

## All India Aakash Test Series for NEET - 2025

**TEST - 5 (Code-C)**

Test Date : 25/02/2024

**ANSWERS**

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

# HINTS & SOLUTIONS

## [PHYSICS]

### SECTION-A

1. Answer (2)

**Hint:** Stress is defined by restoring force per unit area.

**Sol.:** Normal stress =  $\frac{F}{A} = \frac{20}{2 \times 10^{-6}} = 10^7 \text{ N/m}^2$

2. Answer (2)

**Hint:** Within elastic limit, stress = Young's modulus  $\times$  strain

**Sol.:**  $Y_A = \tan 37^\circ = \frac{3}{4}$

$Y_B = \tan 53^\circ = \frac{4}{3}$

$\frac{Y_A}{Y_B} = \frac{9}{16} \Rightarrow 16Y_A = 9Y_B$

3. Answer (1)

**Hint:** Use energy =  $\frac{1}{2} \times$  stress  $\times$  strain  $\times$  volume

**Sol.:**  $\frac{E_A}{E_B} = \frac{\frac{1}{2} \frac{(\text{stress})^2}{Y_A} A_1 l_1}{\frac{1}{2} \frac{(\text{stress})^2}{Y_B} A_2 l_2}$

$= \frac{A_2 l_1}{A_1 l_2} = \left(\frac{r_2}{r_1}\right)^2 \left(\frac{l_1}{l_2}\right)$

$= \frac{3}{4}$

4. Answer (2)

**Hint:** Use equation of continuity

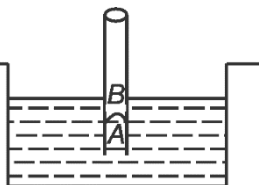
**Sol.:**  $A_1 v_1 = A_2 v_2$

$2 \times v_1 = 8 \times 5$

$v_1 = 20 \text{ m/s}$

5. Answer (4)

**Hint & Sol.:**



For mercury level to fall in capillary

$P_A > P_B$

$\therefore \theta_c > 90^\circ$ , therefore mercury level falls in capillary tube.

6. Answer (1)

**Hint:** Use Bernoulli's Principle

**Sol.:** Since velocity increases down the streamline therefore area decreases. Water stream from tap become narrower.

7. Answer (2)

**Hint & Sol.:** Emissive power  $\propto T^4$

$\frac{E_1}{E_2} = \left(\frac{T_1}{T_2}\right)^4 = \left(\frac{300}{400}\right)^4 = \frac{81}{256}$

8. Answer (4)

**Hint & Sol.:** Rate of heat conduction

$\frac{dQ}{dt} = kA \frac{\Delta T}{\Delta l}$

$\therefore \frac{dQ}{dt} = \frac{k\pi[(3R)^2 - R^2] \times (T_1 - T_2)}{l}$

$\frac{dQ}{dt} = \frac{8\pi kR^2(T_1 - T_2)}{l}$

9. Answer (2)

**Hint & Sol.:** Velocity of efflux =  $\sqrt{2gh}$

10. Answer (3)

**Hint:** Use Newton's law of cooling

**Sol.:**  $\frac{12}{20} = (-k)(56 - T_s) \dots(i)$

$\frac{8}{20} = (-k)(46 - T_s) \dots(ii)$

(i)  $\div$  (ii)

$\frac{3}{2} = \frac{56 - T_s}{46 - T_s}$

$138 - 3T_s = 112 - 2T_s$

$26 = T_s$

$T_s = 26^\circ\text{C}$

11. Answer (1)

**Hint:** At steady state heat current is same through every cross section.

**Sol.:**  $H = KA \frac{dT}{dx}$

$$\left(\frac{dT}{dx}\right) \propto \frac{1}{K}$$

$$\frac{1}{K_1} < \frac{1}{K_2}$$

$$K_2 < K_1$$

12. Answer (1)

**Hint & Sol.:**  $\rho \times g \times 8 = \rho \times g \times l \cos 30^\circ$

Since pressure remains same

$$\Rightarrow 8 = l \times \frac{\sqrt{3}}{2} \Rightarrow l = \frac{16}{\sqrt{3}} \text{ cm}$$

13. Answer (2)

**Hint:** Work required = Change in surface energy.

**Sol.:**  $W = 2T\Delta A$

$$= 2 \times T \times 4\pi(r_2^2 - r_1^2)$$

$$= 8\pi \times 0.03(16 - 4) \times 10^{-4}$$

$$= 8 \times 12\pi \times 3 \times 10^{-6}$$

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

$$= 0.29\pi \text{ mJ}$$

14. Answer (1)

**Hint:**  $v_T \propto r^2$

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

$$\frac{r_1}{r_2} = \sqrt{\frac{v_1}{v_2}} = \frac{3}{5}$$

Ratio of volume :

$$\frac{v_1}{v_2} = \left(\frac{r_1}{r_2}\right)^3 = \frac{27}{125}$$

15. Answer (4)

**Hint & Sol.:** Young's modulus depends upon nature of material and temperature.

16. Answer (1)

**Hint:** Young's modulus =  $\frac{\text{stress}}{\text{strain}}$

**Sol.:**  $Y = \frac{\sigma}{\epsilon} = \frac{F/A}{\Delta l/l} \Rightarrow Y = \frac{Fl}{A\Delta l}$

$$\therefore \Delta l \propto l \Rightarrow \frac{\Delta l_1}{\Delta l_2} = \frac{n}{1}$$

17. Answer (4)

**Hint:** Bulk Modulus,  $B = -\frac{\Delta P}{\frac{\Delta V}{V}}$

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

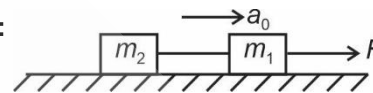
Minus sign indicates that increase in pressure will result in decrease in volume.

$$\therefore \frac{0.2}{100} = -\frac{\Delta P}{2 \times 10^9} \Rightarrow \Delta P = 4 \text{ MPa}$$

18. Answer (2)

**Hint:** Formula for elongation in a wire  $\Delta l = \frac{Fl}{AY}$

**Sol.:**



$$F = (m_1 + m_2)a_0 \Rightarrow a_0 = \frac{F}{m_1 + m_2} \quad \dots(i)$$



$$T = m_2 a_0$$

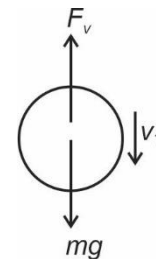
Tension in the string  $\Rightarrow T = m_2 \times \frac{F}{m_1 + m_2} \quad \dots(ii)$

Elongation :  $\Delta l = \frac{Tl_0}{A_0 Y} = \frac{m_2 F l_0}{(m_1 + m_2) A_0 Y}$

19. Answer (3)

**Hint:** Terminal velocity is reached when net force on spherical object becomes zero.

**Sol.:** Since force of buoyancy is to be neglected. Therefore FBD of spherical object will be



$$F_v = 6\pi\eta r v_T = mg$$

$$v_T \propto \frac{m}{r} \quad \dots(i)$$

$$\frac{80}{v_T} = \frac{m_1}{r_1} \times \frac{r_2}{m_2} \Rightarrow \frac{80}{v_T} = \frac{m}{r} \times \frac{r}{2m}$$

$$v_T = 160 \text{ m/s}$$

20. Answer (1)

**Hint:** Surface tension =  $\frac{\text{Force}}{\text{Length}}$

**Sol.:**  $T = \frac{F}{\ell} \Rightarrow F = T \times 2\pi R$

21. Answer (3)

**Hint:** Coefficient of apparent expansion of liquid = coefficient of expansion of liquid – coefficient of expansion of vessel

**Sol.:** Let the coefficient of expansion of liquid is  $\gamma_L$   
Then

$\alpha = \gamma_L - \gamma_1 \quad \dots(i)$

$\beta = \gamma_L - \gamma_2 \quad \dots(ii)$

Eliminate  $\gamma_L$  from both the equations

$\beta = (\alpha + \gamma_1) - \gamma_2 \Rightarrow \gamma_2 = \alpha - \beta + \gamma_1$

22. Answer (1)

**Hint & Sol.:** When a metallic object is heated all its linear dimensions increase.

23. Answer (4)

**Hint:** Apply formula  $Q = ms\Delta T$  for both the liquids.

**Sol.:** Heat lost by liquid B = Heat gained by liquid A  
 $m_B s_B (50 - 44) = m_A s_A (44 - 40)$

Given  $m_A = m_B$

$\therefore s_B \times 6 = s_A \times 4$

$\frac{s_A}{s_B} = \frac{3}{2}$

24. Answer (2)

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

25. Answer (3)

**Hint & Sol.:** Rate of cooling is proportional to the difference in the temperature of object and surroundings. Hence

$T_1 < T_2 < T_3$

26. Answer (1)

**Hint:** Use the concept of velocity of efflux and projectile motion.

**Sol.:** Horizontal velocity with which the water will come out of the container =  $\sqrt{2gH} \quad \dots(i)$

Time to reach the ground,  $T = \sqrt{\frac{2H}{g}} \quad \dots(ii)$

$\therefore$  Horizontal distance :  $x = \sqrt{2gH} \times \sqrt{\frac{2H}{g}}$

$x = 2H$

27. Answer (2)

**Hint:** Change in surface energy  $S = T\Delta A$

**Sol.:** From volume conservation

$\frac{4}{3}\pi R^3 = 64 \times \frac{4}{3}\pi r^3$

$R^3 = 64r^3 \Rightarrow R = 4r \quad \dots(i)$

Change in surface energy =  $T\Delta A$

$\Delta S = T(64 \times 4\pi r^2 - 4\pi R^2)$

$= 7.5 \times 10^{-2} \times 4\pi \left( 64 \times \frac{R^2}{16} - R^2 \right)$

$= 7.5 \times 10^{-2} \times 4\pi \times 3 \times (10^{-2})^2$

$= 90\pi \times 10^{-6} \text{ J} = 90\pi \mu\text{J}$

28. Answer (3)

**Hint:** Buoyant force =  $\rho \times V_d \times g$

where  $\rho$  is density of liquid and  $V_d$  is the volume displaced.

**Sol.:** FBD of block



$T + F_B = 5g \quad \dots(i)$

Given R.D. = 2 =  $\frac{\rho_0}{\rho_w} \Rightarrow \rho_0 = 2\rho_w \quad \dots(ii)$

$\rho_0 \times V_0 \times g = 5g$  and  $\rho_w V_0 g = F_B \quad [V_d = V_0]$

$\therefore \frac{F_B}{5g} = \frac{\rho_w V_0 g}{\rho_0 V_0 g} = \frac{\rho_w}{\rho_0}$

$F_B = \frac{5g}{2} = 25 \text{ N}$

Using equation (i)

$T + 25 = 50 \Rightarrow T = 25 \text{ N}$

29. Answer (4)

**Hint:** For the junction, heat entering is equal to the heat exiting per second.

**Sol.:**  $\left(\frac{dQ}{dt}\right)_1 + \left(\frac{dQ}{dt}\right)_2 + \left(\frac{dQ}{dt}\right)_3 = 0$

$\Rightarrow \frac{KA(100-T)}{\ell} + 2KA \frac{(60-T)}{\ell} + \frac{KA(20-T)}{\ell} = 0$

$100 - T + 120 - 2T + 20 - T = 0 \Rightarrow T = 60^\circ\text{C}$

30. Answer (1)

**Hint:** Apply Bernoulli's equation

$$\text{Sol.: } P_A + \frac{1}{2}\rho v_A^2 = P_B + \frac{1}{2}\rho v_B^2 \quad \dots(i)$$

Equation of continuity

$$A_1 v_1 = A_2 v_2 \Rightarrow 40 v_A = 10 v_B$$

$$v_B = 4 v_A \quad \dots(ii)$$

$$P_A - P_B = \frac{1}{2}\rho v_B^2 - \frac{1}{2}\rho v_A^2$$

$$800 = \frac{1}{2} \times 10^3 \times 15 (v_A)^2$$

$$v_A = \sqrt{\frac{1600}{15000}} \text{ m/s}$$

Flow rate

$$= 40 \text{ cm}^2 \times \sqrt{\frac{16}{150}} \times 100 \text{ cm/s} \approx 1300 \text{ cm}^3/\text{s}$$

31. Answer (4)

**Hint & Sol.:** joule second is not the unit of coefficient viscosity.

32. Answer (4)

**Hint:** Hydraulic machine works on the Pascal's law.

$$\text{Sol.: } \frac{F_1}{A_1} = \frac{F_2}{A_2} \Rightarrow \frac{1000 \times 10}{\pi(15)^2} = \frac{F_2}{\pi(3)^2}$$

$$F_2 = \frac{1000 \times 10 \times 3^2}{15^2} \Rightarrow F_2 = 400 \text{ N}$$

33. Answer (2)

**Hint & Sol.:** In convection mode of heat transfer, bulk motion of medium is required.

34. Answer (4)

**Hint & Sol.:** A perfect black body is a perfect absorber, hence it neither reflect nor transmit any energy incident on it. Also, its emissivity is equal to 1.

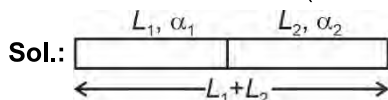
35. Answer (3)

**Hint & Sol.:** At high altitude both pressure and boiling point of water decreases. So the water start boiling at lower temperature, which is much lower than melting point of rice.

**SECTION - B**

36. Answer (2)

**Hint:** Use formula  $L = L_0 (1 + \alpha \Delta T)$



$$L'_1 = L_1(1 + \alpha_1 \Delta T) \text{ and } L'_2 = L_2(1 + \alpha_2 \Delta T)$$

For the series combination

$$L'_{\text{eff}} = (L_1 + L_2)(1 + \alpha' \Delta T)$$

$$\therefore (L_1 + L_2)(1 + \alpha' \Delta T) = L_1(1 + \alpha_1 \Delta T) + L_2(1 + \alpha_2 \Delta T)$$

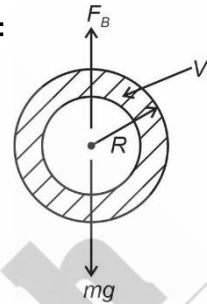
$$(L_1 + L_2)\alpha' = L_1\alpha_1 + L_2\alpha_2$$

$$\alpha' = \frac{\alpha_1 L_1 + \alpha_2 L_2}{L_1 + L_2}$$

37. Answer (3)

**Hint:** Weight of the shell is equal to the buoyant force applied by the water.

**Sol.:**



$$F_B = mg \Rightarrow \rho_w \times V \times g = \rho_0 \times V_0 \times g$$

$$\rho_w \times \frac{4}{3}\pi R^3 = \rho_0 \times V_0 \Rightarrow V_0 = \frac{\rho_w}{\rho_0} \times \frac{4}{3}\pi R^3$$

Given  $\frac{\rho_0}{\rho_w} = K$

$$\therefore V_0 = \frac{4\pi R^3}{3K}$$

38. Answer (3)

**Hint:** When the rod is heated between the rigid supports, then longitudinal stress is developed.

**Sol.:** We know  $Y = \frac{F/A}{\Delta \ell / \ell} \Rightarrow \Delta \ell = \frac{F \ell}{AY} \quad \dots(i)$

Also  $\Delta \ell = \ell \alpha \Delta T \quad \dots(ii)$

$$\therefore \ell \alpha \Delta T = \frac{F \ell}{AY} \Rightarrow F = AY \alpha \Delta T$$

39. Answer (3)

**Hint & Sol.:** Buoyant force of air on raindrops is negligible, therefore viscous force by air on raindrops is majorly responsible for the attainment of terminal velocity of raindrops.

40. Answer (2)

**Hint & Sol.:** Pascal's law states that a pressure change at any point in a confined fluid is transmitted throughout the fluid without diminishing.

41. Answer (3)

**Hint & Sol.:**  $P + \rho gh + \frac{1}{2}\rho v^2 = \text{constant}$

$\Rightarrow$  Bernoulli's principle

$A_1 v_1 = A_2 v_2 \Rightarrow$  Equation of continuity

$v = \sqrt{2gh} \Rightarrow$  Velocity of efflux

$\frac{F_1}{A_1} = \frac{F_2}{A_2} \Rightarrow$  Pascal's law

42. Answer (2)

**Hint:** Excess pressure inside an air bubble inside water is  $\frac{2T}{r}$

**Sol.:**  $P_{\text{inside}} - P_{\text{outside}} = \frac{2T}{r}$

$P_{\text{outside}} = P_0 + \rho gh$

$\therefore P_{\text{inside}} = \frac{2T}{r} + P_0 + \rho gh$

43. Answer (4)

**Hint & Sol.:**

Since the fluid is stationary hence difference of pressure between A and B is  $\rho gh$ .

