N

49. Answer (3)

Hint & Sol.: Due to weight of coin, the volume of water displaced is more than volume of coin. When the ice melts the coin will displace the volume of water equal to its own volume, hence level of water comes down.

50. Answer (2)

Hint & Sol.: Use concept of rise of liquid due to capillary



$$h = \frac{2s}{\rho gr} = \frac{2\times8\times10^{-2}}{10^3\times10\times0.4\times10^{-3}}\text{ m}$$

$h = 4$ cm

$l\sin30° = 4$ cm

$l = 8$ cm

CHEMISTRY

SECTION-A

51. Answer (1)

Hint: H_2SO_4 is a diprotic acid while HCl and HNO_3 are monoprotic acids.

Sol.:

- $[H^+]$ from 0.2 M HCl $\Rightarrow$ 0.2 M
- $[H^+]$ from 0.1 M $HNO_3 \Rightarrow$ 0.1 M
- $[H^+]$ from 0.01 M HCl $\Rightarrow$ 0.01 M
- $[H^+]$ from 0.01 M $H_2SO_4 \Rightarrow$ 0.02 M

So, highest $[H^+]$ concentration is obtained from 0.2 M HCl.

52. Answer (2)

Hint: Bicarbonate anion is HCO_3^-

Sol.: H_2CO_3 (diprotic acid) will be the conjugate acid of HCO_3^-

53. Answer (4)

Hint: For salt of weak acid and strong base, degree of hydrolysis $(h) = \sqrt{\frac{K_w}{C\times K_a}}$

Sol.: Lowest is the concentration of the salt, highest will be its degree of hydrolysis.

54. Answer (4)

Hint: The species which donate electron(s) is known as reducing agent.

Sol. :

$$14H^+ + Cr_2O_7^{2-} + 3Ni \longrightarrow 2Cr^{3+} + 3Ni^{2+} + 7H_2O$$

Reducing agent : Ni

55. Answer (1)

Hint: Hg_2SO_4 ionizes into Hg_2^{2+} and SO_4^{2-} ions.

Sol.: $Hg_2SO_4(s) \rightleftharpoons \underset{s}{Hg_2^{2+}}(aq) + \underset{s}{SO_4^{2-}}(aq)$

$$K_{sp} = [Hg_2^{2+}][SO_4^{2-}] = s \times s = s^2$$

$$7.4 \times 10^{-7} = s^2 \Rightarrow s = \sqrt{74} \times 10^{-4} \text{ mol/L}$$

56. Answer (3)

Hint: A negative E° means that the redox couple is a stronger reducing agent than the H^+/H_2 couple.

Sol.: $E°_{Cu^{2+}/Cu} = 0.34$ V

That means, Cu cannot liberate H_2 gas on reaction with dilute HCl.

57. Answer (4)

Hint: Mixture of weak acid and its salt with strong base will be an acidic buffer.

Sol.: H_3PO_4 (weak acid) and Na_3PO_4 (salt of weak acid with strong base) will be an acidic buffer.

58. Answer (2)

Hint: During disproportionation reaction, reduction and oxidation taking place of the same element, simulataneously.

Sol.:

a. $2\overset{+1}{Se}_2Cl_2 \xrightarrow{\Delta} \overset{+4}{Se}Cl_4 + 3\overset{0}{Se}$

b. $4K_2\overset{+6}{Cr}_2\overset{-2}{O}_7 \xrightarrow{\Delta} K_2\overset{+6}{Cr}O_4 + 2\overset{+3}{Cr}_2O_3 + 3\overset{0}{O}_2$

d. $3\overset{+6}{Mn}O_4^{2-} + 4H^+ \rightarrow 2\overset{+7}{Mn}O_4^- + \overset{+4}{Mn}O_2 + 2H_2O$

59. Answer (3)

Hint: Electron pair donating species will be Lewis base.

Sol.: H_2O contains two lone pair on oxygen atom, so it will be Lewis base.

60. Answer (3)

Hint: $[H^+]_{mix} = \dfrac{N_1V_1 + N_2V_2 + N_3V_3}{V_1 + V_2 + V_3}$

Sol.: $[H^+]_{mix} = \dfrac{1 \times V + 10^{-1} \times V + 10^{-2} \times V}{3V}$

$$= \frac{1 + 10^{-1} + 10^{-2}}{3}$$

$$= \frac{111 \times 10^{-2}}{3} = 370 \times 10^{-3} = 3.7 \times 10^{-1}$$

pH = – log (3.7×10^{-1}) = 1 – log 3.7 = 0.43

61. Answer (2)

Hint: When an equilibrium reaction reverses then new equilibrium constant becomes reciprocal to the old equilibrium constant.

Sol.:

- $2HI(g) \rightleftharpoons H_2(g) + I_2(g)$ $K_c = 64$
- $H_2(g) + I_2 \rightleftharpoons 2HI$ $K'_C = \dfrac{1}{64}$
- $\dfrac{1}{2}H_2(g) + \dfrac{1}{2}I_2(g) \rightleftharpoons HI(g)$

$$K''_C = \left(\frac{1}{64}\right)^{\frac{1}{2}} = 0.125$$

62. Answer (3)

Hint: CO_2 produced at equilibrium will be coming from decomposition of $CaCO_3$.

Sol.: $\because K_p = p_{CO_2} = 1.64$ atm

So, PV = nRT

$\Rightarrow$ 1.64 atm × 5 L = n × 0.0821 × 800

n = 0.125

So mass of $CaCO_3$ left = 80 – (0.125 × 100) = 80 – 12.5 = 67.5 g

63. Answer (3)

Hint: Pressure of NO(g) at equilibrium will be its partial pressure.

Sol.: $N_2O_3(s) \rightleftharpoons \underset{P/2}{NO(g)} + \underset{P/2}{NO_2(g)}$

64. Answer (1)

Hint: Increase of pressure, reaction will move towards the direction of decrease in number of gaseous moles.

Sol.: $CO(g) + 3H_2(g) \rightleftharpoons CH_4(g) + H_2O(g)$

So, as pressure increases, above equilibrium will shift in forward direction.

65. Answer (2)

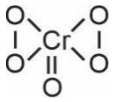
Hint: Equilibrium constant only depends on temperature.

Sol.: With increase or decrease of concentration of any component do not change equilibrium constant.

66. Answer (4)

Hint: CrO_5 has four peroxy oxygen atoms and one oxygen atom is in (–2) oxidation state.

Sol.:



Peroxy oxygen atoms are 4 which are of –1 oxidation state.

67. Answer (4)

Hint: Both hydrogen and chlorine are monovalent in nature.

Sol.: C_2H_6: 2x + 6(+1) = 0, 2x = –6, x = –3

C_2Cl_6: 2x + 6(–1) = 0, 2x = 6, x = +3

So, changes in oxidation state: –3 to +3

68. Answer (4)

Hint: Phosphorus is less electronegative than oxygen atom.

Sol.: $P_2O_7^{4-} \Rightarrow 2x + 7(-2) = -4, x = +5$

$PO_4^{3-} \Rightarrow y + 4(-2) = -3, y = +5$

$P_3O_9^{3-} \Rightarrow 3z + 9(-2) = -3, 3z = 15, z = +5$

69. Answer (1)

Hint: Metal of highest standard oxidation potential (SOP) will be of best reducing power.

Sol.: Order of SOP : B > A > C

So, order of reducing power : B > A > C

70. Answer (2)

Hint: K_{sp} of $Mg(OH)_2$ will be $[Mg^{2+}]\,[OH^-]^2$

Sol.: $Mg(OH)_2(s) \rightleftharpoons \underset{s}{Mg^{2+}}(aq) + \underset{2s}{2OH^-}(aq)$

(Given: $2s = 10^{-6} \Rightarrow s = 5 \times 10^{-7}$)

$K_{sp} = [Mg^{2+}]\,[OH^-]^2 = 4s^3 = 4 \times 125 \times 10^{-21}$

$= 5 \times 10^{-19}$

71. Answer (2)

Hint & Sol.: Summation of the oxidation states of all elements in a neutral molecule/species will be zero.

So, $A_2BC_5 = 2(+3) + 1(+4) + 5(-2) = 0$

72. Answer (1)

Hint: Catalyst does not affect equilibrium constant.

Sol.: Catalyst increases the rate of reaction by decrease of activation energy of the reaction.

73. Answer (2)

Hint: In disproportionation reaction an element in is simultaneously gets oxidised as well reduced.

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

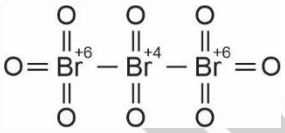
$3ClO_4^- \longrightarrow 2Cl^- + ClO_3^-$

$6ClO_2^- \longrightarrow 4ClO_3^- + Cl^-$

$4ClO_3^- \longrightarrow Cl^- + 3ClO_4^-$

74. Answer (2)

Hint & Sol.: The correct structure of Br_3O_8 is



$\therefore$ The oxidation state of central 'Br' atom in Br_3O_8 is +4.

75. Answer (2)

Hint: $Cr_2O_7^{2-} \longrightarrow Cr^{3+}$

n-factor = change in O.S.

= (+3) × 2 = +6

Sol.: The balanced equation is

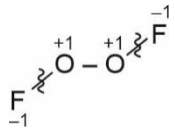
$Cr_2O_7^{2-} + 3C_2O_4^{2-} + 14H^+ \rightarrow 2Cr^{3+} + 6CO_2 + 7H_2O$

$\therefore$ The coefficient of $Cr_2O_7^{2-}, C_2O_4^{2-}$ and H_2O respectively are 1, 3 and 7

76. Answer (3)

Hint: The number assigned to oxygen depend upon the bonding of oxygen.

Sol.:



In O_2F_2, Oxygen is assigned an oxidation number of +1.

77. Answer (1)

Hint: The species with central atom in it highest oxidation state (O.S.) can act as oxidising agent only.

Sol.: In H_3PO_4, 'P' has maximum O.S. *i.e.* +5.

Hence, it acts only as an oxidising agent.

78. Answer (1)

Hint: Solubility of common ion (F^-) is decided by KF.

Sol.: $MgF_2(s) \rightleftharpoons \underset{s}{Mg^{2+}(aq)} + \underset{(2s+0.05)\simeq 0.05}{2F^-(aq)}$

$K_{sp} = [Mg^{2+}][F^-]^2 = s \times (0.05)^2$

$\Rightarrow$ $6.5 \times 10^{-9} = s \times 25 \times 10^{-4}$

$s = \frac{6.5}{25} \times 10^{-5}$

$= 2.6 \times 10^{-6}$ M

79. Answer (2)

Hint: For sparingly soluble salt

$A_xB_y(s) \rightleftharpoons \underset{xs}{xA^{y+}(aq)} + \underset{ys}{yB^{x-}(aq)}$

$Ksp = \left[A^{y+}\right]^x \left[B^{x-}\right]^y$

$Ksp = (xs)^x (ys)^y = x^x \cdot y^y \cdot (s)^{x+y}$

Where 's' is solubility of sparingly soluble salt.

Sol.:

(i) $AB_2(s) \rightleftharpoons \underset{s}{A^{2+}(aq)} + \underset{2s}{2B^-(aq)}$

$Ksp = (s)\,(2s)^2 = 4s^3$

(ii) $A_2B_3(s) \rightleftharpoons \underset{2s}{2A^{3+}(aq)} + \underset{3s}{3B^{2-}(aq)}$

$Ksp = (2s)^2(3s)^3 = 108s^5$

(iii) $AB(s) \rightleftharpoons \underset{s}{A^+(aq)} + \underset{s}{B^-(aq)}$

$Ksp = (s)(s) = s^2$

(iv) $AB_3(s) \rightleftharpoons \underset{s}{A^{3+}(aq)} + \underset{3s}{3B^-(aq)}$

$Ksp = (s)(3s)^3 = 27s^4$

80. Answer (1)

Hint & Sol.: Equilibrium is possible only in a closed system at a given temperature.

All measurable properties like concentration, pressure etc. of the system remain constant.

81. Answer (4)

Hint: For gaseous reaction, $K_p = K_c(RT)^{\Delta ng}$

Sol.: $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$

$\Delta_{ng} = 2 - (1+1) = 0$

$K_p = K_c(RT)^\circ = K_p = K_c$

82. Answer (3)

Hint & Sol.: If $K_c > 10^3$, products predominate over reactants, *i.e.*, if K_c is very large, the reaction proceeds nearly to completion.

83. Answer (2)

Hint: According to Le Chatelier's principle when we increase pressure, reaction proceeds in that direction where gaseous moles are decreasing.

Sol.: $2SO_2(g) + O_2 \rightleftharpoons 2SO_3(g)$

$\Delta H = -45.2$ Kcal

On increasing pressure, reaction moves towards product side. Hence, formation of $SO_3(g)$ takes place.

84. Answer (1)

Hint: For a polyprotic weak acid, it is more difficult to remove a positively charged proton from a negative ion due to electrostatic forces.

Sol.: $H_3PO_4(aq) \overset{Ka_1}{\rightleftharpoons} H_2PO_4^-(aq) + H^+(aq)$

$H_2PO_4^-(aq) \overset{Ka_2}{\rightleftharpoons} HPO_4^{2-}(aq) + H^+(aq)$

It is more difficult to remove H^+ ion from $H_2PO_4^-$ (aq) or HPO_4^{2-} ion. Hence, $Ka_1 > Ka_2$ or Ka_3

85. Answer (1)

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

$pK_w = pK_a + pK_b$

Sol.: OH^- ions from H_2O cannot be neglected in this case

$H_2O \rightleftharpoons \underset{10^{-8}M}{H^+} + OH^-$

$\left[OH^-\right]_{total} = \left(10^{-8} + 10^{-7}\right)M$

pOH = $-\log [10^{-8} + 10^{-7}] = 7 - \log 1.1$

$= 7 - 0.04 = 6.96$

pH = $14 - 6.96 = 7.04$

SECTION - B

86. Answer (3)

Hint: In acidic medium $KMnO_4$ converts into Mn^{2+} and n-factor is 5.

