

All India Aakash Test Series for NEET - 2025

TEST - 4 (Code-C)

Test Date : 21/01/2024

ANSWERS

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

Hints & Solutions

PHYSICS

SECTION-A

1. Answer (2)

Hint: Use $\omega = \frac{d\theta}{dt}$

Sol.: Angle turned = area under the graph

$$= \frac{1}{2} \times 20 \times 10 + 10 \times 20 + \frac{1}{2} \times 20 \times 10$$

$$= 20 \times 10 + 20 \times 10$$

$$= 400$$

2. Answer (4)

Hint: Use $\tau = I\alpha$ i.e., torque becomes zero when angular acceleration becomes zero.

Sol.: $\omega = \frac{d\theta}{dt} = 9t^2 - 6t + 6 \Rightarrow \alpha = \frac{d\omega}{dt} = 18t - 6$

For $\alpha = 0$, $t = \frac{1}{3}$ s

3. Answer (4)

Hint: Use $P_{\text{avg}} = \frac{W}{t}$ and $W = \Delta KE$

Sol.: $P = \frac{\Delta KE}{\Delta t} = \frac{\frac{1}{2} \times 5 \times 40 \times 40}{5} = 800$ W

4. Answer (3)

Hint: Use parallel axis theorem

Sol.: $I_1 = \frac{2}{3}mr^2$, $I_2 = I_3 = \frac{2}{3}mr^2 + mr^2 = \frac{5mr^2}{3}$

$$\Rightarrow I_1 + I_2 + I_3 = \frac{2mr^2}{3} + \frac{10mr^2}{3} = 4mr^2$$

5. Answer (3)

Hint: Orbital velocity, $v = \sqrt{\frac{GM}{r_e + h}}$,

where $r_e \rightarrow$ radius of earth

$h \rightarrow$ height of orbit

Sol.: $v \propto \frac{1}{\sqrt{r_e + h}} \Rightarrow \frac{v_P}{v_Q} = \sqrt{\frac{r_e + h_2}{r_e + h_1}}$

6. Answer (3)

Hint & Sol.: Since the point C lies at maximum distance from sun hence linear velocity at C point will be minimum.

7. Answer (2)

Hint: Use $v = r\omega$ [Relation between angular speed and linear speed in circular motion]

Sol.: $\omega = \frac{120 \times 2\pi}{60} = 4\pi$ rad/s

$$\Rightarrow v = 2 \times 4\pi = 8\pi \text{ m s}^{-1}$$

8. Answer (1)

Hint: Use $\vec{\tau} = \frac{d\vec{L}}{dt}$ [Newton's second law for rotational motion]

Sol.: $\tau_{\text{avg}} = \frac{\Delta L}{\Delta t} = \frac{2 \times 25}{10} = 5$ N m

9. Answer (2)

Hint & Sol.: $I_{\text{Solid sphere about dia}} = \frac{2}{5}MR^2$

10. Answer (1)

Hint: Escape velocity, $v_e = \sqrt{\frac{2GM}{R}}$

Orbital velocity, $v_o = \sqrt{\frac{GM}{R}}$

Sol.: \Rightarrow Hence $v_o = \frac{v_e}{\sqrt{2}}$

11. Answer (2)

Hint: Use $\vec{r}_{\text{COM}} = \frac{M_1\vec{r}_1 + M_2\vec{r}_2}{M_1 + M_2}$

Sol.:

$$\vec{r}_{\text{COM}} = \frac{-4\hat{i} + 4\hat{j} + 8\hat{k} + 20\hat{i} - 15\hat{j} + 5\hat{k}}{9} = \frac{16\hat{i} - 11\hat{j} + 13\hat{k}}{9}$$

12. Answer (3)

Hint: Use conservation of angular momentum.

Sol.: $I_1\omega_1 = I_2\omega_2 \Rightarrow mr_1^2 \times \frac{2\pi}{T_1} = mr_2^2 \times \frac{2\pi}{T_2}$

$$T_1 = 8\text{ s}, r_1 = r, r_2 = \frac{r}{4}$$

$$\Rightarrow T_2 = \frac{1}{2}\text{ s}$$

13. Answer (3)

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

Sol.: $\alpha_{avg} = \frac{\Delta\omega}{\Delta t} = \frac{2\pi \times 40 - 2\pi \times 25}{6} = 5\pi \text{ rad/s}^2$

14. Answer (3)

Hint: Use parallel axis theorem

Sol.: $I = \frac{MR^2}{2}$ and $I' = 2MR^2 \Rightarrow I' = 4I$

15. Answer (1)

Hint & Sol.: For $r_1 < r < r_2$, the mass enclosed will be M_1 hence gravitational field intensity $= \frac{GM_1}{r^2}$.

16. Answer (3)

Hint: $V_0 = \sqrt{\frac{GM}{R+h}}$ [Expression for orbital velocity of a satellite at a height h from surface of earth]

Sol.: Since the projected velocity is equal to orbital velocity hence the object will start rotating around earth in circular orbit.

17. Answer (3)

Hint: $I = -\frac{\partial v}{\partial x}\hat{i} - \frac{\partial v}{\partial y}\hat{j} - \frac{\partial v}{\partial z}\hat{k}$ [Relation between gravitational potential and gravitational field intensity]

Sol.: $\vec{T} = +3\hat{i} + 2\hat{j} + 5\hat{k}$
 $\Rightarrow \vec{T} = (3\hat{i} + 2\hat{j} + 5\hat{k}) \text{ N/kg}$

18. Answer (1)

Hint: Use Kepler's third law

Sol.: From Kepler's third law we know that, $T^2 \propto R^3$

$\Rightarrow \frac{T^2}{(T')^2} = \frac{8R^3}{64R^3}$

$\Rightarrow T' = 2\sqrt{2}T$

19. Answer (3)

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

Sol.: $V_R = \frac{-Gm}{\sqrt{2}L} + \frac{(-Gm)}{\sqrt{2}L} = -\frac{Gm \times 2}{\sqrt{2}L} = -\frac{\sqrt{2}Gm}{L}$

20. Answer (2)

Hint: \Rightarrow Total energy of satellite $= -\frac{GmM_e}{2(R_e + h)}$

Sol.: \Rightarrow Energy required = Difference of total energy

$\Rightarrow (T.E)_f - (T.E)_i = -\frac{GmM}{2 \times 6R_e} + \frac{GmM}{2 \times 4R_e}$

$= -\frac{GmM}{12R_e} + \frac{GmM}{8R_e} = \frac{GmM}{24R_e}$

21. Answer (1)

Hint & Sol.: The moment of inertia of a uniform rod of length l and mass m about an axis perpendicular to length of rod and passing through one end is $\frac{ml^2}{3}$.

22. Answer (4)

Hint: Use conservation of energy.

Sol.: Work done $= \Delta U$ as $\Delta K.E = 0$ because it is moved slowly.

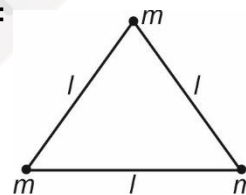
$\Rightarrow W = \Delta U = U_f - U_i = -\frac{GmM}{R} + \frac{GmM}{R} = 0$

23. Answer (3)

Hint: Gravitational potential energy of a two point mass system separated by distance r ,

$U = -\frac{Gm_1m_2}{r}$

Sol.:



$U_{system} = -\frac{Gm^2}{l} - \frac{Gm^2}{l} - \frac{Gm^2}{l}$
 $= \frac{-3Gm^2}{l}$

24. Answer (1)

Hint & Sol: For a satellite moving in circular orbit P.E = 2 T.E and K.E = - T.E

25. Answer (2)

Hint: MOI of rod about on axis passing through one end is $\frac{ML^2}{3}$

Sol.: $I = \frac{ML^2}{3} + \frac{ML^2}{3} = \frac{2ML^2}{3}$

26. Answer (2)

Hint & Sol: Gravitational field intensity due to solid sphere

$$\text{for } r < R, I = \frac{GMr}{R^3}, \text{ for } r \geq R, I = \frac{Gm}{r^2}$$

27. Answer (4)

Hint & Sol: Gravitational potential due to a uniform spherical shell is given by

$$V = -\frac{GM}{r} [\text{for } r > R] \text{ and inside the shell it}$$

remains constant and equal to $-\frac{GM}{R}$

28. Answer (4)

Hint: The expression for acceleration due to gravity in terms of average mass density ρ and radius R is $\frac{4\pi G\rho R}{3}$

$$\text{Sol.: } g \propto R \Rightarrow \frac{g_1}{g_2} = \frac{2}{3}$$

29. Answer (3)

Hint: Gravitational force between two point masses separated by distance r , $F = \frac{Gm_1m_2}{r^2}$

Sol.:

$$F_{1,2} = \frac{Gm_1m_2}{r^2} \text{ and } F_{2,1} = \frac{Gm_1m_2}{r^2} \Rightarrow \text{ratio} = 1:1$$

30. Answer (2)

Hint: Escape speed for a body is given by

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

$$\text{Sol.: } V_e = \sqrt{\frac{2G}{R} \times \rho \times \frac{4\pi R^3}{3}}$$

$$\Rightarrow V_e \propto \sqrt{\rho} \times R$$

$$\Rightarrow \frac{V_o}{V'} = \sqrt{\frac{\rho}{2\rho}} \times \frac{R}{\frac{R}{2}}$$

$$\Rightarrow \frac{V_o}{V'} = \sqrt{\frac{1}{2}} \times 2$$

$$\Rightarrow \frac{V_o}{V'} = \frac{\sqrt{2}}{1}$$

$$\Rightarrow V' = \frac{V_o}{\sqrt{2}}$$

31. Answer (1)

Hint: Variation in acceleration due to gravity above the surface of earth is given by $g_h = g \left[\frac{R}{R+h} \right]^2$

$$\text{Sol.: } g_h = g \left[\frac{R}{R + \frac{R}{2}} \right]^2$$

$$\Rightarrow g_h = g \left[\frac{2R}{3R} \right]^2$$

$$\Rightarrow g_h = \frac{4g}{9}$$

32. Answer (2)

Hint: Potential energy of a body lying at a distance R from centre of earth $U = -\frac{GMm}{R}$

$$\text{Sol.: } U_i = -\frac{GMm}{R}, U_f = -\frac{GMm}{3R}$$

$$\Rightarrow \Delta U = -\frac{GMm}{3R} + \frac{GMm}{R}$$

$$\Rightarrow \Delta U = \frac{GMm}{R} \times \frac{2}{3} = \frac{2}{3} \times \frac{m}{R} \times gR^2 = \frac{2mgR}{3}$$

33. Answer (4)

Hint: $V_e = \sqrt{\frac{2GM}{R}}$ [Expression for escape velocity of a body]

Sol.: Escape velocity is independent of mass of projected body, it depends upon mass of planet from which it is projected.

34. Answer (2)

Hint: Expression for variation in acceleration due to gravity with depth is $g' = g \left[1 - \frac{d}{R_e} \right]$

$$\text{Sol.: } g' = g \left[1 - \frac{R_e}{2R_e} \right] = \frac{g}{2}$$

$$\Rightarrow \text{Weight} = \frac{200}{2} = 100 \text{ N}$$

35. Answer (2)

Hint: The time period of a satellite varies with orbital radius as $T^2 \propto R^3$

$$\text{Sol.: } \text{K.E} \propto \frac{1}{R} \text{ and } T^2 \propto R^3$$

$$\Rightarrow T^2 \propto \left(\frac{1}{K} \right)^3$$

$$\Rightarrow T \propto (K)^{-3/2}$$

SECTION - B

36. Answer (3)

Hint: Use angular momentum conservation.

$$\text{Sol.: } \frac{mr^2}{2} \times 30 = \left[\frac{mr^2}{2} \times \omega' + \frac{m}{4} \times r \times \omega' \times r \right]$$

$$\frac{mr^2}{2} \times 30 = \omega' \left[\frac{mr^2}{2} + \frac{mr^2}{4} \right]$$

$$\Rightarrow \frac{mr^2}{2} \times 30 = \frac{mr^2}{2} \times \frac{3}{2} \times \omega'$$

$$\Rightarrow \omega' = \frac{30 \times 2}{3} = 20 \text{ rad/s}$$

37. Answer (3)

Hint: $\vec{L} = \vec{r} \times \vec{p}$

Sol.: As the line of action of linear momentum vector passes through origin hence angular momentum of particle w.r.t. origin would be zero.

38. Answer (3)

$$\text{Hint: } \vec{r}_{\text{COM}} = \frac{m_1 \vec{r}_1 + m_2 \vec{r}_2}{m_1 + m_2}$$

Sol.: Taking origin to be at m_2 ,

$$|\vec{r}_{\text{COM}}| = \frac{m_1 R + m_2 \times 0}{m_1 + m_2} = \frac{m_1 R}{m_1 + m_2}$$

39. Answer (1)

Hint: Net torque on the system should be zero

Sol.: Taking net torque about fulcrum to be zero

$$\Rightarrow 24 \times g \times l = mg \times \frac{l}{2} + 6 \times g \times \frac{3l}{2}$$

$$\Rightarrow 24 = \frac{m}{2} + \frac{18}{2}$$

$$\Rightarrow 24 = \frac{m}{2} + 9$$

$$\Rightarrow \frac{m}{2} = 15$$

$$\Rightarrow m = 30 \text{ kg}$$

40. Answer (4)

Hint: $\vec{\tau} = \vec{r} \times \vec{F}$ and $\tau_{\text{net}} = 0$ as angular momentum is conserved.

Sol.:

$$\Rightarrow \frac{\alpha}{4} = \frac{6}{-12} = \frac{12}{-24}$$

$$\Rightarrow \alpha = -2$$

41. Answer (2)

Hint: Position vector of centre of mass for three particles system is given by

$$\vec{x}_{\text{COM}} = \frac{M_1 \vec{x}_1 + M_2 \vec{x}_2 + M_3 \vec{x}_3}{M_1 + M_2 + M_3}$$

$$\text{Sol.: } x_{\text{COM}} = \frac{2 \times 0 + 2 \times 2 + 2 \times 1}{6} = \frac{6}{6} = 1 \text{ m}$$

42. Answer (4)

Hint & Sol.: The centre of mass of body may lie outside, inside or on the geometric centre of the body.

43. Answer (1)

Hint & Sol.: The gravitational potential at centre of spherical shell is same as that of potential at surface of uniform spherical shell.