$\Rightarrow P_B = P + \rho gh$

44. Answer (2)

**Hint:** Heat loss/gain when temperature of a substance changes by  $\Delta T$  is

$Q = ms\Delta T$

**Sol.:** Heat loss by iron = Heat gain by water

$2 \times 450 \times (200 - T) = 5 \times 4200 \times (T - 30)$

$900 \times 200 - 900T = 21000T - 21000 \times 30$

$(18 + 63) \times 10^4 = 21900T$

$T = \frac{81 \times 10^2}{219} \approx 37^\circ\text{C}$

45. Answer (3)

**Hint:** Force applied by soap film on wire is balanced by the load.

**Sol.:** There are two interface of the given soap film, therefore force applied by it on the wire is

$F = (T \times \ell) \times 2 \quad \dots(i)$

$\therefore mg = 2T\ell \Rightarrow mg = 2 \times 2 \times 10^{-2} \times \frac{1}{10}$

$m = 4 \times 10^{-4} \text{ kg} \Rightarrow m = 0.4 \text{ g}$

46. Answer (1)

**Hint:** Young's modulus  $Y = \frac{F\ell}{A\Delta\ell}$

**Sol.:** For 1<sup>st</sup> wire:

$Y = \frac{1000 \times \ell}{\pi r^2 \times 4 \text{ mm}} \quad \dots(i)$

For 2<sup>nd</sup> wire:

$Y = \frac{1000 \times \ell}{\pi(2r)^2 \times \Delta\ell} \quad \dots(ii)$

Equate equation (i) and (ii)

$\frac{1000\ell}{\pi r^2 \times 4 \text{ mm}} = \frac{1000 \times \ell}{\pi(2r)^2 \times \Delta\ell}$

$\Delta\ell = 1 \text{ mm}$

47. Answer (3)

**Hint:** Young's modulus =  $\frac{\text{stress}}{\text{strain}}$

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

$F = 4 \times 10^{11} \times 3 \times 10^{-4} \times \frac{\ell}{\ell}$

$F = 12 \times 10^7 \text{ N}$

48. Answer (1)

**Hint:** Apply Newton's law of cooling

**Sol.:**  $\frac{\Delta T}{\Delta t} = K(T_{\text{avg}} - T_0)$

For 1<sup>st</sup> case

$\frac{10}{5} = K\left(\frac{50+40}{2} - 20\right)$

$\frac{10}{5} = K(45 - 20) \quad \dots(i)$

For 2<sup>nd</sup> case

$\frac{40-T}{5} = K\left(\frac{40+T}{2} - 20\right) \quad \dots(ii)$

Divide equation (i) and (ii)

$\frac{10/5}{(40-T)/5} = \frac{K \times 25}{K\left(20 + \frac{T}{2} - 20\right)}$

$\frac{10}{40-T} = \frac{25}{T/2}$

$5T = 25 \times 40 - 25T$

$30T = 25 \times 40$

$T = 33.3^\circ\text{C}$

49. Answer (2)

**Hint & Sol.:** The relation between °C and °F is

$$F = \frac{9C}{5} + 32$$

$$\text{Slope} = \frac{9}{5}$$

50. Answer (3)

**Hint:** Rate of radiation  $\frac{dQ}{dt} \propto T^4$ **Sol.:**  $100 \propto T^4$  ... (i)

$$\text{New temperature } T' = T + \frac{25}{100}T = \frac{5T}{4}$$

$$\frac{dQ}{dt} \propto \left(\frac{5T}{4}\right)^4 \quad \dots \text{(ii)}$$

$$\frac{dQ}{dt} = \left(\frac{5T}{4}\right)^4$$

$$\frac{dQ}{dt} = 100 \times \frac{625}{256} = 244 \text{ J/s}$$

## [CHEMISTRY]

### SECTION-A

51. Answer (1)

**Hint:**  $\text{Na}_2\text{B}_4\text{O}_7 + 7\text{H}_2\text{O} \rightarrow 2\text{NaOH} + 4\text{H}_3\text{BO}_3$ **Sol.:** Boric acid is a weak monobasic acid. It acts as a Lewis acid by accepting electron pair from hydroxyl ion.

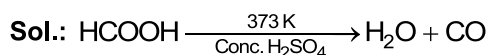
52. Answer (1)

**Hint:** Bead formed is  $\text{Co}(\text{BO}_2)_2$ **Sol.:** When borax is heated in Bunsen burner flame with  $\text{CoO}$ , a blue coloured  $\text{Co}(\text{BO}_2)_2$  bead is formed.

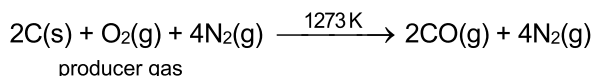
53. Answer (4)

**Hint:** In diborane, 4 terminal B-H bonds are two centre-two electron bonds, while 2 bridge (B-H-B) bonds are three centre-two electron bonds.**Sol.:** Diborane is a colourless, highly toxic gas with a b.p. of 180 K. It catches fire spontaneously upon exposure to air.

54. Answer (2)

**Hint:** Conc.  $\text{H}_2\text{SO}_4$  is a dehydrating agent which removes water from formic acid.

55. Answer (2)

**Hint:**  $(\text{CO} + \text{H}_2)$  mixture is called water gas.**Sol.:**

56. Answer (2)

**Hint:**  $\text{CO}$  is a neutral oxide.**Sol.:**  $\text{SiO}_2$ ,  $\text{GeO}_2$  are acidic whereas  $\text{PbO}$  and  $\text{SnO}$  are amphoteric in nature.

57. Answer (2)

**Hint:**  $K_p = K_c(\text{RT})^{\Delta n}$ **Sol.:**  $\Delta n = (2 + 1) - 2 = 1$ 

$$K_p = 4 \times 10^{-6} (0.082 \times 1100)$$

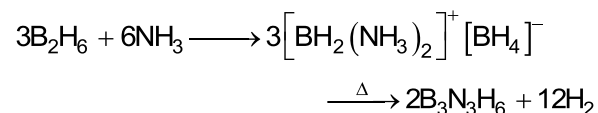
$$K_p = 3.6 \times 10^{-4}$$

58. Answer (4)

**Hint:** The observed discontinuity in the IE values between Al and Ga and between In and Tl are due to inability of d- and f- electrons, which have low screening effect, to compensate the increase in nuclear charge.**Sol.:**

Element	Ionisation Enthalpy (kJ mol <sup>-1</sup> )
B	801
Al	577
Ga	579
In	558
Tl	589

59. Answer (1)

**Hint:** Reaction of ammonia with diborane gives  $\text{B}_2\text{H}_6 \cdot 2\text{NH}_3$  initially.**Sol.:**

60. Answer (3)

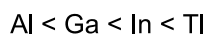
**Hint:** 2<sup>nd</sup> period members cannot expand their octet due to absence of d-orbital.**Sol.:**  $[\text{SiCl}_6]^{2-}$  is not known as 6 large chloride ions cannot be accommodated around  $\text{Si}^{4+}$  due to limitation of its size.

- $\text{BCl}_3$  being covalent form  $[\text{B}(\text{OH})_4]^-$  when hydrolysed by water.

61. Answer (1)

**Hint:** Due to poor shielding effect of  $d$  and  $f$  orbitals, the increased effective nuclear charge holds  $ns$  electrons tightly.

**Sol.:** Due to inert pair effect the relative stability of +1 oxidation state progressively increases for heavier elements.



62. Answer (4)

**Hint:** Element having maximum electronegativity and is smallest in size will show maximum catenation.

**Sol.:** The order of catenation is  $\text{C} \gg \text{Si} > \text{Ge} = \text{Sn}$ . Lead does not show catenation.

63. Answer (1)

**Hint:** Lesser is the electron density on boron stronger is its Lewis acid strength.

**Sol.:** Extent of back bonding decreases from  $\text{BF}_3$  to  $\text{Bl}_3$ .

$\therefore$  Lewis acidic character increases from  $\text{BF}_3$  to  $\text{Bl}_3$ .

64. Answer (3)

**Hint:** For salt of weak acid and strong base

$$h = \sqrt{\frac{K_w}{K_a \times C}}$$

$$\text{Sol.} \quad h = \sqrt{\frac{10^{-14}}{0.1 \times 2 \times 10^{-4}}} = \sqrt{5} \times 10^{-5}$$

65. Answer (2)

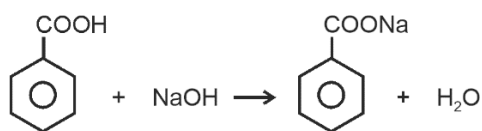
**Hint:** As the size of halogen(X) increases, H-X bond strength decreases.

**Sol.:** HCl is a stronger acid than HF.  $\text{Co}^{3+}$  has vacant orbital hence it acts as Lewis acid.

66. Answer (3)

**Hint:** For acidic buffer, pH of the solution is given

$$\text{as, } \text{pH} = \text{p}K_a + \log \frac{[\text{Salt}]}{[\text{Acid}]}$$

**Sol.:**

Initial	$500 \times 0.1$	$200 \times 0.1$	-	-
	= 50 mmol	= 40 mmol		
Final	10 mmol	0	40	

$$\text{pH} = \text{p}K_a + \log \frac{[\text{Salt}]}{[\text{Acid}]}$$

$$= 4.2 + \log \frac{40}{10}$$

$$= 4.2 + 0.6 = 4.8$$

67. Answer (2)

**Hint:** At constant pressure, addition of inert gas increases the volume of the system.

**Sol.:** The volume increases as the number of moles of gaseous molecules increase. This will lead to the dissociation of ammonia.

68. Answer (3)

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

**Sol.:** KOH is strong electrolyte  $[\text{OH}^-] = 0.04$

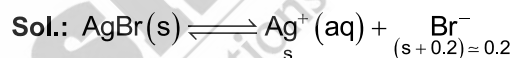
$$\text{pOH} = -\log[\text{OH}^-] = -\log(4 \times 10^{-2})$$

$$\text{pOH} = 2 - \log 4 = 1.4$$

$$\text{pH} = 14 - 1.4 = 12.6$$

69. Answer (3)

**Hint:**  $\text{CaBr}_2$  is a strong electrolyte and it will provide  $\text{Br}^-$  as common ion



$$[\text{Ag}^+][\text{Br}^-] = K_{sp}$$

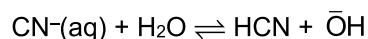
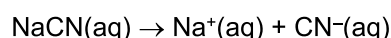
$$s \times 0.2 = 5 \times 10^{-13}$$

$$s = \frac{5 \times 10^{-13}}{0.2} = 2.5 \times 10^{-12}$$

70. Answer (1)

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

**Sol.:**  $\text{NaCN}$  is a salt of weak acid and strong base. Cyanide undergoes aqueous hydrolysis giving alkaline solution.



71. Answer (1)

**Hint:** Mixture of weak acid and salt of weak acid and strong base behaves as acidic buffer.

**Sol.:** • (a)  $\text{CH}_3\text{CH}_2\text{COOH}$  and  $\text{CH}_3\text{CH}_2\text{COONa}$   
• (b)  $\text{H}_2\text{CO}_3$  and  $\text{Na}_2\text{CO}_3$

These two mixtures will behave as acidic buffer

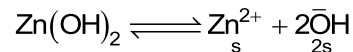
• (d)  $\text{NH}_4\text{Cl}$  and  $\text{NH}_4\text{OH}$  will behave as basic buffer.

• (c)  $\text{HNO}_3$  and  $\text{NaNO}_3$  will not behave as a buffer.

72. Answer (2)

**Hint:**  $\text{pOH} = 14 - 9 = 5$ 

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

**Sol.:** Let us assume thatSolubility of  $\text{Zn}(\text{OH})_2$  be  $s$  mol  $\text{L}^{-1}$ 

$$2s = 10^{-5}$$

$$s = \frac{1}{2} 10^{-5}$$

$$K_{\text{sp}} = [\text{Zn}^{2+}][\text{OH}^-]^2$$

$$= \frac{10^{-5}}{2} (10^{-5})^2$$

$$= \frac{1}{2} \times 10^{-15}$$

$$= \frac{10}{2} \times 10^{-16} = 5 \times 10^{-16}$$

73. Answer (1)

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

$$\begin{aligned} \text{Sol.}: \Delta G^\circ &= -2.303 \times 8.314 \times 300 \log 10^6 \\ &= -2.303 \times 8.314 \times 300 \times 6 \\ &= -3.4 \times 10^4 \text{ J mol}^{-1} \end{aligned}$$

74. Answer (2)

**Hint & Sol.:** A catalyst increases the rate of the chemical reaction by making available a new low energy pathway for the conversion of reactants to the products.

Catalyst does not appear in the balanced chemical equation or in the equilibrium constant expression.

75. Answer (3)

**Hint:** Oxidation state of H in  $\text{PH}_3$  is +1**Sol.:**

- $\text{H}_4\text{P}_2\text{O}_5$  (Let  $x$  is oxidation state of P)

$$1 \times 4 + x \times 2 + 5(-2) = 0$$

$$2x = +6$$

$$x = +3$$

- $\text{H}_3\text{PO}_2$

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

$$x = +1$$

- $\text{PH}_3$

$$x + 1 \times 3 = 0$$

$$x = -3$$

- $\text{H}_4\text{P}_2\text{O}_7$

$$1 \times 4 + x \times 2 + 7(-2) = 0$$

$$x = +5$$

76. Answer (2)

**Hint:** Lower is the value of reduction potential, better is the reducing power of the metal.**Sol.:** Reduction potential of  $\text{Mg}^{2+}$  is minimum hence Mg has the highest reducing power.Correct order of reducing power will be  $\text{Mg} > \text{Zn} > \text{Ni} > \text{Cu}$ .

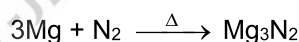
77. Answer (2)

**Hint:** Standard reduction potential of  $\text{Cu}^{2+}/\text{Cu}$ , couple is positive (0.34 V)**Sol.:** If the reduction potential of redox couple ( $\text{Cu}^{2+}/\text{Cu}$ ) is positive then the metal will not liberate  $\text{H}_2$  gas on reaction with dilute HCl. $\text{MnO}_4^-$  is pink colour species. It can act as oxidant as well as self indicator.

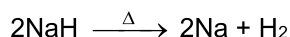
78. Answer (4)

**Hint:** In metal displacement reaction, a metal in a compound can be displaced by another metal in the combined state.**Sol.:**

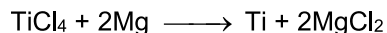
- Combination reaction



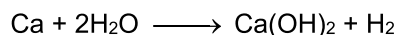
- Decomposition reaction



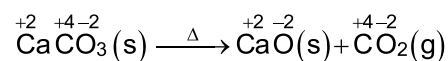
- Metal displacement reaction



- Non-metal displacement reaction



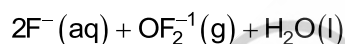
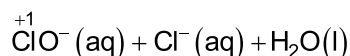
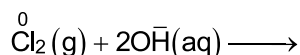
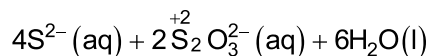
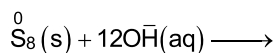
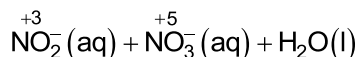
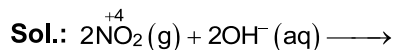
79. Answer (3)

**Hint & Sol.:**

The oxidation states of elements in the reactant side and product side are same. Hence it is not a redox reaction.

80. Answer (3)

**Hint:** One of the reacting substances in a disproportionation reaction always contains an element that can exist in at least three oxidation states.



$\text{F}_2$  does not undergo disproportionation in alkaline medium.

81. Answer (3)

**Hint:** In Buckminsterfullerene ( $\text{C}_{60}$ ) all carbon atoms are  $sp^2$  hybridised

**Sol.:** In  $\text{C}_{60}$  each carbon atom forms three sigma bonds with other three carbon atoms. The remaining electron at each carbon is delocalised in molecular orbitals, which in turn give aromatic character to the molecule.

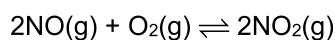
82. Answer (2)

**Hint:** In  $\text{SiO}_2$ , each atom is covalently bonded in a tetrahedral manner to four oxygen atoms.

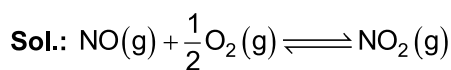
**Sol.:**  $\text{SiO}_2$  is covalent, three-dimensional network solid.

83. Answer (3)

**Hint:** For the equilibrium reaction,



$$K = \frac{[\text{NO}_2]^2}{[\text{NO}]^2 [\text{O}_2]} \quad \dots(\text{i})$$



$$K_1 = \frac{[\text{NO}_2]}{[\text{NO}][\text{O}_2]^{1/2}} \quad \dots(\text{ii})$$

(ii)  $\div$  (i)

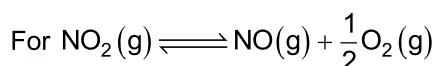
$$\frac{K_1}{K} = \frac{[\text{NO}_2]}{[\text{NO}][\text{O}_2]^{1/2}} \times \frac{[\text{NO}]^2 [\text{O}_2]}{[\text{NO}_2]^2}$$

$$\frac{K_1}{K} = \frac{[\text{NO}][\text{O}_2]^{1/2}}{[\text{NO}_2]}$$

$$\frac{K_1}{K} = \frac{1}{K_1}$$

$$K_1^2 = K$$

$$K_1 = \sqrt{K}$$



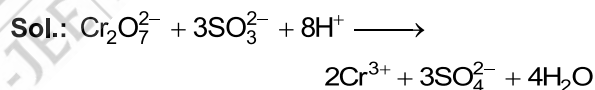
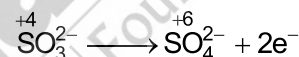
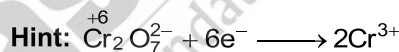
$$K_2 = \frac{1}{\sqrt{K}}$$

84. Answer (2)

**Hint:** Bronsted acid is a substance that is capable of donating a hydrogen ion ( $\text{H}^+$ ) and bases are substances capable of accepting a hydrogen ion.