Sol.:

$\overset{+3}{Fe_2}(\overset{+3}{C_2}O_4)_3 \Rightarrow \overset{+4}{CO_2}$

$n_f = 6$

$\overset{+3}{Fe}(NO_2)_3 \rightarrow \overset{+5}{NO_3^-}$

$n_f = 6$

$\overset{+2}{Fe}\overset{+4}{S}O_3 \rightarrow \overset{+3}{Fe} + SO_4^{2-}$

$n_f = 1 + 2 = 3$

$\overset{+4}{Fe_2}(SO_3)_3 \rightarrow \overset{+6}{SO_4^{2-}}$

$n_f = 6$

For complete oxidation:

Equivalents of $KMnO_4$ = Equivalents of compound given

$(Moles)_{KMnO_4} \times 5 = (Moles)_{given\ compound} \times n\text{-factor}$

So, smaller is the value of n-factor of given compound, least is the quantities of $KMnO_4$ required.

87. Answer (2)

Hint: At 25°C, K_W is equal to 10^{-14}

Sol.: In pure water, at 25°C, $[H^+]$ is equal to 10^{-7} M.

pH of concentrated solution of 1 M concentration will be zero.

As solution of highest pOH, leads to least basic character.

88. Answer (3)

Hint: $\Delta G° = -2.303\ RT \log K_C$

Sol.: $57.44 \times 10^3 = -2.303 \times 8.314 \times 600 \times \log K_C$.

$5 = -\log K_C \Rightarrow K_C = 10^{-5}$

89. Answer (2)

Hint: $K_w = K_a \times K_b$

Sol. : $K_b = K_a/K_b = 10^{-14}/2 \times 10^{-5} = 5 \times 10^{-10}$

90. Answer (4)

Hint: Change in O.S. of atom

= |Final O.S. – Initial O.S.|

Sol.: $\overset{+7}{\underline{Mn}}O_4^- \longrightarrow \overset{+4}{\underline{Mn}}O_2$

Change in O.S. of Mn is 3 *i.e.* from +7 to +4.

91. Answer (4)

Hint: Summation of oxidation states of all elements in a species is equal to the charge present.

Sol.:

$\underline{N}_2O_5$: $2x + 5(-2) = 0$, $x = +5$

$\underline{N}_2O_4$: $2y + 4(-2) = 0$, $y = +4$

$\underline{N}_3H$: $3z + 1(+1) = 0$, $z = -\frac{1}{3}$

$\underline{N}_2H_4$: $2a + 4(+1) = 0$, $a = -2$

92. Answer (4)

Hint: $KMnO_4$ behaves as self indicator.

Sol.: Due to its minimal overshoot in colour beyond the equivalence point, it is acting as self indicator.

93. Answer (1)

Hint: $E°_{cell} = \underset{Cathode}{E°(SRP)} - \underset{Anode}{E°(SRP)}$

Sol.: Cell reaction:

$3Ni(s) + 2Au^{3+}(aq) \rightarrow 3Ni^{2+}(aq) + 2Au(s)$

$E°_{cell} = 1.4 - (-0.25) = 1.4 + 0.25 = 1.65$ V

94. Answer (4)

Hints & Sol.:

- If the volume is kept constant and inert gas such as argon is added which does not take part in reaction, the equilibrium remains undisturbed.
- Addition of an inert gas at constant volume does not change the partial pressure or the molar concentration of the substance involved in the reaction.

95. Answer (1)

Hint & Sol.:

	$PCl_5(g)$	$\rightleftharpoons$	$PCl_3(g)$	$+ Cl_2(g)$
$t = 0$	C		0	0
t_{eq}	$C(1-\alpha)$		$C\alpha$	$C\alpha$

$$K_c = \frac{[PCl_3][Cl_2]}{[PCl_5]} = \frac{(C\alpha)(C\alpha)}{C(1-\alpha)}$$

$$K_c = \frac{C\alpha^2}{1-\alpha} \text{ where } 1 - \alpha \simeq 1$$

$K_c = C\alpha^2$

96. Answer (3)

Hint: For acidic buffer solution

$$pH = pKa + \log \frac{[salt]}{[acid]}$$

Sol.: $[HX] = [X^-]$

K_b of $X^- = 10^{-10}$

K_a of $HA = 10^{-4}$

$$pH = pKa + \log \frac{[salt]}{[acid]}$$

$$pH = 4 + \log \frac{[salt]}{[acid]}$$

$pH = 4$

97. Answer (2)

Hint: Salt of strong acid and strong base does not hydrolyse.

Sol.: Na_2SO_4 salt is formed from strong acid H_2SO_4 and strong base NaOH.

$\therefore$ Na_2SO_4 does not hydrolyse.

98. Answer (3)

Hint & Sol.: Aurous chloride is AuCl having O.S. of Au = +1.

Auric chloride is $AuCl_3$ having O.S. of Au = +3.

Hg_2Cl_2 is the reduced form of $HgCl_2$.

99. Answer (2)

Hint: Redox reactions are those in which both oxidation and reduction takes place.

Sol.:

- Combination redox reaction:

$$CH_4(g) + 2O_2(g) \xrightarrow{\Delta} CO_2(g) + 2H_2O(l)$$

- Decomposition redox solution:

$$2KClO_3(s) \xrightarrow{\Delta} 2KCl(s) + 3O_2(g)$$

- Metal displacement redox reaction:

$$V_2O_5(s) + 5Ca(s) \xrightarrow{\Delta} 2V(s) + 5CaO(s)$$

- Non-metal displacement redox reaction:

$$Fe(s) + 2HCl(aq) \longrightarrow FeCl_2(aq) + H_2(g)$$

100. Answer (4)

Hint & Sol.: On addition of starch after the liberation of iodine from the reaction of Cu^{2+} ions on iodide ions, an intense blue colour appears.

BOTANY

SECTION-A

101. Answer (4)

Hint: Artificial system of classification were based mainly on gross superficial morphological characters.

Sol.: Artificial system of classification was given by Linnaeus. It included vegetative character or androecium structure.

102. Answer (1)

Hint: *Volvox* is a colonial alga.

Sol.: *Ulothrix* is a green filamentous alga, whereas *Chlamydomonas* is a unicellular algae. *Spirogyra* is also filamentous alga.

103. Answer (2)

Hint: Hydrocolloids are produced by brown or red algae.

Sol.: Brown algae produce algin.

Red algae produce carrageen.

104. Answer (4)

Hint: Red algae lack motile stages.

Sol.: *Gracilaria* and *Gelidium* are red algae.

Spirogyra produces non-motile gametes.

Volvox produces motile male gametes.

105. Answer (1)

Hint: Amphibians can live in water and on land as well.

Sol.: Bryophytes are called amphibians of plant kingdom as they require water for sexual reproduction.

106. Answer (4)

Hint: In *Marchantia* the male and female sex organs are produced on different thalli.

Sol.: Green algae has chlorophyll *a* and *b*. Brown algae has fucoxanthin as one of the major pigments.

107. Answer (3)

Hint: *Laminaria* is an alga.

Sol.: *Polytrichum* : Moss

Equisetum : Pteridophyte

Cycas : Gymnosperm

108. Answer (4)

Hint: It is a gametophytic structure.

Sol.: Male thallus of *Marchantia* is haploid in nature.

109. Answer (4)

Hint: This group of plants show haplodiplontic life cycle.

Sol.: Sporophyte is an independent main plant body in pteridophytes. Gametophyte is photosynthetic and independent in most of the pteridophytes.

110. Answer (4)

Hint: Gymnosperms produce naked seeds.

Sol.: *Salvinia* is a heterosporous species. Both *Pinus* and *Cedrus* have branched stems. In gymnosperms ovules are not enclosed by any ovary wall.

111. Answer (4)

Hint: Algae shows usually haplontic life cycle but with few exceptions.

Sol.: Life cycle of *Fucus* is diplontic. Life cycle of *Polysiphonia* is haplo-diplontic.

112. Answer (4)

Hint: Conifers are well adapted to tolerate extreme conditions as they have features such as, needle like leaves.

Sol.: Vessels are absent in gymnosperms. Sunken stomata and thick cuticle also help in reducing water loss.

113. Answer (3)

Hint: Chlorophyceae are green algae.

Sol.: Green algae have chlorophyll *a* & *b* as the major pigments.

114. Answer (2)

Hint: Gymnosperms produce smaller microspore and larger megaspore.

Sol.: All gymnosperms are heterosporous. The *Sequoia* (red wood tree) is one of the tallest tree species.

115. Answer (2)

Hint: Water helps in fertilisation process in ferns.

Sol.: In ferns, pollen grains are not formed. Pollen tube is formed in gymnosperm and angiosperms.

116. Answer (3)

Hint: This event can be observed in pteridophytes.

Sol.: *Selaginella* and *Salvinia* are heterosporous species of pteridophytes and show event precursor to seed habit.

117. Answer (4)

Hint: Secondary nucleus is formed by fusion of two polar nuclei.

Sol.: Secondary nucleus is diploid. Rest all are haploid.

118. Answer (1)

Hint: Both ovules and archegonia are seen in gymnosperms.

Sol.: *Ginkgo* is a gymnosperm. Multicellular female gametophyte bears two or more archegonia in gymnosperms. *Pteris* and *Salvinia* show only the presence of archegonia. Mustard shows only the presence of ovules.

119. Answer (2)

Hint: Brown algae are rich source of Iodine.

Sol.: *Fucus* and *Laminaria* are rich source of iodine.

120. Answer (4)

Hint: Numerical taxonomy involves usage of numerical methods for the evaluation of similarities and differences between species with the help of computer.

Sol.: Cytotaxonomy is based on cytological information like chromosome number, structures and behaviour. Numerical taxonomy is based on all observable characters.

121. Answer (3)

Hint: Motile gametes are found in green and brown algae.

Sol.: Zoospores in brown algae have 2 unequal flagella that are attached laterally. Flagella are absent in red algae.

122. Answer (1)

Hint: Pyrenoids contain protein besides starch in green algae.

Sol.: Floridean starch is present in red algae as stored food.

123. Answer (3)

Hint: In Bryophytes, antheridium is surrounded by a sterile jacket which encloses mass of sperm cells that produces biflagellate antherozoids.

Sol.: *Cycas* is dioecious and their stems are unbranched.

124. Answer (3)

Hint: Both in bryophytes and pteridophytes the gametophyte is haploid.

Sol.: The main plant body of bryophytes and pteridophytes are gametophyte and sporophyte respectively.

125. Answer (1)

Hint: Gymnosperms produce naked seeds.

Sol.: Prothallus represents the gametophyte in pteridophyte. Bryophytes and pteridophytes exhibits haplo-diplontic life cycle. Vascular bundles are absent in bryophytes.

126. Answer (1)

Sol.: *Chara* is an example of green algae. Green algae are usually green due to the dominance of pigments chlorophyll *a* and *b*.

127. Answer (3)

Hint: Leaves of *Gingko biloba* are fan shaped.

Sol.: Coralloid roots of *Cycas* are associated with nitrogen fixing cyanobacteria.

128. Answer (2)

Hint: In angiosperms, endosperm is triploid in nature.

Sol.: Endosperm formation in angiosperm is a result of triple fusion. In this fusion of a male gamete with the secondary nucleus forms triploid primary endosperm nucleus (PEN). PEN develops into endosperm.

129. Answer (3)

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

Sol.: *Fucus*, *Laminaria*, *Ectocarpous* are brown algae. *Chara* and *Volvox* are green algae.

130. Answer (4)

Hint: Bryophytes are found commonly in damp, humid and shaded localities.

Sol.: The plant body of bryophytes is more differentiated than that of algae. The gametophyte has multicellular sex organs. The sporophyte is differentiated into capsule, seta and foot.

131. Answer (3)

Hint: *Spirulina* are rich in proteins.

Sol.: Brown algae have cell wall made up of cellulose which is usually covered on the outside by a gelatinous coating of algin. *Spirulina* is used as a food supplement even by space travellers.

132. Answer (1)

Hint: Microspore is produced in the microsporangium.

MMC/PMC $\xrightarrow{\text{meiosis}}$ microspore.

Sol.: Microspore develops into pollen grains. Anther encloses microsporangia, where the PMC (Pollen Mother Cell) undergoes sporic meiosis to form microspore. Megaspore develops into embryo sac.

133. Answer (4)

Sol: Peat has been used as packing material for trans-shipment of living materials because of their capacity to hold water.

134. Answer (4)

Hint: *Lycopodium* and *Dryopteris* produce single kind of spores.

Sol.: Pteridophytes are the first terrestrial vascular plants. In pteridophytes, the sporophylls bear sporangia.

135. Answer (1)

Hint: Gametophyte is not independent in gymnosperms.

Sol.: In *Marchantia*, *Funaria* and *Pteris,* gametophyte is independent. Unlike bryophytes and pteridophytes in gymnosperms, e.g. *Pinus*, the male and female gametophyte do not have an independent free-living existence.

SECTION - B

136. Answer (2)

Hint: Some pteridophytes may flourish well in sandy soil conditions.

Sol.: Double fertilisation involves syngamy and triple fusion.

137. Answer (3)

Hint: *Fucus* and *Volvox* show oogamous type of reproduction.

Sol.: Both *Fucus* and *Volvox* have smaller motile male gamete and larger static female gamete and their fusion is considered as oogamy.

138. Answer (1)

Hint: Mosses are bryophytes.

Sol.: Protonema as a juvenile gametophytic stage is seen in bryophytes.

139. Answer (2)

Hint: Peat is provided by a moss.

Sol.: *Sphagnum* is a moss. *Spirogyra* is an alga. *Salvinia* and *Selaginella* are pteridophytes.

140. Answer (1)

Hint: *Adiantum* is a pteridophyte.

Sol.: Pteridophytes possess vascular tissues but no fruits and seeds.

141. Answer (3)

Hint: Mannitol is stored food in brown algae.

Sol.: *Fucus* is a brown alga.

142. Answer (1)

Hint: *Pteris* and *Adiantum* belong to the class Pteropsida.

Sol.: *Lycopodium* belongs to the class Lycopsida. *Equisetum* belongs to the class Sphenopsida.

143. Answer (1)

Hint: Zygote is formed when male and female gametes fuse.

Sol.: Ovule develops into seed and ovary develops into fruit after fertilization.