44. Answer (3)

Hint & Sol.: Since the mass distribution about an axis passing through point B is most widely spread hence moment of inertia is maximum about point B.

45. Answer (3)

Hint: The orbital velocity of a satellite is given by,

$$v_0 = \sqrt{\frac{GM}{R_e + h}}$$

$$\text{Sol.: } v\sqrt{R} = v'\sqrt{R + \frac{R}{2}}$$

$$\Rightarrow v\sqrt{R} = v'\sqrt{\frac{3R}{2}}$$

$$\Rightarrow v' = \sqrt{\frac{2}{3}} v$$

46. Answer (1)

Hint: Gravitational forces provide centripetal acceleration and particle rotate with centre of mass being the centre of circle of radius R.

$$\text{Sol.: } \frac{Gm^2}{4R^2} = \frac{m \times v^2}{R}$$

$$\Rightarrow mv^2 = \frac{Gm^2}{4R}$$

$$\Rightarrow \frac{mv^2}{2} = \frac{Gm^2}{8R}$$

$$\Rightarrow \text{K.E.} = \frac{Gm^2}{8R}$$

47. Answer (3)

Hint: Use conservation of mechanical energy.

$$\text{Sol.: } \frac{1}{2}mv^2 - \frac{GMm}{R} = 0 - \frac{GMm}{R + \frac{R}{2}}$$

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

$$\Rightarrow \frac{v^2}{2} = \frac{GM}{R} - \frac{2GM}{3R}$$

$$\Rightarrow \frac{v^2}{2} = \frac{GM}{3R}$$

$$\Rightarrow v = \sqrt{\frac{2GM}{3R}}$$

48. Answer (2)

Hint & Sol.: P.E = 2 T.E and K.E = |T.E|

49. Answer (1)

Hint: Gravitational potential $V = \frac{-GM}{r}$ [for any point lying outside the hollow or solid sphere]

$$\text{Sol.: } V_{\text{Solid sphere}} = -\frac{GM}{3R}, V_{\text{Hollow sphere}} = -\frac{GM}{3R}$$

$$V_{\text{net}} = -\frac{2GM}{3R}$$

50. Answer (4)

Hint & Sol.: When a planet moves around the sun in an elliptical orbit then the areal velocity remains constant.

CHEMISTRY

SECTION-A

51. Answer (2)

Hint: Algebraic summation of oxidation state of each atom in a neutral compound must be zero.**Sol.:**

Compound	Oxidation state of metals
Cr ₂ O ₃	+ 3
Mn ₂ O ₇	+ 7
PbCl ₂	+ 2
Cu ₂ Cl ₂	+ 1

52. Answer (4)

Hint: $K_P = K_C (RT)^{\Delta n_g}$ **Sol.:** Since $K_P = K_C (RT)^{\Delta n_g}$

$$\log\left(\frac{K_P}{K_C}\right) = \Delta n_g \log(RT)$$

$$\log\left(\frac{K_P}{K_C}\right) \text{ will be zero if}$$

$$\Delta n_g = 0$$

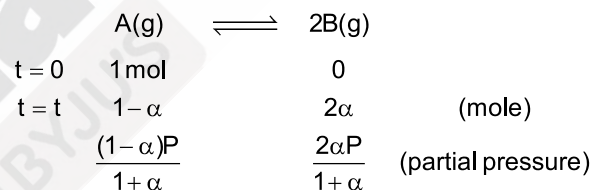
53. Answer (4)

Hint: Equilibrium can be attained only in reversible reaction.**Sol.:** Change in Gibbs free energy (ΔG) is zero at equilibrium state of any reversible reaction.

54. Answer (3)

Hint: For reaction $A(g) \rightleftharpoons 2B(g)$

$$K_P = \frac{p_B^2}{p_A}$$

Sol.:

$$K_P = \frac{\left(\frac{2\alpha P}{1+\alpha}\right)^2}{\frac{(1-\alpha)P}{1+\alpha}}$$

$$K = \frac{4\alpha^2 P}{1-\alpha^2}$$

$$= \frac{4 \times (0.5)^2 P}{1-(0.5)^2} = \frac{4P}{3}$$

$$P = \frac{3K}{4}$$

55. Answer (4)

Hint: $pH + pOH = 14$ (at 25°C)**Sol.:** $[OH^-] = 0.01 M$

$$pOH = -\log[OH^-] = -\log 10^{-2} = 2$$

$$pH = 14 - 2 = 12$$

56. Answer (4)

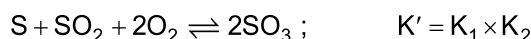
Hint: On increasing temperature equilibrium shifts in the forward direction for an endothermic reaction.

Sol.: Given reaction is endothermic and number of gaseous mole is decreasing in forward direction hence maximum yield of product will be at high temperature and high pressure.

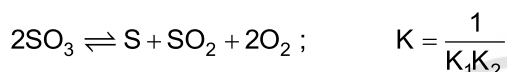
57. Answer (4)

Hint: On adding two reactions, their equilibrium constants get multiplied to get the new equilibrium constant.

Sol.: On adding both reactions



Now reversing the above reaction



58. Answer (2)

Hint: For a weak monoprotic acid

$$\text{Degree of ionisation } \alpha = \sqrt{\frac{K_a}{c}}$$

$$\text{Sol.} \quad \% \alpha = \sqrt{\frac{K_a}{c}} \times 100 = \sqrt{\frac{1.8 \times 10^{-5}}{0.18}} \times 100 = 1\%$$

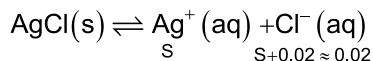
59. Answer (4)

Hint: Lewis base donates lone pair of electrons to empty orbitals.

Sol.: NH_3 has lone pair of electrons in outermost shell of nitrogen.

60. Answer (1)

Hint: Solubility of sparingly soluble salts decreases due to common ion effect.



Sol.: $S = 0.02 \approx 0.02$

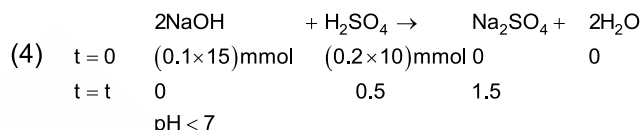
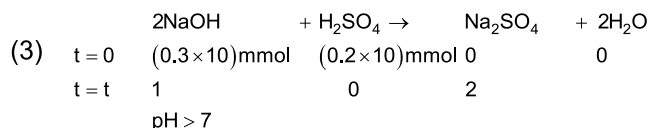
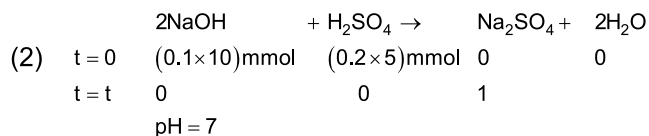
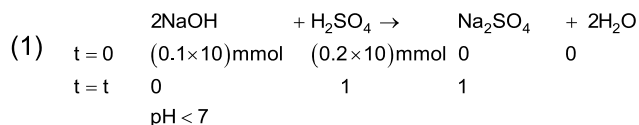
$$K_{SP} = [Ag^+][Cl^-]$$

$$1.6 \times 10^{-10} = S \times 0.02$$

$$S = 8 \times 10^{-9} \text{ M}$$

61. Answer (3)

Hint: On mixing acid and base, neutralisation takes place and the nature of solution is determined by the reagent in excess.

Sol.:

62. Answer (4)

Hint: For given salt $A_xB_y(s)$



$$K_{SP} = x^x y^y s^{x+y}$$

Sol.: For $Ca_3(PO_4)_2(s) \rightleftharpoons 3Ca^{2+}(aq) + 2PO_4^{3-}(aq)$

$$K_{SP} = 3^3 2^2 s^{3+2} = 108s^5$$

63. Answer (4)

Hint: $K_P = K_C (RT)^{\Delta n_g}$

Sol.: For reaction



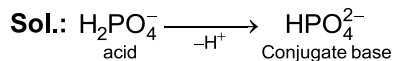
$$\Delta n_g = -1$$

$$K_P = 0.5(0.0821 \times 300)^{-1} = \frac{0.5}{0.0821 \times 300}$$

$$= 0.02 \text{ atm}$$

64. Answer (2)

Hint: Conjugate acid and base are obtained by proton gain or loss respectively.



65. Answer (2)

Hint: For an acid

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

Sol.: Since $[HCl] < 10^{-6}$ here contribution of H^+ ions from H_2O that is 10^{-7} M will be considered.

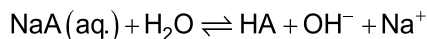
$$[H^+]_{net} = 10^{-7} + 10^{-7} = 2 \times 10^{-7}$$

$$pH = -\log(2 \times 10^{-7})$$

$$= 6.7$$

66. Answer (3)

Hint: Salt of weak acid and strong base undergoes anionic hydrolysis



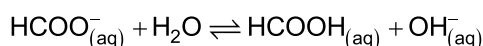
Sol.: For WASB type of salt

$$K_h = \frac{K_w}{K_a} = \frac{10^{-14}}{10^{-5}} = 10^{-9}$$

67. Answer (3)

Hint: Salt of WASB gives basic solution due to anionic hydrolysis.

Sol.: HCOONa is salt of weak acid and strong base.



Presence of $\text{OH}^-_{(\text{aq})}$ will give solution with pH more than 7.

68. Answer (3)

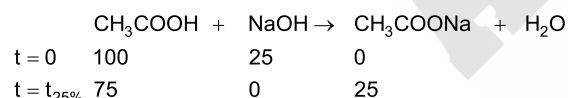
Hint: If any change is made at equilibrium state then equilibrium shifts in such a way that effect of change gets nullified.

Sol.: Introduction of inert gas at constant volume does not change partial pressure of reactant or product gases hence it does not affect equilibrium state.

69. Answer (3)

Hint: On neutralisation of weak acid with strong base, a buffer solution will be obtained if acid is present in excess.

Sol.: On 25% neutralisation of CH_3COOH



Here mixture of CH_3COONa and CH_3COOH will make acidic buffer solution

70. Answer (2)

Hint: Ions produced from weak acid or base gets hydrolysed in aqueous solution.

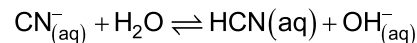
Sol.: In CH_3COOK , CH_3COO^- ion is from weak acid hence anionic hydrolysis will take place.

- In NH_4Cl , NH_4^+ ion is from weak base hence cationic hydrolysis will take place.
- in KNO_3 both ions are from strong electrolytes hence no hydrolysis.
- In $\text{CH}_3\text{COO}^- \text{NH}_4^+$ both cation and anion will get hydrolysed.

71. Answer (3)

Hint: Salt of strong base and weak acid undergoes anionic hydrolysis.

Sol.: Following equilibrium will get stabilise in aqueous NaCN



This will result in basic solution with pH more than 7.

72. Answer (2)

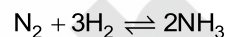
Hint: Species that accept lone pairs of electrons are known as Lewis acid.

Sol.: BF_3 , BeCl_2 & AlCl_3 are Lewis acids.

- NH_3 is Lewis base.
- CCl_4 is neither Lewis acid nor base.

73. Answer (3)

Hint: Manufacture of ammonia by Haber's process is an exothermic reaction



Sol.: Catalyst does not affect the equilibrium composition of reaction mixture.

Decrease in concentration of reactant will shift equilibrium in backward direction.

Since density of water is more than ice hence melting of ice will increase on increase in pressure.

74. Answer (3)

Hint: For any equilibrium

$$\Delta G^\circ = -2.303 RT \log(K_{\text{eq}})$$

Sol.: For given reaction

$$\Delta G^\circ = +31.65 \text{ kJ}$$

$$+31.65 \times 10^3 = -2.303 \times 8.314 \times 298 \log(K_{\text{eq}})$$

$$\log K_{\text{eq}} = \frac{-31650}{2.303 \times 8.314 \times 298}$$

$$= -5.55$$

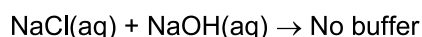
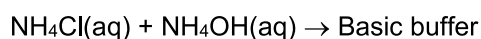
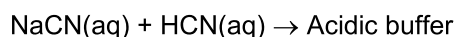
$$K_{\text{eq}} = 10^{-5.55} = 10^{0.45} \times 10^{-6}$$

$$= 2.87 \times 10^{-6}$$

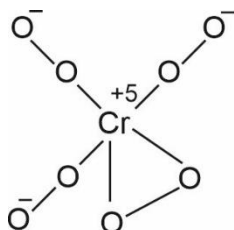
75. Answer (3)

Hint: Mixture of weak base and its salt with a strong acid will result into basic buffer solution

Sol.: $\text{CH}_3\text{COOH(aq)} + \text{CH}_3\text{COOK(aq)} \rightarrow$ Acidic buffer

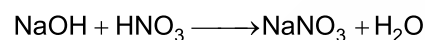
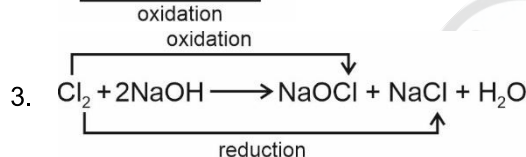
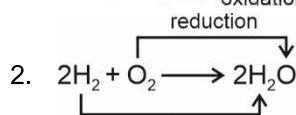
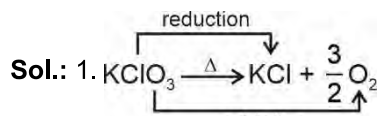


76. Answer (4)

Hint & Sol.: Structure of CrO_8^{3-} is


Here Cr is present in +5 oxidation state.

77. Answer (3)

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


It is not a redox reaction.

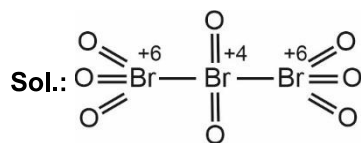
Hence (3) is a disproportionation reaction.

78. Answer (1)

Hint & Sol.:

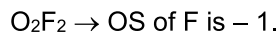
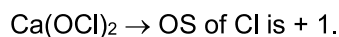
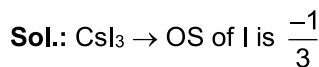
Compound	Oxidation State of nitrogen
NH_3	-3
N_2O	+1
N_2O_3	+3
HNO_3	+5

79. Answer (2)

Hint: For covalent bond, high electronegative element gets negative oxidation state and less electronegative element gets positive oxidation state.