**Sol.:**  $\text{PO}_4^{3-}$  can act as a base but can not act as acid as it does not contain hydrogen atom.

85. Answer (2)



## SECTION - B

86. Answer (2)

**Hint:** C is a non-metal

**Sol.:** Ge is a metalloid. Sn, Pb are soft metals with low melting points.

87. Answer (3)

**Hint:** Number of oxygen shared per unit is 3 in sheet silicates.

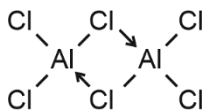
**Sol.:** General formula of sheet silicates is  $(\text{Si}_2\text{O}_5^{2-})_n$ .

88. Answer (4)

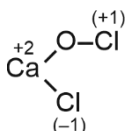
**Hint & Sol.:**

Element	Melting
Al	933
Ga	303
In	430
Tl	576

89. Answer (2)

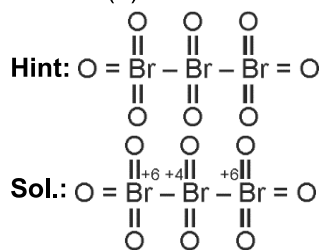
**Hint:** Structure of  $\text{Al}_2\text{Cl}_6$ **Sol.:** There are 2 three centre-four electron bonds and 4 two centre-two electron bonds in  $\text{Al}_2\text{Cl}_6$ .

90. Answer (3)

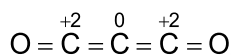
**Hint:** Average oxidation state of chlorine in  $\text{CaOCl}_2$  is 0.**Sol.:**

So, chlorine has +1 and -1 oxidation state.

91. Answer (2)



Tribromooctaoxide



Carbon suboxide

92. Answer (2)

**Hint:**  $2\text{Al}(s) + 3\text{Ni}^{2+}(\text{aq}) \rightarrow 2\text{Al}^{3+}(\text{aq}) + 3\text{Ni}(s)$ 

$$E_{\text{cell}}^{\circ} = E_{\text{R}}^{\circ} - E_{\text{L}}^{\circ}$$

$$\text{Sol. : } E_{\text{cell}}^{\circ} = -0.25 + 1.66 \\ = 1.41 \text{ V}$$

93. Answer (2)

**Hint:** Oxidation state of O in  $\text{MnO}_4^-$  is -2**Sol.:**  $\text{MnO}_4^-$  (Let oxidation state of Mn be x)

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

$$x = +7$$

 $\text{MnO}_2$ 

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

$$x = +4$$

94. Answer (3)

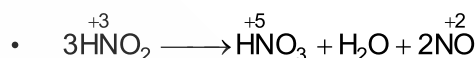
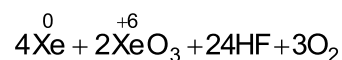
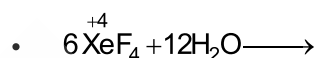
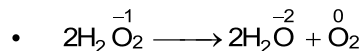
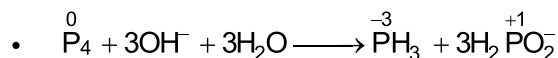
**Hint:** Net charge in the compound will be zero**Sol.:** For  $\text{X}_2(\text{YZ}_3)_3$  the calculated charge will be zero.

$$\text{For } \text{YZ}_3, \text{ charge} = 4 \times 3(-2) = -2$$

For  $\text{X}_2(\text{YZ}_3)_3$  the net charge will be zero

$$[3 \times 2] + [3 \times (-2)] = 0$$

95. Answer (4)

**Hint:** In disproportionation reaction an element in its intermediate oxidation state is oxidised as well as reduced.**Sol.:** All the given reactions are disproportionation reactions

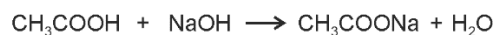
96. Answer (3)

**Hint & Sol.:** Zeolites are widely used as a catalyst in petrochemical industries.

97. Answer (1)

**Hint:** Boric acid is a weak monobasic acid**Sol.:** Boric acid is a Lewis acid but not a protonic acid.

98. Answer (3)

**Hint:** At equivalence point, sodium acetate will be formed which will undergo anionic hydrolysis.**Sol.:**

Initial	100 × 0.2	400 × 0.05	-	-
	= 20 mmol	= 20 mmol		

Final	0	0	20	
-------	---	---	----	--

$$\text{Molarity of } \text{CH}_3\text{COONa} = \frac{20}{500} = 0.04$$

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

$$= 7 + \frac{1}{2} [4.75 + \log 0.04]$$

$$= 7 + \frac{1}{2} [4.75 + \log 4 \times 10^{-2}]$$

$$= 7 + \frac{1}{2} [4.75 - 1.4]$$

$$= 8.67 \approx 8.7$$

99. Answer (2)

**Hint:**  $K_p = p_{\text{NH}_3} \times p_{\text{H}_2\text{S}}$

**Sol.:**  $\text{NH}_4\text{HS}(\text{s}) \rightleftharpoons \underset{p}{\text{NH}_3(\text{g})} + \underset{p}{\text{H}_2\text{S}(\text{g})}$

$$2p = 7$$

$$p = \frac{7}{2}$$

$$K_p = p_{\text{NH}_3} \times p_{\text{H}_2\text{S}}$$

$$= \frac{7}{2} \times \frac{7}{2} = \frac{49}{4}$$

100. Answer (4)

**Hint & Sol.:** Equilibrium in a system having more than one phase is called heterogenous equilibrium.

## [BOTANY]

### SECTION-A

101. Answer (4)

**Hint:** Kranz anatomy is exhibited by  $C_4$  plants.

**Sol.:** Maize is a  $C_4$  plant and thus, exhibits Kranz anatomy. Bell pepper, wheat and tomato are examples of  $C_3$  plants.

102. Answer (1)

**Hint:** In  $C_2$  pathway, RuBisCO acts as oxygenase.

**Sol.:** In photorespiration,  $O_2$  is first utilized (consumed) in chloroplast and then in peroxisomes. Loss of  $CO_2$  occurs in mitochondria.

103. Answer (2)

**Hint:** In anoxygenic photosynthesis, oxygen is not evolved.

**Sol.:** *Rhodospirillum* shows anoxygenic photosynthesis. *Cladophora*, *Oscillatoria* and *Hydrilla* show oxygenic photosynthesis.

104. Answer (1)

**Hint:** A proton gradient is required across thylakoid membrane to facilitate chemiosmotic hypothesis.

**Sol.:** Within the chloroplast, protons in the stroma decrease in number while in the lumen there is accumulation of protons. This causes a decrease in pH in the lumen and creates a proton gradient across the thylakoid membrane.

105. Answer (1)

**Hint:** Sugarcane is a  $C_4$  plant and tomato is a  $C_3$  plant.

**Sol.:** In  $C_4$  plants (sugarcane), primary  $CO_2$  fixation is catalyzed by PEPcase.

In  $C_3$  plants (tomato), primary  $CO_2$  fixation is catalyzed by RuBisCO.

106. Answer (2)

**Hint:**  $C_2$  cycle (photorespiration) occurs in  $C_3$  plants.

**Sol.:**  $C_4$  plants show better water utilization, Kranz anatomy and tolerance to high temperature and saline conditions.

107. Answer (3)

**Hint:** Melvin Calvin used radioactive  $^{14}C$  in algal photosynthetic studies.

**Sol.:** Use of radioactive  $^{14}C$  in algal photosynthetic study led to the discovery that the first  $CO_2$  fixation product was a three-carbon organic acid. Calvin cycle occurs in all photosynthetic plants.

108. Answer (2)

**Hint:** Flow of protons back across the membrane by ATP synthase activates the enzyme for the formation of ATP.

**Sol.:** Flow of protons through  $CF_0$  particle results in the breakdown of proton gradient across the thylakoid membrane. The processes that lead to the development of proton gradient are:

- Photolysis of water towards thylakoid lumen.
- Transfer of  $H^+$  from stroma to lumen as electrons move through photosystems.
- NADP reductase reaction occurring towards stroma.

109. Answer (2)

**Hint:** Carotenoids are also called shield pigments.

**Sol.:** Carotenoids protect plant from excessive heat and prevent photo-oxidation of chlorophyll *a*. They can be a part of LHC. A single molecule of Chlorophyll *a* forms reaction centre of photosystems.

110. Answer (4)

**Hint:** CO<sub>2</sub> fixation takes place twice in mesophyll cells in CAM plants once during day time and other during night time.

**Sol.:** Minimal amount of water loss is there in CAM plants.

111. Answer (2)

**Hint:** Plastocyanin and plastoquinone are mobile carriers in non cyclic photophosphorylation.

**Sol.:** Electrons from cytochrome b<sub>6</sub>f to PS I in non-cyclic photophosphorylation are transferred through plastocyanin.

112. Answer (3)

**Hint:** *Amaranthus* is a C<sub>4</sub> plant and bell pepper is a C<sub>3</sub> plant.

**Sol.:** In C<sub>4</sub> plants, 5 ATP are consumed per CO<sub>2</sub> fixed. Sucrose has 12 carbon molecules for which 12 CO<sub>2</sub> molecules are required. Thus, to make one molecule of sucrose in *Amaranthus*, ATP required = 12 × 5 = 60.

In C<sub>3</sub> plants, 3 ATP are consumed per CO<sub>2</sub> fixed. Sucrose has 12 carbon molecules for which 12 CO<sub>2</sub> molecules are required. Thus, to make 1 molecule of sucrose in bell pepper, ATP required = 12 × 3 = 36.

113. Answer (1)

**Hint:** Cyclic photophosphorylation occurs in stroma lamellae.

**Sol.:** PS-I and electron transport system are included in cyclic photophosphorylation.

114. Answer (3)

**Hint:** Regeneration of PEP occurs in mesophyll cells

**Sol.:** In mesophyll cells, PEP combines with CO<sub>2</sub> to form OAA. This reaction is catalyzed by PEPcase. In the bundle sheath cells, C<sub>4</sub> acids are broken down to release CO<sub>2</sub> and a three-carbon molecule. The 3-C molecule is transported back to the mesophyll cells, where it is converted to PEP with the help of PEP synthetase.

115. Answer (1)

**Hint:** Z-scheme utilizes both PS I and PS II. The electrons that were removed from PS II are replaced by splitting of water.

**Sol.:** Cyclic photophosphorylation operates under low light intensity, anaerobic conditions or when CO<sub>2</sub> availability is poor.

Non-cyclic photophosphorylation requires an external electron donor. Oxygen evolving complex is associated with the PS II.

Cyclic photophosphorylation also occurs when only light of wavelength beyond 680 nm are available for excitation.

116. Answer (1)

**Hint:** Engelmann's experiment helped to describe the first action spectrum which roughly resembles the absorption spectra of chlorophyll *a* and *b*.

**Sol.:** Using a prism, T.W. Engelmann split light into its spectral component and then illuminated a green alga, *Cladophora*, placed in a suspension of aerobic bacteria.

The bacteria were used to detect the sites of O<sub>2</sub> evolution. He observed that the bacteria accumulated mainly in the region of blue and red light of the split spectrum.

117. Answer (3)

**Hint:** In PS I, the reaction centre chlorophyll *a* has an absorption peak at 700 nm.

**Sol.:** In PS II, the reaction centre chlorophyll *a* has an absorption peak at 680 nm. Hence, it is called P<sub>680</sub>.

118. Answer (1)

**Hint:** KOH absorbs CO<sub>2</sub>.

**Sol.:** As during Calvin cycle, CO<sub>2</sub> gets fixed to form sugar, this reaction will most likely to be suspended in absence of CO<sub>2</sub>. As all other factors are optimum, light reaction will take place.

119. Answer (3)

**Sol.:** The bundle sheath cells may form several layers around the vascular bundles; they are characterized by having a large number of chloroplasts, thick walls impervious to gaseous exchange and no intercellular spaces.

120. Answer (4)

**Hint:** Concentration of CO<sub>2</sub> in the atmosphere is between 0.03 and 0.04%.

**Sol.:** Increase in concentration upto 0.05% can cause an increase in CO<sub>2</sub> fixation rates; beyond this the levels can become damaging over longer periods.

121. Answer (3)

**Hint:** Long term exposure to low light conditions can slow down growth in plants.

**Sol.:** At low light intensity, rate of photosynthesis is not maximum. There is a linear relationship between light and CO<sub>2</sub> fixation rates at low light intensities.

122. Answer (2)

**Hint:** Photorespiration occurs in C<sub>3</sub> plants.

**Sol.:** In the photorespiratory pathway there is no synthesis of sugar and ATP or NADPH rather it results in release of CO<sub>2</sub> with the utilization of ATP and thus is a wasteful process.

123. Answer (1)

**Hint:** During photorespiration, RuBisCO binds with O<sub>2</sub>.

**Sol.:** RuBisCO shows oxygenase activity during photorespiration. The RuBP binds with O<sub>2</sub> to form one molecule of PGA and phosphoglycolate.

124. Answer (1)

**Hint:** Ribulose biphosphate is the primary CO<sub>2</sub> acceptor molecule during C<sub>3</sub> cycle.

**Sol.:** The primary CO<sub>2</sub> acceptor molecule during the C<sub>3</sub> cycle is a 5C ketose sugar-Ribulose biphosphate (RuBP).

125. Answer (2)

**Hint:** The relative concentration of CO<sub>2</sub> and O<sub>2</sub> determines which of the two will bind to the enzyme, RuBisCO.

**Sol.:** RuBisCO has a much greater affinity for CO<sub>2</sub> than for O<sub>2</sub> when the CO<sub>2</sub> : O<sub>2</sub> is nearly equal.

126. Answer (3)

**Hint:** PEP synthetase is present in mesophyll cells of C<sub>4</sub> plants.

**Sol.:** PEP synthetase facilitates the regeneration of PEP in mesophyll cells.

127. Answer (4)

**Hint:** This step requires one ATP for phosphorylation to form RuBP.

**Sol.:** Regeneration of the CO<sub>2</sub> acceptor molecule RuBP is crucial if the cycle is to continue uninterrupted.

128. Answer (3)

**Hint:** For the synthesis of ATP, protons move from lumen to stroma.

**Sol.:** Breakdown of proton gradient leads to synthesis of ATP.

129. Answer (1)

**Hint:** It is a form of passive transport.

**Sol.:** The transmembrane channel of ATP synthase carries out facilitated diffusion of protons across the membrane.

130. Answer (1)

**Hint:** Dark reactions take place in the presence of carbon dioxide.

**Sol.:** Cyclic photophosphorylation operates when CO<sub>2</sub> availability is poor. Calvin pathway, CAM pathway and Hatch & Slack pathway cannot occur efficiently if CO<sub>2</sub> availability is poor.

131. Answer (3)

**Hint:** PS II is involved only in non-cyclic flow of electrons.

**Sol.:** PS II occurs on the inner surface of the thylakoids.

132. Answer (2)

**Hint:** The assimilatory powers formed during non-cyclic photophosphorylation are ATP and NADPH.

**Sol.:** ATP and NADPH are used in dark reactions of photosynthesis.

133. Answer (4)

**Hint:** The characteristic shape of the scheme of non-cyclic photophosphorylation is Z-scheme.

**Sol.:** The Z-scheme is formed when all the carriers are placed in a sequence on a redox potential scale.

134. Answer (4)

**Hint:** One molecule of chlorophyll *a* forms the reaction centre.

**Sol.:** The LHC are made up of hundreds of pigment molecules bound to proteins.

135. Answer (2)

**Hint:** When several factors affect any biochemical process, law of limiting factors comes into effect.

**Sol.:** The plant or internal factors are dependent on the genetic predisposition and the growth of the plant. At any point, the rate of photosynthesis will be determined by the factor available at sub-optimal levels.

## SECTION - B

136. Answer (1)

**Hint:** C<sub>4</sub> plants show saturation at about 360 μL<sup>-1</sup>.

**Sol.:** C<sub>3</sub> plants (tomato) show saturation only beyond 450 μL<sup>-1</sup> (ppm). The light reactions (photochemical reactions) are temperature sensitive but they are affected to a much lesser extent. The dark reaction (biosynthetic reactions) being enzymatic are temperature controlled. As the photosynthetic products accumulate in the mesophyll cells, their photosynthetic rate decreases.

137. Answer (4)

**Hint:** C<sub>3</sub> plants show photorespiration.

**Sol.:** In C<sub>4</sub> plants, photorespiration does not occur. This is because these plants have a mechanism that increases the concentration of CO<sub>2</sub> at the enzyme site. During the C<sub>4</sub> pathway, when the C<sub>4</sub> acid from the mesophyll cells is broken down in the bundle sheath cells, it releases CO<sub>2</sub> – this results in increasing the intracellular concentration of CO<sub>2</sub>. This in turn, ensures that the RuBisCO functions as a carboxylase minimising the oxygenase activity. Thus, the productivity and yields are better in C<sub>4</sub> plants as compared to C<sub>3</sub> plants.

138. Answer (2)

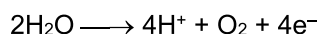
**Hint:** In Calvin cycle, one CO<sub>2</sub> is fixed from one cycle.