144. Answer (4)

Hint: Antheridium produces biflagellate antherozoids in bryophytes and pteridophytes.

Sol.: In angiosperms, female reproductive structure is pistil. In gymnosperms, pollination occurs through air currents.

Water is required for movement of antherozoids from antheridium to archegonium.

145. Answer (4)

Hint: Male gametes are motile in pteridophytes.

Sol.: The reduced male gametophyte in gymnosperms is called pollen grain.

Synergids and antipodal cells degenerate after fertilization.

146. Answer (3)

Hint: Embryo formation does not take place in algae.

Sol.: Embryo formation occurs in bryophytes, pteridophytes, gymnosperms and angiosperms.

147. Answer (4)

Hint: Angiosperms are heterosporous.

Sol.: Algae are considered as non-embryophtes.

148. Answer (2)

Hint: Sporophyte of mosses consists of foot, seta and capsule.

Sol.: The leafy stage in mosses consist of upright, slender axis bearing spirally arranged leaves. Rhizoids are multicellular and branched.

149. Answer (1)

Hint: Angiosperms are flowering plants.

Sol.: Angiosperms do not show the presence of cones but do show the presence of cotyledons, reticulate venation in leaves and haploid megaspores.

150. Answer (1)

Hint: Mosses along with lichens are the first organisms to colonise rocks.

Sol.: *Eudorina* exhibits anisogamous sexual reproduction. Seed inside the fruit represents the sporophyte generation. Male sex organ in bryophytes is surrounded by a sterile jacket. The sporophyte in mosses is more elaborate than liverworts.

ZOOLOGY

SECTION-A

151. Answer (4)

Hint: It undergoes transverse binary fission.

Sol.: In *Paramoecium*, cilia helps in the movement of food through cytopharynx and in locomotion as well.

In *Amoeba*, amoeboid movement occurs. It is effected by pseudopodia formed by the streaming of cytoplasm.

Hydra can use its tentacles for capturing its prey and also use them for locomotion.

Flagellar movement helps in the locomotion of *Euglena*.

152. Answer (2)

Hint: Less than 60%

Sol.: Muscle is a specialised tissue of mesodermal origin.

About 40-50% of the weight of a human adult is contributed by muscles under normal conditions.

153. Answer (4)

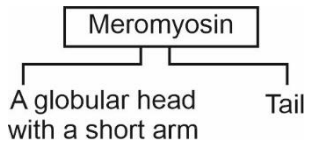
Hint: Facilitated by ciliary movement

Sol.: Ciliary movement occurs in most of our internal tubular organs which are lined by ciliated epithelium. Passage of ova through the female reproductive tract is also facilitated by the ciliary movement. Flagellar movement helps in the swimming of spermatozoa, maintenance of water current in canal system of sponges and in locomotion of *Euglena*.

154. Answer (2)

Hint: Has active sites for actin

Sol.: Many monomeric proteins called meromyosins constitute one thick filament.



The globular head is an active ATPase enzyme and has binding sites for ATP and active sites for actin.

Each 'F' actin is a polymer of monomeric 'G' actins. Troponin is distributed at regular intervals on the tropomyosin.

155. Answer (4)

Hint: Found in the cerebral cortex

Sol.:

Neurons

Unipolar	Bipolar	Multipolar
Cell body with one axon and no dendrite	Cell body with one axon and one dendrite	Cell body with one axon and two or more dendrites
Found usually in the embryonic stage in humans	Found in the retina of the human eye	Found in the cerebral cortex

156. Answer (3)

Hint: Attached to the axon terminal

Sol.: The axon is a long fibre, the distal end of which is branched. Each branch terminates as a bulb like structure called synaptic knob which possesses synaptic vesicles containing chemicals called neurotransmitters. The cell body contains cytoplasm with typical cell organelles and certain granular bodies called Nissl's granules. Schwann cells form a myelin sheath around the axon. Dendrites transmit the impulses towards the cell body of neuron.

157. Answer (3)

Hint: Glands with duct

Sol.: Hormones are non-nutrient chemicals which act as intercellular messengers and are produced in trace amounts. Endocrine glands lack ducts and hence, called ductless glands. Their secretions are called hormones.

158. Answer (4)

Hint: It has the size of a clenched fist.

Sol.: Pituitary, pineal, thyroid, adrenal, pancreas, parathyroid gland, thymus and gonads are the organised endocrine bodies in our body. In addition to these, some other organs *e.g.*, gastrointestinal tract, kidney, heart also produce hormones. ANF is produced by the atrial wall of heart.

159. Answer (3)

Hint: Exclude hormone from GIT

Sol.: Somatostatin secreted from the hypothalamus inhibits the release of growth hormone. GIP inhibits gastric secretion and motility.

GnRH (secreted by hypothalamus) stimulates the synthesis and release of gonadotrophins. Prolactin (secreted by adenohypophysis) regulates the growth of mammary glands and formation of milk in them.

160. Answer (4)

Hint: Function of PTH

Sol.: The pineal gland is located on the dorsal side of forebrain. Pineal gland secretes a hormone called melatonin. Melatonin plays a very important role in the regulation of a 24-hour rhythm of our body.

It helps in maintaining the normal rhythms of sleep-wake cycle, body temperature, *etc*. Parathyroid hormone increases the Ca^{2+} levels in the blood and stimulates the reabsorption of Ca^{2+} by renal tubules.

161. Answer (1)

Hint: Located behind sternum on the ventral side of aorta

Sol.: The thymus plays a major role in the development of the immune system. This gland secretes thymosins. Thymus is degenerated in old individuals resulting in the decreased production of thymosins. As a result, the immune responses of old persons become weak.

The thyroid gland is composed of two lobes which are located on either side of the trachea.

The pineal gland is located on the dorsal side of forebrain. The pituitary gland is located in a bony cavity called sella tursica and is attached to hypothalamus.

162. Answer (4)

Hint: Master of master endocrine gland

Sol.: The hypothalamus is the basal part of diencephalon, forebrain. It regulates a wide spectrum of body functions.

The hormones produced by hypothalamus are of two types

Releasing hormones (Stimulate secretions of anterior pituitary hormones)	Inhibiting hormones (Inhibit secretions of anterior pituitary hormones)

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

163. Answer (1)

Hint: It is a part of diencephalon.

Sol.: The cerebrum wraps around thalamus which is a major coordinating centre for sensory and motor signaling. The hindbrain comprises pons, cerebellum and medulla. The forebrain consists of cerebrum, thalamus and hypothalamus.

164. Answer (4)

Hint: Actin filaments are pulled towards the centre of 'A' band.

Sol.: The events that occur during the contraction of skeletal muscles are:

- Shortening of the sarcomere
- No change in the length of 'A' band
- Reduction in the length of 'I' band
- Disappearance of 'H' zone at complete contraction

165. Answer (3)

Hint: This joint is also present in the bones of ankle.

Sol.: Synovial joints are characterised by the presence of a fluid filled synovial cavity between the articulating surfaces of the two bones.

Ball and socket joint: Between humerus and pectoral girdle

Hinge joint: Knee joint

Pivot joint: Between atlas and axis

Gliding joint: Between the carpals

Saddle joint: Between carpal and metacarpal of human thumb

166. Answer (2)

Hint: A cup shaped bone

Sol.: A cup shaped bone called patella covers the knee ventrally. Each clavicle is a long slender bone with two curvatures. This bone is commonly called collar bone.

Femur is a thigh bone.

The bone of the limbs along with their girdles constitute the appendicular skeleton. Each limb is made of 30 bones.

167. Answer (2)

Hint: Also called visceral muscles

Sol.: Visceral muscles are located in the inner wall of hollow visceral organs.

Smooth muscles assist in the transportation of food through the digestive tract and gametes through the genital tract.

Skeletal muscles are voluntary in nature and striated in appearance.

168. Answer (2)

Hint: Middle of 'A' band

Sol.: The central part of thick filament not overlapped by thin filament is called the 'H' zone.

The thick filament in the middle of 'A' band are held together by thin fibrous membrane called 'M' line.

Sarcomere is the functional unit of contraction. Middle part of 'I' band contains a densely stained membrane called 'Z' line.

169. Answer (2)

Hint: Included in the skull

Sol.: The single U-shaped bone present at the base of the buccal cavity is hyoid.

Malleus, incus and stapes are ear ossicles. Patella covers the knee ventrally.

170. Answer (3)

Hint: Occurs mostly due to genetic disorder

Sol.: **Muscular dystrophy:** Progressive degeneration of skeletal muscle mostly due to genetic disorder.

Tetany: Rapid spasms (wild contractions) in muscles due to low Ca^{++} in body fluid.

Arthritis: Inflammation of joints.

Gout: Accumulation of uric acid crystals in joints.

171. Answer (3)

Hint: This process maintains the ionic gradients across the resting plasma membrane.

Sol.: Neurons are excitable cells because their membranes are in a polarised state.

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

The ionic gradients across the resting membrane are maintained by the active transport of ions by the sodium-potassium pump which transports 3 Na^+ outwards for $2K^+$ into the cell.

172. Answer (4)

Hint: Neurotransmitters are released at synaptic cleft.

Sol.: When an impulse arrives at the axon terminal, it stimulates the movement of the synaptic vesicles towards the membrane where they fuse with the plasma membrane and release their neurotransmitters in the synaptic cleft. The released neurotransmitters bind to their specific receptors, present on the post-synaptic membrane.

173. Answer (4)

Hint: Amygdala, hippocampus, hypothalamus, *etc*., constitute the limbic system.

Sol.: The inner parts of cerebral hemispheres and a group of associated deep structures like amygdala, hippocampus, *etc*., form a complex structure called the limbic system. Along with hypothalamus, it is involved in the regulation of sexual behaviour, expression of emotional reactions and motivation. Olfactory bulbs are the extensions of the brain's limbic system and hypothalamus controls autonomic responses.

174. Answer (4)

Hint: Aldosterone increases osmolarity of body fluid.

Sol.: Aldosterone acts mainly at distal tubules and stimulates the reabsorption of Na^+ and water and excretion of K^+ and phosphate ions.

175. Answer (3)

Hint: Possess Nissl's granules

Sol.: The cerebral cortex is referred to as the grey matter due to its greyish appearance. The neuron cell bodies are concentrated here giving the colour.

Fibres of the tracts are covered with the myelin sheath, which constitute the inner part of cerebral hemisphere. They give an opaque white appearance to the layer and hence, is called the white matter.

176. Answer (1)

Hint: Action potential is termed as nerve impulse

Sol.: During depolarisation of a neuron, Na^+ move inside to the intracellular fluid of axon by voltage gated channels.

The rise in the stimulus-induced permeability to Na^+ is extremely short-lived. It is quickly followed by a rise in permeability to K^+. Within a fraction of a second, K^+ diffuses outside the membrane and restores the resting potential of the membrane at the site of excitation and the fibre becomes once more responsive to further stimulation.

177. Answer (2)

Hint: Include an insect

Sol.: The neural organisation is very simple in lower vertebrates. For example, in *Hydra* it is composed of a network of neurons. The neural system is better organised in insects, where a brain is present along with a number of ganglia and neural tissues. The vertebrates have a more developed neural system.

178. Answer (3)

Hint: Function of hypothalamus

Sol.: Midbrain, pons and medulla oblongata form the brain stem.

Medulla is the terminal portion of brain stem and continues posteriorly with the spinal cord.

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

179. Answer (2)

Hint: Does not involve neurotransmitters

Sol.: A synapse is formed by the membranes of a pre-synaptic neuron and a post-synaptic neuron, which may or may not be separated by a gap called synaptic cleft. There are two types of synapses namely, electrical synapses and chemical synapses. At electrical synapses, the membranes of pre- and post-synaptic neurons are in very close proximity.

Electrical synapses are rare in our system.

180. Answer (4)

Hint: Structure of false ribs

Sol.: There are 12 pairs of ribs. Each rib is a thin flat bone connected dorsally to the vertebral column and ventrally to the sternum. It has two articulation surfaces on its dorsal end and is hence called bicephalic. First seven pairs of ribs are called true ribs. Dorsally, they are attached to the thoracic vertebrae and ventrally connected to the sternum with the help of hyaline cartilage. The 8^{th}, 9^{th} and 10^{th} pairs of ribs do not articulate directly with the sternum but join the seventh rib with the help of hyaline cartilage. These are called vertebrochondral (false) ribs.

181. Answer (2)

Hint: The number of cervical vertebrae are seven in almost all mammals.

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

182. Answer (1)

Hint: Emergency condition

Sol.: The adrenal medulla secretes catecholamines. Adrenaline and noradrenaline are rapidly secreted in response to stress of any kind and during emergency situations and are called emergency hormones.

These hormones increase alertness, pupilary dilation, piloerection, sweating, *etc*.

Both the hormones increase the heart beat and the rate of respiration.

It stimulates the breakdown of glycogen resulting in an increased concentration of glucose in blood.

183. Answer (1)

Hint: Identify a pituitary hormone.

Sol.: Hormones which interact with membrane-bound receptors normally do not enter the target cell, but generate second messengers (*e.g.*, cyclic AMP, IP_3, Ca^{++}, *etc.*) which in turn regulate cellular metabolism. Hormones which interact with intracellular receptors (*e.g.*, steroid hormones, iodothyronines, *etc*.) mostly regulate gene expression or chromosome function by the interaction of hormone-receptor complex with the genome.

184. Answer (3)

Hint: Multiple of three

Sol.: The pars distalis region of pituitary, commonly called anterior pituitary, produces GH (growth hormone), PRL (prolactin), TSH (thyroid-stimulating hormone), ACTH (adrenocorticotrophic hormone), LH (luteinising hormone), FSH (follicle stimulating hormone). They all are considered as trophic hormones.

185. Answer (4)

Hint: Identify a hypothalamic hormone.

Sol.: Thyroxine, testosterone and glucocorticoids support the process of formation of RBCs (erythropoiesis).

Vasopressin or ADH is synthesized by hypothalamus. Vasopressin acts mainly at the kidney and stimulates reabsorption of water and electrolytes by the distal tubules.

SECTION - B

186. Answer (2)

Hint: GnRH stands for gonadotrophin releasing hormone.