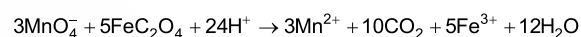
$$\text{Average oxidation state of Br} = \frac{+16}{3}$$

80. Answer (4)

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


81. Answer (1)

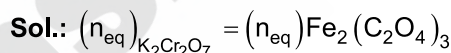
Hint: Number of atoms of each element must be same in both sides of a balanced chemical equation.

Sol.: Balanced chemical equation is as following


82. Answer (4)

Hint: In any redox reaction

$$(n_{\text{eq}})_{\text{OA}} = (n_{\text{eq}})_{\text{RA}}$$



$$(n \times \text{vf})_{\text{K}_2\text{Cr}_2\text{O}_7} = (n \times \text{vf})_{\text{Fe}_2(\text{C}_2\text{O}_4)_3}$$

$$n \times 6 = 1 \times 6$$

$$n = 1$$

83. Answer (1)

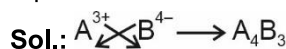
Hint: Metal cation that has less tendency to get reduced results into less value of standard reduction potential.

Sol.: As SRP increases, reducing power of metal decreases

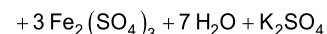
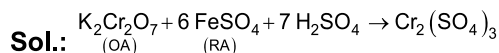
$$\text{Order of SRP} \Rightarrow Y > Z > X$$

 Hence, order of reducing power $X > Z > Y$

84. Answer (3)

Hint: A compound must be electrically neutral, that is summation of total positive charge must be equal to summation of total negative charge.


85. Answer (2)

Hint: Reducing agent gets oxidised in a redox reaction.


SECTION - B

86. Answer (4)

Hint: EMF of cell = (SRP)_{cathode} - (SRP)_{anode}**Sol.:** Cathode : $\text{Cu}^{2+} + 2\text{e}^- \rightarrow \text{Cu}$ Anode : $\text{Zn} \rightarrow \text{Zn}^{2+} + 2\text{e}^-$ EMF = $0.34 - (-0.76)$

= 1.1 V

87. Answer (3)

Hint: Species with higher SRP value have more oxidising power.**Sol.:** Since SRP of F_2 is more than that of Cl_2 , hence F_2 will be a stronger oxidising agent than Cl_2 .

88. Answer (1)

Hint: Oxidising agent gets reduced and reducing agent gets oxidised in redox reaction.**Sol.:** HClO_4 cannot get oxidised and H_2S cannot get reduced hence HClO_4 cannot be reducing agent and H_2S cannot be oxidising agent

89. Answer (2)

Hint & Sol.: Oxidation state of metal in alloy is zero hence oxidation state of Na in sodium amalgam will be zero.

90. Answer (2)

Hint: For a reversible reaction $K_{\text{eq}} = \frac{K_{\text{f}}}{K_{\text{b}}}$ **Sol.:** Equilibrium constant only depends upon temperature and on increasing temperature increases for endothermic reaction but decreases for exothermic reaction.

91. Answer (4)

Hint: Addition of NaCl in water results into neutral solution as it does not get hydrolysed**Sol.:** Addition of aq. NaCl in acidic solution will result into no change in concentration of $[\text{H}^+]$ ion and pH remains constant. K_{a} changes only with temperature.

92. Answer (4)

Hint: Solubility of sparingly soluble salt decreases due to common ion effect.**Sol.:** NaCl, CaCl_2 and AgNO_3 will give a common ion effect to $\text{AgCl}(\text{aq})$ hence maximum solubility will be observed in aqueous NH_3 solution, which forms a complex with Ag^+ ion.

93. Answer (2)

Hint: Addition of HCl in aq. CH_3COOH solution will result into common ion effect.**Sol.:** Due to common ion effect ionisation of CH_3COOH will decrease hence mole of CH_3COO^- ion will decrease and K_{a} will remain constant. pH of solution will decrease as HCl will give more $[\text{H}^+]$ in solution.

94. Answer (3)

Hint: If all the components are in the same physical state, the equilibrium is called homogeneous equilibrium.**Sol.:** In $\text{CaCO}_3(\text{s}) \rightleftharpoons \text{CaO}(\text{s}) + \text{CO}_2(\text{g})$ physical state of all the components is not the same hence it is a heterogeneous equilibrium.

95. Answer (1)

Hint: Aqueous solution of WASB type of salt results into basic solution due to anionic hydrolysis**Sol.:** pH of WASB type of salt solution can be calculated as

$$\text{pH} = 7 + \frac{1}{2}\text{p}K_{\text{a}} + \frac{1}{2}\log c$$

96. Answer (4)

Hint: Aqueous solution of WAWB type of salt undergoes both cationic and anionic hydrolysis.**Sol.:** For WAWB type of salt concentration of $[\text{H}^+]$ ion does not depend on dilution and pH can be calculated as

$$\text{pH} = 7 + \frac{1}{2}\text{p}K_{\text{a}} - \frac{1}{2}\text{p}K_{\text{b}}$$

97. Answer (4)

Hint: Monoprotic acid has only one ionisable hydrogen hence will have basicity 1.**Sol.:**

Acid	Basicity
H_2SO_4	2
H_2SO_3	2
H_3PO_3	2
H_3PO_2	1

98. Answer (2)

Hint: Ionisation of successive H^+ ion gets difficult in case of polyprotic acid.**Sol.:** Since successive ionisation of polyprotic weak acid decreases, order of their ionisation constant will be

$$K_{\text{a}_1} > K_{\text{a}_2} > K_{\text{a}_3}$$

99. Answer (1)

Hint: If K_c for a reaction is less than 10^{-3} then equilibrium mixture will have mostly reactant.

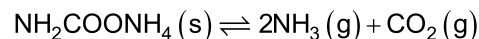
Sol.: Since $K_c \ll 10^{-3}$

Concentration of reactant will be maximum in equilibrium mixture.

100. Answer (3)

Hint: For a gaseous mixture, partial pressure of any gaseous component is equal to its mole fraction multiplied with total pressure of mixture.

Sol.: For equilibrium



$$K_p = P_{\text{NH}_3}^2 \times P_{\text{CO}_2}$$

$$P_{\text{NH}_3} = \frac{2}{3} \times 6 = 4 \text{ atm}$$

$$P_{\text{CO}_2} = \frac{1}{2} \times 6 = 2 \text{ atm}$$

$$K_p = 4^2 \times 2 \\ = 32 \text{ atm}^3$$

BOTANY

SECTION-A

101. Answer (1)

Hint: A sorus (pl.sori) is a cluster of sporangia.

Sol.: Genera like *Selaginella* and *Salvinia* of pteridophytes produce two kinds of spores, and are known as heterosporous.

102. Answer (4)

Hint: *Pinus* is a gymnosperm and bears male and female cones.

Sol.: Coralloid roots are found in *Cycas*.

Pinus shows compact cones, mycorrhizal association as well as pollen grains.

103. Answer (4)

Hint: *Volvox* shows haplontic life cycle.

Sol.: *Ectocarpus* shows haplo-diplontic life cycle. *Ulothrix* exhibits haplontic life cycle.

104. Answer (4)

Hint: Plants show two distinct generations, diploid sporophyte and haploid gametophyte. Embryo sac is female gametophyte of angiosperms.

Sol.: Embryo sac is female gametophyte (n) found inside ovule ($2n$). Microspore (n) is found inside anther ($2n$).

105. Answer (2)

Hint: Numerical taxonomy involves usage of numerical methods to classify organism.

Sol.: Phylogenetic classification system assumes that organisms belonging to the same taxa have a common ancestor. Chemotaxonomy uses the chemical constituents of the plant to resolve confusions.

106. Answer (1)

Hint: Double fertilisation involves syngamy and triple fusion.

Sol.: Because of the occurrence of two fusions, i.e., syngamy and triple fusion, this event is termed as double fertilisation, an event unique to angiosperms.

107. Answer (3)

Hint: In bryophytes, sporophyte is dependent on gametophyte. Sporophyte is independent and photosynthetic in pteridophytes. Sporophyte forms spores.

Sol.: Sporophyte has $2n$ ploidy.

108. Answer (2)

Hint: Agar-agar, a hydrocolloid, is obtained from red algae.

Sol.: Members of brown and red algae have been employed to obtain hydrocolloids.

109. Answer (3)

Hint: *Eucalyptus* is an angiosperm.

Sol.: In *Eucalyptus*, the female sex organ (pistil) consists of an ovary at its base, a long slender style and stigma.

110. Answer (2)

Hint: Gymnosperms bear archegonium.

Sol.: Angiosperms lack archegonium.

111. Answer (4)

Hint: *Volvox* is a colonial alga. *Laminaria* is a kelp. *Volvox* and *Laminaria* are multicellular.

Sol.: *Chlorella* is a unicellular alga.

112. Answer (1)

Hint: Red algae are rich in phycoerythrin.

Sol.: Fucoxanthin is the major pigment in brown algae.

113. Answer (4)

Hint: *Fucus* shows diplontic life cycle.

Sol.: Life cycle of *Fucus* and *Salvinia* respectively are diplontic and haplodiplontic.

114. Answer (3)

Hint: Reduction in surface area can reduce transpiration.

Sol.: In conifers, the needle-like leaves reduce the surface area. Their thick cuticle and sunken stomata also help to reduce water loss. Presence of branched stem does not aid in reducing water loss in conifers.

115. Answer (4)

Hint: *Ginkgo* is a gymnosperm.

Sol.: *Adiantum* is a pteridophyte.

116. Answer (2)

Hint: The diagram shows a male thallus of *Marchantia*.

Sol.:

A	–	Antheridiophore
B	–	Gemma cup
C	–	Rhizoids

Gemma cup bears asexual buds called gemmae.

117. Answer (2)

Hint: Green algae store starch.

Sol.: *Ulothrix* belongs to green algae and stores starch.

118. Answer (1)

Hint: Gymnosperms show the presence of seed.

Sol.: *Cycas* is an example of gymnosperm. Thus, all the given features are true for *Cycas*.

119. Answer (3)

Hint: *Volvox* is an alga and shows haplontic life cycle.

Sol.: *Sphagnum* is a moss. Its gametophyte shows leafy stage.

Pteris is a fern. Its gametophyte is called prothallus.

Ginkgo is a gymnosperm. Its gametophyte is highly reduced.

120. Answer (1)

Hint: Lax is found in gymnosperms.

Sol.: Two kinds of spores are produced within sporangia that are borne on sporophylls which are arranged spirally along an axis to form lax.

121. Answer (4)

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

Sol.: In algae, sexual gametes can be flagellated and similar in size (as in *Ulothrix*) or non-flagellated but similar in size (as in *Spirogyra*).

122. Answer (3)

Hint: *Funaria* and *Marchantia* are bryophyte.

Sol.:

Cuscuta – Angiosperm

Ectocarpus – Alga

Marchantia – Liverwort

Funaria – Moss

123. Answer (4)

Hint: Hydrocolloids are generally produced by algae.

Sol.: Peat is not a hydrocolloid.

124. Answer (1)

Hint: Pyrenoids are proteinaceous structures.

Sol.: Pyrenoids are storage bodies and it contains protein besides starch.

125. Answer (2)

Hint: Laminarin is stored food in brown algae.

Sol.: Phaeophyceae contains chlorophyll a and c, and laminarin. It bears 2 flagella and produces pear shaped gametes.

126. Answer (2)

Hint: Artificial systems gave equal weightage to vegetative and sexual characteristics.

Sol.: Linnaeus classification of plants was based mainly on androecium structure.

127. Answer (2)

Hint: *Laminaria* and *Sargassum* belong to brown algae.

Sol.: Many species of *Porphyra*, *Laminaria* and *Sargassum* are among the 70 species of marine algae used as food.

128. Answer (3)

Hint: Red algae lack flagella.

Sol.: Red algae have poly sulphate esters in cell wall and is mostly found in salt-water.

129. Answer (1)

Hint: *Marchantia* is a liverwort.

Sol.: The plant body of bryophytes is more differentiated than that of algae.

130. Answer (2)

Hint: Spores are haploid.

Sol.: In plants, spores germinate to form gametophyte.

131. Answer (2)

Hint: In brown algae, algin is found in outer cell wall.

Sol.: Chlorophyceae has cellulose and pectose in its cell wall.

132. Answer (4)

Hint: At least half of the total CO₂ fixation on earth is carried out by algae.

Sol.: Around 70 species of marine alga can be used as food.

133. Answer (2)

Hint: Green algae can reproduce by isogamy, anisogamy or oogamy.

Sol.: Green algae bear 2, apical and equal flagella and also have centrioles.

134. Answer (4)

Hint: Gemmae can be found in liverworts.

Sol.: Gemmae are green, multicellular, asexual buds, which develop in small receptacles called gemma cups located on the thalli.

135. Answer (1)

Hint: Body of higher plants is differentiated into root, stem and leaves.

Sol.: Algae are chlorophyll bearing, simple thalloid and mostly aquatic.

SECTION - B

136. Answer (2)

Hint: Union of two gametes is called syngamy.

Sol.: In anisogamy, two kinds of distinct gametes are formed. In oogamy, one motile male gamete and other non-motile female gamete is formed.

137. Answer (2)

Hint: Rhizoids can be unicellular or multicellular in bryophytes.

Sol.: Zygotic meiosis is absent in bryophytes.

138. Answer (2)

Hint: In mosses, spore germinates to form protonema.

Sol.: Protonema is a gametophytic stage.

139. Answer (1)

Hint: Ferns are macrophyllous.

Sol.: *Selaginella* is not a fern, it bears microphylls.

140. Answer (3)

Hint: Integument is the protective covering of ovule.

Sol.: Nucellus is protected by envelope and the composite structure is called an ovule.

141. Answer (3)

Hint: In diplontic life cycle, gametophyte is dependent on sporophyte.

Sol.: In seed bearing plants, gametophyte is few to multi-celled.

142. Answer (3)

Hint: *Fucus* shows diplontic life cycle.

Sol.: In gymnosperms like *Cycas*, multicellular female gametophyte is retained in megasporangium.

143. Answer (2)

Hint: Both *Selaginella* and *Equisetum* are pteridophytes.

Sol.: *Selaginella* is heterosporous but *Equisetum* is homosporous.

144. Answer (4)

Hint: *Ectocarpus* is a brown alga.

Eudorina is a green alga.

Sol.: *Porphyra*, *Gracilaria* and *Polysiphonia* are members of red algae.

145. Answer (4)

Hint: *Sphagnum* is used as packing material for trans-shipment.