**Sol.:** To make one molecule of glucose, 6 turns of the Calvin cycles are required.

139. Answer (2)

**Hint:** Water is split into 2H<sup>+</sup>, [O] and electrons.

**Sol.:** The reaction which evolves one molecule of O<sub>2</sub> is



140. Answer (4)

**Hint:** Chlorophyll *a* imparts bright or blue green colour in chromatogram.

**Sol.:** Carotenoids impart yellow to yellow orange colour in chromatogram.

141. Answer (2)

**Hint:** Law of limiting factors becomes effective when several factors affect any biochemical process.

**Sol.:** Blackman gave the law of limiting factors in 1905. It states that if a chemical process is affected by more than one factor, then its rate will be determined by the factor which is nearest to its minimal value.

Hatch and Slack proposed C<sub>4</sub> pathway.

Calvin proposed C<sub>3</sub> pathway.

Julius von Sachs provided evidence for production of glucose when plants grow.

142. Answer (4)

**Hint:** Photosynthesis is under the influence of several factors, both internal (plant) and external.

**Sol.:** The plant factors include the number, size, age and orientation of leaves, mesophyll cells and chloroplasts, internal CO<sub>2</sub> concentration and the amount of chlorophyll. Light intensity is the extrinsic factor.

143. Answer (1)

**Hint:** Chemiosmotic hypothesis explains how actually ATP is synthesized in chloroplast.

**Sol.:** Chemiosmosis requires a membrane, a proton pump, a proton gradient and ATP synthase.

144. Answer (1)

**Hint:** Jan Ingenhousz used an aquatic plant for his experiment.

**Sol.:** Jan Ingenhousz used *Hydrilla* and Cornelius van Niel used purple and green sulphur bacteria for their experiments.

145. Answer (1)

**Hint:** Absorption spectrum of chlorophyll *a* resembles the action spectrum.

**Sol.:** The wavelengths at which there is maximum absorption by chlorophyll *a* also shows higher rate of photosynthesis. Hence, it can be concluded that chlorophyll *a* is the chief pigment associated with photosynthesis.

146. Answer (3)

**Hint:** Carbon reactions are dark reactions and photochemical reactions are light reactions in photosynthesis.

**Sol.:** Dark reaction occurs in stroma and light reaction occurs in grana of chloroplast.

147. Answer (1)

**Hint:** The chloroplasts align themselves along the walls of the mesophyll cells, such that they get the optimum quantity of the incident light.

**Sol.:** To get the maximum light, the chloroplasts will be aligned perpendicular to the incident light.

148. Answer (1)

**Hint:** Emerson and Lewis observed a sharp decline in quantum yield at wavelengths greater than 680 nm which is called 'red drop'.

**Sol.:** Emerson enhancement effect and red drop experiments led to the discovery of two types of inter-connected photosystems.

149. Answer (1)

**Hint:** Jan Ingenhousz showed that only the green parts of the plants could release oxygen.

**Sol.:** Priestley hypothesized that plants restore the air whatever breathing animals and burning candles remove.

150. Answer (1)

**Hint:** Jan Ingenhousz showed that green parts of the plants could release oxygen.

**Sol.:** Julius von Sachs found out that glucose is stored as starch in plants.

## [ZOOLOGY]

### SECTION-A

151. Answer (4)

**Hint:** Secreted by anterior pituitary

**Sol.:** Estrogen, aldosterone and cortisol are steroid in nature thus, these hormones interact with intracellular receptors.

Growth hormone interacts with membrane bound receptors and normally do not enter the target cell, but it generates a second messenger.

152. Answer (2)

**Hint:** Training school of T-lymphocytes

**Sol.:** The thymus gland is a lobular structure located between lungs behind sternum on the ventral side of aorta.

Thyroid gland is located on either side of the trachea.

Pineal gland is located on the dorsal side of forebrain.

Parathyroid gland is located on the back side of the thyroid gland.

153. Answer (4)

**Hint:** It regulates anterior pituitary by its hormones.

**Sol.:** Oxytocin and vasopressin, which are actually synthesized by hypothalamus are transported axonally to neurohypophysis.

154. Answer (1)

**Hint:** 98-99 per cent is exocrine portion of pancreas

**Sol.:** Pancreas is a composite gland which acts as both exocrine and endocrine gland.

The endocrine pancreas consists of 'Islets of Langerhans'. There are about 1 to 2 million Islets of Langerhans in a normal human pancreas representing only 1 to 2 per cent of the pancreatic tissue.

155. Answer (3)

**Hint:** Antagonistic to TCT

**Sol.:** Four parathyroid glands are present on the back side of the thyroid gland. The parathyroid glands secrete a peptide hormone called parathyroid hormone (PTH). PTH increases the  $Ca^{+2}$  levels in the blood. It acts on bones and stimulates the process of bone resorption (dissolution/demineralisation).

156. Answer (1)

**Hint:** Number of metacarpals in each forelimb

**Sol.:** Pituitary, pineal, thyroid, adrenal, pancreas, parathyroid, thymus and gonads (testes in males and ovaries in females) are the organised endocrine bodies in our body.

157. Answer (2)

**Hint:** Associated with growth hormone

**Sol.:** Cretinism – Hyposecretion of thyroxine

Acromegaly – Hypersecretion of GH

Simple goitre – Hyposecretion of thyroxine

Exophthalmic goitre – Hypersecretion of thyroxine

158. Answer (4)

**Hint:** Zona glomerulosa is the outermost layer.

**Sol.:** Zona reticularis → Innermost layer

Zona fasciculata → Middle layer

Zona glomerulosa → Outermost layer

159. Answer (4)

**Hint:** Hormone secreted by parathyroid gland

- Sol.:**
- Parathyroid hormone (PTH) is a hypercalcemic hormone *i.e.*, it increases the  $\text{Ca}^{2+}$  levels in the blood.
  - Hormones that work opposite to each other are called antagonistic hormones.
  - Calcitonin decreases blood calcium levels.

160. Answer (3)

**Hint:** Provide coordination in the vertebrates

**Sol.:** Hormones are non-nutrient chemicals released into the blood and are transported to distantly located target organs. They act as intercellular messengers and are produced in trace amounts.

161. Answer (3)

**Hint:** Not a function of thyroxine

**Sol.:** Iodine is essential for the normal synthesis of thyroxine. Thyroxine is secreted by thyroid gland. Thyroid hormones control metabolism of carbohydrates, proteins and fats.

162. Answer (4)

**Hint:** Characterised by weight loss and increased BMR**Sol.:**

Hyposecretion of growth hormone during childhood	Dwarfism
Hypersecretion of growth hormone during childhood	Gigantism
Hypersecretion of growth hormone in adults	Acromegaly
Hyposecretion of thyroxine	Goitre
Hypersecretion of thyroxine	Graves' disease or exophthalmic goitre

163. Answer (1)

**Hint:** Thymus is called the throne of immunity.

- Sol.:**
- Each thyroid follicle is composed of follicular cells, enclosing a cavity.
  - Thymus is degenerated in old individuals resulting in a decreased production of thymosins. As a result, the immune responses of old persons become weak.

164. Answer (3)

**Hint:** Secreted from zona glomerulosa

**Sol.:** Aldosterone is the main mineralocorticoid in our body. Aldosterone acts mainly at the renal tubules and stimulates the reabsorption of  $\text{Na}^+$  and water and excretion of  $\text{K}^+$  and phosphate ions.

165. Answer (3)

**Hint:** Function of hormone released by posterior pituitary

**Sol.:** ADH/Vasopressin stimulates reabsorption of water and electrolytes by DCT.

Oxytocin acts on the smooth muscles of uterus and stimulates a vigorous contraction of uterus at the time of child birth. Erythropoietin is produced by JG cells of the kidney. Milk ejection from the mammary glands is also the function of oxytocin.

166. Answer (1)

**Hint:** Exclude enterocytes

**Sol.:** Insulin is a peptide hormone, which plays a major role in the regulation of glucose homeostasis. Insulin is antagonistic to glucagon which is produced by  $\alpha$ -cells of Islets of Langerhans. Insulin acts mainly on hepatocytes and adipocytes (cells of adipose tissue), and enhances cellular glucose uptake and utilisation.

167. Answer (3)

**Hint:** Provide point-to-point rapid coordination

**Sol.:** The neural system and the endocrine system jointly coordinate and regulate the physiological functions in the body.

168. Answer (3)

**Hint:** Hormone that acts on gall bladder also

**Sol.:** CCK acts on both pancreas and gall bladder and stimulates the secretion of pancreatic enzymes and bile juice respectively.

Growth factors are essential for the normal growth of tissues and their repairing/regeneration.

169. Answer (1)

**Hint:** Hormone containing iodine

**Sol.:** Steroidal and iodothyronine hormones regulate gene expression or chromosome function by the interaction of hormone-receptor complex with the genome.

Glucagon and growth hormone interact with membrane-bound receptors and do not enter the target cells, but generate second messengers which in turn regulate cellular metabolism.

170. Answer (1)

**Hint:** Testosterone belongs to this category

**Sol.:** In males, testis is composed of seminiferous tubules and interstitial tissue. The Leydig cells or interstitial cells, which are present in the intertubular spaces produce a group of hormones called androgens, mainly testosterone.

Estrogen and progesterone are female sex hormones produced by ovary.

Epinephrine is released from adrenal medulla.

171. Answer (3)

**Hint:** Function of emergency hormone

**Sol.:** Adrenaline increases heart rate, rate of respiration, alertness, pupillary dilation, etc.

Estrogens produce wide ranging actions such as stimulation of growth and activities of female secondary sex organs, development of growing ovarian follicles, etc. Calcitonin regulates blood calcium levels.

172. Answer (3)

**Hint:** Oxytocin is released from neurohypophysis.

**Sol.:** The pars distalis of pituitary gland produces prolactin (PRL).

Neurohypophysis (pars nervosa) also known as posterior pituitary, stores and releases two hormones called oxytocin and vasopressin.

173. Answer (3)

**Hint:** Released by posterior pituitary

**Sol.:** Prolactin – Milk formation hormone

Oxytocin – Milk ejection hormone

Relaxin – Relaxes pubic symphysis during pregnancy

174. Answer (2)

**Hint:** Vasopressin stimulates reabsorption of water and electrolytes from distal part of nephron.

**Sol.:** An impairment affecting synthesis of ADH results in a diminished ability of the kidney to conserve water leading to water loss and dehydration. This condition is known as diabetes insipidus.

Diabetes mellitus is due to hyposecretion of insulin. Gigantism is caused due to hypersecretion of growth hormone during childhood.

175. Answer (2)

**Hint:** Regulates 24-hour rhythm

**Sol.:** Oxytocin – Milk secretion

Progesterone – Supports pregnancy

ANF – Decreases the blood pressure

176. Answer (1)

**Hint:** RAAS mechanism

**Sol.:** Aldosterone acts mainly at the renal tubules and stimulates the reabsorption of Na<sup>+</sup> and water and excretion of K<sup>+</sup> and phosphate ions.

Aldosterone helps in the maintenance of electrolytes, body fluid volume, osmotic pressure and blood pressure.

Cortisol stimulates RBC production.

Small amounts of androgenic steroids are also excreted by the adrenal cortex which play a role in the growth of axial hair, pubic hair and facial hair during puberty.

177. Answer (2)

**Hint:** Exophthalmic goitre is a form of hyperthyroidism.

**Sol.:** Exophthalmic goitre is a form of hyperthyroidism, characterised by enlargement of the thyroid gland, protrusion of eyeball, increased BMR and weight loss.

178. Answer (2)

**Hint:** Anterior pituitary is regulated by hypothalamus through portal circulation.

**Sol.:** Anterior pituitary releases ACTH which stimulates adrenal cortex for synthesis and release of cortisol. Cortisol stimulates gluconeogenesis to increase blood glucose levels.

179. Answer (1)

**Hint:** Exclude the disease of thyroid gland

**Sol.:** Underproduction of hormones by the adrenal cortex alters carbohydrate metabolism causing acute weakness and fatigue leading to a disease called Addison's disease.

Cretinism and exophthalmic goitre are associated with the thyroid gland.

180. Answer (1)

**Hint:** Suppresses the immune response

**Sol.:** Cortisol produces anti-inflammatory reactions and suppresses the immune response. Cortisol stimulates the RBC production. It is a hyperglycemic hormone.

181. Answer (1)

**Hint:** Lead to certain biochemical changes in the target tissue

**Sol.:** Binding of a hormone to its receptor leads to the formation of a hormone-receptor complex. Each receptor is specific to one hormone only and hence receptors are hormone specific.

182. Answer (3)

**Hint:** Hormone action depends on their chemical nature.

**Sol.:** Protein hormone binds to membrane-bound receptor

↓

Formation of hormone-receptor complex

↓

Biochemical responses

↓

Physiological responses

183. Answer (1)

**Hint:** Associated with sphenoid bone

**Sol.:** The pituitary gland is located in a bony cavity called sella turcica and is attached to hypothalamus by a stalk.

Cranium is the bony protective covering of brain.

184. Answer (4)

**Hint:** Its action is similar to glucagon hormone.

**Sol.:** Glucocorticoids stimulate gluconeogenesis, lipolysis and proteolysis.

It inhibits cellular uptake and utilisation of amino acids.

185. Answer (1)

**Hint:** Master of master endocrine gland

**Sol.:** Hypothalamus is the basal part of diencephalon, forebrain and it regulates a wide spectrum of body functions. It contains several groups of neurosecretory cells called nuclei which produce hormones.

### SECTION - B

186. Answer (2)

**Hint:** Identify a primary lymphoid organ.

**Sol.:**

Glands	Hormones
Thymus	Thymosins
β-cells of Islets of Langerhans	Insulin

187. Answer (1)

**Hint:** Exclude energy currency of the cell

**Sol.:** Hormones which interact with membrane-bound receptors normally do not enter the target cells but generate second messengers (cyclic AMP, IP<sub>3</sub>, Ca<sup>2+</sup>, etc).

188. Answer (1)

**Hint:** GHIH

**Sol.:** Somatostatin from the hypothalamus inhibits the release of growth hormone from the pituitary. Gonadotrophin releasing hormone (GnRH) stimulates the synthesis and release of gonadotrophins.

189. Answer (4)

**Hint:** Gastrin acts on stomach

**Sol.:** CCK acts on both gall bladder and pancreas. It stimulates secretion of pancreatic enzymes. Secretin acts on the exocrine pancreas and stimulates secretion of H<sub>2</sub>O and bicarbonate ions.

Endocrine function of pancreas is the secretion of insulin and glucagon hormone.

GIP (Gastric Inhibitory Peptide) inhibits gastric secretion and motility.

190. Answer (2)

**Hint:** Equal to the number of ear ossicles in one ear.

**Sol.:** In human eyes, there are three types of cones which possess their own characteristic photopigments that respond to red, green and blue lights.

191. Answer (4)

**Hint:** It contains crista

**Sol.:** The membranous canals are surrounded by fluid called perilymph.

Vestibular apparatus is located above the cochlea.

Each semi-circular canal lies in a different plane at right angles to each other. The crista and macula are specific receptors of the vestibular apparatus.

192. Answer (1)

**Hint:** Epinephrine is derived from tyrosine amino acid.

**Sol.:** Amino acid derivative – Epinephrine

Steroid – Cortisol, testosterone

Iodothyronine – Thyroxine

Peptide hormones – Insulin, glucagon

193. Answer (4)

**Hint:** Equal to the number of ear ossicles in each ear

**Sol.:** Peptide, polypeptide and protein hormone (insulin, glucagon, FSH, calcitonin, thymosin) interact with membrane bound receptors and normally do not enter the target cell whereas steroid hormones and iodothyronines interact with intracellular receptors.

194. Answer (3)

**Hint:** Sclera has dense connective tissue.

**Sol.:** The wall of the eye ball is composed of three layers. The external layer of the eye ball, sclera is composed of dense connective tissue. Image formed on the retina is recognised on the basis of earlier memory and experience.

195. Answer (4)

**Hint:** Ear drum is called tympanic membrane.

**Sol.:** The tympanic membrane is composed of connective tissue covered with skin outside and with mucus membrane inside.

196. Answer (4)

**Hint:** Hyperglycemic factor

**Sol.:** Insulin and glucagon interact with membrane bound receptors.

- Insulin decreases the blood sugar levels while glucagon increases the blood sugar levels.

197. Answer (1)

**Hint:** Estrogen regulates libido in females.

**Sol.:** • Progesterone supports pregnancy.

- Progesterone stimulates the formation of alveoli in breast of human females.

198. Answer (3)

**Hint:** Hypothalamus releases releasing and inhibiting hormones.

**Sol.:** • Anterior pituitary or pars distalis – GH, PRL, TSH, ACTH, LH, FSH

- Pars intermedia – MSH

- Hypothalamus – GnRH

- Posterior pituitary – Oxytocin and Vasopressin

199. Answer (2)

**Hint:** Formation of RBCs

**Sol.:** Pineal gland plays a very important role in regulation of a 24-hour (diurnal) rhythm of our body.

Kidneys produce a peptide hormone called erythropoietin which stimulates erythropoiesis (formation of RBCs).

200. Answer (4)

**Hint:** Scotopic vision is function of rods

**Sol.:** Rod cells have low visual acuity whereas cone cell have maximum acuity.

Cone cells are more concentrated in center of macula lutea whereas the rod cells are distributed near retina.

The rods contain a purplish-red protein called the rhodopsin or visual purple.

Iodopsin is present in cones.