Sol.:

ACTH – Stimulates the secretion of glucocorticoids

GIP – Inhibits gastric secretion and motility

CCK – Acts on pancreas and stimulates its exocrine secretion

GnRH – Stimulates the adenohypophysis to release gonadotrophins

187. Answer (2)

Hint: Equal to the number of ear ossicles in right ear

Sol.: On the basis of their chemical nature, hormones can be divided into groups:

(i) **Peptide, polypeptide, protein hormones** [*e.g.*: insulin, glucagon, pituitary hormones, hypothalamic hormones, *etc*]

(ii) **Steroids** [*e.g.*: cortisol, testosterone, estradiol and progesterone]

(iii) **Iodothyronines** [*e.g.*: thyroid hormone]

(iv) **Amino-acid derivatives** [*e.g.*: epinephrine]

188. Answer (3)

Hint: CNS includes the brain and the spinal cord.

Sol.: The somatic neural system relays impulses from the CNS to skeletal muscles, while the autonomic neural system transmits impulses from the CNS to the involuntary organs and smooth muscles of the body.

Visceral nervous system is the part of peripheral nervous system.

189. Answer (3)

Hint: Tract of nerve fibres

Sol.: Bipolar neurons (with one axon and one dendrite) are found in retina of human eye. Unmyelinated nerve fibres are commonly found in autonomous and somatic neural systems.

The cerebral hemispheres are connected by a tract of nerve fibres called corpus callosum. The layer of cells which covers the cerebral hemispheres is called cortex and is thrown into prominent folds.

Brain stem forms the connection between the brain and spinal cord.

190. Answer (2)

Hint: Monosynaptic reflex

Sol.: Knee-jerk reflex is a monosynaptic reflex *i.e.*, interneurons are not involved.

So, there will be no effect on the knee jerk reflex *i.e*, normal reflex action will occur even if interneurons are blocked.

191. Answer (1)

Hint: Iodothyronines require iodine for its formation.

Sol.: Iodine is a rate-limiting element for the synthesis of thyroid hormones.

Deficiency of iodine in our body results in hypothyroidism. Iodine is essential for the normal rate of synthesis of thyroxine.

192. Answer (4)

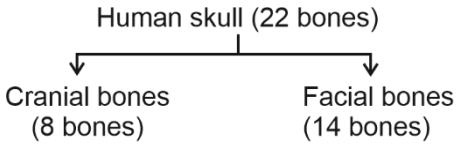
Hint: Feature of white muscle fibres

Sol.: Myoglobin content is high in red muscle fibres and these muscles contain plenty of mitochondria which can utilise the large amounts of oxygen stored in them for ATP production. These muscles, therefore can also be called aerobic muscles. The amount of sarcoplasmic reticulum is high in white muscle fibres.

193. Answer (2)

Hint: Two less than the total number of fingers in hind limbs

Sol.:



The number of carpals in one forelimb = 8

The number of tarsals in one hindlimb = 7

194. Answer (2)

Hint: Fibrous joint

Sol.: Fibrous joint do not allow any movement.

This type of joint is shown by the flat skull bones which fuse end-to-end with the help of dense fibrous connective tissues in the form of sutures.

Shoulder joint is a type of synovial joint.

195. Answer (4)

Hint: The aqueous chamber contains aqueous humor.

Sol.: The anterior portion of sclera is called cornea.

Cornea consists of dense matrix of collagen and is the most sensitive portion of the eye.

Myelin sheath is produced by Schwann cells (in PNS) and oligodendrocytes (in CNS).

The middle ear contains three ossicles called malleus, incus and stapes. The ear ossicles increase the efficiency of transmission of sound waves to the inner ear.

196. Answer (2)

Hint: Exclude the thin elastic membrane present above hair cells

Sol.: The membranes constituting cochlea, the Reissner's and basilar, divide the surrounding perilymph filled bony labyrinth into an upper scala vestibuli and a lower scala tympani.

197. Answer (2)

Hint: Jaw bone is a single bone.

Sol.: Ethmoid and sphenoid are unpaired cranial bones. Sacrum (1) and coccyx (1) are fused bones in adult humans. Maxilla and zygomatic are paired facial bones.

198. Answer (4)

Hint: Exclude the function of glucagon

Sol.: Pancreas is a composite gland which acts as both exocrine and endocrine gland. The two main types of cells in the Islet of Langerhans are called α-cells and β-cells. The α-cells secrete a hormone called glucagon, while the β-cells secrete insulin. Glucagon acts mainly on the hepatocytes and stimulates glycogenolysis resulting in an increased blood sugar level (hyperglycemia).

199. Answer (2)

Hint: A form of hyperthyroidism

Sol.: Exophthalmic goitre or Graves' disease is a form of hyperthryoidism.

Deficiency of ADH leads to diabetes insipidus. Underproduction of hormones by adrenal cortex alters carbohydrate metabolism causing acute weakness and fatigue leading to Addison's disease.

200. Answer (4)

Hint: Associated with medulla oblongata

Sol.: The vomit centre is present in medulla oblongata. The hindbrain comprises pons, cerebellum and medulla oblongata. The cerebellum integrates information received from the semicircular canals of the ear and auditory system.

❑ ❑ ❑

All India Aakash Test Series for NEET - 2025

TEST – 4 (Code-J)

Test Date : 03/03/2024

ANSWERS

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

Hints & Solutions

PHYSICS

SECTION - A

1. Answer (2)

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

Torque = Rate of change of angular momentum.

2. Answer (1)

Hint: Magnitude of vector product = $\left|\vec{A}\times\vec{B}\right|$

Sol.: $\hat{i}(-2+6)-\hat{j}(-3+2)+\hat{k}(9-2)$

$\vec{A}\times\vec{B} = 4\hat{i}+\hat{j}+7\hat{k}$

$\left|\vec{A}\times\vec{B}\right| = \sqrt{(4)^2+(1)^2+(7)^2} = \sqrt{16+1+49}$

$\left|\vec{A}\times\vec{B}\right| = \sqrt{66}$

3. Answer (4)

Hint: Use $\alpha = \frac{\Delta\omega}{\Delta t}$

Sol.: $\alpha = \frac{\omega_2-\omega_1}{t}$

$$\alpha = \frac{\frac{1800}{60}\times 2\pi - \frac{480}{60}\times 2\pi}{11}$$

$$= \frac{2\pi(30-8)}{11}$$

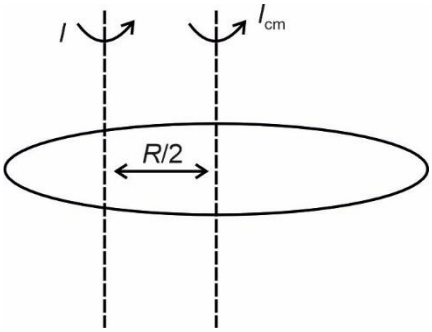
$\alpha = 4\pi$ rad/s^2

4. Answer (2)

Hint: From parallel axis theorem

$I = I_{cm} + md^2$

Sol.:



$I = I_{cm} + m\left(\frac{R}{2}\right)^2$

$I = mR^2 + \frac{mR^2}{4}$

$I = \frac{5}{4}mR^2$

5. Answer (1)

Hint: $I = mK^2$

$K \rightarrow$ radius of gyration

Sol.: $I_{H\cdot S} = \frac{2}{3}mR^2 \Rightarrow mK_{H\cdot S}^2 = \frac{2}{3}mR^2$

$K_{H\cdot S} = \sqrt{\frac{2}{3}}R$

$I_{S\cdot S} = \frac{2}{5}mR^2 \Rightarrow mK_{S\cdot S}^2 = \frac{2}{5}mR^2$

$K_{S\cdot S} = \sqrt{\frac{2}{5}}R$

$\frac{K_{H\cdot S}}{K_{S\cdot S}} = \sqrt{\frac{5}{3}}$

6. Answer (2)

Hint: Distance of C.O.M. from m_2 = $\frac{m_1 r}{m_1+m_2}$

Sol.: Distance of C.O.M. from 40 kg = $\frac{20\times 15}{20+40}$

$= \frac{20}{60}\times 15$

= 5 m

7. Answer (4)

Hint: $W_{net} = K.E_f - K.E_i = 0 - K.E_i$

Sol.: $W = -\frac{1}{2}mv^2\left(1+\frac{K^2}{R^2}\right)$

$= -\frac{1}{2}\times 10\times(2)^2\left(1+\frac{2}{5}\right)$

$= -\frac{1}{2}\times 10\times 4\times\frac{7}{5}$

W = –28 J

8. Answer (3)

Hint: $\tau = I\,\alpha \Rightarrow \alpha = \frac{\tau}{I}$

Sol.: M.O.I. of solid cylinder = $\frac{mR^2}{2}$

$= \frac{5\times(0.5)^2}{2} = \frac{1.25}{2}\text{kg m}^2$

$\tau = I\alpha \Rightarrow \alpha = \frac{\tau}{I}$

$\alpha = \frac{F\cdot R}{I} = \frac{50\times 0.5}{\left(\frac{1.25}{2}\right)}$

α = 40 rad/s^2

9. Answer (2)

Hint & Sol.: A couple consists of two equal and opposite forces whose lines of action are parallel and laterally separated by some distance. Therefore net force of a couple is zero vector, hence there is no translational motion, only rotational motion will be there.

10. Answer (3)

Hint & Sol.: Acceleration of C.O.M. may be zero

Hence, the C.O.M. of body in pure rotation may remain steady.

11. Answer (2)

Hint: $\Delta L = \frac{FL}{AY}$

Sol.: $\Delta L = \frac{FL}{AY} \Rightarrow \Delta L \propto \frac{F}{Y}$

$\frac{\Delta L_1}{\Delta L_2} = \frac{3mg}{Y_1}\times\frac{Y_2}{2mg} = \frac{1}{2}$

12. Answer (4)

Hint & Sol.: Energy/volume $= \frac{1}{2}\times\text{stress}\times\text{strain}$

$= \frac{1}{2}\times(\text{strain})\times Y\times\text{strain}$

$= \frac{1}{2}\times(\text{strain})^2\times Y \quad \left[Y = \frac{\text{stress}}{\text{strain}}\right]$

13. Answer (3)

Hint & Sol.: Strain and Poisson's ratios are dimensionless

Volumetric stress $= \frac{-\Delta P}{\frac{\Delta v}{v}}$

14. Answer (3)

Hint: Stress = $\frac{\text{Normal Restoring Force}}{\text{Area}}$

Sol.: Stress = $\frac{25\times 10}{5\times 10^{-6}}$

Stress = 5 × 10^7 N/m^2

15. Answer (3)

Hint & Sol.: According to Hooke's law within proportional limit

Stress $\propto$ strain

So graph is straight line.

16. Answer (3)

Hint: $v_e = \sqrt{\frac{2Gm}{R}} = \sqrt{\frac{2}{R}G\frac{4}{3}\pi R^3\rho}$

$v_e = R\sqrt{\frac{8}{3}\pi G\rho}$

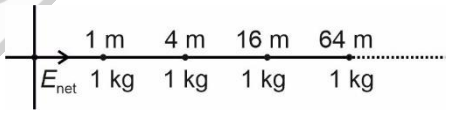
Sol.: $v_e \propto R\sqrt{\rho}$

$\frac{v_e}{v_p} = \frac{R\sqrt{\rho}}{2R\sqrt{4\rho}} = \frac{1}{4}$

17. Answer (3)

Hint: $\therefore$ Intensity $E = \frac{Gm}{r^2}$

Sol.:



$E_{\text{net}} = \frac{G(1)}{(1)^2} + \frac{G(1)}{(4)^2} + \frac{G(1)}{(16)^2} + \ldots$

$= G\left(1 + \frac{1}{16} + \frac{1}{256} + \ldots\right)$

$= G\left(\frac{1}{1-\frac{1}{16}}\right) = \frac{16G}{15}$

18. Answer (3)

Hint: $E = \frac{F}{m}$

Sol.: $E = \frac{4}{\left(\frac{100}{1000}\right)}$

E = 40 N/kg

19. Answer (1)

Hint: g' at a depth d

$$g' = g\left(1-\frac{d}{R}\right)$$

Sol.: $W = mg = 300$

$$W' = mg' = mg\left(1-\frac{2R}{3R}\right)$$

$$= 300\times\frac{1}{3}$$

$W' = 100$ N

20. Answer (2)

Hint: $E = \frac{-dV}{dr}$

Sol.: $E = -\frac{d}{dx}\left(\frac{-3}{x^2}\right)$

$$= 3\left(-\frac{2}{x^3}\right)$$

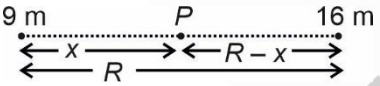
$$E = \frac{-6}{x^3}$$

$$E_{(1,2,3)} = \frac{6}{(1)^3} = 6 \text{ N/kg}$$

21. Answer (3)

Hint: Gravitational potential due to mass $= -\frac{Gm}{r}$

Sol.:



Let at a distance x from $9m$ mass intensity is zero.

$$G\frac{9\text{ m}}{x^2} = G\frac{16\text{ m}}{(R-x)^2}$$

$$\frac{R-x}{x} = \frac{4}{3} \Rightarrow 3R - 3x = 4x$$

$$x = \frac{3R}{7}$$

Potential at point P

$$= -\frac{G(9\text{ m})}{\left(\frac{3R}{7}\right)} + \left(-\frac{G(16\text{ m})}{\frac{4R}{7}}\right)$$

$$= -\frac{21Gm}{R} - \frac{28Gm}{R}$$

$$= -\frac{49\,Gm}{R}$$

22. Answer (2)

Hint: $T = \frac{2\pi R}{v_0}$

Sol.: $T = \frac{2\pi R}{\sqrt{\frac{Gm}{R}}}$

$$T = \frac{2\pi R}{\sqrt{\frac{G\frac{4}{3}\pi R^3\rho}{R}}} \Rightarrow T = \sqrt{\frac{3\pi}{G\rho}}$$

$$T^2 = \frac{3\pi}{G\rho} \Rightarrow \frac{G\rho}{3\pi} = \frac{1}{T^2}$$

23. Answer (1)

Hint & Sol.: $v_o = \sqrt{\frac{GM}{R}} = \sqrt{gR}$

$M \rightarrow$ Mass of earth

So orbital velocity is independent of satellite's mass.

