

## All India Aakash Test Series for NEET-2024

**TEST - I (Code-C)**

Test Date : 27/11/2022

**ANSWERS**

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

**HINTS & SOLUTIONS****[PHYSICS]****SECTION - A**

1. Answer (3)

**Hint:** 1 parsec = 3.26 ly**Sol.:** 2 parsec =  $2 \times 3.26$  ly  
= 6.52 ly

2. Answer (2)

**Hint:** Principle of homogeneity**Sol.:**  $Y = a \cos \left( \omega^2 t - \frac{x}{\sqrt{K}} \right)$  $\omega^2 t$  and  $\frac{x}{\sqrt{K}}$  are dimensionless quantity.

$$[\omega^2 t] = [M^0 L^0 T^0]$$

$$\omega = [T^{-1/2}]$$

$$\left[ \frac{x}{\sqrt{K}} \right] = [M^0 L^0 T^0]$$

$$\Rightarrow \frac{L}{\sqrt{K}} = [M^0 L^0 T^0] \Rightarrow [K] = [L^2]$$

$$\left[ \frac{\omega}{K} \right] = \left[ \frac{T^{-1/2}}{L^2} \right] = [M^0 L^{-2} T^{-1/2}]$$

3. Answer (3)

**Hint and Sol.:** Weak nuclear force is having very short range of nearly  $10^{-16}$  m.

4. Answer (3)

**Hint:** Area of circle (A) =  $\pi r^2$ **Sol.:**  $A = 3.14 \times 1.21 \times 1.21$   
= 4.597274 m<sup>2</sup>  
= 4.60 m<sup>2</sup> (Round-off to three significant digits).

5. Answer (2)

**Hint:** Strain is dimensionless.

**Sol.:** 
$$\left[ \frac{\text{Strain}}{\text{Speed}} \right]^3 = \frac{[M^0 L^0 T^0]^3}{[L T^{-1}]^3}$$

$$= [M^0 L^{-3} T^3]$$

6. Answer (4)

**Hint:**  $V = \pi r^2 L$ **Sol.:**  $V = \pi r^2 L$ 

$$\Rightarrow \frac{\Delta V}{V} = 2 \frac{\Delta r}{r} + \frac{\Delta L}{L}$$

$$\Rightarrow \frac{\Delta V}{V} = (2 \times 3\%) + 1\%$$

$$= 7\%$$

7. Answer (2)

**Hint:**  $v_{av} t = S$ 

**Sol.:**  $S = \frac{u+v}{2} t$

$$= \frac{10 \text{ km/h} + 50 \text{ km/h}}{2} \times 2$$

$$= 60 \text{ km}$$

8. Answer (1)

**Hint:** If  $Y = a \sin x + b \cos x$ .

Then  $Y_{\max} = \sqrt{a^2 + b^2}$

**Sol.:**  $Y = \sqrt{3} \sin x - \sqrt{2} \cos x$

$$Y_{\max} = \sqrt{(\sqrt{3})^2 + (\sqrt{2})^2} = \sqrt{3+2}$$

$$= \sqrt{5}$$

9. Answer (3)

**Hint:**  $v = \frac{dx}{dt}$  and  $a = \frac{dv}{dt}$

**Sol.:**  $x = t^3 - 2t^2 + 5$

$$\Rightarrow v = \frac{dx}{dt} = 3t^2 - 4t$$

$$\Rightarrow a = \frac{dv}{dt} = 6t - 4$$

Put  $a = 6t - 4 = 0$

$$\Rightarrow t = \frac{4}{6} = \frac{2}{3} \text{ s}$$

Position at  $t = \frac{2}{3} \text{ s}$

$$x = \left( \frac{2}{3} \right)^3 - 2 \left( \frac{2}{3} \right)^2 + 5$$

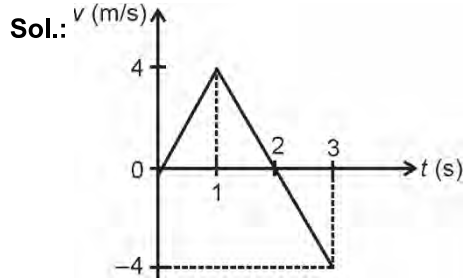
$$= \frac{8}{27} - \frac{8}{9} + 5$$

$$= \frac{8 - 24 + 135}{27}$$

$$= \frac{119}{27} \text{ m}$$

10. Answer (2)

**Hint:** Area under speed-time graph = distance travelled by the object.



Distance travelled

$$= \frac{1}{2}(4 \times 2) + \frac{1}{2}(4)(1)$$

$$= 6 \text{ m}$$

11. Answer (3)

**Hint:** Least count = 1 MSD – 1 VSD.

**Sol.:** 1 Main scale division =  $\frac{1}{2}$  cm

$$n \text{ VSD} = (n-2) \text{ MSD}$$

$$1 \text{ VSD} = \left(\frac{n-2}{n}\right) \text{ MSD}$$

$$\text{LC} = 1 \text{ MSD} - 1 \text{ VSD}$$

$$= 1 \text{ MSD} - \left(\frac{n-2}{n}\right) \text{ MSD}$$

$$= \frac{2}{n} \text{ MSD} = \frac{2}{n} \times \frac{1}{2} = \frac{1}{n} \text{ cm}$$

12. Answer (1)

**Hint:**  $\frac{\Delta P}{P} = \frac{\Delta a}{a} + \frac{1}{2} \frac{\Delta b}{b} + \frac{2}{3} \frac{\Delta c}{c} + \frac{\Delta d}{d}$

**Sol.:**  $P = \frac{a\sqrt{b}}{c^{2/3}d}$

$$= 1\% + \frac{2}{2}\% + \frac{2}{3} \times 1\% + 0.5\%$$

$$= \frac{19}{6}\%$$

13. Answer (4)

**Hint:** Use dimensional analysis.

**Sol.:**  $m \propto P^a v^b T^c$

$$\Rightarrow [M] = [ML^2T^{-3}]^a [LT^{-1}]^b [T^c]$$

$$\Rightarrow M^1 L^0 T^0 = M^a L^{2a+b} T^{-3a-b+c}$$

$$\Rightarrow a = 1, \quad 2a + b = 0$$

$$\Rightarrow b = -2a \quad \Rightarrow b = -2$$

$$-3a - b + c = 0$$

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

$$\boxed{c = 1} \quad [M] = [Pv^{-2}T]$$

14. Answer (1)

**Hint:**  $n_1 u_1 = n_2 u_2$

**Sol.:** Let  $M_1, L_1, T_1$  and  $M_2, L_2, T_2$  be the symbols of mass, length and time in two system respectively.

$$10 [M_1 L_1 T_1^{-2}] = x [M_2 L_2 T_2^{-2}]$$

$$x = 10 \left[ \left(\frac{M_1}{M_2}\right) \left(\frac{L_1}{L_2}\right) \left(\frac{T_1}{T_2}\right)^{-2} \right]$$

$$= 10 \left[ \left(\frac{1}{10}\right) \times \left(\frac{1}{100}\right) \times \left[\left(\frac{1}{60}\right)\right]^{-2} \right] = \frac{36000}{1000}$$

$$= 36 \text{ unit}$$

15. Answer (3)

**Hint:** Reading = MSR + CSR  $\times$  LC – ZE

**Sol.:** Reading = MSR + CSR  $\times$  LC – ZE

$$= 6 \text{ mm} + 25 \times 0.02 \text{ mm} + 0.04 \text{ mm}$$

$$= 6 + 0.50 + 0.04$$

$$= 6.54 \text{ mm}$$

16. Answer (4)

**Hint:** Using dimensional analysis

**Sol.:**  $\left(P + \frac{a}{v^2}\right)(V - b) = \text{constant}$

$$\left[\frac{a}{L^6}\right] = [ML^{-1}T^{-2}]$$

$$[a] = [ML^5T^{-2}]$$

$$[b] = [L^3]$$

$$\left[\frac{a}{b^2}\right] = \frac{ML^5T^{-2}}{L^6} = [ML^{-1}T^{-2}]$$

17. Answer (4)

**Hint & Sol.:** Using dimensional analysis we cannot derive any trigonometric function relation, exponential relation and addition of two functions.

$F = \frac{mv^2}{r}$  can be derived from dimensional analysis.

18. Answer (3)

**Hint:** Concept of significant figures.**Sol.:** 6.2300400 has eight significant figures.

19. Answer (1)

$$\text{Hint: } \frac{\Delta V}{V} = \frac{\Delta L}{L} + \frac{\Delta B}{B} + \frac{\Delta H}{H}$$

$$\text{Sol.: } V = L \times B \times H$$

$$= 100 \times 10 \times 10$$

$$= 10000 \text{ cm}^3$$

$$\frac{\Delta V}{V} = \frac{\Delta L}{L} + \frac{\Delta B}{B} + \frac{\Delta C}{C}$$

$$\frac{\Delta V}{10000} = \frac{0.1}{100} + \frac{0.1}{10} + \frac{0.2}{10}$$

$$\frac{\Delta V}{10000} = \left( \frac{1+10+20}{1000} \right) = \frac{31}{1000}$$

$$\Delta V = 310 \text{ cm}^3$$

20. Answer (3)

$$\text{Hint: } V = \pi r^2 h, \quad A = 2\pi rh$$

$$\text{Sol.: } \frac{\Delta V}{V} = \frac{2\Delta r}{r} + \frac{\Delta h}{h}$$

$$\frac{\Delta A}{A} = \frac{\Delta r}{r} + \frac{\Delta h}{h}$$

Percentage change in volume will be maximum.