## All India Aakash Test Series for NEET - 2025

**TEST - 5 (Code-D)**

Test Date : 25/02/2024

**ANSWERS**

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

# HINTS & SOLUTIONS

## [PHYSICS]

### SECTION-A

1. Answer (2)

**Hint:** Stress is defined by restoring force per unit area.

**Sol.:** Normal stress =  $\frac{F}{A} = \frac{20}{2 \times 10^{-6}} = 10^7 \text{ N/m}^2$

2. Answer (2)

**Hint:** Within elastic limit, stress = Young's modulus  $\times$  strain

**Sol.:**  $Y_A = \tan 37^\circ = \frac{3}{4}$

$Y_B = \tan 53^\circ = \frac{4}{3}$

$\frac{Y_A}{Y_B} = \frac{9}{16} \Rightarrow 16Y_A = 9Y_B$

3. Answer (1)

**Hint:** Use energy =  $\frac{1}{2} \times$  stress  $\times$  strain  $\times$  volume

**Sol.:**  $\frac{E_A}{E_B} = \frac{\frac{1}{2} \frac{(\text{stress})^2}{Y_A} A_1 l_1}{\frac{1}{2} \frac{(\text{stress})^2}{Y_B} A_2 l_2}$

$= \frac{A_2 l_1}{A_1 l_2} = \left(\frac{r_2}{r_1}\right)^2 \left(\frac{l_1}{l_2}\right)$

$= \frac{3}{4}$

4. Answer (2)

**Hint:** Use equation of continuity

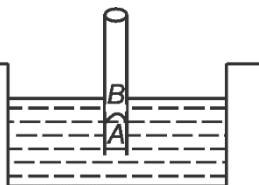
**Sol.:**  $A_1 v_1 = A_2 v_2$

$2 \times v_1 = 8 \times 5$

$v_1 = 20 \text{ m/s}$

5. Answer (4)

**Hint & Sol.:**



For mercury level to fall in capillary

$P_A > P_B$

$\therefore \theta_c > 90^\circ$ , therefore mercury level falls in capillary tube.

6. Answer (1)

**Hint:** Use Bernoulli's Principle

**Sol.:** Since velocity increases down the streamline therefore area decreases. Water stream from tap become narrower.

7. Answer (2)

**Hint & Sol.:** Emissive power  $\propto T^4$

$\frac{E_1}{E_2} = \left(\frac{T_1}{T_2}\right)^4 = \left(\frac{300}{400}\right)^4 = \frac{81}{256}$

8. Answer (4)

**Hint & Sol.:** Rate of heat conduction

$\frac{dQ}{dt} = kA \frac{\Delta T}{\Delta l}$

$\therefore \frac{dQ}{dt} = \frac{k\pi[(3R)^2 - R^2] \times (T_1 - T_2)}{l}$

$\frac{dQ}{dt} = \frac{8\pi kR^2(T_1 - T_2)}{l}$

9. Answer (2)

**Hint & Sol.:** Velocity of efflux =  $\sqrt{2gh}$

10. Answer (3)

**Hint:** Use Newton's law of cooling

**Sol.:**  $\frac{12}{20} = (-k)(56 - T_s) \dots(i)$

$\frac{8}{20} = (-k)(46 - T_s) \dots(ii)$

(i)  $\div$  (ii)

$\frac{3}{2} = \frac{56 - T_s}{46 - T_s}$

$138 - 3T_s = 112 - 2T_s$

$26 = T_s$

$T_s = 26^\circ\text{C}$

11. Answer (3)

**Hint & Sol.:** Rate of cooling is proportional to the difference in the temperature of object and surroundings. Hence

$$T_1 < T_2 < T_3$$

12. Answer (2)

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

13. Answer (4)

**Hint:** Apply formula  $Q = ms\Delta T$  for both the liquids.

**Sol.:** Heat lost by liquid B = Heat gained by liquid A  
 $m_{BS}B(50 - 44) = m_{AS}A(44 - 40)$

Given  $m_A = m_B$

$$\therefore s_B \times 6 = s_A \times 4$$

$$\frac{s_A}{s_B} = \frac{3}{2}$$

14. Answer (1)

**Hint & Sol.:** When a metallic object is heated all its linear dimensions increase.

15. Answer (3)

**Hint:** Coefficient of apparent expansion of liquid = coefficient of expansion of liquid – coefficient of expansion of vessel

**Sol.:** Let the coefficient of expansion of liquid is  $\gamma_L$   
 Then

$$\alpha = \gamma_L - \gamma_1 \quad \dots(i)$$

$$\beta = \gamma_L - \gamma_2 \quad \dots(ii)$$

Eliminate  $\gamma_L$  from both the equations

$$\beta = (\alpha + \gamma_1) - \gamma_2 \Rightarrow \gamma_2 = \alpha - \beta + \gamma_1$$

16. Answer (1)

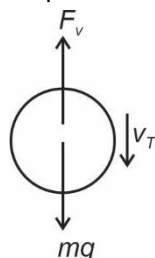
**Hint:** Surface tension =  $\frac{\text{Force}}{\text{Length}}$

$$\text{Sol.} : T = \frac{F}{\ell} \Rightarrow F = T \times 2\pi R$$

17. Answer (3)

**Hint:** Terminal velocity is reached when net force on spherical object becomes zero.

**Sol.:** Since force of buoyancy is to be neglected. Therefore FBD of spherical object will be



$$F_v = 6\pi\eta r v_T = mg$$

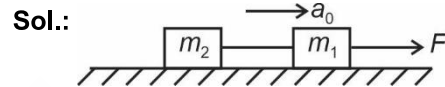
$$v_T \propto \frac{m}{r} \quad \dots(i)$$

$$\frac{80}{v_T} = \frac{m_1}{r_1} \times \frac{r_2}{m_2} \Rightarrow \frac{80}{v_T} = \frac{m}{r} \times \frac{r}{2m}$$

$$v_T = 160 \text{ m/s}$$

18. Answer (2)

**Hint:** Formula for elongation in a wire  $\Delta\ell = \frac{F\ell}{AY}$



$$F = (m_1 + m_2)a_0 \Rightarrow a_0 = \frac{F}{m_1 + m_2} \quad \dots(i)$$



$$T = m_2 a_0$$

$$\text{Tension in the string} \Rightarrow T = m_2 \times \frac{F}{m_1 + m_2} \quad \dots(ii)$$

$$\text{Elongation} : \Delta\ell = \frac{T\ell_0}{A_0 Y} = \frac{m_2 F \ell_0}{(m_1 + m_2) A_0 Y}$$

19. Answer (4)

**Hint:** Bulk Modulus,  $B = -\frac{\Delta P}{\frac{\Delta V}{V}}$

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

Minus sign indicates that increase in pressure will result in decrease in volume.

$$\therefore \frac{0.2}{100} = \frac{\Delta P}{2 \times 10^9} \Rightarrow \Delta P = 4 \text{ MPa}$$

20. Answer (1)

**Hint:** Young's modulus =  $\frac{\text{stress}}{\text{strain}}$

$$\text{Sol.} : Y = \frac{\sigma}{\epsilon} = \frac{F/A}{\Delta\ell/\ell} \Rightarrow Y = \frac{F\ell}{A\Delta\ell}$$

$$\therefore \Delta\ell \propto \ell \Rightarrow \frac{\Delta\ell_1}{\Delta\ell_2} = \frac{n}{1}$$

21. Answer (4)

**Hint & Sol.:** Young's modulus depends upon nature of material and temperature.

22. Answer (1)

**Hint:**  $v_T \propto r^2$

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

$$\frac{r_1}{r_2} = \sqrt{\frac{v_1}{v_2}} = \frac{3}{5}$$

Ratio of volume :

$$\frac{v_1}{v_2} = \left(\frac{r_1}{r_2}\right)^3 = \frac{27}{125}$$

23. Answer (2)

**Hint:** Work required = Change in surface energy.

**Sol.:**  $W = 2T\Delta A$

$$= 2 \times T \times 4\pi(r_2^2 - r_1^2)$$

$$= 8\pi \times 0.03(16 - 4) \times 10^{-4}$$

$$= 8 \times 12\pi \times 3 \times 10^{-6}$$

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

$$= 0.29\pi \text{ mJ}$$

24. Answer (1)

**Hint & Sol.:**  $\rho \times g \times 8 = \rho \times g \times \ell \cos 30^\circ$

Since pressure remains same

$$\Rightarrow 8 = \ell \times \frac{\sqrt{3}}{2} \quad \Rightarrow \quad \ell = \frac{16}{\sqrt{3}} \text{ cm}$$

25. Answer (1)

**Hint:** At steady state heat current is same through every cross section.

**Sol.:**  $H = KA \frac{dT}{dx}$

$$\left(\frac{dT}{dx}\right) \propto \frac{1}{K}$$

$$\frac{1}{K_1} < \frac{1}{K_2}$$

$$K_2 < K_1$$

26. Answer (3)

**Hint & Sol.:** At high altitude both pressure and boiling point of water decreases. So the water start boiling at lower temperature, which is much lower than melting point of rice.

27. Answer (4)

**Hint & Sol.:** A perfect black body is a perfect absorber, hence it neither reflect nor transmit any energy incident on it. Also, its emissivity is equal to 1.

28. Answer (2)

**Hint & Sol.:** In convection mode of heat transfer, bulk motion of medium is required.

29. Answer (4)

**Hint:** Hydraulic machine works on the Pascal's law.

$$\text{Sol.: } \frac{F_1}{A_1} = \frac{F_2}{A_2} \Rightarrow \frac{1000 \times 10}{\pi(15)^2} = \frac{F_2}{\pi(3)^2}$$

$$F_2 = \frac{1000 \times 10 \times 3^2}{15^2} \Rightarrow F_2 = 400 \text{ N}$$

30. Answer (4)

**Hint & Sol.:** joule second is not the unit of coefficient viscosity.

31. Answer (1)

**Hint:** Apply Bernoulli's equation

$$\text{Sol.: } P_A + \frac{1}{2}\rho v_A^2 = P_B + \frac{1}{2}\rho v_B^2 \quad \dots(i)$$

Equation of continuity

$$A_1 v_1 = A_2 v_2 \Rightarrow 40 v_A = 10 v_B$$

$$v_B = 4 v_A \quad \dots(ii)$$

$$P_A - P_B = \frac{1}{2}\rho v_B^2 - \frac{1}{2}\rho v_A^2$$

$$800 = \frac{1}{2} \times 10^3 \times 15 (v_A)^2$$

$$v_A = \sqrt{\frac{1600}{15000}} \text{ m/s}$$

Flow rate

$$= 40 \text{ cm}^2 \times \sqrt{\frac{16}{150}} \times 100 \text{ cm/s} \approx 1300 \text{ cm}^3/\text{s}$$

32. Answer (4)

**Hint:** For the junction, heat entering is equal to the heat exiting per second.

$$\text{Sol.: } \left(\frac{dQ}{dt}\right)_1 + \left(\frac{dQ}{dt}\right)_2 + \left(\frac{dQ}{dt}\right)_3 = 0$$

$$\Rightarrow \frac{KA(100-T)}{\ell} + 2KA \frac{(60-T)}{\ell} + \frac{KA(20-T)}{\ell} = 0$$

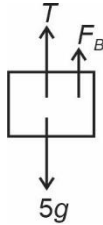
$$100 - T + 120 - 2T + 20 - T = 0 \Rightarrow T = 60^\circ\text{C}$$

33. Answer (3)

**Hint:** Buoyant force =  $\rho \times V_d \times g$

where  $\rho$  is density of liquid and  $V_d$  is the volume displaced.

**Sol.:** FBD of block



$$T + F_B = 5g \quad \dots(i)$$

$$\text{Given R.D.} = 2 = \frac{\rho_0}{\rho_w} \Rightarrow \rho_0 = 2\rho_w \quad \dots(ii)$$

$$\rho_0 \times V_0 \times g = 5g \text{ and } \rho_w V_0 g = F_B \quad [V_d = V_0]$$

$$\therefore \frac{F_B}{5g} = \frac{\rho_w V_0 g}{\rho_0 V_0 g} = \frac{\rho_w}{\rho_0}$$

$$F_B = \frac{5g}{2} = 25 \text{ N}$$

Using equation (i)

$$T + 25 = 50 \Rightarrow T = 25 \text{ N}$$

34. Answer (2)

**Hint:** Change in surface energy  $S = T\Delta A$

**Sol.:** From volume conservation

$$\frac{4}{3}\pi R^3 = 64 \times \frac{4}{3}\pi r^3$$

$$R^3 = 64r^3 \Rightarrow R = 4r \quad \dots(i)$$

Change in surface energy =  $T\Delta A$

$$\begin{aligned} \Delta S &= T(64 \times 4\pi r^2 - 4\pi R^2) \\ &= 7.5 \times 10^{-2} \times 4\pi \left( 64 \times \frac{R^2}{16} - R^2 \right) \end{aligned}$$

$$= 7.5 \times 10^{-2} \times 4\pi \times 3 \times (10^{-2})^2$$

$$= 90\pi \times 10^{-6} \text{ J} = 90\pi \mu\text{J}$$

35. Answer (1)

**Hint:** Use the concept of velocity of efflux and projectile motion.

**Sol.:** Horizontal velocity with which the water will come out of the container =  $\sqrt{2gH}$  ... (i)

$$\text{Time to reach the ground, } T = \sqrt{\frac{2H}{g}} \quad \dots(ii)$$

$$\therefore \text{Horizontal distance : } x = \sqrt{2gH} \times \sqrt{\frac{2H}{g}}$$

$$x = 2H$$

**SECTION - B**

36. Answer (3)

**Hint:** Rate of radiation  $\frac{dQ}{dt} \propto T^4$

$$\text{Sol. : } 100 \propto T^4 \quad \dots(i)$$

$$\text{New temperature } T' = T + \frac{25}{100}T = \frac{5T}{4}$$

$$\frac{dQ}{dt} \propto \left(\frac{5T}{4}\right)^4 \quad \dots(ii)$$

$$\frac{dQ}{dt} = \left(\frac{5T}{T}\right)^4$$

$$\frac{dQ}{dt} = 100 \times \frac{625}{256} = 244 \text{ J/s}$$

37. Answer (2)

**Hint & Sol.:** The relation between °C and °F is

$$F = \frac{9C}{5} + 32$$

$$\text{Slope} = \frac{9}{5}$$

38. Answer (1)

**Hint:** Apply Newton's law of cooling

$$\text{Sol. : } \frac{\Delta T}{\Delta t} = K(T_{\text{avg}} - T_0)$$

For 1<sup>st</sup> case

$$\frac{10}{5} = K\left(\frac{50+40}{2} - 20\right)$$

$$\frac{10}{5} = K(45 - 20) \quad \dots(i)$$

For 2<sup>nd</sup> case

$$\frac{40-T}{5} = K\left(\frac{40+T}{2} - 20\right) \quad \dots(ii)$$

Divide equation (i) and (ii)

$$\frac{10/5}{(40-T)/5} = \frac{K \times 25}{K\left(20 + \frac{T}{2} - 20\right)}$$

$$\frac{10}{40-T} = \frac{25}{T/2}$$

$$5T = 25 \times 40 - 25T$$

$$30T = 25 \times 40$$

$$T = 33.3^\circ\text{C}$$

39. Answer (3)

**Hint:** Young's modulus =  $\frac{\text{stress}}{\text{strain}}$

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

$$F = 4 \times 10^{11} \times 3 \times 10^{-4} \times \frac{\ell}{\ell}$$

$$F = 12 \times 10^7 \text{ N}$$

40. Answer (1)

**Hint:** Young's modulus  $Y = \frac{F\ell}{A\Delta\ell}$

**Sol.:** For 1<sup>st</sup> wire:

$$Y = \frac{1000 \times \ell}{\pi r^2 \times 4 \text{ mm}} \quad \dots(i)$$

For 2<sup>nd</sup> wire:

$$Y = \frac{1000 \times \ell}{\pi (2r)^2 \times \Delta\ell} \quad \dots(ii)$$

Equate equation (i) and (ii)

$$\frac{1000\ell}{\pi r^2 \times 4 \text{ mm}} = \frac{1000 \times \ell}{\pi (2r)^2 \times \Delta\ell}$$

$$\Delta\ell = 1 \text{ mm}$$

41. Answer (3)

**Hint:** Force applied by soap film on wire is balanced by the load.

**Sol.:** There are two interface of the given soap film, therefore force applied by it on the wire is

$$F = (T \times \ell) \times 2 \quad \dots(i)$$

$$\therefore mg = 2T\ell \Rightarrow mg = 2 \times 2 \times 10^{-2} \times \frac{1}{10}$$

$$m = 4 \times 10^{-4} \text{ kg} \Rightarrow m = 0.4 \text{ g}$$

42. Answer (2)

**Hint:** Heat loss/gain when temperature of a substance changes by  $\Delta T$  is

$$Q = ms\Delta T$$

**Sol.:** Heat loss by iron = Heat gain by water

$$2 \times 450 \times (200 - T) = 5 \times 4200 \times (T - 30)$$

$$900 \times 200 - 900T = 21000T - 21000 \times 30$$

$$(18 + 63) \times 10^4 = 21900T$$

$$T = \frac{81 \times 10^2}{219} \approx 37^\circ\text{C}$$

43. Answer (4)

**Hint & Sol.:**

Since the fluid is stationary hence difference of pressure between A and B is  $\rho gh$ .

$$\Rightarrow P_B = P + \rho gh$$

44. Answer (2)

**Hint:** Excess pressure inside an air bubble inside water is  $\frac{2T}{r}$

$$\text{Sol.: } P_{\text{inside}} - P_{\text{outside}} = \frac{2T}{r}$$

$$P_{\text{outside}} = P_0 + \rho gh$$

$$\therefore P_{\text{inside}} = \frac{2T}{r} + P_0 + \rho gh$$

45. Answer (3)

**Hint & Sol.:**  $P + \rho gh + \frac{1}{2}\rho v^2 = \text{constant}$

$\Rightarrow$  Bernoulli's principle

$A_1v_1 = A_2v_2 \Rightarrow$  Equation of continuity

$v = \sqrt{2gh} \Rightarrow$  Velocity of efflux

$$\frac{F_1}{A_1} = \frac{F_2}{A_2} \Rightarrow \text{Pascal's law}$$

46. Answer (2)

**Hint & Sol.:** Pascal's law states that a pressure change at any point in a confined fluid is transmitted throughout the fluid without diminishing.