24. Answer (4)

Hint: Angular momentum of planet w.r.t. centre of sun is conserved

mvr = constant

Sol.: Since the planet is revolving in elliptical orbit, its distance from the planet changes. So the speed of the planet changes.

It is minimum at farthest point and maximum at nearest point.

25. Answer (1)

Hint: Use conservation of mechanical energy $v_e = \sqrt{2gR}$

Sol.: Expression of escape velocity is obtained by conservation of mechanical energy and doesn't involve in which direction the body is projected. Escape velocity of the body from earth surface is a constant irrespective of direction of projection.

26. Answer (4)

Hint: $Y = \frac{\text{stress}}{\text{strain}}$

Sol.: $Y = \frac{\frac{F}{A}}{\frac{\Delta\ell}{\ell}} = \frac{F\ell}{A\Delta\ell}\left[\begin{matrix}\Delta\ell = 2\ell - \ell \\ \Delta\ell = \ell\end{matrix}\right]$

$$F = \frac{AY}{\ell}\Delta\ell$$

$$= \frac{AY}{\ell}\ell$$

$F = AY = 4 \times 10^{-5} \times 2 \times 10^{11}$

$F = 8 \times 10^6$ N

27. Answer (4)

Hint: $v_T \propto r^2$

Sol.: $\frac{v_1}{v_2} = \left(\frac{r_1}{r_2}\right)^2$

$\frac{v_1}{v_2} = \left(\frac{2}{3}\right)^2$

$\frac{v_1}{v_2} = \frac{4}{9}$

28. Answer (1)

Hint: Velocity head $= \frac{v^2}{2g}$

Sol.: $\frac{v^2}{2g} = 50$ cm

$v^2 = 50 \times 2 \times 1000$

$v = \sqrt{10^5}$

$v = 100\sqrt{10}$ cm/s

29. Answer (2)

Hint: Use Bernoulli's theorem

Sol.: $P_1 = P_2 + \frac{1}{2}\rho v^2$

$4.5 \times 10^5 = 4 \times 10^5 + \frac{1}{2}\rho v^2$

$v^2 = \frac{0.5 \times 10^5 \times 2}{10^3} = 10^2$

v = 10 m/s

30. Answer (3)

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

Sol.: $\sigma = 0$

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

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

$\eta = \frac{2}{9}\frac{\left(3 \times 10^{-2}\right)^2 \times \left(1.5 \times 10^3\right) \times 10}{2 \times 10^{-3}}$

$\eta = \frac{2}{9} \times \frac{9 \times 10^{-4} \times 1.5 \times 10^4}{2 \times 10^{-3}}$

$\eta = 1.5 \times 10^3 = 1500$ units

31. Answer (3)

Hint: $v_T \propto r^2$

Sol.: Volume = constant

$n\frac{4}{3}\pi r^3 = \frac{4}{3}\pi R^3$

$R = n^{1/3} r$

$v_T' = n^{2/3} v_T$

$= (27)^{2/3} 10$

$= 9 \times 10 = 90$ cm s^{-1}

32. Answer (3)

Hint: Rate of flow of water $= A\sqrt{2gh}$

Sol.: Rate of flow of water

$= 1 \times 10^{-6}\sqrt{2 \times 10 \times 5}$

$= 1 \times 10^{-6} \times 10$

$= 10^{-5}$ m^3/s

33. Answer (3)

Hint & Sol.: Equation of continuity is based on conservation of mass.

34. Answer (1)

Hint: $E = T(2\Delta A)$

Sol.: $E = 2T(4\pi r^2)$

$= 2 \times 3 \times 10^{-2} \times 4 \times 3.14\ (4 \times 10^{-2})^2$

$E = 12.06 \times 10^{-4}$ J

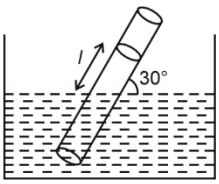
35. Answer (4)

Hint & Sol.: Young's modulus is the property of material it is independent of dimension of material.

SECTION - B

36. Answer (2)

Hint & Sol.: Use concept of rise of liquid due to capillary



$h = \frac{2s}{\rho g r} = \frac{2 \times 8 \times 10^{-2}}{10^3 \times 10 \times 0.4 \times 10^{-3}}$ m

h = 4 cm

$l\sin 30° = 4$ cm

l = 8 cm

37. Answer (3)

Hint & Sol.: Due to weight of coin, the volume of water displaced is more than volume of coin. When the ice melts the coin will displace the volume of water equal to its own volume, hence level of water comes down.

38. Answer (1)

Hint: Use Bernoulli's theorem

Sol.: $P_1 + \frac{1}{2}\rho v_1^2 = P_2$

$P_2 - P_1 = \frac{1}{2}\rho v_1^2 = \frac{1}{2}\times 1.2 \times (25)^2$

$P_2 - P_1 = 375\ \text{N/m}^2$

Magnitude of aerodynamic lift = Pressure × Area

$= 375 \times 50$

$= 18750$

$= 1.875 \times 10^4$ N

39. Answer (3)

Hint: Horizontal range = vt

Sol.: Velocity of efflux at depth $v = \sqrt{2gx}$

Time of flight $= \sqrt{\frac{2(2.2+3.8-x)}{g}}$

$= \sqrt{\frac{2(6-x)}{g}}$

Range $= \sqrt{2gx}\sqrt{\frac{2(6-x)}{g}} = 2x\sqrt{x(6-x)}$

For maximum range $\frac{dR}{dx} = 0$

$x = \frac{6}{2} = 3$ m

40. Answer (3)

Hint: $Y = \frac{\frac{F}{A}}{\frac{\Delta\ell}{\ell}}$

Sol.: $Y = \frac{F\ell}{A\Delta\ell}$

$\Delta\ell = \frac{F\ell}{AY}$

$\Delta\ell = \frac{mg'\ell}{AY}$

$= \frac{6\times\left(\frac{3}{4}g\right)\times 8}{4\times10^{-6}\times4\times10^{11}}$

$= \frac{6\times3\times10\times8}{64\times10^5}$

$= 2.25 \times 10^{-4}$ m

$\Delta\ell = 0.225$ mm

41. Answer (2)

Hint & Sol: For a satellite moving in circular orbit:

$-TE = -\frac{PE}{2} = KE$

$\therefore \frac{KE}{|PE|} = \frac{1}{2}$

42. Answer (2)

Hint: $B = -\frac{dP}{\left(\frac{dV}{V}\right)} = -V\frac{dP}{dV}$

Sol.: $P = \frac{\alpha}{V^2}$

$\frac{dP}{dV} = -2\alpha V^{-3} = -\frac{2\alpha}{V^3}$

$B = -V\left(-\frac{2\alpha}{V^3}\right) = \frac{2\alpha}{V^2} = 2P$

43. Answer (4)

Hint & Sol.: The net gravitational field is zero at the centre of a uniform ring.

44. Answer (2)

Hint: $L = mvr = m\sqrt{\frac{GM}{r}}r$

$L = m\sqrt{GMr}$

Sol.: $L = m\sqrt{GM(R+3R)} = 2m\sqrt{GMR}$

$L' = m\sqrt{GM(R+15R)} = 4m\sqrt{GMR}$

$L' = 2L$

45. Answer (3)

Hint: $V_{in} = -\frac{Gm}{R}\left(\frac{3}{2} - \frac{r^2}{2R^2}\right)$

at centre $r = 0$

$V_{in} = -\frac{3}{2}\frac{Gm}{R}$

Sol.: $V_{centre} = \frac{3}{2}V_{surface}$

$V_{surface} = \frac{2}{3}V_{centre}$

$= \frac{2V}{3}$

46. Answer (2)

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

Sol.: $\frac{G(m)(m)}{(2r)^2} = mr\omega^2$

$\omega = \sqrt{\frac{Gm}{4r^3}}$

$T = \frac{2\pi}{\omega} = 2\pi\sqrt{\frac{4r^3}{Gm}}$

47. Answer (3)

Hint: Use conservation of mechanical energy

Sol.: Loss in potential energy = Gain in kinetic energy

$2mgR = \frac{1}{2}\left[\frac{mR^2}{2} + mR^2\right]\omega^2$

$2mgR = \frac{3}{4}mR^2\omega^2$

$\sqrt{\frac{8}{3}\frac{g}{R}} = \omega$

$\omega = \sqrt{\frac{8}{3} \times \frac{10}{\frac{5}{3}}}$

$\omega = \sqrt{16}$ rad/s

ω = 4 rad/s

48. Answer (4)

Hint: M.O.I. of ring passing through C.O.M. & lying in the plane of ring $= \frac{mr^2}{2}$

Sol.: $I = 2 \times \left(\frac{m\left(\frac{R}{2}\right)^2}{2}\right) + 2 \times \left(\frac{m\left(\frac{R}{2}\right)^2}{2} + m\left(\frac{R}{2}\right)^2\right)$

$I = mR^2$

49. Answer (2)

Hint: Parallel axis theorem

Sol.: According to parallel axis theorem:

$I_P = I_{cm} + Md^2$

It means, MOI will be maximum about the axis which is at maximum distance from the COM.

50. Answer (3)

Hint: $\vec{\tau} = \frac{d\vec{L}}{dt}$

Sol.: $\tau = \frac{9-3}{3}$ N m

τ = 2 N m

CHEMISTRY

SECTION-A

51. Answer (1)

Hint: H_2SO_4 is a diprotic acid while HCl and HNO_3 are monoprotic acids.

Sol.:

- $[H^+]$ from 0.2 M HCl $\Rightarrow$ 0.2 M
- $[H^+]$ from 0.1 M $HNO_3 \Rightarrow$ 0.1 M
- $[H^+]$ from 0.01 M HCl $\Rightarrow$ 0.01 M
- $[H^+]$ from 0.01 M $H_2SO_4 \Rightarrow$ 0.02 M

So, highest $[H^+]$ concentration is obtained from 0.2 M HCl.

52. Answer (2)

Hint: Bicarbonate anion is HCO_3^-

Sol.: H_2CO_3 (diprotic acid) will be the conjugate acid of HCO_3^-

53. Answer (4)

Hint: For salt of weak acid and strong base, degree of hydrolysis $(h) = \sqrt{\frac{K_w}{C \times K_a}}$

Sol.: Lowest is the concentration of the salt, highest will be its degree of hydrolysis.

54. Answer (4)

Hint: The species which donate electron(s) is known as reducing agent.

Sol. :

$14H^+ + Cr_2O_7^{2-} + 3Ni \longrightarrow 2Cr^{3+} + 3Ni^{2+} + 7H_2O$

Reducing agent : Ni

55. Answer (1)

Hint: Hg_2SO_4 ionizes into Hg_2^{2+} and SO_4^{2-} ions.

Sol.: $Hg_2SO_4(s) \rightleftharpoons \underset{s}{Hg_2^{2+}}(aq) + \underset{s}{SO_4^{2-}}(aq)$

$K_{sp} = [Hg_2^{2+}][SO_4^{2-}] = s \times s = s^2$

$7.4 \times 10^{-7} = s^2 \Rightarrow s = \sqrt{74} \times 10^{-4}$ mol/L

56. Answer (3)

Hint: A negative E° means that the redox couple is a stronger reducing agent than the H^+/H_2 couple.

Sol.: $E°_{Cu^{2+}/Cu} = 0.34$ V

That means, Cu cannot liberate H_2 gas on reaction with dilute HCl.

57. Answer (4)

Hint: Mixture of weak acid and its salt with strong base will be an acidic buffer.

Sol.: H_3PO_4 (weak acid) and Na_3PO_4 (salt of weak acid with strong base) will be an acidic buffer.

58. Answer (2)

Hint: During disproportionation reaction, reduction and oxidation taking place of the same element, simulataneously.

Sol.:

a. $2\overset{+1}{Se_2}Cl_2 \xrightarrow{\Delta} \overset{+4}{Se}Cl_4 + 3\overset{0}{Se}$

b. $4K_2\overset{+6}{Cr_2}\overset{-2}{O_7} \xrightarrow{\Delta} K_2\overset{+6}{Cr}O_4 + 2\overset{+3}{Cr_2}O_3 + 3\overset{0}{O_2}$

d. $3\overset{+6}{Mn}O_4^{2-} + 4H^+ \rightarrow 2\overset{+7}{Mn}O_4^- + \overset{+4}{Mn}O_2 + 2H_2O$

59. Answer (3)

Hint: Electron pair donating species will be Lewis base.

Sol.: H_2O contains two lone pair on oxygen atom, so it will be Lewis base.

60. Answer (3)

Hint: $[H^+]_{mix} = \dfrac{N_1V_1 + N_2V_2 + N_3V_3}{V_1 + V_2 + V_3}$

Sol.: $[H^+]_{mix} = \dfrac{1 \times V + 10^{-1} \times V + 10^{-2} \times V}{3V}$

$= \dfrac{1 + 10^{-1} + 10^{-2}}{3}$

$= \dfrac{111 \times 10^{-2}}{3} = 370 \times 10^{-3} = 3.7 \times 10^{-1}$

pH = – log (3.7×10^{-1}) = 1 – log 3.7 = 0.43

61. Answer (2)

Hint: $Cr_2O_7^{2-} \longrightarrow Cr^{3+}$

n-factor = change in O.S.

= (+3) × 2 = +6

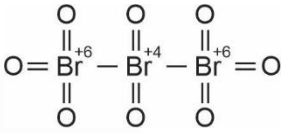
Sol.: The balanced equation is

$Cr_2O_7^{2-} + 3C_2O_4^{2-} + 14H^+ \rightarrow 2Cr^{3+} + 6CO_2 + 7H_2O$

$\therefore$ The coefficient of $Cr_2O_7^{2-}, C_2O_4^{2-}$ and H_2O respectively are 1, 3 and 7

62. Answer (2)

Hint & Sol.: The correct structure of Br_3O_8 is



$\therefore$ The oxidation state of central 'Br' atom in Br_3O_8 is +4.