21. Answer (2)

**Hint & Sol.:** Angle and refractive index both are dimensionless.

22. Answer (1)

$$\text{Hint: Percentage error} = \frac{\Delta m}{m} \times 100$$

$$\text{Sol.: } m = \frac{1.52 + 1.53 + 1.55 + 1.45}{4} \text{ kg}$$

$$\approx 1.51 \text{ kg}$$

Mean absolute error

$$\Delta m = \frac{0.01 + 0.02 + 0.04 + 0.06}{4}$$

$$\approx 0.03$$

$$\text{Percentage error} = \frac{0.03}{1.51} \times 100\%$$

$$\approx 1.99\%$$

23. Answer (3)

$$\text{Hint: } \frac{\Delta R}{R} = \frac{\Delta V}{V} + \frac{\Delta I}{I}$$

$$\text{Sol.: } R = \frac{200}{10} = 20 \Omega$$

$$\frac{\Delta R}{R} = \frac{\Delta V}{V} + \frac{\Delta I}{I}$$

$$\frac{\Delta R}{20} = \frac{3}{200} + \frac{0.1}{10}$$

$$\Delta R = 0.3 + 0.2 = 0.5 \Omega$$

24. Answer (1)

**Hint and Sol.:** Plane angle and solid angle both are dimensionless quantity but are having units.

Reynold's number and dielectric constant both are ratio, therefore both are unitless as well as dimensionless.

25. Answer (3)

$$\text{Hint and Sol.: } \left[ \frac{I}{h} \right] = \left[ \frac{\text{ML}^2}{\text{ML}^2\text{T}^{-1}} \right] = [\text{T}]$$

26. Answer (4)

$$\text{Hint: Average speed} = \frac{\text{Distance travelled}}{\text{Time taken}}$$

$$\text{Sol.: Distance} = \frac{1}{2} at^2$$

$$\text{Average speed} = \frac{\text{Distance}}{\text{time}} = \frac{\left( \frac{at^2}{2} \right)}{t}$$

$$= \frac{at}{2}$$

27. Answer (4)

**Hint:** Use concept of Galilean ratio.

$$\text{Sol.: Let } s_1 = x$$

$$s_2 = 3x$$

$$s_1 + s_2 = x + 3x = 4x$$

$$s_3 + s_4 = 5x + 7x = 12x$$

$$s_5 + s_6 + s_7 = 9x + 11x + 13x = 33x$$

$$\text{Ratio} = 4 : 12 : 33$$

28. Answer (2)

**Hint:** Distance covered by object in last 3 seconds of ascent = Distance travelled by the object in first 3 seconds of descent.

$$\text{Sol.: Distance} = \frac{1}{2} gt^2 = \frac{9}{2} g$$

29. Answer (3)

**Hint and Sol.:** While going up distance will increase and shape of curve will be downward parabola as velocity and acceleration are in opposite directions. While coming down distance will further increase with time and shape of curve will be upward parabola as velocity and acceleration are in same direction.

30. Answer (1)

**Hint:** Area under  $a - t$  graph gives change in velocity.

**Sol.:** Velocity of the object will keep on increasing till 5 seconds as acceleration is positive till 5 seconds.

$\Delta v = \text{Area under } a - t \text{ graph}$

$$v_{\max} = \frac{1}{2} \times 20 \times 5 = 50 \text{ m/s}$$

31. Answer (3)

**Hint:**  $v^2 - u^2 = 2as$

**Sol.:**  $\left(\frac{2v}{3}\right)^2 - v^2 = 2as \quad \dots(1)$

$0^2 - v^2 = 2as \quad \dots(2)$

Dividing equation (2) by equation (1)

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

$$n = \frac{1}{1 - \frac{4}{9}} = \frac{9}{5} = 1.8$$

It requires two planks to stop it completely.

32. Answer (4)

**Hint:**  $a = \frac{d^2x}{dt^2}$

**Sol.:** At point A rate of change of velocity is negative and at point B rate of change of velocity is positive.

33. Answer (1)

**Hint:**  $s = ut + \frac{1}{2}at^2$

**Sol.:**  $h = -4.9 \times 4 + \frac{1}{2} \times 9.8 \times 4^2$

$= -19.6 + 78.4$

$= 58.8 \text{ m}$

34. Answer (3)

**Hint:** Average speed =  $\frac{\text{Distance travelled}}{\text{Total time taken}}$

**Sol.:**  $v_{\text{av}} = \frac{x_1 + x_2}{t_1 + t_2}$

$$v_{\text{av}} = \frac{\frac{x}{4} + \frac{3x}{4}}{\frac{x}{4v_1} + \frac{3x}{4v_2}} = \frac{1}{\frac{v_2 + 3v_1}{4v_1v_2}}$$

$$v_{\text{av}} = \frac{4v_1v_2}{3v_1 + v_2}$$

35. Answer (1)

**Hint and Sol.:** Charge is not a fundamental quantity.

**SECTION - B**

36. Answer (4)

**Hint and Sol.:** [Surface tension] =  $[MT^{-2}]$

[Tension] =  $[MLT^{-2}]$

37. Answer (1)

**Hint and Sol.:**  $t = R_2 - R_1, \Delta t = \Delta R_1 + \Delta R_2$

$= (0.34 \pm 0.02) \text{ cm}$

38. Answer (4)

**Hint:** When relative error is least, then reading is most accurate

**Sol.:** Relative error =  $\frac{\Delta m}{m}$

For 1.01 kg,  $\frac{\Delta m}{m} = \frac{0.01}{1.01}$

For 3.52 kg,  $\frac{\Delta m}{m} = \frac{0.01}{3.52}$

For 1.510 kg,  $\frac{\Delta m}{m} = \frac{0.001}{1.510}$

For 1.542 kg,  $\frac{\Delta m}{m} = \frac{0.001}{1.542}$

$\therefore$  1.542 kg is most accurate.

39. Answer (2)

**Hint and Sol.:**

[G] =  $[M^{-1}L^3T^{-2}]$

[ $\rho$ ] =  $[ML^{-3}T^0]$

[Poisson's ratio] =  $[M^0L^0T^0]$

$\left[\frac{W}{t}\right] = [ML^2T^{-3}]$

40. Answer (2)

**Hint:** Principle of homogeneity

**Sol.:** (a) LHS =  $[v_{\text{av}}] = [LT^{-1}]$

RHS =  $\left[\frac{v+u}{3}\right] = [LT^{-1}]$

(b) LHS =  $[s] = [L]$

RHS =  $[ut] + [at^2]$

$= [LT^{-1}T] + [LT^{-2}T^2]$

$= [L] + [L] = [L]$

(c) LHS =  $[v^2 - u^2] = [L^2T^{-2}]$

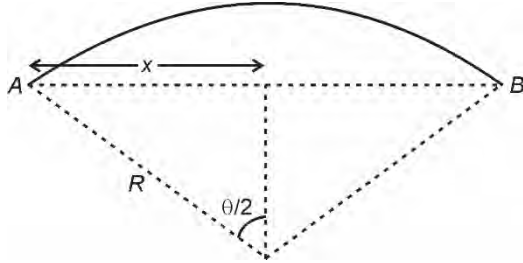
$$\text{RHS} = \left[ \frac{2a}{s} \right] = \left[ \frac{LT^{-2}}{L} \right] = [T^{-2}]$$

$$[\text{LHS}] \neq [\text{RHS}]$$

41. Answer (3)

**Hint:** Use geometry

**Sol.:**



$$\frac{x}{R} = \sin\left(\frac{\theta}{2}\right)$$

$$x = R \sin\left(\frac{\theta}{2}\right)$$

$$\text{Displacement } AB = 2x$$

$$= 2R \sin\frac{\theta}{2}$$

42. Answer (2)

**Hint:**  $a = \frac{vdv}{dx}$

**Sol.:**  $v = 2x^{3/2} \Rightarrow \frac{dv}{dx} = 3x^{1/2}$

$$a = \frac{vdv}{dx}$$

$$a = 2x^{3/2} \times 3x^{1/2}$$

$$= 6x^2$$

43. Answer (1)

**Hint:** Distance = speed  $\times$  time

**Sol.:**  $\frac{4}{v} + \frac{4}{v} = 1$

$$v = 8 \text{ km/h}$$

$$t = \frac{4}{8+4} + \frac{4}{8-4}$$

$$= \frac{1}{3} + 1 = \frac{4}{3} \text{ h}$$

$$= 80 \text{ minutes}$$

44. Answer (4)

**Hint:** Use division rule of differentiation

**Sol.:**  $y = \frac{\log_e x}{x}$

$$\frac{dy}{dx} = \frac{x \frac{d}{dx}(\log_e x) - \log_e x \frac{d}{dx}(x)}{x^2}$$

$$\frac{dy}{dx} = \frac{x\left(\frac{1}{x}\right) - \log_e x(1)}{x^2}$$

$$\frac{dy}{dx} = \frac{1 - \log_e x}{x^2}$$

45. Answer (1)

**Hint:**  $|\bar{v}_{av}| = \frac{\text{Displacement}}{\text{time}}$

**Sol.:** For first 12 seconds

$$|\bar{v}_{av}| = \frac{\frac{1}{2} \times 10 \times 12}{12} = 5 \text{ m/s}$$

For first 24 seconds

$$|\bar{v}_{av}| = \frac{\frac{1}{2} \times 10 \times 24}{24} = 5 \text{ m/s}$$

46. Answer (2)

**Hint:**  $R_{eq} = \frac{R_1 R_2}{R_1 + R_2}$

$$\Rightarrow \frac{\Delta R_{eq}}{R_{eq}} = \left( \frac{\Delta R_1}{R_1^2} + \frac{\Delta R_2}{R_2^2} \right) R_{eq}$$