47. Answer (3)

**Hint & Sol.:** Buoyant force of air on raindrops is negligible, therefore viscous force by air on raindrops is majorly responsible for the attainment of terminal velocity of raindrops.

48. Answer (3)

**Hint:** When the rod is heated between the rigid supports, then longitudinal stress is developed.

$$\text{Sol.: } \text{We know } Y = \frac{F/A}{\Delta\ell/\ell} \Rightarrow \Delta\ell = \frac{F\ell}{AY} \quad \dots(i)$$

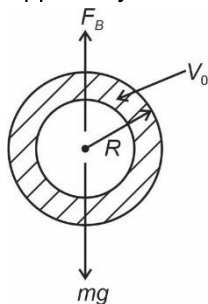
$$\text{Also } \Delta\ell = \ell\alpha\Delta T \quad \dots(ii)$$

$$\therefore \ell\alpha\Delta T = \frac{F\ell}{AY} \Rightarrow F = AY\alpha\Delta T$$

49. Answer (3)

**Hint:** Weight of the shell is equal to the buoyant force applied by the water.

**Sol.:**



$$F_B = mg \Rightarrow \rho_w \times V \times g = \rho_0 \times V_0 \times g$$

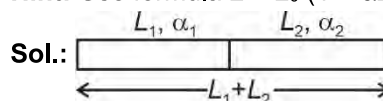
$$\rho_w \times \frac{4}{3}\pi R^3 = \rho_0 \times V_0 \Rightarrow V_0 = \frac{\rho_w}{\rho_0} \times \frac{4}{3}\pi R^3$$

Given  $\frac{\rho_0}{\rho_w} = K$

$$\therefore V_0 = \frac{4\pi R^3}{3K}$$

50. Answer (2)

**Hint:** Use formula  $L = L_0 (1 + \alpha\Delta T)$



$$L'_1 = L_1(1 + \alpha_1\Delta T) \text{ and } L'_2 = L_2(1 + \alpha_2\Delta T)$$

For the series combination

$$L'_{\text{eff}} = (L_1 + L_2)(1 + \alpha'\Delta T)$$

$$\therefore (L_1 + L_2)(1 + \alpha'\Delta T) = L_1(1 + \alpha_1\Delta T) + L_2(1 + \alpha_2\Delta T)$$

$$(L_1 + L_2)\alpha' = L_1\alpha_1 + L_2\alpha_2$$

$$\alpha' = \frac{\alpha_1 L_1 + \alpha_2 L_2}{L_1 + L_2}$$

## [CHEMISTRY]

### SECTION-A

51. Answer (1)

**Hint:**  $\text{Na}_2\text{B}_4\text{O}_7 + 7\text{H}_2\text{O} \rightarrow 2\text{NaOH} + 4\text{H}_3\text{BO}_3$

**Sol.:** Boric acid is a weak monobasic acid. It acts as a Lewis acid by accepting electron pair from hydroxyl ion.

52. Answer (1)

**Hint:** Bead formed is  $\text{Co}(\text{BO}_2)_2$

**Sol.:** When borax is heated in Bunsen burner flame with  $\text{CoO}$ , a blue coloured  $\text{Co}(\text{BO}_2)_2$  bead is formed.

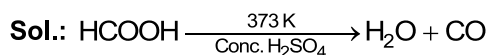
53. Answer (4)

**Hint:** In diborane, 4 terminal B-H bonds are two centre-two electron bonds, while 2 bridge (B-H-B) bonds are three centre-two electron bonds.

**Sol.:** Diborane is a colourless, highly toxic gas with a b.p. of 180 K. It catches fire spontaneously upon exposure to air.

54. Answer (2)

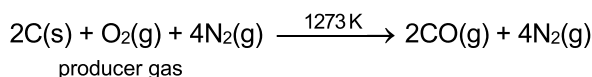
**Hint:** Conc.  $\text{H}_2\text{SO}_4$  is a dehydrating agent which removes water from formic acid.



55. Answer (2)

**Hint:**  $(\text{CO} + \text{H}_2)$  mixture is called water gas.

**Sol.:**



56. Answer (2)

**Hint:** CO is a neutral oxide.

**Sol.:**  $\text{SiO}_2$ ,  $\text{GeO}_2$  are acidic whereas  $\text{PbO}$  and  $\text{SnO}$  are amphoteric in nature.

57. Answer (2)

**Hint:**  $K_p = K_c(\text{RT})^{\Delta n}$

$$\text{Sol.} \Delta n = (2 + 1) - 2 = 1$$

$$K_p = 4 \times 10^{-6} (0.082 \times 1100)$$

$$K_p = 3.6 \times 10^{-4}$$

58. Answer (4)

**Hint:** The observed discontinuity in the IE values between Al and Ga and between In and Tl are due to inability of d- and f- electrons, which have low screening effect, to compensate the increase in nuclear charge.

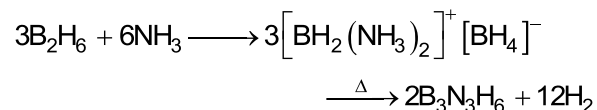
**Sol.:**

Element	Ionisation Enthalpy (kJ mol <sup>-1</sup> )
B	801
Al	577
Ga	579
In	558
Tl	589

59. Answer (1)

**Hint:** Reaction of ammonia with diborane gives  $\text{B}_2\text{H}_6 \cdot 2\text{NH}_3$  initially.

**Sol.:**



60. Answer (3)

**Hint:** 2<sup>nd</sup> period members cannot expand their octet due to absence of *d*-orbital.**Sol.:** [SiCl<sub>6</sub>]<sup>2-</sup> is not known as 6 large chloride ions cannot be accommodated around Si<sup>4+</sup> due to limitation of its size.

- BCl<sub>3</sub> being covalent form [B(OH)<sub>4</sub>]<sup>-</sup> when hydrolysed by water.

61. Answer (3)

**Hint:** Oxidation state of H in PH<sub>3</sub> is +1**Sol.:**

- H<sub>4</sub>P<sub>2</sub>O<sub>5</sub> (Let x is oxidation state of P)

$$1 \times 4 + x \times 2 + 5(-2) = 0$$

$$2x = +6$$

$$x = +3$$

- H<sub>3</sub>PO<sub>2</sub>

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

$$x = +1$$

- PH<sub>3</sub>

$$x + 1 \times 3 = 0$$

$$x = -3$$

- H<sub>4</sub>P<sub>2</sub>O<sub>7</sub>

$$1 \times 4 + x \times 2 + 7(-2) = 0$$

$$x = +5$$

62. Answer (2)

**Hint & Sol.:** A catalyst increases the rate of the chemical reaction by making available a new low energy pathway for the conversion of reactants to the products.

Catalyst does not appear in the balanced chemical equation or in the equilibrium constant expression.

63. Answer (1)

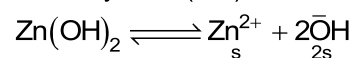
**Hint:**  $\Delta G^\circ = -2.303 RT \log K_c$ 

$$\begin{aligned} \text{Sol.} \Delta G^\circ &= -2.303 \times 8.314 \times 300 \log 10^6 \\ &= -2.303 \times 8.314 \times 300 \times 6 \\ &= -3.4 \times 10^4 \text{ J mol}^{-1} \end{aligned}$$

64. Answer (2)

**Hint:** pOH = 14 - 9 = 5

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

**Sol.:** Let us assume thatSolubility of Zn(OH)<sub>2</sub> be *s* mol L<sup>-1</sup>

$$2s = 10^{-5}$$

$$s = \frac{1}{2} 10^{-5}$$

$$K_{sp} = [\text{Zn}^{2+}][\text{OH}^-]^2$$

$$= \frac{10^{-5}}{2} (10^{-5})^2$$

$$= \frac{1}{2} \times 10^{-15}$$

$$= \frac{10}{2} \times 10^{-16} = 5 \times 10^{-16}$$

65. Answer (1)

**Hint:** Mixture of weak acid and salt of weak acid and strong base behaves as acidic buffer.

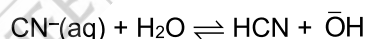
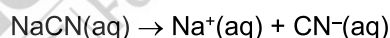
- (a) CH<sub>3</sub>CH<sub>2</sub>COOH and CH<sub>3</sub>CH<sub>2</sub>COONa
- (b) H<sub>2</sub>CO<sub>3</sub> and Na<sub>2</sub>CO<sub>3</sub>

These two mixtures will behave as acidic buffer

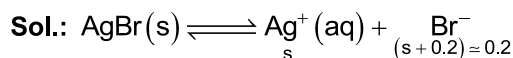
- (d) NH<sub>4</sub>Cl and NH<sub>4</sub>OH will behave as basic buffer.

- (c) HNO<sub>3</sub> and NaNO<sub>3</sub> will not behave as a buffer.

66. Answer (1)

**Hint:** Salt of weak acid and strong base undergo anionic hydrolysis.**Sol.:** NaCN is a salt of weak acid and strong base. Cyanide undergoes aqueous hydrolysis giving alkaline solution.

67. Answer (3)

**Hint:** CaBr<sub>2</sub> is a strong electrolyte and it will provide Br<sup>-</sup> as common ion

$$[\text{Ag}^+][\text{Br}^-] = K_{sp}$$

$$s \times 0.2 = 5 \times 10^{-13}$$

$$s = \frac{5 \times 10^{-13}}{0.2} = 2.5 \times 10^{-12}$$

68. Answer (3)

**Hint:** pOH = -log[OH<sup>-</sup>]**Sol.:** KOH is strong electrolyte [OH<sup>-</sup>] = 0.04

$$\text{pOH} = -\log[\text{OH}^-] = -\log(4 \times 10^{-2})$$

$$\text{pOH} = 2 - \log 4 = 1.4$$

$$\text{pH} = 14 - 1.4 = 12.6$$

69. Answer (2)

**Hint:** At constant pressure, addition of inert gas increases the volume of the system.

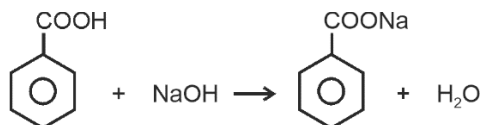
**Sol.:** The volume increases as the number of moles of gaseous molecules increase. This will lead to the dissociation of ammonia.

70. Answer (3)

**Hint:** For acidic buffer, pH of the solution is given

$$\text{as, } \text{pH} = \text{pK}_a + \log \frac{[\text{Salt}]}{[\text{Acid}]}$$

**Sol.:**



Initial	500 × 0.1	200 × 0.1	-	-
	= 50 mmol	= 40 mmol		

Final	10 mmol	0	40	
-------	---------	---	----	--

$$\text{pH} = \text{pK}_a + \log \frac{[\text{Salt}]}{[\text{Acid}]}$$

$$= 4.2 + \log \frac{40}{10}$$

$$= 4.2 + 0.6 = 4.8$$

71. Answer (2)

**Hint:** As the size of halogen(X) increases, H-X bond strength decreases.

**Sol.:** HCl is a stronger acid than HF  
Co<sup>3+</sup> has vacant orbital hence it acts as Lewis acid.

72. Answer (3)

**Hint:** For salt of weak acid and strong base

$$h = \sqrt{\frac{K_w}{K_a \times C}}$$

$$\text{Sol.} : h = \sqrt{\frac{10^{-14}}{0.1 \times 2 \times 10^{-4}}} = \sqrt{5} \times 10^{-5}$$

73. Answer (1)

**Hint:** Lesser is the electron density on boron stronger is its Lewis acid strength.

**Sol.:** Extent of back bonding decreases from BF<sub>3</sub> to BI<sub>3</sub>.

∴ Lewis acidic character increases from BF<sub>3</sub> to BI<sub>3</sub>.

74. Answer (4)

**Hint:** Element having maximum electronegativity and is smallest in size will show maximum catenation.

**Sol.:** The order of catenation is C >> Si > Ge = Sn. Lead does not show catenation.

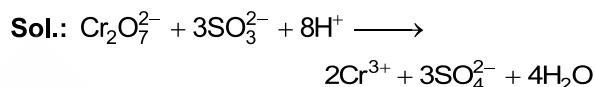
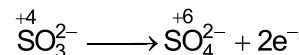
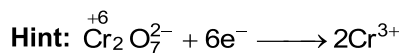
75. Answer (1)

**Hint:** Due to poor shielding effect of *d* and *f* orbitals, the increased effective nuclear charge holds *ns* electrons tightly.

**Sol.:** Due to inert pair effect the relative stability of +1 oxidation state progressively increases for heavier elements.

Al < Ga < In < Tl

76. Answer (2)



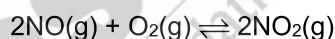
77. Answer (2)

**Hint:** Bronsted acid is a substance that is capable of donating a hydrogen ion (H<sup>+</sup>) and bases are substances capable of accepting a hydrogen ion.

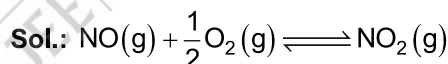
**Sol.:** PO<sub>4</sub><sup>3-</sup> can act as a base but cannot act as acid as it does not contain hydrogen atom.

78. Answer (3)

**Hint:** For the equilibrium reaction,



$$K = \frac{[\text{NO}_2]^2}{[\text{NO}]^2[\text{O}_2]} \quad \dots(\text{i})$$



$$K_1 = \frac{[\text{NO}_2]}{[\text{NO}][\text{O}_2]^{1/2}} \quad \dots(\text{ii})$$

(ii) ÷ (i)

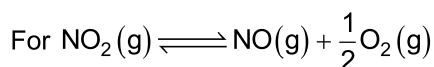
$$\frac{K_1}{K} = \frac{[\text{NO}_2]}{[\text{NO}][\text{O}_2]^{1/2}} \times \frac{[\text{NO}]^2[\text{O}_2]}{[\text{NO}_2]^2}$$

$$\frac{K_1}{K} = \frac{[\text{NO}][\text{O}_2]^{1/2}}{[\text{NO}_2]}$$

$$\frac{K_1}{K} = \frac{1}{K_1}$$

$$K_1^2 = K$$

$$K_1 = \sqrt{K}$$



$$K_2 = \frac{1}{\sqrt{K}}$$

79. Answer (2)

**Hint:** In  $\text{SiO}_2$ , each atom is covalently bonded in a tetrahedral manner to four oxygen atoms.

**Sol.:**  $\text{SiO}_2$  is covalent, three-dimensional network solid.

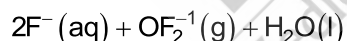
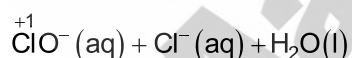
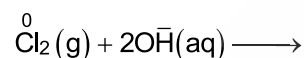
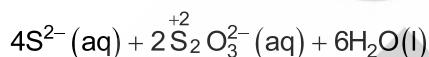
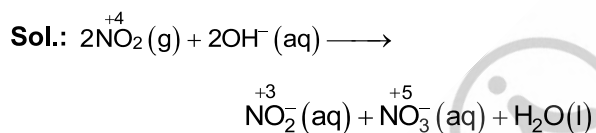
80. Answer (3)

**Hint:** In Buckminsterfullerene ( $\text{C}_{60}$ ) all carbon atoms are  $sp^2$  hybridised

**Sol.:** In  $\text{C}_{60}$  each carbon atom forms three sigma bonds with other three carbon atoms. The remaining electron at each carbon is delocalised in molecular orbitals, which in turn give aromatic character to the molecule.

81. Answer (3)

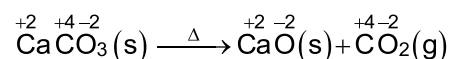
**Hint:** One of the reacting substances in a disproportionation reaction always contains an element that can exist in at least three oxidation states.



$\text{F}_2$  does not undergo disproportionation in alkaline medium.

82. Answer (3)

**Hint & Sol.:**



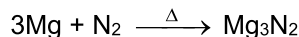
The oxidation states of elements in the reactant side and product side are same. Hence it is not a redox reaction.

83. Answer (4)

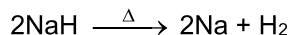
**Hint:** In metal displacement reaction, a metal in a compound can be displaced by another metal in the combined state.

**Sol.:**

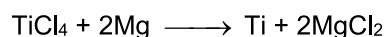
- Combination reaction



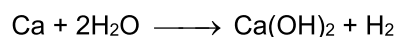
- Decomposition reaction



- Metal displacement reaction



- Non-metal displacement reaction



84. Answer (2)

**Hint:** Standard reduction potential of  $\text{Cu}^{2+}/\text{Cu}$ , couple is positive (0.34 V)

**Sol.:** If the reduction potential of redox couple ( $\text{Cu}^{2+}/\text{Cu}$ ) is positive then the metal will not liberate  $\text{H}_2$  gas on reaction with dilute HCl.