63. Answer (2)

Hint: In disproportionation reaction an element in is simultaneously gets oxidised as well reduced.

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

$3ClO_4^- \longrightarrow 2Cl^- + ClO_3^-$

$6ClO_2^- \longrightarrow 4ClO_3^- + Cl^-$

$4ClO_3^- \longrightarrow Cl^- + 3ClO_4^-$

64. Answer (1)

Hint: Catalyst does not affect equilibrium constant.

Sol.: Catalyst increases the rate of reaction by decrease of activation energy of the reaction.

65. Answer (2)

Hint & Sol.: Summation of the oxidation states of all elements in a neutral molecule/species will be zero.

So, A_2BC_5 = 2 (+3) + 1(+4) + 5(–2) = 0

66. Answer (2)

Hint: K_{sp} of $Mg(OH)_2$ will be $[Mg^{2+}]\,[OH^-]^2$

Sol.: $Mg(OH)_2(s) \rightleftharpoons \underset{s}{Mg^{2+}}(aq) + \underset{2s}{2OH^-}(aq)$

(Given: $2s = 10^{-6} \Rightarrow s = 5 \times 10^{-7}$)

$K_{sp} = [Mg^{2+}]\,[OH^-]^2 = 4s^3 = 4 \times 125 \times 10^{-21}$

$= 5 \times 10^{-19}$

67. Answer (1)

Hint: Metal of highest standard oxidation potential (SOP) will be of best reducing power.

Sol.: Order of SOP : B > A > C

So, order of reducing power : B > A > C

68. Answer (4)

Hint: Phosphorus is less electronegative than oxygen atom.

Sol.: $P_2O_7^{4-} \Rightarrow 2x + 7(-2) = -4,\ x = +5$

$PO_4^{3-} \Rightarrow y + 4(-2) = -3,\ y = +5$

$P_3O_9^{3-} \Rightarrow 3z + 9(-2) = -3,\ 3z = 15,\ z = +5$

69. Answer (4)

Hint: Both hydrogen and chlorine are monovalent in nature.

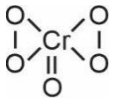
Sol.: C_2H_6: $2x + 6(+1) = 0,\ 2x = -6,\ x = -3$

C_2Cl_6: $2x + 6(-1) = 0,\ 2x = 6,\ x = +3$

So, changes in oxidation state: –3 to +3

70. Answer (4)

Hint: CrO_5 has four peroxy oxygen atoms and one oxygen atom is in (–2) oxidation state.

Sol.: 

Peroxy oxygen atoms are 4 which are of –1 oxidation state.

71. Answer (2)

Hint: Equilibrium constant only depends on temperature.

Sol.: With increase or decrease of concentration of any component do not change equilibrium constant.

72. Answer (1)

Hint: Increase of pressure, reaction will move towards the direction of decrease in number of gaseous moles.

Sol.: $CO(g) + 3H_2(g) \rightleftharpoons CH_4(g) + H_2O(g)$

So, as pressure increases, above equilibrium will shift in forward direction.

73. Answer (3)

Hint: Pressure of NO(g) at equilibrium will be its partial pressure.

Sol.: $N_2O_3(s) \rightleftharpoons \underset{P/2}{NO(g)} + \underset{P/2}{NO_2(g)}$

74. Answer (3)

Hint: CO_2 produced at equilibrium will be coming from decomposition of $CaCO_3$.

Sol.: $\because K_p = p_{CO_2} = 1.64$ atm

So, PV = nRT

$\Rightarrow$ 1.64 atm × 5 L = n × 0.0821 × 800

n = 0.125

So mass of $CaCO_3$ left = 80 – (0.125 × 100) = 80 – 12.5 = 67.5 g

75. Answer (2)

Hint: When an equilibrium reaction reverses then new equilibrium constant becomes reciprocal to the old equilibrium constant.

Sol.:

- $2HI(g) \rightleftharpoons H_2(g) + I_2(g) \quad K_c = 64$
- $H_2(g) + I_2 \rightleftharpoons 2HI \quad K_C' = \frac{1}{64}$
- $\frac{1}{2}H_2(g) + \frac{1}{2}I_2(g) \rightleftharpoons HI(g)$

$K_C'' = \left(\frac{1}{64}\right)^{\frac{1}{2}} = 0.125$

76. Answer (1)

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

$pK_w = pK_a + pK_b$

Sol.: OH^- ions from H_2O cannot be neglected in this case

$H_2O \rightleftharpoons H^+ + OH^- 10^{-8} M$

$\left[OH^-\right]_{total} = \left(10^{-8} + 10^{-7}\right) M$

pOH = –log $[10^{-8} + 10^{-7}]$ = 7 – log 1.1

= 7 – 0.04 = 6.96

pH = 14 – 6.96 = 7.04

77. Answer (1)

Hint: For a polyprotic weak acid, it is more difficult to remove a positively charged proton from a negative ion due to electrostatic forces.

Sol.: $H_3PO_4(aq) \overset{Ka_1}{\rightleftharpoons} H_2PO_4^-(aq) + H^+(aq)$

$H_2PO_4^-(aq) \overset{Ka_2}{\rightleftharpoons} HPO_4^{2-}(aq) + H^+(aq)$

It is more difficult to remove H^+ ion from $H_2PO_4^-$ (aq) or HPO_4^{2-} ion. Hence, $Ka_1 > Ka_2$ or Ka_3

78. Answer (2)

Hint: According to Le Chatelier's principle when we increase pressure, reaction proceeds in that direction where gaseous moles are decreasing.

Sol.: $2SO_2(g) + O_2 \rightleftharpoons 2SO_3(g)$

$\Delta H = -45.2$ Kcal

On increasing pressure, reaction moves towards product side. Hence, formation of $SO_3(g)$ takes place.

79. Answer (3)

Hint & Sol.: If $K_c > 10^3$, products predominate over reactants, *i.e.*, if K_c is very large, the reaction proceeds nearly to completion.

80. Answer (4)

Hint: For gaseous reaction, $K_p = K_c(RT)^{\Delta ng}$

Sol.: $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$

$\Delta_{ng} = 2 - (1+1) = 0$

$K_p = K_c(RT)^{\circ} = K_p = K_c$

81. Answer (1)

Hint & Sol.: Equilibrium is possible only in a closed system at a given temperature.

All measurable properties like concentration, pressure etc. of the system remain constant.

82. Answer (2)

Hint: For sparingly soluble salt

$A_xB_y(s) \rightleftharpoons xA^{y+}(aq) + yB^{x-}(aq)$

xs ys

$Ksp = \left[A^{y+}\right]^x \left[B^{x-}\right]^y$

$Ksp = (xs)^x (ys)^y = x^x \cdot y^y \cdot (s)^{x+y}$

Where 's' is solubility of sparingly soluble salt.

Sol.:

(i) $AB_2(s) \rightleftharpoons A^{2+}(aq) + 2B^-(aq)$

s 2s

$Ksp = (s)(2s)^2 = 4s^3$

(ii) $A_2B_3(s) \rightleftharpoons 2A^{3+}(aq) + 3B^{2-}(aq)$

2s 3s

$Ksp = (2s)^2(3s)^3 = 108s^5$

(iii) $AB(s) \rightleftharpoons A^+(aq) + B^-(aq)$

s s

$Ksp = (s)(s) = s^2$

(iv) $AB_3(s) \rightleftharpoons A^{3+}(aq) + 3B^-(aq)$

s 3s

$Ksp = (s)(3s)^3 = 27s^4$

83. Answer (1)

Hint: Solubility of common ion (F^-) is decided by KF.

Sol.: $MgF_2(s) \rightleftharpoons \underset{s}{Mg^{2+}(aq)} + \underset{(2s+0.05)\simeq 0.05}{2F^-(aq)}$

$K_{sp} = [Mg^{2+}][F^-]^2 = s \times (0.05)^2$

$\Rightarrow$ $6.5 \times 10^{-9} = s \times 25 \times 10^{-4}$

$s = \frac{6.5}{25} \times 10^{-5}$

$= 2.6 \times 10^{-6}$ M

84. Answer (1)

Hint: The species with central atom in it highest oxidation state (O.S.) can act as oxidising agent only.

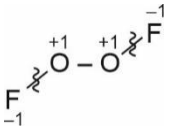
Sol.: In H_3PO_4, 'P' has maximum O.S. *i.e.* +5.

Hence, it acts only as an oxidising agent.

85. Answer (3)

Hint: The number assigned to oxygen depend upon the bonding of oxygen.

Sol.:



In O_2F_2, Oxygen is assigned an oxidation number of +1.

SECTION - B

86. Answer (4)

Hint & Sol.: On addition of starch after the liberation of iodine from the reaction of Cu^{2+} ions on iodide ions, an intense blue colour appears.

87. Answer (2)

Hint: Redox reactions are those in which both oxidation and reduction takes place.

Sol.:

- Combination redox reaction:

$CH_4(g) + 2O_2(g) \xrightarrow{\Delta} CO_2(g) + 2H_2O(l)$

- Decomposition redox solution:

$2KClO_3(s) \xrightarrow{\Delta} 2KCl(s) + 3O_2(g)$

- Metal displacement redox reaction:

$V_2O_5(s) + 5Ca(s) \xrightarrow{\Delta} 2V(s) + 5CaO(s)$

- Non-metal displacement redox reaction:

$Fe(s) + 2HCl(aq) \longrightarrow FeCl_2(aq) + H_2(g)$

88. Answer (3)

Hint & Sol.: Aurous chloride is AuCl having O.S. of Au = +1.

Auric chloride is $AuCl_3$ having O.S. of Au = +3.

Hg_2Cl_2 is the reduced form of $HgCl_2$.

89. Answer (2)

Hint: Salt of strong acid and strong base does not hydrolyse.

Sol.: Na_2SO_4 salt is formed from strong acid H_2SO_4 and strong base NaOH.

$\therefore$ Na_2SO_4 does not hydrolyse.

90. Answer (3)

Hint: For acidic buffer solution

$$pH = pKa + \log \frac{[salt]}{[acid]}$$

Sol.: [HX] = [X^-]

K_b of X^- = 10^{-10}

K_a of HA = 10^{-4}

$$pH = pKa + \log \frac{[salt]}{[acid]}$$

$$pH = 4 + \log \frac{[salt]}{[acid]}$$

pH = 4

91. Answer (1)

Hint & Sol.:

	$PCl_5(g)$	$\rightleftharpoons$	$PCl_3(g)$	$+ Cl_2(g)$
$t = 0$	C		0	0
t_{eq}	$C(1-\alpha)$		$C\alpha$	$C\alpha$

$$K_c = \frac{[PCl_3][Cl_2]}{[PCl_5]} = \frac{(C\alpha)(C\alpha)}{C(1-\alpha)}$$

$$K_c = \frac{C\alpha^2}{1-\alpha} \text{ where } 1 - \alpha \simeq 1$$

$K_c = C\alpha^2$

92. Answer (4)

Hints & Sol.:

- If the volume is kept constant and inert gas such as argon is added which does not take part in reaction, the equilibrium remains undisturbed.
- Addition of an inert gas at constant volume does not change the partial pressure or the molar concentration of the substance involved in the reaction.

93. Answer (1)

Hint: $E^\circ_{cell} = \underset{\text{Cathode}}{E^\circ(SRP)} - \underset{\text{Anode}}{E^\circ(SRP)}$

Sol.: Cell reaction:

$3Ni(s) + 2Au^{3+}(aq) \rightarrow 3Ni^{2+}(aq) + 2Au(s)$

E°_{cell} = 1.4 – (–0.25) = 1.4 + 0.25 = 1.65 V

94. Answer (4)

Hint: $KMnO_4$ behaves as self indicator.

Sol.: Due to its minimal overshoot in colour beyond the equivalence point, it is acting as self indicator.

95. Answer (4)

Hint: Summation of oxidation states of all elements in a species is equal to the charge present.

Sol.:

$\underline{N}_2O_5$: 2x + 5(–2) = 0, x = +5

$\underline{N}_2O_4$: 2y + 4 (–2) = 0, y = +4

$\underline{N}_3H$: 3z + 1(+1) = 0, $z = -\frac{1}{3}$

$\underline{N}_2H_4$: 2a + 4(+1) = 0, a = –2

96. Answer (4)

Hint: Change in O.S. of atom

= |Final O.S. – Initial O.S.|

Sol.: $\overset{+7}{\underline{Mn}}O_4^- \longrightarrow \overset{+4}{\underline{Mn}}O_2$

Change in O.S. of Mn is 3 *i.e.* from +7 to +4.

97. Answer (2)

Hint: $K_w = K_a \times K_b$

Sol. : $K_b = K_a/K_b = 10^{-14}/2 \times 10^{-5} = 5 \times 10^{-10}$

98. Answer (3)

Hint: $\Delta G^\circ = -2.303\ RT \log K_C$

Sol.: $57.44 \times 10^3 = -2.303 \times 8.314 \times 600 \times \log K_C$.

$5 = -\log K_C \Rightarrow K_C = 10^{-5}$

99. Answer (2)

Hint: At 25°C, K_W is equal to 10^{-14}

Sol.: In pure water, at 25°C, $[H^+]$ is equal to 10^{-7} M.

pH of concentrated solution of 1 M concentration will be zero.

As solution of highest pOH, leads to least basic character.

100. Answer (3)

Hint: In acidic medium $KMnO_4$ converts into Mn^{2+} and n-factor is 5.

Sol.:

$\overset{+3}{Fe_2}(\overset{+3}{C_2}O_4)_3 \Rightarrow \overset{+4}{CO_2}$

$n_f = 6$

$\overset{+3}{Fe}(\overset{+3}{NO_2})_3 \rightarrow \overset{+5}{NO_3^-}$

$n_f = 6$

$\overset{+2}{Fe}\overset{+4}{S}O_3 \rightarrow \overset{+3}{Fe} + SO_4^{2-}$

$n_f = 1 + 2 = 3$

$Fe_2(\overset{+4}{SO_3})_3 \rightarrow \overset{+6}{SO_4^{2-}}$

$n_f = 6$

For complete oxidation:

Equivalents of $KMnO_4$ = Equivalents of compound given

$(Moles)_{KMnO_4} \times 5 = (Moles)_{given\ compound} \times n\text{-factor}$

So, smaller is the value of n-factor of given compound, least is the quantities of $KMnO_4$ required.