**Sol.:**  $R_{eq} = \frac{100 \times 200}{100 + 200} = \frac{200}{3} \Omega$

$$\frac{\Delta R_{eq}}{R_{eq}} = \left( \frac{2}{100^2} + \frac{3}{200^2} \right) \times \frac{200}{3}$$

$$\frac{\Delta R_{eq}}{R_{eq}} = \left( \frac{2}{100} + \frac{3}{400} \right) \times \frac{2}{3}$$

$$= \frac{11}{600}$$

47. Answer (2)

**Hint:** When  $x$  is very small  $(1+x)^n \approx 1+nx$

**Sol.:**  $(9998)^{1/4} = (10000 - 2)^{1/4}$

$$= (10000)^{1/4} \times \left( 1 - \frac{2}{10000} \right)^{1/4}$$

$$= 10(1 - 0.0002)^{1/4}$$

$$\approx 10(1 - 0.00005)$$

$$= 10(0.99995)$$

$$= 9.9995$$

48. Answer (3)

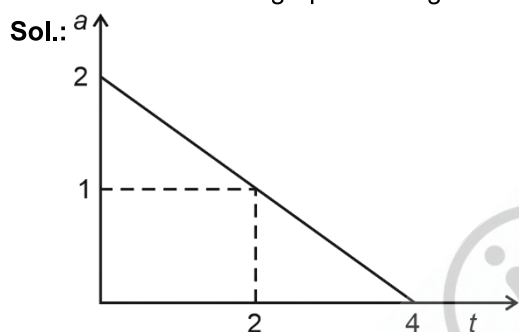
**Hint and Sol.:**  $\eta = \frac{\text{Force} \times \text{distance}}{\text{Area} \times \text{velocity}}$

$$[\eta] = [ML^{-1}T^{-1}]$$

$$[\eta^{3/2}] = [M^{3/2}L^{-3/2}T^{-3/2}]$$

49. Answer (1)

**Hint:** Area under  $a - t$  graph = change in velocity.



Area under  $a-t$  graph

$$= \frac{1}{2}(2+1) \times 2 = v - 6$$

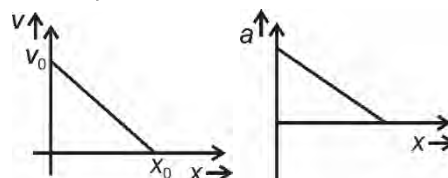
$$\Rightarrow 3 = v - 6$$

$$v = 9 \text{ m/s}$$

50. Answer (1)

**Hint:**  $a = \frac{v dv}{dx}$

**Sol.:** Let equation of  $v$  is



$$v = -\frac{v_0 x}{x_0} + v_0$$

$$\frac{dv}{dx} = \frac{-v_0}{x_0}$$

$$a = v \frac{dv}{dx} = \frac{v_0^2}{x_0^2} (x - x_0)$$

$$\text{at } x = 0, a = \frac{-v_0^2}{x_0}$$

## [CHEMISTRY]

### SECTION - A

51. Answer (3)

**Hint:** 1 mol contains  $N_A$  particles

**Sol.:** Number of electrons in 9.1 kg =  $10^{31}$

$$\text{Moles of electrons in 9.1 kg} = \frac{10^{31}}{6.022 \times 10^{23}}$$

$$= 1.66 \times 10^7$$

52. Answer (4)

**Hint:** Number of atoms = Atomicity  $\times$  Moles of molecule  $\times N_A$

**Sol.:** •  $n_{\text{H}_2\text{SO}_4} = \frac{1}{98}$

$$\text{Total atoms} = \frac{7 N_A}{98}$$

•  $n_{\text{H}_2\text{O}} = \frac{1}{18}$

$$\text{Total atoms} = \frac{3}{18} N_A = \frac{N_A}{6}$$

•  $n_{\text{O}_3} = \frac{1}{48}$

$$\text{Total atoms} = \frac{3}{48} \times N_A = \frac{N_A}{16}$$

•  $n_{\text{H}_2} = \frac{1}{2}$

$$\text{Total atoms} = \frac{2}{2} \times N_A = N_A$$

$\therefore$  Maximum number of atoms is in 1 g  $\text{H}_2$

53. Answer (4)

**Hint:** Law of multiple proportions is valid only for the different compounds made up of atoms of same elements.

**Sol.:**  $\text{H}_2\text{O}$  and  $\text{H}_2\text{S}$  do not follow law of multiple proportions as both the molecules contain different elements.

54. Answer (3)

**Hint:** Zeros at the end or right of a number are significant, provided they are on the right side of decimal point.

**Sol.:** Significant digits in 1.220 kg are 4.

55. Answer (2)

**Hint:** Average atomic mass

$$= \frac{(\%)_1 M_1 + (\%)_2 M_2 + \dots}{100}$$

**Sol.:** Average atomic mass

$$= \frac{(20 \times 10) + (80 \times 11)}{100}$$

$$= 10.8 \text{ u}$$

56. Answer (2)

**Hint:** Number of neutron = A – Z**Sol.:** Neutron in  $^{40}_{20}\text{Ca} = 40 - 20 = 20$ Neutron in  $^{55}_{25}\text{Mn} = 55 - 25 = 30$ Neutron in  $^{35}_{17}\text{Cl} = 35 - 17 = 18$ Neutron in  $^{24}_{12}\text{Mg} = 24 - 12 = 12$ 

57. Answer (4)

**Hint:** Minimum mass of sulphur possible in a molecule is 32 u.**Sol.:** % of element =  $\frac{\text{Weight of element}}{\text{Molecular weight}} \times 100$ 

$$4 = \frac{32}{M} \times 100$$

$$M = 800 \text{ u}$$

58. Answer (4)

**Hint:** Under same conditions, for gaseous species stoichiometry can be used for volume calculation**Sol.:**  $\text{CH}_4 + 2\text{O}_2 \rightarrow \text{CO}_2 + 2\text{H}_2\text{O}$ 400 ml of  $\text{O}_2$  is required completely to react with 200 ml of  $\text{CH}_4$ .

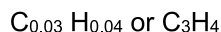
59. Answer (2)

**Hint:** Empirical formula is simple whole number ratio of elements present in a compound.

$$\text{Sol.}: n_{\text{CO}_2} = \frac{1.32}{44} = 0.03 \Rightarrow n_{\text{C}} = 0.03$$

$$n_{\text{H}_2\text{O}} = \frac{0.36}{18} = 0.02 \Rightarrow n_{\text{H}} = 2 \times 0.02 = 0.04$$

Empirical formula of the compound:



60. Answer (4)

**Hint:**  $1 \text{ u} = 1.66 \times 10^{-24} \text{ g}$ **Sol.:** Mass of one molecule of  $\text{MgCO}_3 = 84 \text{ u}$ 

$$= 84 \times 1.66 \times 10^{-24} \text{ g}$$

$$= 1.39 \times 10^{-22} \text{ g}$$

61. Answer (1)

**Hint:** mole fraction of A =  $\frac{\text{moles of A}}{\text{total moles}}$ 

$$\text{Sol.}: x_{\text{H}_2} = \frac{\frac{w}{2}}{\frac{w}{2} + \frac{w}{32}} = \frac{16}{17}$$

62. Answer (2)

**Hint:** 1 mole  $\text{H}_3\text{PO}_4$  contains 4 mol oxygen atoms**Sol.:** 0.1 mole  $\text{H}_3\text{PO}_4$  contains 0.4 mol oxygen atoms

63. Answer (4)

**Hint:** Normality of acid = Basicity  $\times \frac{\text{moles}}{\text{Volume (L)}}$ 

$$\text{Sol.}: n_{\text{H}_2\text{SO}_4} = \frac{9.8}{98} = 0.1$$

$$N_{\text{H}_2\text{SO}_4} = 2 \times \frac{0.1}{2} = 0.1 \text{ N}$$

64. Answer (1)

**Hint and Sol.:** Energies of the orbitals in the same subshell decrease with increase in atomic number.

$$E_{2s}(\text{H}) > E_{2s}(\text{Li}) > E_{2s}(\text{Na}) > E_{2s}(\text{K})$$

65. Answer (4)

**Hint:** Cathode rays are beam of electrons.**Sol.:**

- Cathode rays being beam of electrons are negatively charged particles.

- Electrons are fundamental particles, independent of material of electrodes and nature of gas present in the cathode ray tube.

66. Answer (3)

**Hint:** Number of angular nodes = l**Sol.:** Number of angular nodes in  $d_{xy} = 2$ 

67. Answer (4)

**Hint:** Angular momentum =  $\frac{nh}{2\pi}$ Where  $n = 1, 2, 3 \dots$ 

$$\text{Sol.}: \frac{nh}{2\pi} = 0.5 \frac{h}{\pi} \Rightarrow n = 1 \text{ (Permissible)}$$

$$\frac{nh}{2\pi} = \frac{h}{\pi} \Rightarrow n = 2 \text{ (Permissible)}$$

$$\frac{nh}{2\pi} = 1.5 \frac{h}{\pi} \Rightarrow n = 3 \text{ (Permissible)}$$

$$\frac{nh}{2\pi} = 1.25 \frac{h}{\pi} \Rightarrow n = 2.5 \text{ (Not Permissible)}$$

68. Answer (4)

**Hint:** Isoelectronic species have same number of electrons.

**Sol.:**  $F^-$  and  $O^{2-}$  have 10 electrons

 $Al^{3+}$  and Ne have 10 electrons

 CO and  $NO^+$  have 14 electrons

 NO has 15 electrons and  $N_2$  has 14 electrons

69. Answer (2)

**Hint:** Electronic configuration of 'O' is  $1s^2 2s^2 2p^4$ 
**Sol.:** Last electron of 'O' enters in  $2p$  orbitals.