Sol.: Pteridophytes reduce the impact of falling rain and prevent soil erosion.

146. Answer (2)

Hint: *Psilotum* belongs to class Psilopsida.

Sol.: *Dryopteris* belongs to class Pteropsida.

147. Answer (2)

Hint: Gymnosperms are well adapted to withstand extreme temperature, humidity and wind.

Sol.: Event precursor to seed habit is seen in pteridophytes.

148. Answer (4)

Hint: Capsule is found in bryophytes.

Sol.: Kelps can grow up to 100 metres.

149. Answer (1)

Hint & Sol.: Polysulphate esters can be found in the cell wall of red algae, e.g., *Gracilaria*.

150. Answer (3)

Hint: The sporophyte of mosses is divided into foot, seta and capsule.

Sol.: In gymnosperms, the roots are generally tap roots. In mosses, the capsule contains spores.

ZOOLOGY

SECTION-A

151. Answer (1)

Hint: Undergoes transverse binary fission

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

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

Amoeba possesses pseudopodia for amoeboid movement.

152. Answer (4)

Hint: Structure responsible for locomotory movement of female gamete.

Sol.: Passage of ova through the female reproductive tract is facilitated by ciliary movement. Flagellar movement helps in swimming of spermatozoa, maintenance of water current in the canal system of sponges and in locomotion of protozoans like *Euglena*.

153. Answer (2)

Hint: Contraction of muscles is unique property.

Sol.: Muscles have special properties like conductivity, excitability, contractility, extensibility and elasticity while neurons have excitability and conductivity.

Neurons and muscles are excitable cells of the body.

154. Answer (1)

Hint: Striped appearance

Sol.:

Features	Cardiac muscle fibres	Skeletal muscle fibres
Striations	+nt	+nt
Intercalated discs	+nt	-nt
Nucleus	Uninucleated	Multinucleated
Branching	+nt	-nt

155. Answer (2)

Hint: More than 30%

Sol.: About 40-50 per cent of the weight of a normal human adult is contributed by muscles.

156. Answer (2)

Hint: Fusiform in shape

Sol.: Smooth muscles assist in the transport of food through the digestive tract and gametes through the genital tract. Striated muscle fibres are cylindrical in shape and voluntary in action.

Cardiac muscles exhibit branched muscle fibres.

157. Answer (1)

Hint: Coordination is required for normal physiology.

Sol.: Coordination is the process through which two or more organs interact and complement the functions of each other. The neural system provides an organised network of point-to-point connections for quick coordination.

In our body, the neural system and the endocrine system jointly coordinate and integrate all the activities of the organs.

158. Answer (4)

Hint: More than one are correct.

Sol.: The neural system of all animals is composed of highly specialised cells called neurons which can detect, receive and transmit different kinds of stimuli.

159. Answer (3)

Hint: Arachnoid is the middle covering of brain.

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

160. Answer (3)

Hint: Ilium, ischium and pubis fuse to form a cavity.

Sol.: 'X' is scapula. Scapula is a large triangular flat bone situated in the dorsal part of the thorax between the second and the seventh ribs. The dorsal, flat, triangular body of scapula has a slightly elevated ridge called the spine which projects as a flat, expanded process called the acromion. The clavicle articulates with this. Below the acromion is a depression called the glenoid cavity which articulates with the head of the humerus to form the shoulder joint.

161. Answer (2)

Hint: Exclude the divisions of ANS

Sol.: The PNS is divided into two divisions called somatic neural system and autonomic neural system. The somatic neural system relays impulses from CNS to skeletal muscles while the autonomic neural system transmits impulses from CNS to involuntary organs and smooth muscles of the body.

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

162. Answer (2)

Hint: Identify the muscle cell.

Sol.: Muscle fibre is the anatomical unit of muscles.

Each muscle fibre has many parallelly arranged myofibrils.

Each myosin (thick) filament is a polymerised protein, made up of monomeric proteins called meromyosins.

163. Answer (2)

Hint: Troponin consists of three sub-units.

Sol.: A complex protein, troponin is distributed at regular intervals on the tropomyosin. In the resting state, a subunit of troponin masks the active binding sites for myosin on the actin filaments.

Each myosin (thick) filament is a polymerised protein, made up of monomeric proteins called meromyosins.

164. Answer (1)

Hint: Length of 'A' band remains same.

Sol.: Mechanism of muscle contraction is best explained by the sliding filament theory which states that contraction of a muscle fibre takes place by sliding of thin filaments over the thick filaments. The length of 'A' band remains unchanged during muscle contraction.

165. Answer (3)

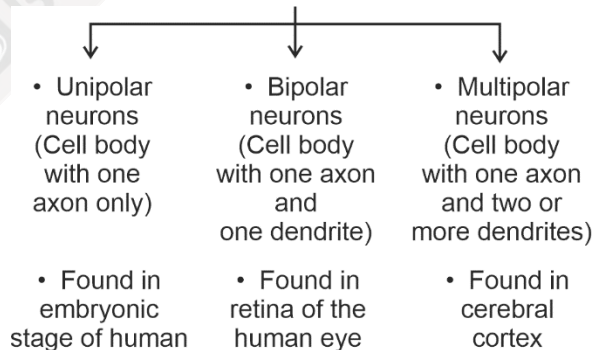
Hint: Identify an arthropod.

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

166. Answer (4)

Hint: Two or more dendrites are present in neurons of cerebrum.

Sol.: Based on the number of axon and dendrites the neurons are divided into three types



167. Answer (2)

Hint: Present between cranial bones.

Sol.: Fibrous joints 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 to form cranium.

Ball and socket joint is present in between head of femur and acetabulum of coxal bone.

Pivot joint is present between atlas and axis.

168. Answer (4)

Hint: Voltage gated sodium channels open

Sol.: When a stimulus is applied at a site on the polarised membrane, the membrane at that site becomes freely permeable to Na^+ . This leads to rapid influx of Na^+ followed by reversal of polarity at that site.

169. Answer (2)

Hint: Storehouse of calcium

Sol.:

Red muscle fibres	White muscle fibres
Myoglobin content is high	Myoglobin content is low
More number of mitochondria	Less number of mitochondria
Usually involved in aerobic respiration	Usually involved in anaerobic respiration
Low amount of sarcoplasmic reticulum	High amount of sarcoplasmic reticulum

170. Answer (3)

Hint: Home of pituitary gland

Sol.: Maxilla, zygomatic and nasal bones are paired facial bones.

Sphenoid is an unpaired cranial bone. It forms a depression called sella turcica which lodges the pituitary gland.

171. Answer (2)

Hint: Exclude the function associated with medulla oblongata

Sol.: The limbic system is involved in the regulation of sexual behaviour, expression of emotional reactions (e.g. excitement, pleasure, rage and fear) and motivation.

The medulla oblongata contains centre for regulation of respiration.

172. Answer (2)

Hint: Include the branched fibres and cyton

Sol.: Nissl's granules are present in cell body and dendrites.

173. Answer (3)

Hint: Also called muscle bundles

Sol.: Each organised skeletal muscle in our body is made of a number of muscle bundles or fascicles held together by a common collagenous connective tissue layer called fascia.

Each muscle bundle contains a number of muscle fibres.

174. Answer (4)

Hint: Involved in regulating body equilibrium

Sol.: Thalamus, hippocampus and amygdala are associated with forebrain.

Cerebellum is a part of hindbrain.

175. Answer (2)

Hint: 'Quad' means four

Sol.: A deep cleft divides the cerebrum longitudinally into two halves, which are termed as the cerebral hemisphere. The cerebral hemispheres are connected by corpus callosum. Midbrain consists of corpora quadrigemina and a canal (cerebral aqueduct).

176. Answer (2)

Hint: Outer region of cerebrum

Sol.: The layer of cells that covers the cerebral hemisphere and is thrown into prominent folds is cerebral cortex.

The human brain is well protected by skull. Inside the skull, the brain is covered by cranial meninges. A canal called the cerebral aqueduct passes through the midbrain.

177. Answer (2)

Hint: Also known as duct of sylvius

Sol.: Midbrain is located in between thalamus/hypothalamus of the forebrain and pons of the hindbrain.

A canal called cerebral aqueduct passes through it. Hypothalamus is involved in thermoregulation.

ADH or vasopressin synthesized by hypothalamus regulates electrolyte balance of the body.

178. Answer (2)

Hint: Contain satiety centre

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

Medulla contains centre for regulation of respiration. The visual cortex is the primary cortical region of brain that receives, integrates and processes visual information.

179. Answer (1)

Hint: Hypothalamus lies at the base of it.**Sol.:** The cerebrum wraps around a structure called thalamus which is a major coordinating centre for sensory and motor signalling.

Amygdala is a structure of limbic system.

The hindbrain comprises pons, cerebellum and medulla oblongata.

180. Answer (4)

Hint: It regulates the heart rate.**Sol.:** The association areas are neither sensory nor motor in function. They are responsible for complex functions such as intersensory association, memory and communication. The medulla contains centres which control respiration, cardiovascular reflexes and gastric secretions.

181. Answer (4)

Hint: Part of hindbrain**Sol.:** The hindbrain comprises pons, cerebellum and medulla oblongata.

Cerebellum has very convoluted surface in order to provide the additional space for many more neurons.

The forebrain consists of cerebrum, thalamus and hypothalamus.

Hippocampus is an integral part of limbic system.

182. Answer (4)

Hint: More than one are correct.**Sol.:** Visceral neural system is the part of PNS that comprises the whole complex of nerves, fibres, ganglia and plexuses by which impulses travel from CNS to the viscera and from the viscera to the CNS.

183. Answer (4)

Hint: Axon terminates at synaptic knob.**Sol.:** The dendrites transmit the impulses towards the cell body. The axon is a long fibre, the distal end of which is branched. The axon transmits nerve impulses away from cell body to a synapse.

184. Answer (1)

Hint: Myelin sheath producing cells**Sol.:** Unmyelinated nerve fibre is enclosed by a Schwann cell that does not form a myelin sheath around the axon and is commonly found in somatic and autonomic neural system.

Myelinated nerve fibres are found in spinal and cranial nerves.

The axon terminals contain vesicles filled with neurotransmitters.

185. Answer (1)

Hint: Exclude the function of ear**Sol.:** The medulla oblongata contains centres which control respiration, cardiovascular reflexes and gastric secretions.

Balance of the body is associated with cerebellum and cerebral cortex.

Hypothalamus regulates circadian rhythm of the body.

SECTION - B

186. Answer (1)

Hint: Hypoparathyroidism leads to deficiency of this ion.**Sol.:** Tetany is characterised by rapid spasms (wild contractions) in muscles due to low Ca^{2+} in body fluids.

187. Answer (2)

Hint: Characterised by progressive degeneration of skeletal muscles.**Sol.:** Lack of relaxation between successive stimuli in sustained muscle contraction is called tetanus.

Cartilage and bones are specialised connective tissues.

An acromion process is characteristically present in pectoral girdle of mammals.

Muscular dystrophy is a genetic disorder.

188. Answer (3)

Hint: Exclude the bone cells and cartilage cells**Sol.:** Schwann cells produce myelin sheath around axons of neurons of PNS.

Osteocytes and chondrocytes are bone cells and cartilage cells respectively.

Osteoclasts are responsible for the resorption of bone.

Astrocytes are neuroglia present in brain.

189. Answer (4)

Hint: Identify a tract of nerve fibres.**Sol.:** The forebrain consists of cerebrum, thalamus and hypothalamus.

Flagella is not the part of a neuron.

Midbrain, pons and medulla oblongata make up the brain stem.

190. Answer (1)

Hint: Polymer of amino acids

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

191. Answer (3)

Hint: At rest, outer surface of axonal membrane is positively charged.

Sol.: The rise in the stimulus induced permeability to Na^+ is extremely short lived. It is quickly followed by a rise in permeability to K^+ .

Neurons are excitable cells as their membrane are in a polarised state.

192. Answer (3)

Hint: Causes active transport

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

When a stimulus is applied to a site on the neuron, the closed voltage gated channels suddenly open, allowing Na^+ ions to enter the neuron.

193. Answer (4)

Hint: Multiple of 4

Sol.: Carpals are 8 in number in each hand, so 16 carpals are present in a human.

Metacarpals and metatarsals are 5 in each limb.

194. Answer (3)

Hint: Associated with dark band or thick fibre

Sol.: During complete muscle contraction of a muscle:

- Length of 'I' band reduces
- Length of 'A' band remains same
- H-zone disappears
- Length of sarcomere reduces

195. Answer (2)

Hint: Tongue is found attached to it.

Sol.: Hyoid is included in the skull.

Ethmoid is an unpaired cranial bone.

Patella covers the knee ventrally.

Tibia is the bone of lower limb.

196. Answer (4)

Hint: Pivot joint is present between 1st and 2nd vertebra.

Sol.:

a.	Gliding joint	(iii)	Between the carpals
b.	Saddle joint	(ii)	Between carpal and metacarpal of thumb
c.	Hinge joint	(iv)	Knee joint
d.	Pivot joint	(i)	Between atlas and axis

197. Answer (3)

Hint: Malleus is attached to tympanic membrane.

Sol.: Each middle ear contains three ear ossicles malleus, incus and stapes, arranged in a chain like fashion.

198. Answer (1)

Hint: Articulates with the occipital condyles

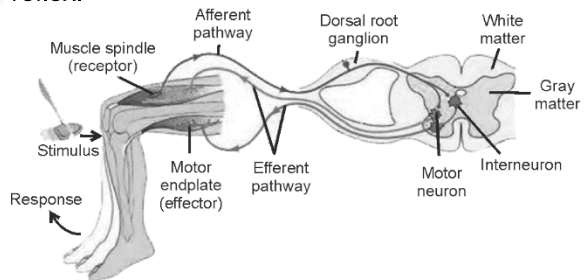
Sol.: The first vertebra is atlas and it articulates with the occipital condyles.

The second vertebra is axis.

199. Answer (2)

Hint: Knee-jerk reflex is a monosynaptic reflex.

Sol.: Interneuron is not involved in knee-jerk reflex.



200. Answer (2)

Hint: Synapses that involve neurotransmitter

Sol.: Transmission of an impulse across an electrical synapse is always faster than across a chemical synapse.