BOTANY

SECTION-A

101. Answer (4)

Hint: Artificial system of classification were based mainly on gross superficial morphological characters.

Sol.: Artificial system of classification was given by Linnaeus. It included vegetative character or androecium structure.

102. Answer (1)

Hint: *Volvox* is a colonial alga.

Sol.: *Ulothrix* is a green filamentous alga, whereas *Chlamydomonas* is a unicellular algae. *Spirogyra* is also filamentous alga.

103. Answer (2)

Hint: Hydrocolloids are produced by brown or red algae.

Sol.: Brown algae produce algin.

Red algae produce carrageen.

104. Answer (4)

Hint: Red algae lack motile stages.

Sol.: *Gracilaria* and *Gelidium* are red algae.

Spirogyra produces non-motile gametes.

Volvox produces motile male gametes.

105. Answer (1)

Hint: Amphibians can live in water and on land as well.

Sol.: Bryophytes are called amphibians of plant kingdom as they require water for sexual reproduction.

106. Answer (4)

Hint: In *Marchantia* the male and female sex organs are produced on different thalli.

Sol.: Green algae has chlorophyll *a* and *b*. Brown algae has fucoxanthin as one of the major pigments.

107. Answer (3)

Hint: *Laminaria* is an alga.

Sol.: *Polytrichum* : Moss

Equisetum : Pteridophyte

Cycas : Gymnosperm

108. Answer (4)

Hint: It is a gametophytic structure.

Sol.: Male thallus of *Marchantia* is haploid in nature.

109. Answer (4)

Hint: This group of plants show haplodiplontic life cycle.

Sol.: Sporophyte is an independent main plant body in pteridophytes. Gametophyte is photosynthetic and independent in most of the pteridophytes.

110. Answer (4)

Hint: Gymnosperms produce naked seeds.

Sol.: *Salvinia* is a heterosporous species. Both *Pinus* and *Cedrus* have branched stems. In gymnosperms ovules are not enclosed by any ovary wall.

111. Answer (1)

Hint: Gymnosperms produce naked seeds.

Sol.: Prothallus represents the gametophyte in pteridophyte. Bryophytes and pteridophytes exhibits haplo-diplontic life cycle. Vascular bundles are absent in bryophytes.

112. Answer (3)

Hint: Both in bryophytes and pteridophytes the gametophyte is haploid.

Sol.: The main plant body of bryophytes and pteridophytes are gametophyte and sporophyte respectively.

113. Answer (3)

Hint: In Bryophytes, antheridium is surrounded by a sterile jacket which encloses mass of sperm cells that produces biflagellate antherozoids.

Sol.: *Cycas* is dioecious and their stems are unbranched.

114. Answer (1)

Hint: Pyrenoids contain protein besides starch in green algae.

Sol.: Floridean starch is present in red algae as stored food.

115. Answer (3)

Hint: Motile gametes are found in green and brown algae.

Sol.: Zoospores in brown algae have 2 unequal flagella that are attached laterally. Flagella are absent in red algae.

116. Answer (4)

Hint: Numerical taxonomy involves usage of numerical methods for the evaluation of similarities and differences between species with the help of computer.

Sol.: Cytotaxonomy is based on cytological information like chromosome number, structures and behaviour. Numerical taxonomy is based on all observable characters.

117. Answer (2)

Hint: Brown algae are rich source of Iodine.

Sol.: *Fucus* and *Laminaria* are rich source of iodine.

118. Answer (1)

Hint: Both ovules and archegonia are seen in gymnosperms.

Sol.: *Ginkgo* is a gymnosperm. Multicellular female gametophyte bears two or more archegonia in gymnosperms. *Pteris* and *Salvinia* show only the presence of archegonia. Mustard shows only the presence of ovules.

119. Answer (4)

Hint: Secondary nucleus is formed by fusion of two polar nuclei.

Sol.: Secondary nucleus is diploid. Rest all are haploid.

120. Answer (3)

Hint: This event can be observed in pteridophytes.

Sol.: *Selaginella* and *Salvinia* are heterosporous species of pteridophytes and show event precursor to seed habit.

121. Answer (2)

Hint: Water helps in fertilisation process in ferns.

Sol.: In ferns, pollen grains are not formed. Pollen tube is formed in gymnosperm and angiosperms.

122. Answer (2)

Hint: Gymnosperms produce smaller microspore and larger megaspore.

Sol.: All gymnosperms are heterosporous. The *Sequoia* (red wood tree) is one of the tallest tree species.

123. Answer (3)

Hint: Chlorophyceae are green algae.

Sol.: Green algae have chlorophyll *a* & *b* as the major pigments.

124. Answer (4)

Hint: Conifers are well adapted to tolerate extreme conditions as they have features such as, needle like leaves.

Sol.: Vessels are absent in gymnosperms. Sunken stomata and thick cuticle also help in reducing water loss.

125. Answer (4)

Hint: Algae shows usually haplontic life cycle but with few exceptions.

Sol.: Life cycle of *Fucus* is diplontic. Life cycle of *Polysiphonia* is haplo-diplontic.

126. Answer (1)

Hint: Gametophyte is not independent in gymnosperms.

Sol.: In *Marchantia*, *Funaria* and *Pteris,* gametophyte is independent. Unlike bryophytes and pteridophytes in gymnosperms, e.g. *Pinus*, the male and female gametophyte do not have an independent free-living existence.

127. Answer (4)

Hint: *Lycopodium* and *Dryopteris* produce single kind of spores.

Sol.: Pteridophytes are the first terrestrial vascular plants. In pteridophytes, the sporophylls bear sporangia.

128. Answer (4)

Sol: Peat has been used as packing material for trans-shipment of living materials because of their capacity to hold water.

129. Answer (1)

Hint: Microspore is produced in the microsporangium.

MMC/PMC $\xrightarrow{\text{meiosis}}$ microspore.

Sol.: Microspore develops into pollen grains. Anther encloses microsporangia, where the PMC (Pollen Mother Cell) undergoes sporic meiosis to form microspore. Megaspore develops into embryo sac.

130. Answer (3)

Hint: *Spirulina* are rich in proteins.

Sol.: Brown algae have cell wall made up of cellulose which is usually covered on the outside by a gelatinous coating of algin. *Spirulina* is used as a food supplement even by space travellers.

131. Answer (4)

Hint: Bryophytes are found commonly in damp, humid and shaded localities.

Sol.: The plant body of bryophytes is more differentiated than that of algae. The gametophyte has multicellular sex organs. The sporophyte is differentiated into capsule, seta and foot.

132. Answer (3)

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

Sol.: *Fucus*, *Laminaria*, *Ectocarpous* are brown algae. *Chara* and *Volvox* are green algae.

133. Answer (2)

Hint: In angiosperms, endosperm is triploid in nature.

Sol.: Endosperm formation in angiosperm is a result of triple fusion. In this fusion of a male gamete with the secondary nucleus forms triploid primary endosperm nucleus (PEN). PEN develops into endosperm.

134. Answer (3)

Hint: Leaves of *Gingko biloba* are fan shaped.

Sol.: Coralloid roots of *Cycas* are associated with nitrogen fixing cyanobacteria.

135. Answer (1)

Sol.: *Chara* is an example of green algae. Green algae are usually green due to the dominance of pigments chlorophyll *a* and *b*.

SECTION - B

136. Answer (1)

Hint: Mosses along with lichens are the first organisms to colonise rocks.

Sol.: *Eudorina* exhibits anisogamous sexual reproduction. Seed inside the fruit represents the sporophyte generation. Male sex organ in bryophytes is surrounded by a sterile jacket. The sporophyte in mosses is more elaborate than liverworts.

137. Answer (1)

Hint: Angiosperms are flowering plants.

Sol.: Angiosperms do not show the presence of cones but do show the presence of cotyledons, reticulate venation in leaves and haploid megaspores.

138. Answer (2)

Hint: Sporophyte of mosses consists of foot, seta and capsule.

Sol.: The leafy stage in mosses consist of upright, slender axis bearing spirally arranged leaves. Rhizoids are multicellular and branched.

139. Answer (4)

Hint: Angiosperms are heterosporous.

Sol.: Algae are considered as non-embryophtes.

140. Answer (3)

Hint: Embryo formation does not take place in algae.

Sol.: Embryo formation occurs in bryophytes, pteridophytes, gymnosperms and angiosperms.

141. Answer (4)

Hint: Male gametes are motile in pteridophytes.

Sol.: The reduced male gametophyte in gymnosperms is called pollen grain.

Synergids and antipodal cells degenerate after fertilization.

142. Answer (4)

Hint: Antheridium produces biflagellate antherozoids in bryophytes and pteridophytes.

Sol.: In angiosperms, female reproductive structure is pistil. In gymnosperms, pollination occurs through air currents.

Water is required for movement of antherozoids from antheridium to archegonium.

143. Answer (1)

Hint: Zygote is formed when male and female gametes fuse.

Sol.: Ovule develops into seed and ovary develops into fruit after fertilization.

144. Answer (1)

Hint: *Pteris* and *Adiantum* belong to the class Pteropsida.

Sol.: *Lycopodium* belongs to the class Lycopsida. *Equisetum* belongs to the class Sphenopsida.

145. Answer (3)

Hint: Mannitol is stored food in brown algae.

Sol.: *Fucus* is a brown alga.

146. Answer (1)

Hint: *Adiantum* is a pteridophyte.

Sol.: Pteridophytes possess vascular tissues but no fruits and seeds.

147. Answer (2)

Hint: Peat is provided by a moss.

Sol.: *Sphagnum* is a moss. *Spirogyra* is an alga. *Salvinia* and *Selaginella* are pteridophytes.

148. Answer (1)

Hint: Mosses are bryophytes.

Sol.: Protonema as a juvenile gametophytic stage is seen in bryophytes.

149. Answer (3)

Hint: *Fucus* and *Volvox* show oogamous type of reproduction.

Sol.: Both *Fucus* and *Volvox* have smaller motile male gamete and larger static female gamete and their fusion is considered as oogamy.

150. Answer (2)

Hint: Some pteridophytes may flourish well in sandy soil conditions.

Sol.: Double fertilisation involves syngamy and triple fusion.

ZOOLOGY

SECTION-A

151. Answer (4)

Hint: It undergoes transverse binary fission.

Sol.: In *Paramoecium*, cilia helps in the movement of food through cytopharynx and in locomotion as well.

In *Amoeba*, amoeboid movement occurs. It is effected by pseudopodia formed by the streaming of cytoplasm.

Hydra can use its tentacles for capturing its prey and also use them for locomotion.

Flagellar movement helps in the locomotion of *Euglena*.

152. Answer (2)

Hint: Less than 60%

Sol.: Muscle is a specialised tissue of mesodermal origin.

About 40-50% of the weight of a human adult is contributed by muscles under normal conditions.

153. Answer (4)

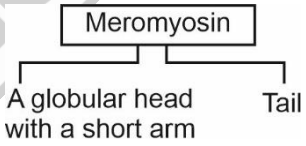
Hint: Facilitated by ciliary movement

Sol.: Ciliary movement occurs in most of our internal tubular organs which are lined by ciliated epithelium. Passage of ova through the female reproductive tract is also facilitated by the ciliary movement. Flagellar movement helps in the swimming of spermatozoa, maintenance of water current in canal system of sponges and in locomotion of *Euglena*.

154. Answer (2)

Hint: Has active sites for actin

Sol.: Many monomeric proteins called meromyosins constitute one thick filament.



The globular head is an active ATPase enzyme and has binding sites for ATP and active sites for actin.

Each 'F' actin is a polymer of monomeric 'G' actins. Troponin is distributed at regular intervals on the tropomyosin.

155. Answer (4)

Hint: Found in the cerebral cortex

Sol.:

Neurons

Unipolar	Bipolar	Multipolar
Cell body with one axon and no dendrite	Cell body with one axon and one dendrite	Cell body with one axon and two or more dendrites
Found usually in the embryonic stage in humans	Found in the retina of the human eye	Found in the cerebral cortex

156. Answer (3)

Hint: Attached to the axon terminal

Sol.: The axon is a long fibre, the distal end of which is branched. Each branch terminates as a bulb like structure called synaptic knob which possesses synaptic vesicles containing chemicals called neurotransmitters. The cell body contains cytoplasm with typical cell organelles and certain granular bodies called Nissl's granules. Schwann cells form a myelin sheath around the axon. Dendrites transmit the impulses towards the cell body of neuron.

157. Answer (3)

Hint: Glands with duct

Sol.: Hormones are non-nutrient chemicals which act as intercellular messengers and are produced in trace amounts. Endocrine glands lack ducts and hence, called ductless glands. Their secretions are called hormones.

158. Answer (4)

Hint: It has the size of a clenched fist.

Sol.: Pituitary, pineal, thyroid, adrenal, pancreas, parathyroid gland, thymus and gonads are the organised endocrine bodies in our body. In addition to these, some other organs *e.g.*, gastrointestinal tract, kidney, heart also produce hormones. ANF is produced by the atrial wall of heart.

159. Answer (3)

Hint: Exclude hormone from GIT

Sol.: Somatostatin secreted from the hypothalamus inhibits the release of growth hormone. GIP inhibits gastric secretion and motility.

GnRH (secreted by hypothalamus) stimulates the synthesis and release of gonadotrophins. Prolactin (secreted by adenohypophysis) regulates the growth of mammary glands and formation of milk in them.

160. Answer (4)

Hint: Function of PTH

Sol.: The pineal gland is located on the dorsal side of forebrain. Pineal gland secretes a hormone called melatonin. Melatonin plays a very important role in the regulation of a 24-hour rhythm of our body.

It helps in maintaining the normal rhythms of sleep-wake cycle, body temperature, *etc*. Parathyroid hormone increases the Ca^{2+} levels in the blood and stimulates the reabsorption of Ca^{2+} by renal tubules.

161. Answer (3)

Hint: Possess Nissl's granules

Sol.: The cerebral cortex is referred to as the grey matter due to its greyish appearance. The neuron cell bodies are concentrated here giving the colour.