Possible set of quantum numbers

$$n = 2, l = 1, m_l = -1, s = +\frac{1}{2}$$

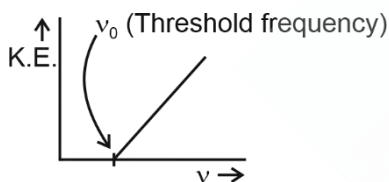
70. Answer (4)

**Hint:** Energy of a quanta =  $\frac{1240}{\lambda(\text{nm})} \text{ eV}$ 

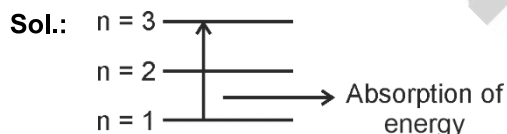
**Sol.:**  $62 = \frac{1240}{\lambda(\text{nm})}$

$\lambda = 20 \text{ nm}$

71. Answer (3)

**Hint:**  $KE = h\nu - h\nu_0$ 
**Sol.:**


72. Answer (4)

**Hint:** Absorption of energy results when transitions, occur from lower level to higher level.


73. Answer (2)

**Hint:**  $r_n = 0.529 \frac{n^2}{Z} \text{ \AA}$

**Sol.:**  $\frac{r_{He^+}}{r_{Li^{2+}}} = \frac{0.529 \left(\frac{2^2}{2}\right)}{0.529 \left(\frac{3^2}{3}\right)}$

$$\frac{r_{He^+}}{r_{Li^{2+}}} = \frac{2}{3}$$

74. Answer (4)

**Hint:** Magnetic moment =  $\sqrt{n(n+2)}$  B.M.

 $n$  = Number of unpaired electrons

**Sol.:**

	Number of unpaired electrons	$\mu(\text{B.M.})$
$Fe^{2+}$	4	4.89
$Mn^{2+}$	5	5.91
$V^{5+}$	0	0
$Cr^{3+}$	3	3.87

75. Answer (4)

**Hint and Sol.:** Maximum number of orbitals in a subshell is calculated by  $2l + 1$ .

76. Answer (3)

**Hint:** Electronic configuration of  $Cu^{2+}$  is  $1s^2 2s^2 2p^6 3s^2 3p^6 3d^9$ .

**Sol.:** Number of unpaired electron in  $Cu^{2+}$  is 1.

77. Answer (1)

**Hint:** Energy of photon emitted is given by

$$\Delta E = 13.6 Z^2 \left[ \frac{1}{n_1^2} - \frac{1}{n_2^2} \right] \text{ eV}$$

**Sol.:** For  $3 \rightarrow 1$   $\Delta E = 12.08 \text{ eV}$

For  $6 \rightarrow 2$   $\Delta E = 3.022 \text{ eV}$

For  $5 \rightarrow 4$   $\Delta E = 0.306 \text{ eV}$

For  $\infty \rightarrow 4$   $\Delta E = 0.85 \text{ eV}$

78. Answer (1)

**Hint:**  $IE = 13.6 \times \frac{Z^2}{n^2} \text{ eV atom}^{-1}$

**Sol.:**  $IE = 13.6 \times \frac{2^2}{1^2} \text{ eV atom}^{-1}$

$= 54.4 \text{ eV atom}^{-1}$

79. Answer (4)

**Hint:** Bohr's model is applicable to one electron species.

**Sol.:**  $Li^+$  has 2 electrons and hence Bohr's model is not applicable to it.

80. Answer (2)

**Hint:** de-Broglie's wavelength  $\lambda = \frac{h}{p}$ 
**Sol.:**

On increasing momentum four times, wavelength decreases four times.

81. Answer (4)

**Hint:** Subshell for  $n = 3$  are  $3s$ ,  $3p$  and  $3d$ **Sol.:** For  $3s$   $\begin{array}{|c|} \hline \uparrow\downarrow \\ \hline 0 \end{array}$  $3p$   $\begin{array}{|c|c|c|} \hline \uparrow\downarrow & \uparrow\downarrow & \uparrow\downarrow \\ \hline -1 & 0 & +1 \end{array}$  $3d$   $\begin{array}{|c|c|c|c|c|} \hline \uparrow\downarrow & \uparrow\downarrow & \uparrow\downarrow & \uparrow\downarrow & \uparrow\downarrow \\ \hline -2 & -1 & 0 & +1 & +2 \end{array}$ Total electrons having  $m_l = 1$  are 4.

82. Answer (3)

**Hint:** Metals having low work function, ejects electron easily.**Sol.:** K has minimum work function, so easily ejects the electron.

83. Answer (3)

**Hint:** According to Hund's rule, pairing of electrons in the orbitals belonging to the same subshell does not take place until each orbital belonging to that subshell has got one electron each having same spin.**Sol.:** In  $\begin{array}{|c|c|c|c|c|} \hline \uparrow\downarrow & \uparrow & \uparrow & \downarrow & \uparrow \\ \hline \end{array}$  all singly occupied electrons don't have same spin. Hence, Hund's rule is not followed.

84. Answer (4)

**Hint and Sol.:** Heisenberg's uncertainty principle can be expressed in following ways.

$$\Delta E \times \Delta t \geq \frac{h}{4\pi}$$

$$\Delta p \times \Delta x \geq \frac{h}{4\pi}$$

$$\Delta x \times \Delta v \geq \frac{h}{4\pi m}$$

85. Answer (4)

**Hint:** Electronic configuration of  $\text{Cl}^-$  is  $1s^2 2s^2 2p^6 3s^2 3p^6$ .**Sol.:** Number of 's' electrons in  $\text{Cl}^-$  is 6.

- $d$  electrons in  $\text{Co}^{3+}$  is 6
- $p$  electrons in Ne is 6
- $s$  electrons in  $\text{K}^+$  is 6
- $p$  electrons in F is 5

**SECTION - B**

86. Answer (4)

**Hint:** For  $g$  orbitals,  $l = 4$ **Sol.:**  $g$  orbitals are possible from  $n = 5$  onwards.

87. Answer (4)

**Hint:** Smaller the energy gap between two energy levels, higher will be the wavelength.**Sol.:** In Lyman series, smallest energy gap is in between  $n = 2$  to  $n = 1$ , hence wavelength of photon emitted is highest.

88. Answer (1)

**Hint:**  $\Delta x \cdot \Delta p \geq \frac{h}{4\pi}$

**Sol.:** If  $\Delta x = \Delta p$ 

$$(\Delta x)^2 = \frac{h}{4\pi}$$

$$\Delta x = \sqrt{\frac{h}{4\pi}}$$

89. Answer (4)

**Hint:**  $\lambda = \frac{h}{mv}$  (de-Broglie's wavelength)

**Sol.:**  $\lambda = \frac{6.626 \times 10^{-34}}{(10 \times 10^{-3})(1000)}$

$$\lambda = 6.626 \times 10^{-35} \text{ m}$$

90. Answer (3)

**Hint:** For hydrogen atom, energy of orbitals depends on 'n' only.**Sol.:** Energy order of orbitals of H-atom

$$6p > 5d = 5s > 4f$$

91. Answer (1)

**Hint:** Radial nodes =  $n - l - 1$ **Sol.:**For  $4d_{xy}$ : Radial nodes =  $4 - 2 - 1 = 1$ For  $2p_x$ : Radial nodes =  $2 - 1 - 1 = 0$ 

92. Answer (4)

**Hint and Sol.:**

	Gives idea for
Principal quantum number	Size and energy of orbit
Azimuthal quantum number	Shape of orbital
Magnetic quantum number	Orientation of orbital
Spin quantum number	Spin of electron in orbital

93. Answer (2)

$$\text{Hint: moles} = \frac{\text{mass in g}}{\text{molar mass}}$$

**Sol.:** If a and b are molar mass of 'A' and 'B'

$$(a + b) \times 0.1 = 5$$

$$a + b = 50 \quad \dots (1)$$

$$(2a + 3b) \times 0.25 = 30$$

$$2a + 3b = 120 \quad \dots (2)$$

On solving b = 20, a = 30

94. Answer (4)

$$\text{Hint: Number of moles} = \frac{\text{mass in g}}{\text{molar mass}}$$

$$\text{Sol.: } \frac{w_{\text{Cl}_2}}{w_{\text{F}_2}} = \frac{1}{76}$$

$$\frac{n_{\text{Cl}_2}}{n_{\text{F}_2}} = \frac{\frac{1}{76}}{\frac{1}{38}} = \frac{1}{142}$$

95. Answer (1)

$$\text{Hint: } \% (w/w) = \frac{\text{mass of solute (g)} \times 100}{\text{mass of solution (g)}}$$

$$\text{Sol.: } \% (w/w) = \frac{4.9}{14.9} \times 100 = 32.88 \%$$

% (w/w) is a unitless quantity.

96. Answer (2)

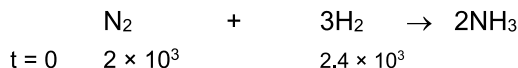
**Hint and Sol.:** Volume changes with temperature so the molarity.