All India Aakash Test Series for NEET - 2025

TEST - 4 (Code-D)

Test Date : 21/01/2024

ANSWERS

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

Hints & Solutions

PHYSICS

SECTION-A

1. Answer (2)

Hint: Use $\omega = \frac{d\theta}{dt}$

Sol.: Angle turned = area under the graph

$$= \frac{1}{2} \times 20 \times 10 + 10 \times 20 + \frac{1}{2} \times 20 \times 10$$

$$= 20 \times 10 + 20 \times 10$$

$$= 400$$

2. Answer (4)

Hint: Use $\tau = I\alpha$ i.e., torque becomes zero when angular acceleration becomes zero.

$$\text{Sol.} \quad \omega = \frac{d\theta}{dt} = 9t^2 - 6t + 6 \Rightarrow \alpha = \frac{d\omega}{dt} = 18t - 6$$

$$\text{For } \alpha = 0, t = \frac{1}{3} \text{ s}$$

3. Answer (4)

Hint: Use $P_{\text{avg}} = \frac{W}{t}$ and $W = \Delta \text{KE}$

$$\text{Sol.} \quad P = \frac{\Delta \text{KE}}{\Delta t} = \frac{\frac{1}{2} \times 5 \times 40 \times 40}{5} = 800 \text{ W}$$

4. Answer (3)

Hint: Use parallel axis theorem

$$\text{Sol.} \quad I_1 = \frac{2}{3} mr^2, I_2 = I_3 = \frac{2}{3} mr^2 + mr^2 = \frac{5mr^2}{3}$$

$$\Rightarrow I_1 + I_2 + I_3 = \frac{2mr^2}{3} + \frac{10mr^2}{3} = 4mr^2$$

5. Answer (3)

Hint: Orbital velocity, $v = \sqrt{\frac{GM}{r_e + h}}$,

where $r_e \rightarrow$ radius of earth

$h \rightarrow$ height of orbit

$$\text{Sol.} \quad v \propto \frac{1}{\sqrt{r_e + h}} \Rightarrow \frac{v_P}{v_Q} = \sqrt{\frac{r_e + h_2}{r_e + h_1}}$$

6. Answer (3)

Hint & Sol.: Since the point C lies at maximum distance from sun hence linear velocity at C point will be minimum.

7. Answer (2)

Hint: Use $v = r\omega$ [Relation between angular speed and linear speed in circular motion]

$$\text{Sol.} \quad \omega = \frac{120 \times 2\pi}{60} = 4\pi \text{ rad/s}$$

$$\Rightarrow v = 2 \times 4\pi = 8\pi \text{ m s}^{-1}$$

8. Answer (1)

Hint: Use $\vec{\tau} = \frac{d\vec{L}}{dt}$ [Newton's second law for rotational motion]

$$\text{Sol.} \quad \tau_{\text{avg}} = \frac{\Delta L}{\Delta t} = \frac{2 \times 25}{10} = 5 \text{ N m}$$

9. Answer (2)

Hint & Sol.: $I_{\text{Solid sphere about dia}} = \frac{2}{5} MR^2$

10. Answer (1)

Hint: Escape velocity, $v_e = \sqrt{\frac{2GM}{R}}$

Orbital velocity, $v_o = \sqrt{\frac{GM}{R}}$

$$\text{Sol.} \quad \Rightarrow \text{Hence } v_o = \sqrt{2} v_e$$

11. Answer (2)

Hint: MOI of rod about on axis passing through

one end is $\frac{ML^2}{3}$

$$\text{Sol.} \quad I = \frac{ML^2}{3} + \frac{ML^2}{3} = \frac{2ML^2}{3}$$

12. Answer (1)

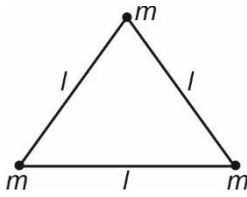
Hint & Sol: For a satellite moving in circular orbit P.E = 2 T.E and K.E = - T.E

13. Answer (3)

Hint: Gravitational potential energy of a two point mass system separated by distance r ,

$$U = -\frac{Gm_1m_2}{r}$$

Sol.:



$$U_{\text{system}} = -\frac{Gm^2}{l} - \frac{Gm^2}{l} - \frac{Gm^2}{l}$$

$$= \frac{-3Gm^2}{l}$$

14. Answer (4)

Hint: Use conservation of energy.

Sol.: Work done = ΔU as $\Delta K.E = 0$ because it is moved slowly.

$$\Rightarrow W = \Delta U = U_f - U_i = -\frac{GMm}{R} + \frac{GMm}{R} = 0$$

15. Answer (1)

Hint & Sol.: The moment of inertia of a uniform rod of length l and mass m about an axis perpendicular to length of rod and passing through one end is $\frac{ml^2}{3}$.

16. Answer (2)

Hint: \Rightarrow Total energy of satellite = $-\frac{GmM_e}{2(R_e + h)}$

Sol.: \Rightarrow Energy required = Difference of total energy

$$\Rightarrow (T.E)_f - (T.E)_i = -\frac{GMm}{2 \times 6R_e} + \frac{GMm}{2 \times 4R_e}$$

$$= -\frac{GMm}{12R_e} + \frac{GMm}{8R_e} = \frac{GMm}{24R_e}$$

17. Answer (3)

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

Sol.: $V_R = \frac{-Gm}{\sqrt{2}L} + \frac{(-Gm)}{\sqrt{2}L} = -\frac{Gm \times 2}{\sqrt{2}L} = -\frac{\sqrt{2}Gm}{L}$

18. Answer (1)

Hint: Use Kepler's third law

Sol.: From Kepler's third law we know that, $T^2 \propto R^3$

$$\Rightarrow \frac{T^2}{(T')^2} = \frac{8R^3}{64R^3}$$

$$\Rightarrow T' = 2\sqrt{2}T$$

19. Answer (3)

Hint: $I = -\frac{\partial v}{\partial x} \hat{i} - \frac{\partial v}{\partial y} \hat{j} - \frac{\partial v}{\partial z} \hat{k}$ [Relation between gravitational potential and gravitational field intensity]

Sol.: $\vec{I} = +3\hat{i} + 2\hat{j} + 5\hat{k}$

$$\Rightarrow \vec{I} = (3\hat{i} + 2\hat{j} + 5\hat{k}) \text{ N/kg}$$

20. Answer (3)

Hint: $V_0 = \sqrt{\frac{GM}{R+h}}$ [Expression for orbital velocity of a satellite at a height h from surface of earth]

Sol.: Since the projected velocity is equal to orbital velocity hence the object will start rotating around earth in circular orbit.

21. Answer (1)

Hint & Sol.: For $r_1 < r < r_2$, the mass enclosed will be M_1 hence gravitational field intensity = $\frac{GM_1}{r^2}$.

22. Answer (3)

Hint: Use parallel axis theorem

Sol.: $I = \frac{MR^2}{2}$ and $I' = 2MR^2 \Rightarrow I' = 4I$

23. Answer (3)

Hint: Use $\alpha_{\text{avg}} = \frac{\Delta\omega}{\Delta t}$

Sol.: $\alpha_{\text{avg}} = \frac{\Delta\omega}{\Delta t} = \frac{2\pi \times 40 - 2\pi \times 25}{6} = 5\pi \text{ rad/s}^2$

24. Answer (3)

Hint: Use conservation of angular momentum.

Sol.: $I_1\omega_1 = I_2\omega_2 \Rightarrow mr_1^2 \times \frac{2\pi}{T_1} = mr_2^2 \times \frac{2\pi}{T_2}$

$$T_1 = 8\text{s}, r_1 = r, r_2 = \frac{r}{4}$$

$$\Rightarrow T_2 = \frac{1}{2}\text{s}$$

25. Answer (2)

Hint: Use $\vec{r}_{\text{COM}} = \frac{M_1\vec{r}_1 + M_2\vec{r}_2}{M_1 + M_2}$

Sol.:

$$\vec{r}_{\text{COM}} = \frac{-4\hat{i} + 4\hat{j} + 8\hat{k} + 20\hat{i} - 15\hat{j} + 5\hat{k}}{9} = \frac{16\hat{i} - 11\hat{j} + 13\hat{k}}{9}$$

26. Answer (2)

Hint: The time period of a satellite varies with orbital radius as $T^2 \propto R^3$

Sol.: $K.E \propto \frac{1}{R}$ and $T^2 \propto R^3$

$$\Rightarrow T^2 \propto \left(\frac{1}{K}\right)^3$$

$$\Rightarrow T \propto (K)^{-3/2}$$

27. Answer (2)

Hint: Expression for variation in acceleration due to gravity with depth is $g' = g \left[1 - \frac{d}{R_e}\right]$

$$\text{Sol. : } g' = g \left[1 - \frac{R_e}{2R_e}\right] = \frac{g}{2}$$

$$\Rightarrow \text{Weight} = \frac{200}{2} = 100 \text{ N}$$

28. Answer (4)

Hint: $V_e = \sqrt{\frac{2GM}{R}}$ [Expression for escape velocity of a body]

Sol.: Escape velocity is independent of mass of projected body, it depends upon mass of planet from which it is projected.

29. Answer (2)

Hint: Potential energy of a body lying at a distance R from centre of earth $U = -\frac{GMm}{R}$

$$\text{Sol. : } U_i = -\frac{GMm}{R}, U_f = -\frac{GMm}{3R}$$

$$\Rightarrow \Delta U = -\frac{GMm}{3R} + \frac{GMm}{R}$$

$$\Rightarrow \Delta U = \frac{GMm}{R} \times \frac{2}{3} = \frac{2}{3} \times \frac{m}{R} \times gR^2 = \frac{2mgR}{3}$$

30. Answer (1)

Hint: Variation in acceleration due to gravity above the surface of earth is given by $g_h = g \left[\frac{R}{R+h}\right]^2$

$$\text{Sol. : } g_h = g \left[\frac{R}{R + \frac{R}{2}}\right]^2$$

$$\Rightarrow g_h = g \left[\frac{2R}{3R}\right]^2$$

$$\Rightarrow g_h = \frac{4g}{9}$$

31. Answer (2)

Hint: Escape speed for a body is given by

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

$$\text{Sol. : } V_e = \sqrt{\frac{2G}{R} \times \rho \times \frac{4\pi R^3}{3}}$$

$$\Rightarrow V_e \propto \sqrt{\rho} \times R$$

$$\Rightarrow \frac{V_o}{V'} = \sqrt{\frac{\rho}{2\rho}} \times \frac{R}{\frac{R}{2}}$$

$$\Rightarrow \frac{V_o}{V'} = \sqrt{\frac{1}{2}} \times 2$$

$$\Rightarrow \frac{V_o}{V'} = \frac{\sqrt{2}}{1}$$

$$\Rightarrow V' = \frac{V_o}{\sqrt{2}}$$

32. Answer (3)

Hint: Gravitational force between two point masses separated by distance r , $F = \frac{Gm_1m_2}{r^2}$

Sol.:

$$F_{1,2} = \frac{Gm_1m_2}{r^2} \text{ and } F_{2,1} = \frac{Gm_1m_2}{r^2} \Rightarrow \text{ratio} = 1:1$$

33. Answer (4)

Hint: The expression for acceleration due to gravity in terms of average mass density ρ and radius R is $\frac{4\pi G\rho R}{3}$

$$\text{Sol. : } g \propto R \Rightarrow \frac{g_1}{g_2} = \frac{2}{3}$$

34. Answer (4)

Hint & Sol: Gravitational potential due to a uniform spherical shell is given by

$$V = -\frac{GM}{r} \text{ [for } r > R] \text{ and inside the shell it}$$

remains constant and equal to $\frac{-GM}{R}$

35. Answer (2)

Hint & Sol: Gravitational field intensity due to solid sphere

$$\text{for } r < R, I = \frac{GMr}{R^3}, \text{ for } r \geq R, I = \frac{Gm}{r^2}$$

SECTION - B

36. Answer (4)

Hint & Sol.: When a planet moves around the sun in an elliptical orbit then the areal velocity remains constant.

37. Answer (1)

Hint: Gravitational potential $V = \frac{-GM}{r}$ [for any point lying outside the hollow or solid sphere]

Sol.: $V_{\text{Solid sphere}} = -\frac{GM}{3R}$, $V_{\text{Hollow sphere}} = -\frac{GM}{3R}$

$$V_{\text{net}} = -\frac{2GM}{3R}$$

38. Answer (2)

Hint & Sol.: P.E = 2 T.E and K.E = |T.E|

39. Answer (3)

Hint: Use conservation of mechanical energy.

Sol.: $\frac{1}{2}mv^2 - \frac{GMm}{R} = 0 - \frac{GMm}{R + \frac{R}{2}}$

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

$$\Rightarrow \frac{v^2}{2} = \frac{GM}{R} - \frac{2GM}{3R}$$

$$\Rightarrow \frac{v^2}{2} = \frac{GM}{3R}$$

$$\Rightarrow v = \sqrt{\frac{2GM}{3R}}$$

40. Answer (1)

Hint: Gravitational forces provide centripetal acceleration and particle rotate with centre of mass being the centre of circle of radius R .

Sol.: $\frac{Gm^2}{4R^2} = \frac{m \times v^2}{R}$

$$\Rightarrow mv^2 = \frac{Gm^2}{4R}$$

$$\Rightarrow \frac{mv^2}{2} = \frac{Gm^2}{8R}$$

$$\Rightarrow \text{K.E.} = \frac{Gm^2}{8R}$$

41. Answer (3)

Hint: The orbital velocity of a satellite is given by,

$$v_0 = \sqrt{\frac{GM}{R_e + h}}$$

Sol.: $v\sqrt{R} = v'\sqrt{R + \frac{R}{2}}$

$$\Rightarrow v\sqrt{R} = v'\sqrt{\frac{3R}{2}}$$

$$\Rightarrow v' = \sqrt{\frac{2}{3}}v$$

42. Answer (3)

Hint & Sol.: Since the mass distribution about an axis passing through point B is most widely spread hence moment of inertia is maximum about point B .

43. Answer (1)

Hint & Sol.: The gravitational potential at centre of spherical shell is same as that of potential at surface of uniform spherical shell.

44. Answer (4)

Hint & Sol.: The centre of mass of body may lie outside, inside or on the geometric centre of the body.

45. Answer (2)

Hint: Position vector of centre of mass for three particles system is given by

$$\vec{x}_{\text{COM}} = \frac{M_1\vec{x}_1 + M_2\vec{x}_2 + M_3\vec{x}_3}{M_1 + M_2 + M_3}$$

Sol.: $x_{\text{COM}} = \frac{2 \times 0 + 2 \times 2 + 2 \times 1}{6} = \frac{6}{6} = 1 \text{ m}$

46. Answer (4)

Hint: $\vec{\tau} = \vec{r} \times \vec{F}$ and $\tau_{\text{net}} = 0$ as angular momentum is conserved.