Fibres of the tracts are covered with the myelin sheath, which constitute the inner part of cerebral hemisphere. They give an opaque white appearance to the layer and hence, is called the white matter.

162. Answer (4)

Hint: Aldosterone increases osmolarity of body fluid.

Sol.: Aldosterone acts mainly at distal tubules and stimulates the reabsorption of Na^+ and water and excretion of K^+ and phosphate ions.

163. Answer (4)

Hint: Amygdala, hippocampus, hypothalamus, *etc*., constitute the limbic system.

Sol.: The inner parts of cerebral hemispheres and a group of associated deep structures like amygdala, hippocampus, *etc*., form a complex structure called the limbic system. Along with hypothalamus, it is involved in the regulation of sexual behaviour, expression of emotional reactions and motivation. Olfactory bulbs are the extensions of the brain's limbic system and hypothalamus controls autonomic responses.

164. Answer (4)

Hint: Neurotransmitters are released at synaptic cleft.

Sol.: When an impulse arrives at the axon terminal, it stimulates the movement of the synaptic vesicles towards the membrane where they fuse with the plasma membrane and release their neurotransmitters in the synaptic cleft. The released neurotransmitters bind to their specific receptors, present on the post-synaptic membrane.

165. Answer (3)

Hint: This process maintains the ionic gradients across the resting plasma membrane.

Sol.: Neurons are excitable cells because their membranes are in a polarised state.

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

The ionic gradients across the resting membrane are maintained by the active transport of ions by the sodium-potassium pump which transports 3 Na^+ outwards for $2K^+$ into the cell.

166. Answer (3)

Hint: Occurs mostly due to genetic disorder

Sol.: **Muscular dystrophy:** Progressive degeneration of skeletal muscle mostly due to genetic disorder.

Tetany: Rapid spasms (wild contractions) in muscles due to low Ca^{++} in body fluid.

Arthritis: Inflammation of joints.

Gout: Accumulation of uric acid crystals in joints.

167. Answer (2)

Hint: Included in the skull

Sol.: The single U-shaped bone present at the base of the buccal cavity is hyoid.

Malleus, incus and stapes are ear ossicles. Patella covers the knee ventrally.

168. Answer (2)

Hint: Middle of 'A' band

Sol.: The central part of thick filament not overlapped by thin filament is called the 'H' zone.

The thick filament in the middle of 'A' band are held together by thin fibrous membrane called 'M' line.

Sarcomere is the functional unit of contraction. Middle part of 'I' band contains a densely stained membrane called 'Z' line.

169. Answer (2)

Hint: Also called visceral muscles

Sol.: Visceral muscles are located in the inner wall of hollow visceral organs.

Smooth muscles assist in the transportation of food through the digestive tract and gametes through the genital tract.

Skeletal muscles are voluntary in nature and striated in appearance.

170. Answer (2)

Hint: A cup shaped bone

Sol.: A cup shaped bone called patella covers the knee ventrally. Each clavicle is a long slender bone with two curvatures. This bone is commonly called collar bone.

Femur is a thigh bone.

The bone of the limbs along with their girdles constitute the appendicular skeleton. Each limb is made of 30 bones.

171. Answer (3)

Hint: This joint is also present in the bones of ankle.

Sol.: Synovial joints are characterised by the presence of a fluid filled synovial cavity between the articulating surfaces of the two bones.

Ball and socket joint: Between humerus and pectoral girdle

Hinge joint: Knee joint

Pivot joint: Between atlas and axis

Gliding joint: Between the carpals

Saddle joint: Between carpal and metacarpal of human thumb

172. Answer (4)

Hint: Actin filaments are pulled towards the centre of 'A' band.

Sol.: The events that occur during the contraction of skeletal muscles are:

- Shortening of the sarcomere
- No change in the length of 'A' band
- Reduction in the length of 'I' band
- Disappearance of 'H' zone at complete contraction

173. Answer (1)

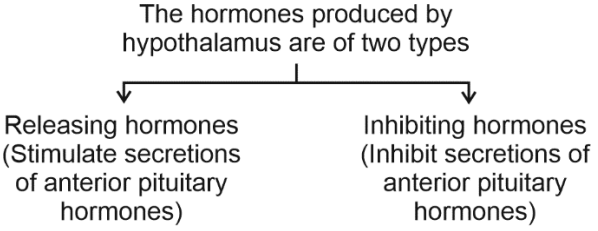
Hint: It is a part of diencephalon.

Sol.: The cerebrum wraps around thalamus which is a major coordinating centre for sensory and motor signaling. The hindbrain comprises pons, cerebellum and medulla. The forebrain consists of cerebrum, thalamus and hypothalamus.

174. Answer (4)

Hint: Master of master endocrine gland

Sol.: The hypothalamus is the basal part of diencephalon, forebrain. It regulates a wide spectrum of body functions.



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

175. Answer (1)

Hint: Located behind sternum on the ventral side of aorta

Sol.: The thymus plays a major role in the development of the immune system. This gland secretes thymosins. Thymus is degenerated in old individuals resulting in the decreased production of thymosins. As a result, the immune responses of old persons become weak.

The thyroid gland is composed of two lobes which are located on either side of the trachea.

The pineal gland is located on the dorsal side of forebrain. The pituitary gland is located in a bony cavity called sella tursica and is attached to hypothalamus.

176. Answer (4)

Hint: Identify a hypothalamic hormone.

Sol.: Thyroxine, testosterone and glucocorticoids support the process of formation of RBCs (erythropoiesis).

Vasopressin or ADH is synthesized by hypothalamus. Vasopressin acts mainly at the kidney and stimulates reabsorption of water and electrolytes by the distal tubules.

177. Answer (3)

Hint: Multiple of three

Sol.: The pars distalis region of pituitary, commonly called anterior pituitary, produces GH (growth hormone), PRL (prolactin), TSH (thyroid-stimulating hormone), ACTH (adrenocorticotrophic hormone), LH (luteinising hormone), FSH (follicle stimulating hormone). They all are considered as trophic hormones.

178. Answer (1)

Hint: Identify a pituitary hormone.

Sol.: Hormones which interact with membrane-bound receptors normally do not enter the target cell, but generate second messengers (*e.g.*, cyclic AMP, IP_3, Ca^{++}, *etc.*) which in turn regulate cellular metabolism. Hormones which interact with intracellular receptors (*e.g.*, steroid hormones, iodothyronines, *etc*.) mostly regulate gene expression or chromosome function by the interaction of hormone-receptor complex with the genome.

179. Answer (1)

Hint: Emergency condition

Sol.: The adrenal medulla secretes catecholamines. Adrenaline and noradrenaline are rapidly secreted in response to stress of any kind and during emergency situations and are called emergency hormones.

These hormones increase alertness, pupilary dilation, piloerection, sweating, *etc*.

Both the hormones increase the heart beat and the rate of respiration.

It stimulates the breakdown of glycogen resulting in an increased concentration of glucose in blood.

180. Answer (2)

Hint: The number of cervical vertebrae are seven in almost all mammals.

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

181. Answer (4)

Hint: Structure of false ribs

Sol.: There are 12 pairs of ribs. Each rib is a thin flat bone connected dorsally to the vertebral column and ventrally to the sternum. It has two articulation surfaces on its dorsal end and is hence called bicephalic. First seven pairs of ribs are called true ribs. Dorsally, they are attached to the thoracic vertebrae and ventrally connected to the sternum with the help of hyaline cartilage. The 8^{th}, 9^{th} and 10^{th} pairs of ribs do not articulate directly with the sternum but join the seventh rib with the help of hyaline cartilage. These are called vertebrochondral (false) ribs.

182. Answer (2)

Hint: Does not involve neurotransmitters

Sol.: A synapse is formed by the membranes of a pre-synaptic neuron and a post-synaptic neuron, which may or may not be separated by a gap called synaptic cleft. There are two types of synapses namely, electrical synapses and chemical synapses. At electrical synapses, the membranes of pre- and post-synaptic neurons are in very close proximity.

Electrical synapses are rare in our system.

183. Answer (3)

Hint: Function of hypothalamus

Sol.: Midbrain, pons and medulla oblongata form the brain stem.

Medulla is the terminal portion of brain stem and continues posteriorly with the spinal cord.

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

184. Answer (2)

Hint: Include an insect

Sol.: The neural organisation is very simple in lower vertebrates. For example, in *Hydra* it is composed of a network of neurons. The neural system is better organised in insects, where a brain is present along with a number of ganglia and neural tissues. The vertebrates have a more developed neural system.

185. Answer (1)

Hint: Action potential is termed as nerve impulse

Sol.: During depolarisation of a neuron, Na^+ move inside to the intracellular fluid of axon by voltage gated channels.

The rise in the stimulus-induced permeability to Na^+ is extremely short-lived. It is quickly followed by a rise in permeability to K^+. Within a fraction of a second, K^+ diffuses outside the membrane and restores the resting potential of the membrane at the site of excitation and the fibre becomes once more responsive to further stimulation.

SECTION - B

186. Answer (4)

Hint: Associated with medulla oblongata

Sol.: The vomit centre is present in medulla oblongata. The hindbrain comprises pons, cerebellum and medulla oblongata. The cerebellum integrates information received from the semicircular canals of the ear and auditory system.

187. Answer (2)

Hint: A form of hyperthyroidism

Sol.: Exophthalmic goitre or Graves' disease is a form of hyperthryoidism.

Deficiency of ADH leads to diabetes insipidus. Underproduction of hormones by adrenal cortex alters carbohydrate metabolism causing acute weakness and fatigue leading to Addison's disease.

188. Answer (4)

Hint: Exclude the function of glucagon

Sol.: Pancreas is a composite gland which acts as both exocrine and endocrine gland. The two main types of cells in the Islet of Langerhans are called α-cells and β-cells. The α-cells secrete a hormone called glucagon, while the β-cells secrete insulin. Glucagon acts mainly on the hepatocytes and stimulates glycogenolysis resulting in an increased blood sugar level (hyperglycemia).

189. Answer (2)

Hint: Jaw bone is a single bone.

Sol.: Ethmoid and sphenoid are unpaired cranial bones. Sacrum (1) and coccyx (1) are fused bones in adult humans. Maxilla and zygomatic are paired facial bones.

190. Answer (2)

Hint: Exclude the thin elastic membrane present above hair cells

Sol.: The membranes constituting cochlea, the Reissner's and basilar, divide the surrounding perilymph filled bony labyrinth into an upper scala vestibuli and a lower scala tympani.

191. Answer (4)

Hint: The aqueous chamber contains aqueous humor.

Sol.: The anterior portion of sclera is called cornea.

Cornea consists of dense matrix of collagen and is the most sensitive portion of the eye.

Myelin sheath is produced by Schwann cells (in PNS) and oligodendrocytes (in CNS).

The middle ear contains three ossicles called malleus, incus and stapes. The ear ossicles increase the efficiency of transmission of sound waves to the inner ear.

192. Answer (2)

Hint: Fibrous joint

Sol.: Fibrous joint do not allow any movement.

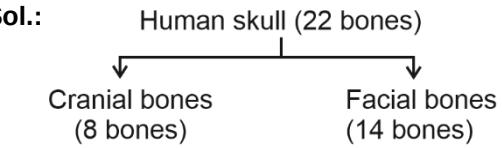
This type of joint is shown by the flat skull bones which fuse end-to-end with the help of dense fibrous connective tissues in the form of sutures.

Shoulder joint is a type of synovial joint.

193. Answer (2)

Hint: Two less than the total number of fingers in hind limbs

Sol.:



The number of carpals in one forelimb = 8

The number of tarsals in one hindlimb = 7

194. Answer (4)

Hint: Feature of white muscle fibres

Sol.: Myoglobin content is high in red muscle fibres and these muscles contain plenty of mitochondria which can utilise the large amounts of oxygen stored in them for ATP production. These muscles, therefore can also be called aerobic muscles. The amount of sarcoplasmic reticulum is high in white muscle fibres.

195. Answer (1)

Hint: Iodothyronines require iodine for its formation.

Sol.: Iodine is a rate-limiting element for the synthesis of thyroid hormones.

Deficiency of iodine in our body results in hypothyroidism. Iodine is essential for the normal rate of synthesis of thyroxine.

196. Answer (2)

Hint: Monosynaptic reflex

Sol.: Knee-jerk reflex is a monosynaptic reflex *i.e*., interneurons are not involved.

So, there will be no effect on the knee jerk reflex *i.e*, normal reflex action will occur even if interneurons are blocked.

197. Answer (3)

Hint: Tract of nerve fibres

Sol.: Bipolar neurons (with one axon and one dendrite) are found in retina of human eye. Unmyelinated nerve fibres are commonly found in autonomous and somatic neural systems.

The cerebral hemispheres are connected by a tract of nerve fibres called corpus callosum. The layer of cells which covers the cerebral hemispheres is called cortex and is thrown into prominent folds.

Brain stem forms the connection between the brain and spinal cord.

198. Answer (3)

Hint: CNS includes the brain and the spinal cord.

Sol.: The somatic neural system relays impulses from the CNS to skeletal muscles, while the autonomic neural system transmits impulses from the CNS to the involuntary organs and smooth muscles of the body.

Visceral nervous system is the part of peripheral nervous system.

199. Answer (2)

Hint: Equal to the number of ear ossicles in right ear

Sol.: On the basis of their chemical nature, hormones can be divided into groups:

(i) **Peptide, polypeptide, protein hormones** [*e.g*.: insulin, glucagon, pituitary hormones, hypothalamic hormones, *etc*]

(ii) **Steroids** [*e.g.*: cortisol, testosterone, estradiol and progesterone]

(iii) **Iodothyronines** [*e.g.*: thyroid hormone]

(iv) **Amino-acid derivatives** [*e.g.*: epinephrine]

200. Answer (2)

Hint: GnRH stands for gonadotrophin releasing hormone.

Sol.:

ACTH	–	Stimulates the secretion of glucocorticoids
GIP	–	Inhibits gastric secretion and motility
CCK	–	Acts on pancreas and stimulates its exocrine secretion
GnRH	–	Stimulates the adenohypophysis to release gonadotrophins

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