97. Answer (4)

**Hint:** Limiting reagent gets consumed completely and excess reagent is calculated stoichiometrically.

$$\text{Sol.: } n_{\text{N}_2} = \frac{56}{28} \times 10^3 = 2 \times 10^3$$

$$n_{\text{H}_2} = \frac{4.8}{2} \times 10^3 = 2.4 \times 10^3$$



$$t = \infty \quad \left( 2 - \frac{1}{3} \times 2.4 \right) \times 10^3 \quad 0 \quad \frac{2}{3} \times 2.4 \times 10^3$$

Moles of N<sub>2</sub> left = 1.2 × 10<sup>3</sup>

$$\text{Mass of N}_2 \text{ left} = 1.2 \times 10^3 \times 28 \text{ g} \\ = 33.6 \text{ kg}$$

98. Answer (3)

**Hint:** M<sub>1</sub>V<sub>1</sub> = M<sub>2</sub>V<sub>2</sub>



$$t = 0 \quad \begin{array}{cccc} 20 \text{ mmol} & 20 \text{ mmol} & & \end{array}$$

$$t = \infty \quad \begin{array}{cccc} 0 & 0 & 20 \text{ mmol} & 20 \text{ mmol} \end{array}$$

$$[\text{NO}_3^-] = \frac{20}{400} = 0.05 \text{ M}$$

99. Answer (4)

**Hint:** Formula mass is used for ionic solids.

**Sol.:** NaCl is ionic solid and formula mass is 58.5 u.

100. Answer (4)

**Hint:** moles = Molarity × volume (L)

$$\text{Sol.: } n_{\text{NaOH}} = 0.2 \times 0.5 = 0.1 \text{ M}$$

$$m_{\text{NaOH}} = 0.1 \times 40 \text{ g} \\ = 4 \text{ g}$$

## [BOTANY]

### SECTION - A

101. Answer (3)

**Hint:** Protein synthesis occurs in all types of cells.

**Sol.:** Ribosomes help in protein synthesis. They are seen in both types of cells. In prokaryotes, they are 70S type and in eukaryotes they are 80S type.

102. Answer (2)

**Hint:** Sub-metacentric chromosome has centromere slightly away from middle.

**Sol.:** Here p and q arms are small and large respectively. These chromosomes are heterobrachial chromosomes.

103. Answer (3)

**Hint:** PPLO are smallest organisms.

**Sol.:** The largest single cell is the egg of an ostrich.

104. Answer (1)

**Hint:** Genetic material is naked in prokaryotes.

**Sol.:** Blue green algae are prokaryotes. They have cell wall and ribosomes but they lack nuclear membrane.

105. Answer (4)

**Hint:** Mesosome is infolding of plasma membrane, seen in prokaryotes.

**Sol.:** Mesosome helps in replication, cell wall formation etc. Chromatophores store pigments in photosynthetic prokaryotes.

106. Answer (2)

**Hint:** Bacterial cells have three layered cell envelope.

**Sol.:** Glycocalyx is the outermost and cell membrane is the innermost layer.

107. Answer (4)

**Hint:** Cell membrane is selectively permeable and made up of phospholipids.

**Sol.:** Cell wall prevents bacterial cell from bursting or collapsing.

108. Answer (4)

**Hint:** The structure in bacteria which plays role in motility is made up of flagellin protein.

**Sol.:** Flagella in prokaryotes are made up of flagellin protein and help in locomotion.

109. Answer (3)

**Hint:** Ribosomes help in protein synthesis.

**Sol.:** The ribosomes of polysome translate the mRNA into proteins.

110. Answer (3)

**Hint:** Sap vacuoles are found in plant cells.

**Sol.:** Sap vacuoles are not inclusion bodies. They store excretory products of plant cell.

111. Answer (3)

**Hint:** Cell membrane is found in all cells.

**Sol.:** Cell wall, plastids and large-central vacuole are seen in plant cells. They all are absent in animal cells.

112. Answer (4)

**Hint:** Heads of lipids in membrane are water loving or hydrophilic.

**Sol.:** Non-polar tails of saturated hydrocarbons in plasma membrane are protected from aqueous environment.

113. Answer (3)

**Hint:** In active transport, molecules move against the concentration gradient.

**Sol.:** Active transport requires energy in the form of ATP.

114. Answer (2)

**Hint:** Plant cell wall has cellulose, hemicellulose, pectin.

**Sol.:** Algal cell wall has cellulose, mannans, galactans and minerals like calcium carbonate.

Cellulose is common between algal and plant cell wall.

115. Answer (4)

**Hint:** Mitochondria produce energy in the form of ATP.

**Sol.:** Mitochondria is not the part of endomembrane system. Endomembrane system has Golgi, ER, vacuole and lysosome.

116. Answer (4)

**Hint:** Chloroplast is seen in green cells of the plants.

**Sol.:** Chloroplast synthesizes glucose but mitochondria oxidises it.

117. Answer (3)

**Hint:** Lysosome is single membrane bound organelle.

**Sol.:** Centriole is membraneless.

118. Answer (1)

**Hint:** Nucleolus is membraneless structure helps in synthesis of a type of RNA which is a component of ribosome.

**Sol.:** Nucleolus is site for synthesis of rRNA.

119. Answer (3)

**Hint:** Aleurone layer of maize has aleuroplasts to store proteins.

**Sol.:** Elaioplast stores oils and fats as in castor seeds.

120. Answer (3)

**Hint:** Chlorophyll pigments are present in thylakoid membrane.

**Sol.:** Stroma contains proteins, DNA, RNA and ribosomes.

121. Answer (3)

**Hint:** Cilia are found many in number as compared to flagella.

**Sol.:** Cilia are smaller in size as compared to flagella.

122. Answer (1)

**Hint:** In acrocentric chromosome, one arm is very short and another is very long.

**Sol.:** In acrocentric chromosomes, the centromere is situated close to its one end.

123. Answer (4)

**Hint:** Interphase is the phase where a cell prepares itself for division.

**Sol.:** M phase is actual phase of cell division.

124. Answer (3)

**Hint:** DNA replication begins in the nucleus and centriole duplication in the cytoplasm.

**Sol.:** In S phase, the number of chromosomes remains the same.

125. Answer (4)

**Hint:** Mitochondria and chloroplast are semi-autonomous organelles.

**Sol.:** Mitochondria and chloroplast duplicate during G<sub>2</sub> phase.

126. Answer (2)

**Hint:** Leptotene is the first stage and Diakinesis is the last stage of prophase I.

**Sol.:** The correct sequence is

Leptotene → Zygotene → Pachytene → Diplotene → Diakinesis.

127. Answer (4)

**Hint:** Splitting of centromere takes place in second last stage of karyokinesis.

**Sol.:** Anaphase is second last stage of karyokinesis where splitting of centromere takes place.

128. Answer (3)

**Hint:** Mitosis is equational division where crossing over does not take place.

**Sol.:** Mitosis does not introduce variations in progeny.

129. Answer (4)

**Hint:** Total number of mitotic divisions can be calculated by formula  $(n - 1)$  where 'n' is total number of daughter cells.

**Sol.:** Total number of mitotic divisions =  $(n - 1) = 128 - 1 = 127$ .

130. Answer (4)

**Hint:** Double metaphasic plates have homologous chromosomes.

**Sol.:** Double metaphasic plates are seen during metaphase I.

131. Answer (1)

**Hint:** First phase of meiosis I is the longest phase.

**Sol.:** Prophase I is the longest phase as it has 5 sub stages.

132. Answer (3)

**Hint:** Interkinesis is the stage between telophase I and prophase II.

**Sol.:** There is no replication of DNA in interkinesis.

133. Answer (1)

**Hint:** Meiosis II occurs after meiosis I.

**Sol.:** Meiosis II always occurs in haploid cells.

134. Answer (1)

**Hint:** Number of bivalents = Half of the total number of chromosomes and each bivalent has 4 chromatids.

**Sol.:**  $2n = 20$

Bivalents = 10

Chromatids =  $10 \times 4 = 40$ .

135. Answer (2)

**Hint:** APC is responsible for transition from metaphase to anaphase.

**Sol.:** It checks chromatids separation and trigger the cell to move from metaphase to anaphase.

### SECTION - B

136. Answer (2)

**Hint:** The space between cell membrane and nuclear membrane is main arena of cellular activities.

**Sol.:** Cytoplasm is the space between cell membrane and nuclear membrane.

137. Answer (4)

**Hint:** Glyoxysomes are found in plant cells.

**Sol.:** Glyoxysomes contain enzymes which convert fats into carbohydrates.

138. Answer (1)

**Hint:** The number of doublets in flagella are 9.

**Sol.:** The number of triplets in centrioles are also 9.

139. Answer (2)

**Hint:** Terminal part of chromosome seals the ends of a chromosome.

**Sol.:** Telomere is terminal part of chromosome which seals the ends of the chromosome.

140. Answer (3)

**Hint:** The functions of peroxisomes are not coordinated with the organelles of endomembrane system.

**Sol.:** Peroxisome is not included in endomembrane system.

141. Answer (4)

**Hint:** The cytoskeleton which is made up of tubulin proteins helps in spindle formation.

**Sol.:** Microtubules help in spindle and astral rays formation.

142. Answer (4)

**Hint:** These are proteinaceous structures.

**Sol.:** Kinetochores are disc shaped structures present on the sides of the centromere.

143. Answer (3)

**Hint:** Chromatin contains DNA and histones.

**Sol.:** Polyribosomes refers to the chain of ribosomes attached to the single mRNA.

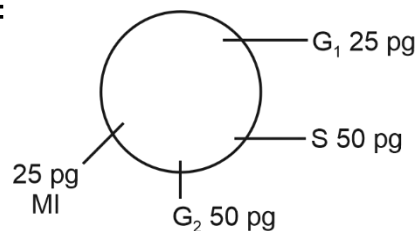
144. Answer (4)