$\text{MnO}_4^-$  is pink colour species. It can act as oxidant as well as self indicator.

85. Answer (2)

**Hint:** Lower is the value of reduction potential, better is the reducing power of the metal.

**Sol.:** Reduction potential of  $\text{Mg}^{2+}$  is minimum hence Mg has the highest reducing power.

Correct order of reducing power will be  $\text{Mg} > \text{Zn} > \text{Ni} > \text{Cu}$ .

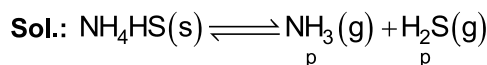
### SECTION - B

86. Answer (4)

**Hint & Sol.:** Equilibrium in a system having more than one phase is called heterogenous equilibrium.

87. Answer (2)

**Hint:**  $K_p = p_{\text{NH}_3} \times p_{\text{H}_2\text{S}}$



$$2p = 7$$

$$p = \frac{7}{2}$$

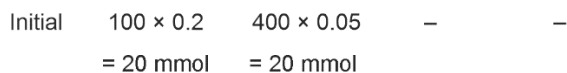
$$K_p = p_{\text{NH}_3} \times p_{\text{H}_2\text{S}}$$

$$= \frac{7}{2} \times \frac{7}{2} = \frac{49}{4}$$

88. Answer (3)

**Hint:** At equivalence point, sodium acetate will be formed which will undergo anionic hydrolysis.

**Sol.:**



$$\text{Molarity of CH}_3\text{COONa} = \frac{20}{500} = 0.04$$

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

$$= 7 + \frac{1}{2} [4.75 + \log 0.04]$$

$$= 7 + \frac{1}{2} [4.75 + \log 4 \times 10^{-2}]$$

$$= 7 + \frac{1}{2} [4.75 - 1.4]$$

$$= 8.67 \approx 8.7$$

89. Answer (1)

**Hint:** Boric acid is a weak monobasic acid

**Sol.:** Boric acid is a Lewis acid but not a protonic acid.

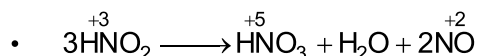
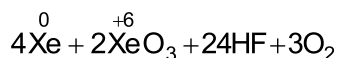
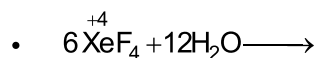
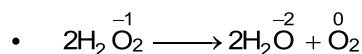
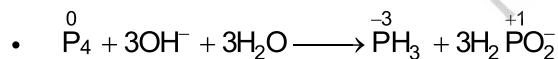
90. Answer (3)

**Hint & Sol.:** Zeolites are widely used as a catalyst in petrochemical industries.

91. Answer (4)

**Hint:** In disproportionation reaction an element in its intermediate oxidation state is oxidised as well as reduced.

**Sol.:** All the given reactions are disproportionation reactions



92. Answer (3)

**Hint:** Net charge in the compound will be zero

**Sol.:** For  $\text{X}_2(\text{YZ}_3)_3$ , the calculated charge will be zero.

$$\text{For } \text{YZ}_3, \text{ charge} = 4 \times 3(-2) = -2$$

For  $\text{X}_2(\text{YZ}_3)_3$  the net charge will be zero

$$[3 \times 2] + [3 \times (-2)] = 0$$

93. Answer (2)

**Hint:** Oxidation state of O in  $\text{MnO}_4^-$  is  $-2$

**Sol.:**  $\text{MnO}_4^-$  (Let oxidation state of Mn be x)

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

$$x = +7$$

$\text{MnO}_2$

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

$$x = +4$$

94. Answer (2)

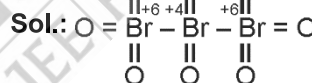
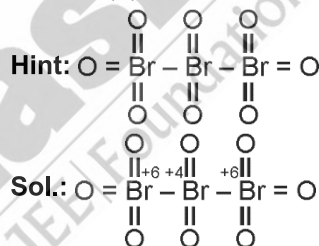
**Hint:**  $2\text{Al}(s) + 3\text{Ni}^{2+}(\text{aq}) \rightarrow 2\text{Al}^{3+}(\text{aq}) + 3\text{Ni}(s)$

$$E_{\text{cell}}^\circ = E_{\text{R}}^\circ - E_{\text{L}}^\circ$$

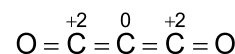
$$\text{Sol. } E_{\text{cell}}^\circ = -0.25 + 1.66$$

$$= 1.41 \text{ V}$$

95. Answer (2)



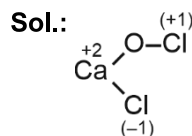
Tribromooctaoxide



Carbon suboxide

96. Answer (3)

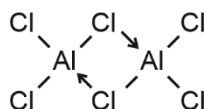
**Hint:** Average oxidation state of chlorine in  $\text{CaOCl}_2$  is 0.



So, chlorine has +1 and  $-1$  oxidation state.

97. Answer (2)

**Hint:** Structure of  $\text{Al}_2\text{Cl}_6$



**Sol.:** There are 2 three centre-four electron bonds and 4 two centre-two electron bonds in  $\text{Al}_2\text{Cl}_6$ .

98. Answer (4)

**Hint & Sol.:**

Element	Melting
Al	933
Ga	303
In	430
Tl	576

99. Answer (3)

**Hint:** Number of oxygen shared per unit is 3 in sheet silicates.**Sol.:** General formula of sheet silicates is  $(\text{Si}_2\text{O}_5^{2-})_n$ .

100. Answer (2)

**Hint:** C is a non-metal**Sol.:** Ge is a metalloid. Sn, Pb are soft metals with low melting points.**[BOTANY]****SECTION-A**

101. Answer (4)

**Hint:** Kranz anatomy is exhibited by  $C_4$  plants.**Sol.:** Maize is a  $C_4$  plant and thus, exhibits Kranz anatomy. Bell pepper, wheat and tomato are examples of  $C_3$  plants.

102. Answer (1)

**Hint:** In  $C_2$  pathway, RuBisCO acts as oxygenase.**Sol.:** In photorespiration,  $O_2$  is first utilized (consumed) in chloroplast and then in peroxisomes. Loss of  $CO_2$  occurs in mitochondria.

103. Answer (2)

**Hint:** In anoxygenic photosynthesis, oxygen is not evolved.**Sol.:** *Rhodospirillum* shows anoxygenic photosynthesis. *Cladophora*, *Oscillatoria* and *Hydrilla* show oxygenic photosynthesis.

104. Answer (1)

**Hint:** A proton gradient is required across thylakoid membrane to facilitate chemiosmotic hypothesis.**Sol.:** Within the chloroplast, protons in the stroma decrease in number while in the lumen there is accumulation of protons. This causes a decrease in pH in the lumen and creates a proton gradient across the thylakoid membrane.

105. Answer (1)

**Hint:** Sugarcane is a  $C_4$  plant and tomato is a  $C_3$  plant.**Sol.:** In  $C_4$  plants (sugarcane), primary  $CO_2$  fixation is catalyzed by PEPcase.In  $C_3$  plants (tomato), primary  $CO_2$  fixation is catalyzed by RuBisCO.

106. Answer (2)

**Hint:**  $C_2$  cycle (photorespiration) occurs in  $C_3$  plants.**Sol.:**  $C_4$  plants show better water utilization, Kranz anatomy and tolerance to high temperature and saline conditions.

107. Answer (3)

**Hint:** Melvin Calvin used radioactive  $^{14}C$  in algal photosynthetic studies.**Sol.:** Use of radioactive  $^{14}C$  in algal photosynthetic study led to the discovery that the first  $CO_2$  fixation product was a three-carbon organic acid. Calvin cycle occurs in all photosynthetic plants.

108. Answer (2)

**Hint:** Flow of protons back across the membrane by ATP synthase activates the enzyme for the formation of ATP.**Sol.:** Flow of protons through  $CF_0$  particle results in the breakdown of proton gradient across the thylakoid membrane. The processes that lead to the development of proton gradient are:

- Photolysis of water towards thylakoid lumen.
- Transfer of  $H^+$  from stroma to lumen as electrons move through photosystems.
- NADP reductase reaction occurring towards stroma.

109. Answer (2)

**Hint:** Carotenoids are also called shield pigments.**Sol.:** Carotenoids protect plant from excessive heat and prevent photo-oxidation of chlorophyll *a*. They can be a part of LHC. A single molecule of Chlorophyll *a* forms reaction centre of photosystems.

110. Answer (4)

**Hint:** CO<sub>2</sub> fixation takes place twice in mesophyll cells in CAM plants once during day time and other during night time.

**Sol.:** Minimal amount of water loss is there in CAM plants.

111. Answer (2)

**Hint:** The relative concentration of CO<sub>2</sub> and O<sub>2</sub> determines which of the two will bind to the enzyme, RuBisCO.

**Sol.:** RuBisCO has a much greater affinity for CO<sub>2</sub> than for O<sub>2</sub> when the CO<sub>2</sub> : O<sub>2</sub> is nearly equal.

112. Answer (1)

**Hint:** Ribulose biphosphate is the primary CO<sub>2</sub> acceptor molecule during C<sub>3</sub> cycle.

**Sol.:** The primary CO<sub>2</sub> acceptor molecule during the C<sub>3</sub> cycle is a 5C ketose sugar-Ribulose biphosphate (RuBP).

113. Answer (1)

**Hint:** During photorespiration, RuBisCO binds with O<sub>2</sub>.

**Sol.:** RuBisCO shows oxygenase activity during photorespiration. The RuBP binds with O<sub>2</sub> to form one molecule of PGA and phosphoglycolate.

114. Answer (2)

**Hint:** Photorespiration occurs in C<sub>3</sub> plants.

**Sol.:** In the photorespiratory pathway there is no synthesis of sugar and ATP or NADPH rather it results in release of CO<sub>2</sub> with the utilization of ATP and thus is a wasteful process.

115. Answer (3)

**Hint:** Long term exposure to low light conditions can slower down growth in plants.

**Sol.:** At low light intensity, rate of photosynthesis is not maximum. There is a linear relationship between light and CO<sub>2</sub> fixation rates at low light intensities.

116. Answer (4)

**Hint:** Concentration of CO<sub>2</sub> in the atmosphere is between 0.03 and 0.04%.

**Sol.:** Increase in concentration upto 0.05% can cause an increase in CO<sub>2</sub> fixation rates; beyond this the levels can become damaging over longer periods.

117. Answer (3)

**Sol.:** The bundle sheath cells may form several layers around the vascular bundles; they are characterized by having a large number of chloroplasts, thick walls impervious to gaseous exchange and no intercellular spaces.

118. Answer (1)

**Hint:** KOH absorbs CO<sub>2</sub>.

**Sol.:** As during Calvin cycle, CO<sub>2</sub> gets fixed to form sugar, this reaction will most likely to be suspended in absence of CO<sub>2</sub>. As all other factors are optimum, light reaction will take place.

119. Answer (3)

**Hint:** In PS I, the reaction centre chlorophyll *a* has an absorption peak at 700 nm.

**Sol.:** In PS II, the reaction centre chlorophyll *a* has an absorption peak at 680 nm. Hence, it is called P<sub>680</sub>.

120. Answer (1)

**Hint:** Engelmann's experiment helped to describe the first action spectrum which roughly resembles the absorption spectra of chlorophyll *a* and *b*.

**Sol.:** Using a prism, T.W. Engelmann split light into its spectral component and then illuminated a green alga, *Cladophora*, placed in a suspension of aerobic bacteria.

The bacteria were used to detect the sites of O<sub>2</sub> evolution. He observed that the bacteria accumulated mainly in the region of blue and red light of the split spectrum.

121. Answer (1)

**Hint:** Z-scheme utilizes both PS I and PS II. The electrons that were removed from PS II are replaced by splitting of water.

**Sol.:** Cyclic photophosphorylation operates under low light intensity, anaerobic conditions or when CO<sub>2</sub> availability is poor.

Non-cyclic photophosphorylation requires an external electron donor. Oxygen evolving complex is associated with the PS II.

Cyclic photophosphorylation also occurs when only light of wavelength beyond 680 nm are available for excitation.

122. Answer (3)

**Hint:** Regeneration of PEP occurs in mesophyll cells

**Sol.:** In mesophyll cells, PEP combines with  $\text{CO}_2$  to form OAA. This reaction is catalyzed by PEPcase. In the bundle sheath cells,  $\text{C}_4$  acids are broken down to release  $\text{CO}_2$  and a three-carbon molecule. The 3-C molecule is transported back to the mesophyll cells, where it is converted to PEP with the help of PEP synthetase.

123. Answer (1)

**Hint:** Cyclic photophosphorylation occurs in stroma lamellae.

**Sol.:** PS-I and electron transport system are included in cyclic photophosphorylation.

124. Answer (3)

**Hint:** *Amaranthus* is a  $\text{C}_4$  plant and bell pepper is a  $\text{C}_3$  plant.

**Sol.:** In  $\text{C}_4$  plants, 5 ATP are consumed per  $\text{CO}_2$  fixed. Sucrose has 12 carbon molecules for which 12  $\text{CO}_2$  molecules are required. Thus, to make one molecule of sucrose in *Amaranthus*, ATP required =  $12 \times 5 = 60$ .

In  $\text{C}_3$  plants, 3 ATP are consumed per  $\text{CO}_2$  fixed. Sucrose has 12 carbon molecules for which 12  $\text{CO}_2$  molecules are required. Thus, to make 1 molecule of sucrose in bell pepper, ATP required =  $12 \times 3 = 36$ .

125. Answer (2)

**Hint:** Plastocyanin and plastoquinone are mobile carriers in non cyclic photophosphorylation.

**Sol.:** Electrons from cytochrome  $b_6/f$  to PS I in non-cyclic photophosphorylation are transferred through plastocyanin.

126. Answer (2)

**Hint:** When several factors affect any biochemical process, law of limiting factors comes into effect.

**Sol.:** The plant or internal factors are dependent on the genetic predisposition and the growth of the plant. At any point, the rate of photosynthesis will be determined by the factor available at sub-optimal levels.

127. Answer (4)

**Hint:** One molecule of chlorophyll *a* forms the reaction centre.

**Sol.:** The LHC are made up of hundreds of pigment molecules bound to proteins.

128. Answer (4)

**Hint:** The characteristic shape of the scheme of non-cyclic photophosphorylation is Z-scheme.

**Sol.:** The Z-scheme is formed when all the carriers are placed in a sequence on a redox potential scale.

129. Answer (2)

**Hint:** The assimilatory powers formed during non-cyclic photophosphorylation are ATP and NADPH.

**Sol.:** ATP and NADPH are used in dark reactions of photosynthesis.

130. Answer (3)

**Hint:** PS II is involved only in non-cyclic flow of electrons.

**Sol.:** PS II occurs on the inner surface of the thylakoids.

131. Answer (1)

**Hint:** Dark reactions take place in the presence of carbon dioxide.

**Sol.:** Cyclic photophosphorylation operates when  $\text{CO}_2$  availability is poor. Calvin pathway, CAM pathway and Hatch & Slack pathway cannot occur efficiently if  $\text{CO}_2$  availability is poor.

132. Answer (1)

**Hint:** It is a form of passive transport.

**Sol.:** The transmembrane channel of ATP synthase carries out facilitated diffusion of protons across the membrane.

133. Answer (3)

**Hint:** For the synthesis of ATP, protons move from lumen to stroma.

**Sol.:** Breakdown of proton gradient leads to synthesis of ATP.

134. Answer (4)

**Hint:** This step requires one ATP for phosphorylation to form RuBP.

**Sol.:** Regeneration of the  $\text{CO}_2$  acceptor molecule RuBP is crucial if the cycle is to continue uninterrupted.

135. Answer (3)

**Hint:** PEP synthetase is present in mesophyll cells of  $\text{C}_4$  plants.

**Sol.:** PEP synthetase facilitates the regeneration of PEP in mesophyll cells.

## SECTION - B

136. Answer (1)

**Hint:** Jan Ingenhousz showed that green parts of the plants could release oxygen.

**Sol.:** Julius von Sachs found out that glucose is stored as starch in plants.

137. Answer (1)

**Hint:** Jan Ingenhousz showed that only the green parts of the plants could release oxygen.

**Sol.:** Priestley hypothesized that plants restore the air whatever breathing animals and burning candles remove.

138. Answer (1)

**Hint:** Emerson and Lewis observed a sharp decline in quantum yield at wavelengths greater than 680 nm which is called 'red drop'.

**Sol.:** Emerson enhancement effect and red drop experiments led to the discovery of two types of inter-connected photosystems.

139. Answer (1)

**Hint:** The chloroplasts align themselves along the walls of the mesophyll cells, such that they get the optimum quantity of the incident light.

**Sol.:** To get the maximum light, the chloroplasts will be aligned perpendicular to the incident light.

140. Answer (3)

**Hint:** Carbon reactions are dark reactions and photochemical reactions are light reactions in photosynthesis.

**Sol.:** Dark reaction occurs in stroma and light reaction occurs in grana of chloroplast.

141. Answer (1)

**Hint:** Absorption spectrum of chlorophyll *a* resembles the action spectrum.

**Sol.:** The wavelengths at which there is maximum absorption by chlorophyll *a* also shows higher rate of photosynthesis. Hence, it can be concluded that chlorophyll *a* is the chief pigment associated with photosynthesis.