Sol.:

$$\Rightarrow \frac{\alpha}{4} = \frac{6}{-12} = \frac{12}{-24}$$

$$\Rightarrow \alpha = -2$$

47. Answer (1)

Hint: Net torque on the system should be zero**Sol.:** Taking net torque about fulcrum to be zero

$$\Rightarrow 24 \times g \times l = mg \times \frac{l}{2} + 6 \times g \times \frac{3l}{2}$$

$$\Rightarrow 24 = \frac{m}{2} + \frac{18}{2}$$

$$\Rightarrow 24 = \frac{m}{2} + 9$$

$$\Rightarrow \frac{m}{2} = 15$$

$$\Rightarrow m = 30 \text{ kg}$$

48. Answer (3)

$$\text{Hint: } \vec{r}_{\text{COM}} = \frac{m_1 \vec{r}_1 + m_2 \vec{r}_2}{m_1 + m_2}$$

Sol.: Taking origin to be at m_2 ,

$$|\vec{r}_{\text{COM}}| = \frac{m_1 R + m_2 \times 0}{m_1 + m_2} = \frac{m_1 R}{m_1 + m_2}$$

49. Answer (3)

$$\text{Hint: } \vec{L} = \vec{r} \times \vec{p}$$

Sol.: As the line of action of linear momentum vector passes through origin hence angular momentum of particle w.r.t. origin would be zero.

50. Answer (3)

Hint: Use angular momentum conservation.

$$\text{Sol.} \quad \frac{mr^2}{2} \times 30 = \left[\frac{mr^2}{2} \times \omega' + \frac{m}{4} \times r \times \omega' \times r \right]$$

$$\frac{mr^2}{2} \times 30 = \omega' \left[\frac{mr^2}{2} + \frac{mr^2}{4} \right]$$

$$\Rightarrow \frac{mr^2}{2} \times 30 = \frac{mr^2}{2} \times \frac{3}{2} \times \omega'$$

$$\Rightarrow \omega' = \frac{30 \times 2}{3} = 20 \text{ rad/s}$$

CHEMISTRY

SECTION-A

51. Answer (2)

Hint: Algebraic summation of oxidation state of each atom in a neutral compound must be zero.**Sol.:**

Compound	Oxidation state of metals
Cr_2O_3	+ 3
Mn_2O_7	+ 7
PbCl_2	+ 2
Cu_2Cl_2	+ 1

52. Answer (4)

$$\text{Hint: } K_P = K_C (RT)^{\Delta n_g}$$

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

$$\log \left(\frac{K_P}{K_C} \right) = \Delta n_g \log(RT)$$

$$\log \left(\frac{K_P}{K_C} \right) \text{ will be zero if}$$

$$\Delta n_g = 0$$

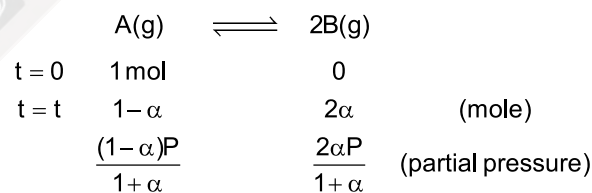
53. Answer (4)

Hint: Equilibrium can be attained only in reversible reaction.**Sol.:** Change in Gibbs free energy (ΔG) is zero at equilibrium state of any reversible reaction.

54. Answer (3)

Hint: For reaction $\text{A(g)} \rightleftharpoons 2\text{B(g)}$

$$K_P = \frac{p_B^2}{p_A}$$

Sol.:

$$K_P = \frac{\left(\frac{2\alpha P}{1+\alpha} \right)^2}{(1-\alpha)P}$$

$$K = \frac{4\alpha^2 P}{1-\alpha^2}$$

$$= \frac{4 \times (0.5)^2 P}{1 - (0.5)^2} = \frac{4P}{3}$$

$$P = \frac{3K}{4}$$

55. Answer (4)

Hint: $\text{pH} + \text{pOH} = 14$ (at 25°C)**Sol.:** $[\text{OH}^-] = 0.01 \text{ M}$

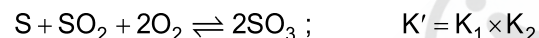
$$\text{pOH} = -\log[\text{OH}^-] = -\log 10^{-2} = 2$$

$$\text{pH} = 14 - 2 = 12$$

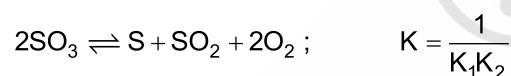
56. Answer (4)

Hint: On increasing temperature equilibrium shifts in the forward direction for an endothermic reaction.**Sol.:** Given reaction is endothermic and number of gaseous mole is decreasing in forward direction hence maximum yield of product will be at high temperature and high pressure.

57. Answer (4)

Hint: On adding two reactions, their equilibrium constants get multiplied to get the new equilibrium constant.**Sol.:** On adding both reactions

Now reversing the above reaction



58. Answer (2)

Hint: For a weak monoprotic acid

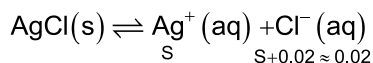
$$\text{Degree of ionisation } \alpha = \sqrt{\frac{K_a}{c}}$$

$$\text{Sol.} \quad \% \alpha = \sqrt{\frac{K_a}{c}} \times 100 = \sqrt{\frac{1.8 \times 10^{-5}}{0.18}} \times 100 = 1\%$$

59. Answer (4)

Hint: Lewis base donates lone pair of electrons to empty orbitals.**Sol.:** NH_3 has lone pair of electrons in outermost shell of nitrogen.

60. Answer (1)

Hint: Solubility of sparingly soluble salts decreases due to common ion effect.**Sol.:**

$$K_{\text{SP}} = [\text{Ag}^+][\text{Cl}^-]$$

$$1.6 \times 10^{-10} = \text{S} \times 0.02$$

$$\text{S} = 8 \times 10^{-9} \text{ M}$$

61. Answer (3)

Hint: Mixture of weak base and its salt with a strong acid will result into basic buffer solution**Sol.:** $\text{CH}_3\text{COOH(aq)} + \text{CH}_3\text{COOK(aq)} \rightarrow$ Acidic buffer $\text{NaCN(aq)} + \text{HCN(aq)} \rightarrow$ Acidic buffer $\text{NH}_4\text{Cl(aq)} + \text{NH}_4\text{OH(aq)} \rightarrow$ Basic buffer $\text{NaCl(aq)} + \text{NaOH(aq)} \rightarrow$ No buffer

62. Answer (3)

Hint: For any equilibrium

$$\Delta G^\circ = -2.303 \text{ RT } \log(K_{\text{eq}})$$

Sol.: For given reaction

$$\Delta G^\circ = +31.65 \text{ kJ}$$

$$+31.65 \times 10^3 = -2.303 \times 8.314 \times 298 \log(K_{\text{eq}})$$

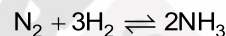
$$\log K_{\text{eq}} = \frac{-31650}{2.303 \times 8.314 \times 298}$$

$$= -5.55$$

$$K_{\text{eq}} = 10^{-5.55} = 10^{0.45} \times 10^{-6}$$

$$= 2.87 \times 10^{-6}$$

63. Answer (3)

Hint: Manufacture of ammonia by Haber's process is an exothermic reaction**Sol.:** Catalyst does not affect the equilibrium composition of reaction mixture.

Decrease in concentration of reactant will shift equilibrium in backward direction.

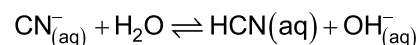
Since density of water is more than ice hence melting of ice will increase on increase in pressure.

64. Answer (2)

Hint: Species that accept lone pairs of electrons are known as Lewis acid.**Sol.:** BF_3 , BeCl_2 & AlCl_3 are Lewis acids.

- NH_3 is Lewis base.
- CCl_4 is neither Lewis acid nor base.

65. Answer (3)

Hint: Salt of strong base and weak acid undergoes anionic hydrolysis.**Sol.:** Following equilibrium will get stabilise in aqueous NaCN 

This will result in basic solution with pH more than 7.

66. Answer (2)

Hint: Ions produced from weak acid or base gets hydrolysed in aqueous solution.

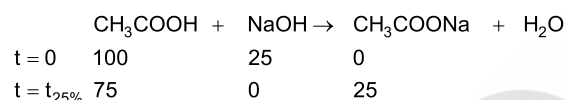
Sol.: In CH_3COOK , CH_3COO^- ion is from weak acid hence anionic hydrolysis will take place.

- In NH_4Cl , NH_4^+ ion is from weak base hence cationic hydrolysis will take place.
- in KNO_3 both ions are from strong electrolytes hence no hydrolysis.
- In $\text{CH}_3\text{COO NH}_4$ both cation and anion will get hydrolysed.

67. Answer (3)

Hint: On neutralisation of weak acid with strong base, a buffer solution will be obtained if acid is present in excess.

Sol.: On 25% neutralisation of CH_3COOH



Here mixture of CH_3COONa and CH_3COOH will make acidic buffer solution

68. Answer (3)

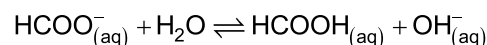
Hint: If any change is made at equilibrium state then equilibrium shifts in such a way that effect of change gets nullified.

Sol.: Introduction of inert gas at constant volume does not change partial pressure of reactant or product gases hence it does not affect equilibrium state.

69. Answer (3)

Hint: Salt of WASB gives basic solution due to anionic hydrolysis.

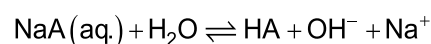
Sol.: HCOONa is salt of weak acid and strong base.



Presence of $\text{OH}^-_{(\text{aq})}$ will give solution with pH more than 7.

70. Answer (3)

Hint: Salt of weak acid and strong base undergoes anionic hydrolysis



Sol.: For WASB type of salt

$$K_h = \frac{K_w}{K_a} = \frac{10^{-14}}{10^{-5}} = 10^{-9}$$

71. Answer (2)

Hint: For an acid

$$\text{pH} = -\log [\text{H}^+]$$

Sol.: Since $[\text{HCl}] < 10^{-6}$ here contribution of H^+ ions from H_2O that is 10^{-7} M will be considered.

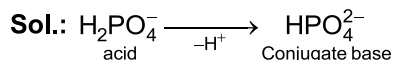
$$[\text{H}^+]_{\text{net}} = 10^{-7} + 10^{-7} = 2 \times 10^{-7}$$

$$\text{pH} = -\log(2 \times 10^{-7})$$

$$= 6.7$$

72. Answer (2)

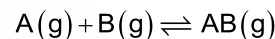
Hint: Conjugate acid and base are obtained by proton gain or loss respectively.



73. Answer (4)

$$\text{Hint: } K_P = K_C (\text{RT})^{\Delta n_g}$$

Sol.: For reaction



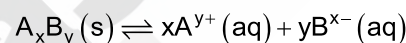
$$\Delta n_g = -1$$

$$K_P = 0.5(0.0821 \times 300)^{-1} = \frac{0.5}{0.0821 \times 300}$$

$$= 0.02 \text{ atm}$$

74. Answer (4)

Hint: For given salt $\text{A}_x\text{B}_y(\text{s})$



$$K_{SP} = x^x y^y s^{x+y}$$

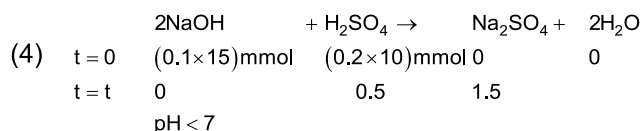
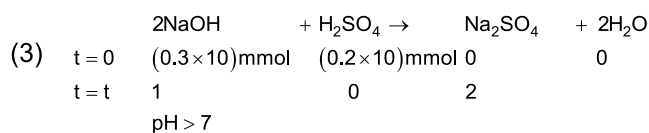
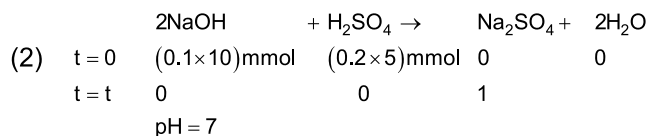
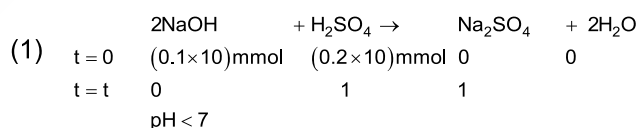
Sol.: For $\text{Ca}_3(\text{PO}_4)_2(\text{s}) \rightleftharpoons 3\text{Ca}^{2+}(\text{aq}) + 2\text{PO}_4^{3-}(\text{aq})$

$$K_{SP} = 3^3 2^2 s^{3+2} = 108s^5$$

75. Answer (3)

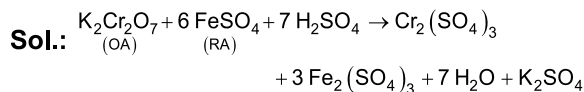
Hint: On mixing acid and base, neutralisation takes place and the nature of solution is determined by the reagent in excess.

Sol.:



76. Answer (2)

Hint: Reducing agent gets oxidised in a redox reaction.



77. Answer (3)

Hint: A compound must be electrically neutral, that is summation of total positive charge must be equal to summation of total negative charge.



78. Answer (1)

Hint: Metal cation that has less tendency to get reduced results into less value of standard reduction potential.

Sol.: As SRP increases, reducing power of metal decreases

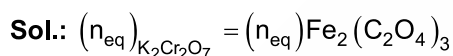
Order of SRP $\Rightarrow Y > Z > X$

Hence, order of reducing power $X > Z > Y$

79. Answer (4)

Hint: In any redox reaction

$$(n_{eq})_{OA} = (n_{eq})_{RA}$$



$$(n \times vf)_{K_2Cr_2O_7} = (n \times vf)_{Fe_2(C_2O_4)_3}$$

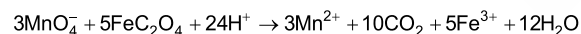
$$n \times 6 = 1 \times 6$$

$$n = 1$$

80. Answer (1)

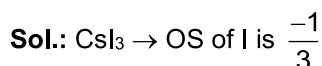
Hint: Number of atoms of each element must be same in both sides of a balanced chemical equation.