**Sol.:** Dissolution of synaptonemal complex takes place during diplotene.

145. Answer (2)

**Hint:** Meiosis I products have half the number of DNA as compared to meicyte in  $G_2$  phase.

**Sol.:**



146. Answer (2)

**Hint:** In zygotene, synapsis occurs.

**Sol.:** In pachytene, crossing over takes place. In Diakinesis, terminalisation of chiasmata occurs.

147. Answer (2)

**Hint:** Centromere splits in anaphase II.

**Sol.:** Separation of homologous chromosomes takes place in anaphase I.

148. Answer (3)

**Hint:** Nucleic acid is synthesized in S phase.

**Sol.:** A bivalent is a pair of synapsed chromosomes.

149. Answer (3)

**Hint:** Best stage to study morphology of chromosomes is metaphase.

**Sol.:** To study shape of the chromosomes, the best stage is anaphase.

150. Answer (3)

**Hint:** Most of the cell organelles duplicate during Gap 1 phase.

**Sol.:**  $G_1$  phase is Gap 1 phase where most of the cell organelles duplicate

## [ZOOLOGY]

### SECTION - A

151. Answer (2)

**Hint:** CNS is mainly formed by this tissue

**Sol.:** Nervous tissue is concerned with control and co-ordination.

Epithelial tissue is involved in secretion and absorption. Muscular tissue is responsible for movement of body parts. Connective tissue links and supports other tissues/organs of the body.

152. Answer (2)

**Hint:** This epithelium is mainly present in the inner surface of hollow organs.

**Sol.:** The function of ciliated epithelium is to move particles or mucus in a specific direction over the epithelium.

They are mainly present in the inner surface of hollow organs like bronchioles and fallopian tubes

153. Answer (2)

**Hint:** This tissue has cells and fibres loosely arranged in semifluid ground substance.

**Sol.:** Tissues are classified into four types:

(i) Epithelial, (ii) Connective, (iii) Muscular and (iv) Neural.

Connective tissues are named so because of their special function of linking and supporting other tissues/organs of the body.

154. Answer (2)

**Hint:** Bones are rich in  $Ca^{2+}$  ions.

**Sol.:** Bones have a hard and non-pliable ground substance. The bone marrow in some bones is the site of production of blood cells. Bone also interact with skeletal muscles attached to them to bring about movements.

155. Answer (4)

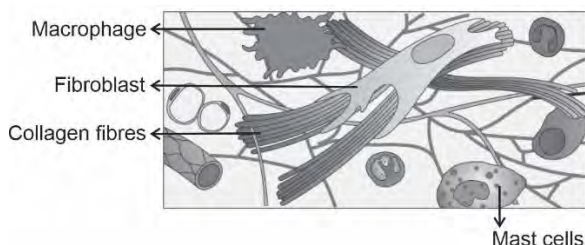
**Hint:** Tissue which links and supports other tissues/organs

**Sol.:** Connective tissues are named so, because of their special function of linking and supporting other tissues/organs of the body. They range from soft connective tissues to specialized types, which include cartilage, bone, adipose and blood.

156. Answer (4)

**Hint:** Involved in allergic reactions

**Sol.:** Mast cells are involved in the secretion of heparin, histamine and serotonin.



Histamine – Vasodilator

Heparin – Anti-coagulant

Serotonin – Vasoconstrictor

157. Answer (3)

**Hint:** Sites for digestion

**Sol.:** Columnar epithelium is found in the lining of stomach and intestine and helps in secretion and absorption.

Wall of blood vessels	Squamous epithelium
Tubular parts of nephron	Cuboidal epithelium
Bronchioles and fallopian tube	Ciliated epithelium

158. Answer (4)

**Hint:** Chemical messengers

**Sol.:** The endocrine glands are involved in the secretion of hormones whereas enzymes, earwax and saliva are the secretions of glands with ducts i.e., exocrine glands.

159. Answer (2)

**Hint:** Unique feature of cardiac muscle

**Sol.:** In cardiac muscle, junctions at fusion points allow the cells to contract as a unit. Cell junctions fuse the plasma membranes of cardiac muscle cells and make them stick together. Communication junctions at some fusion points allow movement of ions in between adjacent cells, so they function as a unit.

Neurons and neuroglia constitute neural tissue.

160. Answer (4)

**Hint:** Neuroglia are non-excitabile cells of neural tissue.

**Sol.:** Simple epithelium is composed of a single layer of cells.

Cuboidal epithelium is composed of a single layer of cube-like cells found in tubular parts of nephrons, PCT, DCT, etc.

Neuroglia make up more than one half the volume of neural tissue in our body.

Smooth muscle fibres taper at both ends, do not show striations and are involuntary.

161. Answer (3)

**Hint:** Structures which form the contractile tissue

**Sol.:** Skeletal muscle fibres together form the skeletal muscle tissue.

Adipose tissue is a type of loose connective tissue located mainly beneath the skin.

Ligament is a type of dense regular connective tissue.

Blood is a specialised connective tissue.

162. Answer (1)

**Hint:** Bone-forming cells

**Sol.:** Bones have special bone-forming cells called osteoblasts that produce new osteocytes.

Lacunae are fluid-filled spaces present in cartilage as well as bones.

Long bones possess a cavity which is filled with bone marrow. Ground substance of tissues is called the matrix.

163. Answer (4)

**Hint:** Complex animals consist of only four types of tissue

**Sol.:** Cells, tissues, organs and organ systems split-up the work in a way that exhibits division of labour and contributes to the survival of the body as a whole. Epithelial tissue has a free surface, which faces either a body fluid or the outside environment and thus provides a covering or a lining for some part of the body.

164. Answer (4)

**Hint:** Hydra is a simple organism

**Sol.:** Cells, tissues, organs and organ systems split up the work in a way that exhibits division of labour and contribute to the survival of body as a whole.

165. Answer (2)

**Hint:** The main function is to move particles in specific direction.

**Sol.:** The main function of ciliated epithelium is to move particles or mucus in a specific direction. They are mainly present in the inner surface of hollow organs.

Transitional epithelium lines the inner surface of the urinary bladders and ureters.

Compound epithelium is made up of more than one layers of cells.

166. Answer (1)

**Hint:** Enzymes are biochemical catalysts.**Sol.:** Almost all enzymes are proteins. There are some nucleic acids that behave like enzymes. These are called ribozymes.

167. Answer (1)

**Hint:** It is an unstable structure**Sol.:** During the state where the substrate is bound to the active site of enzyme, a new structure of the substrate called transition state structure is formed.

168. Answer (3)

**Hint:** Constitutes 70-90% of the total cellular mass**Sol.:** If we perform chemical analysis on a plant tissue, animal tissue or a microbial paste we obtain a list of several elements (C, H, O, etc) and their respective content (almost similar) per unit mass of living tissue.

Water is the most abundant chemical in living organisms.

169. Answer (3)

**Hint:**  $\text{Cl}_3\text{COOH}$ **Sol.:** Glycerol is trihydroxy propane. Palmitic acid is a fatty acid which has 16 carbon atoms including carboxyl carbon. Stearic acid is a saturated fatty acid.

170. Answer (1)

**Hint:** Highest percent weight of element in humans as well as in earth crust.**Sol.:**

Element	% weight in	
	Earth's crust	Human body
Na	2.8	0.2
Mg	2.1	0.1
Si	27.7	Negligible

171. Answer (4)

**Hint:** Present in both filtrate and retentate**Sol.:** Biomolecules, on the basis of molecular weight can be classified as macromolecules and micromolecules. Carbohydrates are biomolecules but all biomolecules are not carbohydrates.

172. Answer (1)

**Hint:** The acid soluble pool represents roughly the cytoplasmic composition.**Sol.:** If the tissue is fully burnt, all the carbon compounds are oxidized to gaseous form and the remaining substance is called 'ash'.

173. Answer (1)

**Hint:** Exclude carbon compounds**Sol.:** Several inorganic compounds like carbonates, phosphates, sulphates are seen in acid soluble fraction. $\text{C}_6\text{H}_{12}\text{O}_6$  (glucose) and  $\text{C}_5\text{H}_{10}\text{O}_5$  (ribose) are organic compounds.

174. Answer (4)

**Hint:** In amino acids, R-group is variable.**Sol.:** In  $\alpha$ -amino acids, there are four substituent groups occupying the four valency positions in which a variable group is designated as 'R'-group.

R-group is hydrogen for glycine.

R-group is methyl for alanine.

R-group is hydroxy methyl for serine.

175. Answer (3)

**Hint:** If a phosphate group is found esterified to sugar of nucleoside they are called nucleotides.**Sol.:**

- Lecithin is a phospholipid found in cell membrane.
- Arachidonic acid has 20 carbon atoms including the carboxyl carbon.
- Uracil is a nitrogen base (pyrimidine).
- Phosphate + sugar + nitrogenous base = Nucleotide.

176. Answer (2)

**Hint:** Enzymes responsible for breakdown of molecules without water**Sol.:** Lyases. eg. Aldolase.

Dehydrogenases catalyses oxidation-reduction reactions.

Transferases catalyse the transfer of specific groups other than hydrogen from one substrate to another.