142. Answer (1)

**Hint:** Jan Ingenhousz used an aquatic plant for his experiment.

**Sol.:** Jan Ingenhousz used *Hydrilla* and Cornelius van Niel used purple and green sulphur bacteria for their experiments.

143. Answer (1)

**Hint:** Chemiosmotic hypothesis explains how actually ATP is synthesized in chloroplast.

**Sol.:** Chemiosmosis requires a membrane, a proton pump, a proton gradient and ATP synthase.

144. Answer (4)

**Hint:** Photosynthesis is under the influence of several factors, both internal (plant) and external.

**Sol.:** The plant factors include the number, size, age and orientation of leaves, mesophyll cells and chloroplasts, internal CO<sub>2</sub> concentration and the amount of chlorophyll. Light intensity is the extrinsic factor.

145. Answer (2)

**Hint:** Law of limiting factors becomes effective when several factors affect any biochemical process.

**Sol.:** Blackman gave the law of limiting factors in 1905. It states that if a chemical process is affected by more than one factor, then its rate will be determined by the factor which is nearest to its minimal value.

Hatch and Slack proposed C<sub>4</sub> pathway.

Calvin proposed C<sub>3</sub> pathway.

Julius von Sachs provided evidence for production of glucose when plants grow.

146. Answer (4)

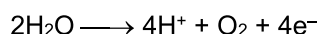
**Hint:** Chlorophyll *a* imparts bright or blue green colour in chromatogram.

**Sol.:** Carotenoids impart yellow to yellow orange colour in chromatogram.

147. Answer (2)

**Hint:** Water is split into 2H<sup>+</sup>, [O] and electrons.

**Sol.:** The reaction which evolves one molecule of O<sub>2</sub> is



148. Answer (2)

**Hint:** In Calvin cycle, one CO<sub>2</sub> is fixed from one cycle.

**Sol.:** To make one molecule of glucose, 6 turns of the Calvin cycles are required.

149. Answer (4)

**Hint:** C<sub>3</sub> plants show photorespiration.**Sol.:** In C<sub>4</sub> plants, photorespiration does not occur. This is because these plants have a mechanism that increases the concentration of CO<sub>2</sub> at the enzyme site. During the C<sub>4</sub> pathway, when the C<sub>4</sub> acid from the mesophyll cells is broken down in the bundle sheath cells, it releases CO<sub>2</sub> – this results in increasing the intracellular concentration of CO<sub>2</sub>. This in turn, ensures that the RuBisCO functions as a carboxylase minimising the oxygenase activity. Thus, the productivity and yields are better in C<sub>4</sub> plants as compared to C<sub>3</sub> plants.

150. Answer (1)

**Hint:** C<sub>4</sub> plants show saturation at about 360  $\mu\text{L}^{-1}$ .**Sol.:** C<sub>3</sub> plants (tomato) show saturation only beyond 450  $\mu\text{L}^{-1}$  (ppm). The light reactions (photochemical reactions) are temperature sensitive but they are affected to a much lesser extent. The dark reaction (biosynthetic reactions) being enzymatic are temperature controlled. As the photosynthetic products accumulate in the mesophyll cells, their photosynthetic rate decreases.

## [ZOOLOGY]

### SECTION-A

151. Answer (4)

**Hint:** Secreted by anterior pituitary**Sol.:** Estrogen, aldosterone and cortisol are steroid in nature thus, these hormones interact with intracellular receptors.

Growth hormone interacts with membrane bound receptors and normally do not enter the target cell, but it generates a second messenger.

152. Answer (2)

**Hint:** Training school of T-lymphocytes**Sol.:** The thymus gland is a lobular structure located between lungs behind sternum on the ventral side of aorta.

Thyroid gland is located on either side of the trachea.

Pineal gland is located on the dorsal side of forebrain.

Parathyroid gland is located on the back side of the thyroid gland.

153. Answer (4)

**Hint:** It regulates anterior pituitary by its hormones.**Sol.:** Oxytocin and vasopressin, which are actually synthesized by hypothalamus are transported axonally to neurohypophysis.

154. Answer (1)

**Hint:** 98-99 per cent is exocrine portion of pancreas**Sol.:** Pancreas is a composite gland which acts as both exocrine and endocrine gland.

The endocrine pancreas consists of 'Islets of Langerhans'. There are about 1 to 2 million Islets of Langerhans in a normal human pancreas representing only 1 to 2 per cent of the pancreatic tissue.

155. Answer (3)

**Hint:** Antagonistic to TCT**Sol.:** Four parathyroid glands are present on the back side of the thyroid gland. The parathyroid glands secrete a peptide hormone called parathyroid hormone (PTH). PTH increases the Ca<sup>+2</sup> levels in the blood. It acts on bones and stimulates the process of bone resorption (dissolution/demineralisation).

156. Answer (1)

**Hint:** Number of metacarpals in each forelimb**Sol.:** Pituitary, pineal, thyroid, adrenal, pancreas, parathyroid, thymus and gonads (testes in males and ovaries in females) are the organised endocrine bodies in our body.

157. Answer (2)

**Hint:** Associated with growth hormone**Sol.:** Cretinism – Hyposecretion of thyroxine

Acromegaly – Hypersecretion of GH

Simple goitre – Hyposecretion of thyroxine

Exophthalmic goitre – Hypersecretion of thyroxine

158. Answer (4)

**Hint:** Zona glomerulosa is the outermost layer.**Sol.:** Zona reticularis → Innermost layer

Zona fasciculata → Middle layer

Zona glomerulosa → Outermost layer

159. Answer (4)

**Hint:** Hormone secreted by parathyroid gland

- Sol.:**
- Parathyroid hormone (PTH) is a hypercalcemic hormone *i.e.*, it increases the  $\text{Ca}^{2+}$  levels in the blood.
  - Hormones that work opposite to each other are called antagonistic hormones.
  - Calcitonin decreases blood calcium levels.

160. Answer (3)

**Hint:** Provide coordination in the vertebrates

**Sol.:** Hormones are non-nutrient chemicals released into the blood and are transported to distantly located target organs. They act as intercellular messengers and are produced in trace amounts.

161. Answer (2)

**Hint:** Regulates 24-hour rhythm

**Sol.:** Oxytocin – Milk secretion

Progesterone – Supports pregnancy

ANF – Decreases the blood pressure

162. Answer (2)

**Hint:** Vasopressin stimulates reabsorption of water and electrolytes from distal part of nephron.

**Sol.:** An impairment affecting synthesis of ADH results in a diminished ability of the kidney to conserve water leading to water loss and dehydration. This condition is known as diabetes insipidus.

Diabetes mellitus is due to hyposecretion of insulin. Gigantism is caused due to hypersecretion of growth hormone during childhood.

163. Answer (3)

**Hint:** Released by posterior pituitary

**Sol.:** Prolactin – Milk formation hormone

Oxytocin – Milk ejection hormone

Relaxin – Relaxes pubic symphysis during pregnancy

164. Answer (3)

**Hint:** Oxytocin is released from neurohypophysis.

**Sol.:** The pars distalis of pituitary gland produces prolactin (PRL).

Neurohypophysis (pars nervosa) also known as posterior pituitary, stores and releases two hormones called oxytocin and vasopressin.

165. Answer (3)

**Hint:** Function of emergency hormone

**Sol.:** Adrenaline increases heart rate, rate of respiration, alertness, pupillary dilation, *etc.*

Estrogens produce wide ranging actions such as stimulation of growth and activities of female secondary sex organs, development of growing ovarian follicles, *etc.* Calcitonin regulates blood calcium levels.

166. Answer (1)

**Hint:** Testosterone belongs to this category

**Sol.:** In males, testis is composed of seminiferous tubules and interstitial tissue. The Leydig cells or interstitial cells, which are present in the intertubular spaces produce a group of hormones called androgens, mainly testosterone.

Estrogen and progesterone are female sex hormones produced by ovary.

Epinephrine is released from adrenal medulla.

167. Answer (1)

**Hint:** Hormone containing iodine

**Sol.:** Steroidal and iodothyronine hormones regulate gene expression or chromosome function by the interaction of hormone-receptor complex with the genome.

Glucagon and growth hormone interact with membrane-bound receptors and do not enter the target cells, but generate second messengers which in turn regulate cellular metabolism.

168. Answer (3)

**Hint:** Hormone that acts on gall bladder also

**Sol.:** CCK acts on both pancreas and gall bladder and stimulates the secretion of pancreatic enzymes and bile juice respectively.

Growth factors are essential for the normal growth of tissues and their repairing/regeneration.

169. Answer (3)

**Hint:** Provide point-to-point rapid coordination

**Sol.:** The neural system and the endocrine system jointly coordinate and regulate the physiological functions in the body.

170. Answer (1)

**Hint:** Exclude enterocytes

**Sol.:** Insulin is a peptide hormone, which plays a major role in the regulation of glucose homeostasis. Insulin is antagonistic to glucagon which is produced by  $\alpha$ -cells of Islets of Langerhans. Insulin acts mainly on hepatocytes and adipocytes (cells of adipose tissue), and enhances cellular glucose uptake and utilisation.

171. Answer (3)

**Hint:** Function of hormone released by posterior pituitary

**Sol.:** ADH/Vasopressin stimulates reabsorption of water and electrolytes by DCT.

Oxytocin acts on the smooth muscles of uterus and stimulates a vigorous contraction of uterus at the time of child birth. Erythropoietin is produced by JG cells of the kidney. Milk ejection from the mammary glands is also the function of oxytocin.

172. Answer (3)

**Hint:** Secreted from zona glomerulosa

**Sol.:** Aldosterone is the main mineralocorticoid in our body. Aldosterone acts mainly at the renal tubules and stimulates the reabsorption of  $\text{Na}^+$  and water and excretion of  $\text{K}^+$  and phosphate ions.

173. Answer (1)

**Hint:** Thymus is called the throne of immunity.

**Sol.:**

- Each thyroid follicle is composed of follicular cells, enclosing a cavity.
- Thymus is degenerated in old individuals resulting in a decreased production of thymosins. As a result, the immune responses of old persons become weak.

174. Answer (4)

**Hint:** Characterised by weight loss and increased BMR**Sol.:**

Hyposecretion of growth hormone during childhood	Dwarfism
Hypersecretion of growth hormone during childhood	Gigantism
Hypersecretion of growth hormone in adults	Acromegaly
Hyposecretion of thyroxine	Goitre
Hypersecretion of thyroxine	Graves' disease or exophthalmic goitre

175. Answer (3)

**Hint:** Not a function of thyroxine

**Sol.:** Iodine is essential for the normal synthesis of thyroxine. Thyroxine is secreted by thyroid gland. Thyroid hormones control metabolism of carbohydrates, proteins and fats.

176. Answer (1)

**Hint:** Master of master endocrine gland

**Sol.:** Hypothalamus is the basal part of diencephalon, forebrain and it regulates a wide spectrum of body functions. It contains several groups of neurosecretory cells called nuclei which produce hormones.

177. Answer (4)

**Hint:** Its action is similar to glucagon hormone.

**Sol.:** Glucocorticoids stimulate gluconeogenesis, lipolysis and proteolysis.

It inhibits cellular uptake and utilisation of amino acids.

178. Answer (1)

**Hint:** Associated with sphenoid bone

**Sol.:** The pituitary gland is located in a bony cavity called sella turcica and is attached to hypothalamus by a stalk.

Cranium is the bony protective covering of brain.

179. Answer (3)

**Hint:** Hormone action depends on their chemical nature.

**Sol.:** Protein hormone binds to membrane-bound receptor

↓

Formation of hormone-receptor complex

↓

Biochemical responses

↓

Physiological responses

180. Answer (1)

**Hint:** Lead to certain biochemical changes in the target tissue

**Sol.:** Binding of a hormone to its receptor leads to the formation of a hormone-receptor complex. Each receptor is specific to one hormone only and hence receptors are hormone specific.

181. Answer (1)

**Hint:** Suppresses the immune response

**Sol.:** Cortisol produces anti-inflammatory reactions and suppresses the immune response. Cortisol stimulates the RBC production. It is a hyperglycemic hormone.

182. Answer (1)

**Hint:** Exclude the disease of thyroid gland

**Sol.:** Underproduction of hormones by the adrenal cortex alters carbohydrate metabolism causing acute weakness and fatigue leading to a disease called Addison's disease.

Crenitism and exophthalmic goitre are associated with the thyroid gland.

183. Answer (2)

**Hint:** Anterior pituitary is regulated by hypothalamus through portal circulation.

**Sol.:** Anterior pituitary releases ACTH which stimulates adrenal cortex for synthesis and release of cortisol. Cortisol stimulates gluconeogenesis to increase blood glucose levels.

184. Answer (2)

**Hint:** Exophthalmic goitre is a form of hyperthyroidism.

**Sol.:** Exophthalmic goitre is a form of hyperthyroidism, characterised by enlargement of the thyroid gland, protrusion of eyeball, increased BMR and weight loss.

185. Answer (1)

**Hint:** RAAS mechanism

**Sol.:** Aldosterone acts mainly at the renal tubules and stimulates the reabsorption of  $\text{Na}^+$  and water and excretion of  $\text{K}^+$  and phosphate ions.

Aldosterone helps in the maintenance of electrolytes, body fluid volume, osmotic pressure and blood pressure.

Cortisol stimulates RBC production.

Small amounts of androgenic steroids are also excreted by the adrenal cortex which play a role in the growth of axial hair, pubic hair and facial hair during puberty.

### SECTION - B

186. Answer (4)

**Hint:** Scotopic vision is function of rods

**Sol.:** Rod cells have low visual acuity whereas cone cell have maximum acuity.

Cone cells are more concentrated in center of macula lutea whereas the rod cells are distributed near retina.

The rods contain a purplish-red protein called the rhodopsin or visual purple.

Iodopsin is present in cones.

187. Answer (2)

**Hint:** Formation of RBCs

**Sol.:** Pineal gland plays a very important role in regulation of a 24-hour (diurnal) rhythm of our body.

Kidneys produce a peptide hormone called erythropoietin which stimulates erythropoiesis (formation of RBCs).

188. Answer (3)

**Hint:** Hypothalamus releases releasing and inhibiting hormones.

**Sol.:** • Anterior pituitary or pars distalis – GH, PRL, TSH, ACTH, LH, FSH

• Pars intermedia – MSH

• Hypothalamus – GnRH

• Posterior pituitary – Oxytocin and Vasopressin

189. Answer (1)

**Hint:** Estrogen regulates libido in females.

**Sol.:** • Progesterone supports pregnancy.

• Progesterone stimulates the formation of alveoli in breast of human females.

190. Answer (4)

**Hint:** Hyperglycemic factor

**Sol.:** Insulin and glucagon interact with membrane bound receptors.

• Insulin decreases the blood sugar levels while glucagon increases the blood sugar levels.

191. Answer (4)

**Hint:** Ear drum is called tympanic membrane.

**Sol.:** The tympanic membrane is composed of connective tissue covered with skin outside and with mucus membrane inside.

192. Answer (3)

**Hint:** Sclera has dense connective tissue.

**Sol.:** The wall of the eye ball is composed of three layers. The external layer of the eye ball, sclera is composed of dense connective tissue. Image formed on the retina is recognised on the basis of earlier memory and experience.

193. Answer (4)

**Hint:** Equal to the number of ear ossicles in each ear

**Sol.:** Peptide, polypeptide and protein hormone (insulin, glucagon, FSH, calcitonin, thymosin) interact with membrane bound receptors and normally do not enter the target cell whereas steroid hormones and iodothyronines interact with intracellular receptors.

194. Answer (1)

**Hint:** Epinephrine is derived from tyrosine amino acid.

**Sol.:** Amino acid derivative – Epinephrine

Steroid – Cortisol, testosterone

Iodothyronine – Thyroxine

Peptide hormones – Insulin, glucagon

195. Answer (4)

**Hint:** It contains crista

**Sol.:** The membranous canals are surrounded by fluid called perilymph.

Vestibular apparatus is located above the cochlea.

Each semi-circular canal lies in a different plane at right angles to each other. The crista and macula are specific receptors of the vestibular apparatus.

196. Answer (2)

**Hint:** Equal to the number of ear ossicles in one ear.

**Sol.:** In human eyes, there are three types of cones which possess their own characteristic photopigments that respond to red, green and blue lights.

197. Answer (4)

**Hint:** Gastrin acts on stomach

**Sol.:** CCK acts on both gall bladder and pancreas. It stimulates secretion of pancreatic enzymes. Secretin acts on the exocrine pancreas and stimulates secretion of H<sub>2</sub>O and bicarbonate ions. Endocrine function of pancreas is the secretion of insulin and glucagon hormone.

GIP (Gastric Inhibitory Peptide) inhibits gastric secretion and motility.

198. Answer (1)

**Hint:** GHIH

**Sol.:** Somatostatin from the hypothalamus inhibits the release of growth hormone from the pituitary. Gonadotrophin releasing hormone (GnRH) stimulates the synthesis and release of gonadotrophins.

199. Answer (1)

**Hint:** Exclude energy currency of the cell

**Sol.:** Hormones which interact with membrane-bound receptors normally do not enter the target cells but generate second messengers (cyclic AMP, IP<sub>3</sub>, Ca<sup>2+</sup>, etc).

200. Answer (2)

**Hint:** Identify a primary lymphoid organ.

**Sol.:**

Glands	Hormones
Thymus	Thymosins
β-cells of Islets of Langerhans	Insulin