Sol.: Balanced chemical equation is as following



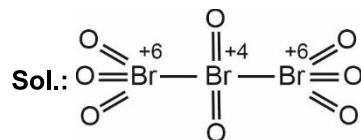
81. Answer (4)

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



82. Answer (2)

Hint: For covalent bond, high electronegative element gets negative oxidation state and less electronegative element gets positive oxidation state.



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

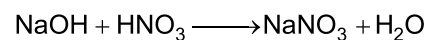
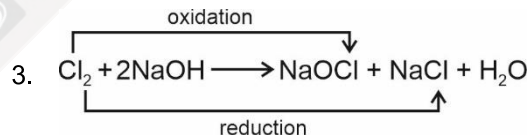
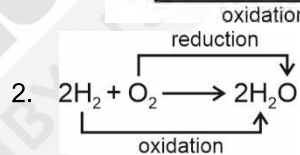
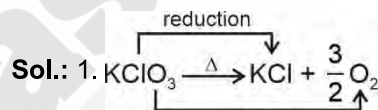
83. Answer (1)

Hint & Sol.:

Compound	Oxidation State of nitrogen
NH ₃	-3
N ₂ O	+1
N ₂ O ₃	+3
HNO ₃	+5

84. Answer (3)

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

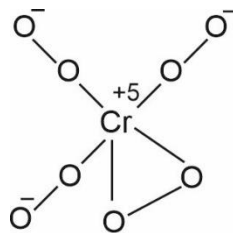


It is not a redox reaction.

Hence (3) is a disproportionation reaction.

85. Answer (4)

Hint & Sol.: Structure of CrO_8^{3-} is



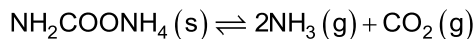
Here Cr is present in +5 oxidation state.

SECTION - B

86. Answer (3)

Hint: For a gaseous mixture, partial pressure of any gaseous component is equal to its mole fraction multiplied with total pressure of mixture.

Sol.: For equilibrium



$$K_p = P_{\text{NH}_3}^2 \times P_{\text{CO}_2}$$

$$P_{\text{NH}_3} = \frac{2}{3} \times 6 = 4 \text{ atm}$$

$$P_{\text{CO}_2} = \frac{1}{2} \times 6 = 2 \text{ atm}$$

$$K_p = 4^2 \times 2 \\ = 32 \text{ atm}^3$$

87. Answer (1)

Hint: If K_c for a reaction is less than 10^{-3} then equilibrium mixture will have mostly reactant.

Sol.: Since $K_c \ll 10^{-3}$

Concentration of reactant will be maximum in equilibrium mixture.

88. Answer (2)

Hint: Ionisation of successive H^+ ion gets difficult in case of polyprotic acid.

Sol.: Since successive ionisation of polyprotic weak acid decreases, order of their ionisation constant will be

$$K_{a_1} > K_{a_2} > K_{a_3}$$

89. Answer (4)

Hint: Monoprotic acid has only one ionisable hydrogen hence will have basicity 1.

Sol.:

Acid	Basicity
H_2SO_4	2
H_2SO_3	2
H_3PO_3	2
H_3PO_2	1

90. Answer (4)

Hint: Aqueous solution of WAWB type of salt undergoes both cationic and anionic hydrolysis.

Sol.: For WAWB type of salt concentration of $[\text{H}^+]$ ion does not depend on dilution and pH can be calculated as

$$\text{pH} = 7 + \frac{1}{2}\text{p}K_a - \frac{1}{2}\text{p}K_b$$

91. Answer (1)

Hint: Aqueous solution of WASB type of salt results into basic solution due to anionic hydrolysis

Sol.: pH of WASB type of salt solution can be calculated as

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

92. Answer (3)

Hint: If all the components are in the same physical state, the equilibrium is called homogeneous equilibrium.

Sol.: In $\text{CaCO}_3(\text{s}) \rightleftharpoons \text{CaO}(\text{s}) + \text{CO}_2(\text{g})$ physical state of all the components is not the same hence it is a heterogeneous equilibrium.

93. Answer (2)

Hint: Addition of HCl in aq. CH_3COOH solution will result into common ion effect.

Sol.: Due to common ion effect ionisation of CH_3COOH will decrease hence mole of CH_3COO^- ion will decrease and K_a will remain constant. pH of solution will decrease as HCl will give more $[\text{H}^+]$ in solution.

94. Answer (4)

Hint: Solubility of sparingly soluble salt decreases due to common ion effect.

Sol.: NaCl , CaCl_2 and AgNO_3 will give a common ion effect to $\text{AgCl}(\text{aq})$ hence maximum solubility will be observed in aqueous NH_3 solution, which forms a complex with Ag^+ ion.

95. Answer (4)

Hint: Addition of NaCl in water results into neutral solution as it does not get hydrolysed

Sol.: Addition of aq. NaCl in acidic solution will result into no change in concentration of $[\text{H}^+]$ ion and pH remains constant. K_a changes only with temperature.

96. Answer (2)

Hint: For a reversible reaction $K_{\text{eq}} = \frac{K_f}{K_b}$

Sol.: Equilibrium constant only depends upon temperature and on increasing temperature increases for endothermic reaction but decreases for exothermic reaction.

97. Answer (2)

Hint & Sol.: Oxidation state of metal in alloy is zero hence oxidation state of Na in sodium amalgam will be zero.

98. Answer (1)

Hint: Oxidising agent gets reduced and reducing agent gets oxidised in redox reaction.

Sol.: HClO_4 cannot get oxidised and H_2S cannot get reduced hence HClO_4 cannot be reducing agent and H_2S cannot be oxidising agent

99. Answer (3)

Hint: Species with higher SRP value have more oxidising power.

Sol.: Since SRP of F_2 is more than that of Cl_2 , hence F_2 will be a stronger oxidising agent than Cl_2 .

100. Answer (4)

Hint: EMF of cell = $(\text{SRP})_{\text{cathode}} - (\text{SRP})_{\text{anode}}$

Sol.: Cathode : $\text{Cu}^{2+} + 2\text{e}^- \rightarrow \text{Cu}$

Anode : $\text{Zn} \rightarrow \text{Zn}^{2+} + 2\text{e}^-$

EMF = $0.34 - (-0.76)$

= 1.1 V

BOTANY

SECTION-A

101. Answer (1)

Hint: A sorus (pl.sori) is a cluster of sporangia.

Sol.: Genera like *Selaginella* and *Salvinia* of pteridophytes produce two kinds of spores, and are known as heterosporous.

102. Answer (4)

Hint: *Pinus* is a gymnosperm and bears male and female cones.

Sol.: Coralloid roots are found in *Cycas*.

Pinus shows compact cones, mycorrhizal association as well as pollen grains.

103. Answer (4)

Hint: *Volvox* shows haplontic life cycle.

Sol.: *Ectocarpus* shows haplo-diplontic life cycle. *Ulothrix* exhibits haplontic life cycle.

104. Answer (4)

Hint: Plants show two distinct generations, diploid sporophyte and haploid gametophyte. Embryo sac is female gametophyte of angiosperms.

Sol.: Embryo sac is female gametophyte (n) found inside ovule (2n). Microspore (n) is found inside anther (2n).

105. Answer (2)

Hint: Numerical taxonomy involves usage of numerical methods to classify organism.

Sol.: Phylogenetic classification system assumes that organisms belonging to the same taxa have a common ancestor. Chemotaxonomy uses the chemical constituents of the plant to resolve confusions.

106. Answer (1)

Hint: Double fertilisation involves syngamy and triple fusion.

Sol.: Because of the occurrence of two fusions, i.e., syngamy and triple fusion, this event is termed as double fertilisation, an event unique to angiosperms.

107. Answer (3)

Hint: In bryophytes, sporophyte is dependent on gametophyte. Sporophyte is independent and photosynthetic in pteridophytes. Sporophyte forms spores.

Sol.: Sporophyte has 2n ploidy.

108. Answer (2)

Hint: Agar-agar, a hydrocolloid, is obtained from red algae.

Sol.: Members of brown and red algae have been employed to obtain hydrocolloids.

109. Answer (3)

Hint: *Eucalyptus* is an angiosperm.

Sol.: In *Eucalyptus*, the female sex organ (pistil) consists of an ovary at its base, a long slender style and stigma.

110. Answer (2)

Hint: Gymnosperms bear archegonium.

Sol.: Angiosperms lack archegonium.

111. Answer (2)

Hint: Laminarin is stored food in brown algae.

Sol.: Phaeophyceae contains chlorophyll a and c, and laminarin. It bears 2 flagella and produces pear shaped gametes.

112. Answer (1)

Hint: Pyrenoids are proteinaceous structures.

Sol.: Pyrenoids are storage bodies and it contains protein besides starch.

113. Answer (4)

Hint: Hydrocolloids are generally produced by algae.

Sol.: Peat is not a hydrocolloid.

114. Answer (3)

Hint: *Funaria* and *Marchantia* are bryophyte.

Sol.:

Cuscuta – Angiosperm

Ectocarpus – Alga

Marchantia – Liverwort

Funaria – Moss

115. Answer (4)

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

Sol.: In algae, sexual gametes can be flagellated and similar in size (as in *Ulothrix*) or non-flagellated but similar in size (as in *Spirogyra*).

116. Answer (1)

Hint: Lax is found in gymnosperms.

Sol.: Two kinds of spores are produced within sporangia that are borne on sporophylls which are arranged spirally along an axis to form lax.

117. Answer (3)

Hint: *Volvox* is an alga and shows haplontic life cycle.

Sol.: *Sphagnum* is a moss. Its gametophyte shows leafy stage.

Pteris is a fern. Its gametophyte is called prothallus.

Ginkgo is a gymnosperm. Its gametophyte is highly reduced.

118. Answer (1)

Hint: Gymnosperms show the presence of seed.

Sol.: *Cycas* is an example of gymnosperm. Thus, all the given features are true for *Cycas*.

119. Answer (2)

Hint: Green algae store starch.

Sol.: *Ulothrix* belongs to green algae and stores starch.

120. Answer (2)

Hint: The diagram shows a male thallus of *Marchantia*.

Sol.:

A	–	Antheridiophore
B	–	Gemma cup
C	–	Rhizoids

Gemma cup bears asexual buds called gemmae.

121. Answer (4)

Hint: *Ginkgo* is a gymnosperm.

Sol.: *Adiantum* is a pteridophyte.

122. Answer (3)

Hint: Reduction in surface area can reduce transpiration.

Sol.: In conifers, the needle-like leaves reduce the surface area. Their thick cuticle and sunken stomata also help to reduce water loss. Presence of branched stem does not aid in reducing water loss in conifers.

123. Answer (4)

Hint: *Fucus* shows diplontic life cycle.

Sol.: Life cycle of *Fucus* and *Salvinia* respectively are diplontic and haplodiplontic.

124. Answer (1)

Hint: Red algae are rich in phycoerythrin.

Sol.: Fucoxanthin is the major pigment in brown algae.

125. Answer (4)

Hint: *Volvox* is a colonial alga. *Laminaria* is a kelp. *Volvox* and *Laminaria* are multicellular.

Sol.: *Chlorella* is a unicellular alga.

126. Answer (1)

Hint: Body of higher plants is differentiated into root, stem and leaves.

Sol.: Algae are chlorophyll bearing, simple thalloid and mostly aquatic.

127. Answer (4)

Hint: Gemmae can be found in liverworts.

Sol.: Gemmae are green, multicellular, asexual buds, which develop in small receptacles called gemma cups located on the thalli.

128. Answer (2)

Hint: Green algae can reproduce by isogamy, anisogamy or oogamy.

Sol.: Green algae bear 2, apical and equal flagella and also have centrioles.

129. Answer (4)

Hint: At least half of the total CO₂ fixation on earth is carried out by algae.

Sol.: Around 70 species of marine alga can be used as food.

130. Answer (2)

Hint: In brown algae, algin is found in outer cell wall.

Sol.: Chlorophyceae has cellulose and pectose in its cell wall.

131. Answer (2)

Hint: Spores are haploid.

Sol.: In plants, spores germinate to form gametophyte.

132. Answer (1)

Hint: *Marchantia* is a liverwort.

Sol.: The plant body of bryophytes is more differentiated than that of algae.

133. Answer (3)

Hint: Red algae lack flagella.

Sol.: Red algae have poly sulphate esters in cell wall and is mostly found in salt-water.

134. Answer (2)

Hint: *Laminaria* and *Sargassum* belong to brown algae.

Sol.: Many species of *Porphyra*, *Laminaria* and *Sargassum* are among the 70 species of marine algae used as food.

135. Answer (2)

Hint: Artificial systems gave equal weightage to vegetative and sexual characteristics.

Sol.: Linnaeus classification of plants was based mainly on androecium structure.

SECTION - B

136. Answer (3)

Hint: The sporophyte of mosses is divided into foot, seta and capsule.

Sol.: In gymnosperms, the roots are generally tap roots. In mosses, the capsule contains spores

137. Answer (1)

Hint & Sol.: Polysulphate esters can be found in the cell wall of red algae, e.g., *Gracilaria*.

138. Answer (4)

Hint: Capsule is found in bryophytes.

Sol.: Kelps can grow up to 100 metres.

139. Answer (2)

Hint: Gymnosperms are well adapted to withstand extreme temperature, humidity and wind.

Sol.: Event precursor to seed habit is seen in pteridophytes.

140. Answer (2)

Hint: *Psilotum* belongs to class Psilopsida.

Sol.: *Dryopteris* belongs to class Pteropsida.

141. Answer (4)

Hint: *Sphagnum* is used as packing material for trans-shipment.

Sol.: Pteridophytes reduce the impact of falling rain and prevent soil erosion.

142. Answer (4)

Hint: *Ectocarpus* is a brown alga.

Eudorina is a green alga.

Sol.: *Porphyra*, *Gracilaria* and *Polysiphonia* are members of red algae.

143. Answer (2)

Hint: Both *Selaginella* and *Equisetum* are pteridophytes.

Sol.: *Selaginella* is heterosporous but *Equisetum* is homosporous.

144. Answer (3)

Hint: *Fucus* shows diplontic life cycle.

Sol.: In gymnosperms like *Cycas*, multicellular female gametophyte is retained in megasporangium.

145. Answer (3)

Hint: In diplontic life cycle, gametophyte is dependent on sporophyte.

Sol.: In seed bearing plants, gametophyte is few to multi-celled.