177. Answer (3)

**Hint:** It is a purine**Sol.:** Purines are of two types: adenine and guanine. Adenine and guanine are substituted purines, whereas thymine, cytosine and uracil are substituted pyrimidines.

178. Answer (3)

**Hint:** ATP is a primary metabolite.**Sol.:** The compounds other than primary metabolites (have identifiable functions) are called secondary metabolites. Secondary metabolites are derived from plant, fungi and microbial cells but not animals. Nucleotides are not secondary metabolite. Some secondary metabolites have ecological importance.

179. Answer (4)

**Hint:** Carbohydrate binding proteins.**Sol.:**

Alkaloids	—	Morphine, codeine
Terpenoides	—	Monoterpenes, diterpenes
Polymeric substances	—	Rubber, gums, cellulose
Lectins	—	Concanavalin A

180. Answer (4)

**Hint:** Equals to number of fingers in each limb of man**Sol.:**

Component	% of the total cellular mass
Water	70-90
Proteins	10-15
Lipids	2
Nucleic acids	5-7

181. Answer (2)

**Hint:** Proteins are heteropolymers of amino acids.**Sol.:** RuBisCO is an enzyme. Collagen is the most abundant protein in animal world, and RuBisCO is the most abundant protein in the whole of the biosphere. Inulin is a polymer of fructose.

GLUT-4 enable glucose transport into cells.

182. Answer (1)

**Hint:** Starch holds I<sub>2</sub> due to helices**Sol.:** In a polysaccharide chain, the right end is called the reducing end and the left end is called the non-reducing end. Eg. glycogen and starch.

183. Answer (3)

**Hint:** This component is also present in fungal cell wall.**Sol.:** Cellulose and inulin are polysaccharides. Chitin is a complex polysaccharide made up of N-acetyl glucosamine.

184. Answer (3)

**Hint:** Gives 3-dimensional view of a protein**Sol.:** Tertiary structure gives us a three dimensional view of proteins. In quaternary structure, linear strings of spheres, spheres arranged one upon each other in the form of a cube or plate is observed eg. haemoglobin.

185. Answer (3)

**Hint:** Glycosidic bond is present in carbohydrates**Sol.:** In proteins, amino acids are linked by peptide bond.

In polysaccharides, monosaccharides are linked by glycosidic bond.

In nucleic acid, successive nucleotides are joined by phosphodiester bond.

Ester bonds are reported in lipids.

**SECTION - B**

186. Answer (3)

**Hint:** Epithelium which has limited role in secretion and absorption.**Sol.:** Main function of compound epithelium is to provide protection against chemical and mechanical stresses.

Simple epithelium is composed of a single layer of cells and functions as a lining for body cavities, ducts and tubes.

187. Answer (1)

**Hint:** Gap junction responsible for connecting cytoplasm of adjacent cells**Sol.:**

Adhering junctions	Keep neighbouring cells together
Gap junctions	For rapid transport of ions
Tight junctions	Help to stop substances from leaking across a tissue

188. Answer (4)

**Hint:** Fluid connective tissue**Sol.:** Blood is a fluid connective tissue, containing plasma, RBCs and WBCs. Fibres and fibroblasts are absent in blood.

Smooth muscles are reported in the wall of blood vessels, stomach and intestine.

189. Answer (3)

**Hint:** Given muscle fibres are spindle shaped**Sol.:** The smooth muscle fibres taper at both ends (fusiform) and do not show striations. These muscles are involuntary.

190. Answer (4)

**Hint:** Stomach, lung, heart and kidney**Sol.:** When two or more organs perform a common function by their physical and /or chemical interaction, they together form the organ system.

191. Answer (2)

**Hint:** Fallopian tubes**Sol.:**

Lining of duct of salivary glands	Compound epithelium
Tubular part of nephrons	Simple cuboidal epithelium
Inner surface of bronchioles and oviducts	Ciliated epithelium

192. Answer (4)

**Hint:** Proteins secreted by B-lymphocytes**Sol.:** Antibodies (immunoglobulins) are synthesized by plasma cells, which are modified B-lymphocytes. Heparin, histamine and serotonin are secretions of mast cells.

193. Answer (4)

**Hint:** Pentose sugar**Sol.:** When oxygen is absent at the 2<sup>nd</sup> carbon of ribose, it is known as deoxyribose (present in DNA).

Glucose and fructose are hexoses.

Ribose is a pentose sugar.

194. Answer (3)

**Hint:** Apoenzyme is the protein portion of the enzyme.**Sol.:** Co-factors may be identified as—

Prosthetic groups, co-enzymes and metal ions. Prosthetic groups are organic compounds and are distinguished from other co-factors in that they are tightly bound to apoenzyme.

195. Answer (2)

**Hint:** A component of haemoglobin**Sol.:** Haem is the prosthetic group for peroxidase and catalase. NAD and NADP are co-enzymes.

196. Answer (4)

**Hint:** Identify a nucleotide**Sol.:** Living organisms have learnt to trap energy liberated during degradation and store it in the form of chemical bonds as in ATP.

197. Answer (2)

**Hint:** Living organisms work continuously.**Sol.:** The living state is a non-equilibrium steady-state to be able to perform work. Without metabolism there cannot be a living state.

198. Answer (3)

**Hint:** Enzymes increase the rate of reaction**Sol.:** In catalysed reactions, the rate of reaction would be vastly higher than the same but uncatalyzed reaction. Carbonic anhydrase accelerates the reaction rate by 10 million times.

199. Answer (2)

**Hint:** Inhibitor which resembles the substrate.**Sol.:** Malonate closely resembles the substrate succinate in structure. Such competitive inhibitors are often used for the control of bacterial pathogens.In non-competitive inhibition,  $V_{max}$  changes and  $K_m$  remains the same.

200. Answer (4)

**Hint:** According to Chargaff's rule ( $[A] = [T]$ ,  $[G] = [C]$ )**Sol.:** G is 40% of 500 = 200So,  $(G = C)$  i.e.,  $C = 200$ 

10% A = 50, 10% T = 50.



## All India Aakash Test Series for NEET-2024

**TEST - I (Code-D)**

Test Date : 27/11/2022

**ANSWERS**

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

**HINTS & SOLUTIONS****[PHYSICS]****SECTION - A**

1. Answer (1)

**Hint and Sol.:** Charge is not a fundamental quantity.

2. Answer (3)

**Hint:** Average speed =  $\frac{\text{Distance travelled}}{\text{Total time taken}}$

$$\text{Sol.: } v_{\text{av}} = \frac{x_1 + x_2}{t_1 + t_2}$$

$$v_{\text{av}} = \frac{\frac{x}{4} + \frac{3x}{4}}{\frac{x}{4v_1} + \frac{3x}{4v_2}} = \frac{1}{\frac{v_2 + 3v_1}{4v_1v_2}}$$

$$v_{\text{av}} = \frac{4v_1v_2}{3v_1 + v_2}$$

3. Answer (1)

**Hint:**  $s = ut + \frac{1}{2}at^2$

$$\text{Sol.: } h = -4.9 \times 4 + \frac{1}{2} \times 9.8 \times 4^2$$

$$= -19.6 + 78.4$$

$$= 58.8 \text{ m}$$

4. Answer (4)

**Hint:**  $a = \frac{d^2x}{dt^2}$

**Sol.:** At point A rate of change of velocity is negative and at point B rate of change of velocity is positive.

5. Answer (3)

**Hint:**  $v^2 - u^2 = 2as$

$$\text{Sol.: } \left(\frac{2v}{3}\right)^2 - v^2 = 2as \quad \dots(1)$$

$$0^2 - v^2 = 2ans \quad \dots(2)$$

Dividing equation (2) by equation (1)

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

$$n = \frac{1}{1 - \frac{4}{9}} = \frac{9}{5} = 1.8$$

It requires two planks to stop it completely.

6. Answer (1)

**Hint:** Area under  $a - t$  graph gives change in velocity.

**Sol.:** Velocity of the object will keep on increasing till 5 seconds as acceleration is positive till 5 seconds.

$\Delta v = \text{Area under } a - t \text{ graph}$

$$v_{\text{max}} = \frac{1}{2} \times 20 \times 5 = 50 \text{ m/s}$$

7. Answer (3)

**Hint and Sol.:** While going up distance will increase and shape of curve will be downward parabola as velocity and acceleration are in opposite directions. While coming down distance will further increase with time and shape of curve will be upward parabola as velocity and acceleration are in same direction.

8. Answer (2)

**Hint:** Distance covered by object in last 3 seconds of ascent = Distance travelled by the object in first 3 seconds of descent.

$$\text{Sol.: } \text{Distance} = \frac{1}{2}gt^2 = \frac{9}{2}g$$

9. Answer (4)

**Hint:** Use concept of Galilean ratio.

**Sol.:** Let  $s_1 = x$

$$s_2 = 3x$$

$$s_1 + s_2 = x + 3x = 4x$$

$$s_3 + s_4 = 5x + 7x = 12x$$

$$s_5 + s_6 + s_7 = 9x + 11x + 13x = 33x$$

$$\text{Ratio} = 4 : 12 : 33$$

10. Answer (4)

**Hint:** Average speed =  $\frac{\text{Distance travelled}}{\text{Time taken}}$

$$\text{Sol.: } \text{Distance} = \frac{1}{2}at^2$$

$$\text{Average speed} = \frac{\text{Distance}}{\text{time}} = \frac{\left(\frac{at^2}{2}\right)}{t}$$

$$= \frac{at}{2}$$

11. Answer (3)

**Hint and Sol.:**  $\left[\frac{I}{h}\right] = \left[\frac{\text{ML}^2}{\text{ML}^2\text{T}^{-1}}\right] = [\text{T}]$

12. Answer (1)

**Hint and Sol.:** Plane angle and solid angle both are dimensionless quantity but are having units.

Reynold's number and dielectric constant both are ratio, therefore both are unitless as well as dimensionless.