146. Answer (3)

Hint: Integument is the protective covering of ovule.

Sol.: Nucellus is protected by envelope and the composite structure is called an ovule.

147. Answer (1)

Hint: Ferns are macrophyllous.

Sol.: *Selaginella* is not a fern, it bears microphylls.

148. Answer (2)

Hint: In mosses, spore germinates to form protonema.

Sol.: Protonema is a gametophytic stage.

149. Answer (2)

Hint: Rhizoids can be unicellular or multicellular in bryophytes.

Sol.: Zygotic meiosis is absent in bryophytes.

150. Answer (2)

Hint: Union of two gametes is called syngamy.

Sol.: In anisogamy, two kinds of distinct gametes are formed. In oogamy, one motile male gamete and other non-motile female gamete is formed.

ZOOLOGY

SECTION-A

151. Answer (1)

Hint: Undergoes transverse binary fission**Sol.:** In *Paramecium*, cilia help in the movement of food through cytopharynx and in locomotion as well.*Hydra* can use its tentacles for capturing its prey and also use them for locomotion.*Amoeba* possesses pseudopodia for amoeboid movement.

152. Answer (4)

Hint: Structure responsible for locomotory movement of female gamete.**Sol.:** Passage of ova through the female reproductive tract is facilitated by ciliary movement. Flagellar movement helps in swimming of spermatozoa, maintenance of water current in the canal system of sponges and in locomotion of protozoans like *Euglena*.

153. Answer (2)

Hint: Contraction of muscles is unique property.**Sol.:** Muscles have special properties like conductivity, excitability, contractility, extensibility and elasticity while neurons have excitability and conductivity.

Neurons and muscles are excitable cells of the body.

154. Answer (1)

Hint: Striped appearance**Sol.:**

Features	Cardiac muscle fibres	Skeletal muscle fibres
Striations	+nt	+nt
Intercalated discs	+nt	-nt
Nucleus	Uninucleated	Multinucleated
Branching	+nt	-nt

155. Answer (2)

Hint: More than 30%**Sol.:** About 40-50 per cent of the weight of a normal human adult is contributed by muscles.

156. Answer (2)

Hint: Fusiform in shape**Sol.:** Smooth muscles assist in the transport of food through the digestive tract and gametes through the genital tract. Striated muscle fibres are cylindrical in shape and voluntary in action.

Cardiac muscles exhibit branched muscle fibres.

157. Answer (1)

Hint: Coordination is required for normal physiology.**Sol.:** Coordination is the process through which two or more organs interact and complement the functions of each other. The neural system provides an organised network of point-to-point connections for quick coordination.

In our body, the neural system and the endocrine system jointly coordinate and integrate all the activities of the organs.

158. Answer (4)

Hint: More than one are correct.**Sol.:** The neural system of all animals is composed of highly specialised cells called neurons which can detect, receive and transmit different kinds of stimuli.

159. Answer (3)

Hint: Arachnoid is the middle covering of brain.**Sol.:** The human brain is well protected by the skull. Inside the skull, the brain is covered by cranial meninges consisting of an outer layer called dura mater and very thin middle layer called arachnoid and an inner layer, pia mater.

160. Answer (3)

Hint: Ilium, ischium and pubis fuse to form a cavity.**Sol.:** 'X' is scapula. Scapula is a large triangular flat bone situated in the dorsal part of the thorax between the second and the seventh ribs. The dorsal, flat, triangular body of scapula has a slightly elevated ridge called the spine which projects as a flat, expanded process called the acromion. The clavicle articulates with this. Below the acromion is a depression called the glenoid cavity which articulates with the head of the humerus to form the shoulder joint.

161. Answer (2)

Hint: 'Quad' means four

Sol.: A deep cleft divides the cerebrum longitudinally into two halves, which are termed as the cerebral hemisphere. The cerebral hemispheres are connected by corpus callosum. Midbrain consists of corpora quadrigemina and a canal (cerebral aqueduct).

162. Answer (4)

Hint: Involved in regulating body equilibrium

Sol.: Thalamus, hippocampus and amygdala are associated with forebrain.

Cerebellum is a part of hindbrain.

163. Answer (3)

Hint: Also called muscle bundles

Sol.: Each organised skeletal muscle in our body is made of a number of muscle bundles or fascicles held together by a common collagenous connective tissue layer called fascia.

Each muscle bundle contains a number of muscle fibres.

164. Answer (2)

Hint: Include the branched fibres and cyton

Sol.: Nissl's granules are present in cell body and dendrites.

165. Answer (2)

Hint: Exclude the function associated with medulla oblongata

Sol.: The limbic system is involved in the regulation of sexual behaviour, expression of emotional reactions (e.g. excitement, pleasure, rage and fear) and motivation.

The medulla oblongata contains centre for regulation of respiration.

166. Answer (3)

Hint: Home of pituitary gland

Sol.: Maxilla, zygomatic and nasal bones are paired facial bones.

Sphenoid is an unpaired cranial bone. It forms a depression called sella turcica which lodges the pituitary gland.

167. Answer (2)

Hint: Storehouse of calcium

Sol.:

Red muscle fibres	White muscle fibres
Myoglobin content is high	Myoglobin content is low
More number of mitochondria	Less number of mitochondria
Usually involved in aerobic respiration	Usually involved in anaerobic respiration
Low amount of sarcoplasmic reticulum	High amount of sarcoplasmic reticulum

168. Answer (4)

Hint: Voltage gated sodium channels open

Sol.: When a stimulus is applied at a site on the polarised membrane, the membrane at that site becomes freely permeable to Na⁺. This leads to rapid influx of Na⁺ followed by reversal of polarity at that site.

169. Answer (2)

Hint: Present between cranial bones.

Sol.: Fibrous joints 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 to form cranium.

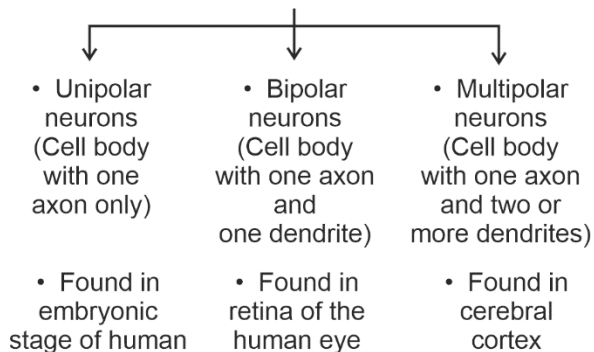
Ball and socket joint is present in between head of femur and acetabulum of coxal bone.

Pivot joint is present between atlas and axis.

170. Answer (4)

Hint: Two or more dendrites are present in neurons of cerebrum.

Sol.: Based on the number of axon and dendrites the neurons are divided into three types



171. Answer (3)

Hint: Identify an arthropod.

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

172. Answer (1)

Hint: Length of 'A' band remains same.

Sol.: Mechanism of muscle contraction is best explained by the sliding filament theory which states that contraction of a muscle fibre takes place by sliding of thin filaments over the thick filaments. The length of 'A' band remains unchanged during muscle contraction.

173. Answer (2)

Hint: Troponin consists of three sub-units.

Sol.: A complex protein, troponin is distributed at regular intervals on the tropomyosin. In the resting state, a subunit of troponin masks the active binding sites for myosin on the actin filaments.

Each myosin (thick) filament is a polymerised protein, made up of monomeric proteins called meromyosins.

174. Answer (2)

Hint: Identify the muscle cell.

Sol.: Muscle fibre is the anatomical unit of muscles.

Each muscle fibre has many parallelly arranged myofibrils.

Each myosin (thick) filament is a polymerised protein, made up of monomeric proteins called meromyosins.

175. Answer (2)

Hint: Exclude the divisions of ANS

Sol.: The PNS is divided into two divisions called somatic neural system and autonomic neural system. The somatic neural system relays impulses from CNS to skeletal muscles while the autonomic neural system transmits impulses from CNS to involuntary organs and smooth muscles of the body.

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

176. Answer (1)

Hint: Exclude the function of ear

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

Balance of the body is associated with cerebellum and cerebral cortex.

Hypothalamus regulates circadian rhythm of the body.

177. Answer (1)

Hint: Myelin sheath producing cells

Sol.: Unmyelinated nerve fibre is enclosed by a Schwann cell that does not form a myelin sheath around the axon and is commonly found in somatic and autonomic neural system.

Myelinated nerve fibres are found in spinal and cranial nerves.

The axon terminals contain vesicles filled with neurotransmitters.

178. Answer (4)

Hint: Axon terminates at synaptic knob.

Sol.: The dendrites transmit the impulses towards the cell body. The axon is a long fibre, the distal end of which is branched. The axon transmits nerve impulses away from cell body to a synapse.

179. Answer (4)

Hint: More than one are correct.

Sol.: Visceral neural system is the part of PNS that comprises the whole complex of nerves, fibres, ganglia and plexuses by which impulses travel from CNS to the viscera and from the viscera to the CNS.

180. Answer (4)

Hint: Part of hindbrain

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

Cerebellum has very convoluted surface in order to provide the additional space for many more neurons.

The forebrain consists of cerebrum, thalamus and hypothalamus.

Hippocampus is an integral part of limbic system.

181. Answer (4)

Hint: It regulates the heart rate.

Sol.: The association areas are neither sensory nor motor in function. They are responsible for complex functions such as intersensory association, memory and communication. The medulla contains centres which control respiration, cardiovascular reflexes and gastric secretions.

182. Answer (1)

Hint: Hypothalamus lies at the base of it.

Sol.: The cerebrum wraps around a structure called thalamus which is a major coordinating centre for sensory and motor signalling.

Amygdala is a structure of limbic system.

The hindbrain comprises pons, cerebellum and medulla oblongata.

183. Answer (2)

Hint: Contain satiety centre

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

Medulla contains centre for regulation of respiration. The visual cortex is the primary cortical region of brain that receives, integrates and processes visual information.

184. Answer (2)

Hint: Also known as duct of sylvius

Sol.: Midbrain is located in between thalamus/hypothalamus of the forebrain and pons of the hindbrain.

A canal called cerebral aqueduct passes through it. Hypothalamus is involved in thermoregulation.

ADH or vasopressin synthesized by hypothalamus regulates electrolyte balance of the body.

185. Answer (2)

Hint: Outer region of cerebrum

Sol.: The layer of cells that covers the cerebral hemisphere and is thrown into prominent folds is cerebral cortex.

The human brain is well protected by skull. Inside the skull, the brain is covered by cranial meninges. A canal called the cerebral aqueduct passes through the midbrain.

SECTION - B

186. Answer (2)

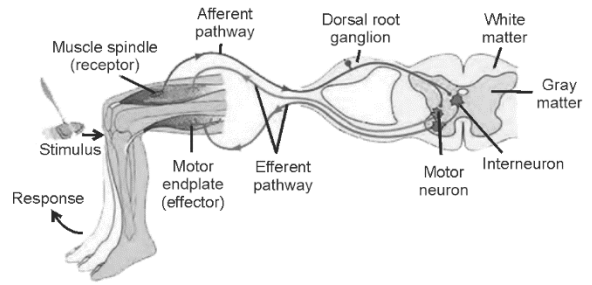
Hint: Synapses that involve neurotransmitter

Sol.: Transmission of an impulse across an electrical synapse is always faster than across a chemical synapse.

187. Answer (2)

Hint: Knee-jerk reflex is a monosynaptic reflex.

Sol.: Interneuron is not involved in knee-jerk reflex.



188. Answer (1)

Hint: Articulates with the occipital condyles

Sol.: The first vertebra is atlas and it articulates with the occipital condyles.

The second vertebra is axis.

189. Answer (3)

Hint: Malleus is attached to tympanic membrane.

Sol.: Each middle ear contains three ear ossicles malleus, incus and stapes, arranged in a chain like fashion.

190. Answer (4)

Hint: Pivot joint is present between 1st and 2nd vertebra.

Sol.:

a.	Gliding joint	(iii)	Between the carpals
b.	Saddle joint	(ii)	Between carpal and metacarpal of thumb
c.	Hinge joint	(iv)	Knee joint
d.	Pivot joint	(i)	Between atlas and axis

191. Answer (2)

Hint: Tongue is found attached to it.

Sol.: Hyoid is included in the skull.

Ethmoid is an unpaired cranial bone.

Patella covers the knee ventrally.

Tibia is the bone of lower limb.

192. Answer (3)

Hint: Associated with dark band or thick fibre

Sol.: During complete muscle contraction of a muscle:

– Length of 'I' band reduces

– Length of 'A' band remains same

– H-zone disappears

– Length of sarcomere reduces

193. Answer (4)

Hint: Multiple of 4

Sol.: Carpals are 8 in number in each hand, so 16 carpals are present in a human.

Metacarpals and metatarsals are 5 in each limb.

194. Answer (3)

Hint: Causes active transport

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

When a stimulus is applied to a site on the neuron, the closed voltage gated channels suddenly open, allowing Na⁺ ions to enter the neuron.

195. Answer (3)

Hint: At rest, outer surface of axonal membrane is positively charged.

Sol.: The rise in the stimulus induced permeability to Na⁺ is extremely short lived. It is quickly followed by a rise in permeability to K⁺.

Neurons are excitable cells as their membrane are in a polarised state.

196. Answer (1)

Hint: Polymer of amino acids

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

197. Answer (4)

Hint: Identify a tract of nerve fibres.

Sol.: The forebrain consists of cerebrum, thalamus and hypothalamus.

Flagella is not the part of a neuron.

Midbrain, pons and medulla oblongata make up the brain stem.

198. Answer (3)

Hint: Exclude the bone cells and cartilage cells

Sol.: Schwann cells produce myelin sheath around axons of neurons of PNS.

Osteocytes and chondrocytes are bone cells and cartilage cells respectively.

Osteoclasts are responsible for the resorption of bone.

Astrocytes are neuroglia present in brain.

199. Answer (2)

Hint: Characterised by progressive degeneration of skeletal muscles.

Sol.: Lack of relaxation between successive stimuli in sustained muscle contraction is called tetanus.

Cartilage and bones are specialised connective tissues.

An acromion process is characteristically present in pectoral girdle of mammals.

Muscular dystrophy is a genetic disorder.

200. Answer (1)

Hint: Hypoparathyroidism leads to deficiency of this ion.

Sol.: Tetany is characterised by rapid spasms (wild contractions) in muscles due to low Ca²⁺ in body fluids.