13. Answer (3)

$$\text{Hint: } \frac{\Delta R}{R} = \frac{\Delta V}{V} + \frac{\Delta I}{I}$$

$$\text{Sol.: } R = \frac{200}{10} = 20 \Omega$$

$$\frac{\Delta R}{R} = \frac{\Delta V}{V} + \frac{\Delta I}{I}$$

$$\frac{\Delta R}{20} = \frac{3}{200} + \frac{0.1}{10}$$

$$\Delta R = 0.3 + 0.2 = 0.5 \Omega$$

14. Answer (1)

$$\text{Hint: Percentage error} = \frac{\Delta m}{m} \times 100$$

$$\text{Sol.: } m = \frac{1.52 + 1.53 + 1.55 + 1.45}{4} \text{ kg}$$

$$\approx 1.51 \text{ kg}$$

Mean absolute error

$$\Delta m = \frac{0.01 + 0.02 + 0.04 + 0.06}{4}$$

$$\approx 0.03$$

$$\text{Percentage error} = \frac{0.03}{1.51} \times 100\%$$

$$\approx 1.99\%$$

15. Answer (2)

**Hint & Sol.:** Angle and refractive index both are dimensionless.

16. Answer (3)

$$\text{Hint: } V = \pi r^2 h, \quad A = 2\pi rh$$

$$\text{Sol.: } \frac{\Delta V}{V} = \frac{2\Delta r}{r} + \frac{\Delta h}{h}$$

$$\frac{\Delta A}{A} = \frac{\Delta r}{r} + \frac{\Delta h}{h}$$

Percentage change in volume will be maximum.

17. Answer (1)

$$\text{Hint: } \frac{\Delta V}{V} = \frac{\Delta L}{L} + \frac{\Delta B}{B} + \frac{\Delta H}{H}$$

$$\text{Sol.: } V = L \times B \times H$$

$$= 100 \times 10 \times 10$$

$$= 10000 \text{ cm}^3$$

$$\frac{\Delta V}{V} = \frac{\Delta L}{L} + \frac{\Delta B}{B} + \frac{\Delta C}{C}$$

$$\frac{\Delta V}{10000} = \frac{0.1}{100} + \frac{0.1}{10} + \frac{0.2}{10}$$

$$\frac{\Delta V}{10000} = \left( \frac{1+10+20}{1000} \right) = \frac{31}{1000}$$

$$\Delta V = 310 \text{ cm}^3$$

18. Answer (3)

**Hint:** Concept of significant figures.

**Sol.:** 6.2300400 has eight significant figures.

19. Answer (4)

**Hint & Sol.:** Using dimensional analysis we cannot derive any trigonometric function relation, exponential relation and addition of two functions.

$F = \frac{mv^2}{r}$  can be derived from dimensional analysis.

20. Answer (4)

**Hint:** Using dimensional analysis

$$\text{Sol.: } \left( P + \frac{a}{V^2} \right) (V - b) = \text{constant}$$

$$\left[ \frac{a}{L^6} \right] = [ML^{-1}T^{-2}]$$

$$[a] = [ML^5T^{-2}]$$

$$[b] = [L^3]$$

$$\left[ \frac{a}{b^2} \right] = \frac{ML^5T^{-2}}{L^6} = [ML^{-1}T^{-2}]$$

21. Answer (3)

**Hint:** Reading = MSR + CSR × LC – ZE

**Sol.:** Reading = MSR + CSR × LC – ZE

$$= 6 \text{ mm} + 25 \times 0.02 \text{ mm} + 0.04 \text{ mm}$$

$$= 6 + 0.50 + 0.04$$

$$= 6.54 \text{ mm}$$

22. Answer (1)

**Hint:**  $n_1 u_1 = n_2 u_2$

**Sol.:** Let  $M_1, L_1, T_1$  and  $M_2, L_2, T_2$  be the symbols of mass, length and time in two system respectively.

$$10 [M_1 L_1 T_1^{-2}] = x [M_2 L_2 T_2^{-2}]$$

$$x = 10 \left[ \left( \frac{M_1}{M_2} \right) \left( \frac{L_1}{L_2} \right) \left( \frac{T_1}{T_2} \right)^{-2} \right]$$

$$= 10 \left[ \left( \frac{1}{10} \right) \times \left( \frac{1}{100} \right) \times \left[ \left( \frac{1}{60} \right) \right]^{-2} \right] = \frac{36000}{1000}$$

= 36 unit

23. Answer (4)

**Hint:** Use dimensional analysis.

**Sol.:**  $m \propto P^a v^b T^c$

$$\Rightarrow [M] = [ML^2T^{-3}]^a [LT^{-1}]^b [T^c]$$

$$\Rightarrow M^1 L^0 T^0 = M^a L^{2a+b} T^{-3a-b+c}$$

$$\Rightarrow a = 1, \quad 2a + b = 0$$

$$\Rightarrow b = -2a \quad \Rightarrow b = -2$$

$$-3a - b + c = 0$$

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

$$\boxed{c=1} \quad [M] = [P v^{-2} T]$$

24. Answer (1)

**Hint:**  $\frac{\Delta P}{P} = \frac{\Delta a}{a} + \frac{1}{2} \frac{\Delta b}{b} + \frac{2}{3} \frac{\Delta c}{c} + \frac{\Delta d}{d}$

**Sol.:**  $P = \frac{a\sqrt{b}}{c^{2/3}d}$

$$= 1\% + \frac{2}{2}\% + \frac{2}{3} \times 1\% + 0.5\%$$

$$= \frac{19}{6}\%$$

25. Answer (3)

**Hint:** Least count = 1 MSD – 1 VSD.

**Sol.:** 1 Main scale division =  $\frac{1}{2}$  cm

$$n \text{ VSD} = (n-2) \text{ MSD}$$

$$1 \text{ VSD} = \left( \frac{n-2}{n} \right) \text{ MSD}$$

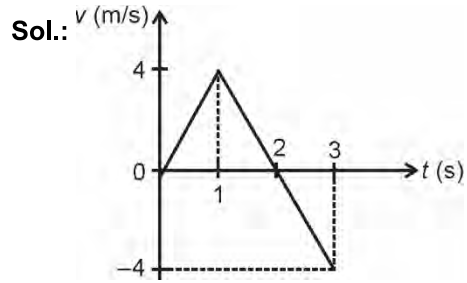
$$\text{LC} = 1 \text{ MSD} - 1 \text{ VSD}$$

$$= 1 \text{ MSD} - \left( \frac{n-2}{n} \right) \text{ MSD}$$

$$= \frac{2}{n} \text{ MSD} = \frac{2}{n} \times \frac{1}{2} = \frac{1}{n} \text{ cm}$$

26. Answer (2)

**Hint:** Area under speed-time graph = distance travelled by the object.



Distance travelled

$$= \frac{1}{2}(4 \times 2) + \frac{1}{2}(4)(1)$$

$$= 6 \text{ m}$$

27. Answer (3)

**Hint:**  $v = \frac{dx}{dt}$  and  $a = \frac{dv}{dt}$

**Sol.:**  $x = t^3 - 2t^2 + 5$

$$\Rightarrow v = \frac{dx}{dt} = 3t^2 - 4t$$

$$\Rightarrow a = \frac{dv}{dt} = 6t - 4$$

$$\text{Put } a = 6t - 4 = 0$$

$$\Rightarrow t = \frac{4}{6} = \frac{2}{3} \text{ s}$$

Position at  $t = \frac{2}{3}$  s

$$x = \left( \frac{2}{3} \right)^3 - 2 \left( \frac{2}{3} \right)^2 + 5$$

$$= \frac{8}{27} - \frac{8}{9} + 5$$

$$= \frac{8 - 24 + 135}{27}$$

$$= \frac{119}{27} \text{ m}$$

28. Answer (1)

**Hint:** If  $Y = a \sin x + b \cos x$ .

$$\text{Then } Y_{\max} = \sqrt{a^2 + b^2}$$

**Sol.:**  $Y = \sqrt{3} \sin x - \sqrt{2} \cos x$

$$Y_{\max} = \sqrt{(\sqrt{3})^2 + (\sqrt{2})^2} = \sqrt{3+2}$$

$$= \sqrt{5}$$

29. Answer (2)

**Hint:**  $v_{av} t = S$

**Sol.:**  $S = \frac{u+v}{2} t$

$$= \frac{10 \text{ km/h} + 50 \text{ km/h}}{2} \times 2$$

$$= 60 \text{ km}$$

30. Answer (4)

**Hint:**  $V = \pi r^2 L$

**Sol.:**  $V = \pi r^2 L$

$$\Rightarrow \frac{\Delta V}{V} = 2 \frac{\Delta r}{r} + \frac{\Delta L}{L}$$

$$\Rightarrow \frac{\Delta V}{V} = (2 \times 3\%) + 1\%$$

$$= 7\%$$

31. Answer (2)

**Hint:** Strain is dimensionless.

$$\text{Sol.: } \left[ \frac{\text{Strain}}{\text{Speed}} \right]^3 = \frac{[M^0 L^0 T^0]^3}{[LT^{-1}]^3}$$

$$= [M^0 L^{-3} T^3]$$

32. Answer (3)

**Hint:** Area of circle (A) =  $\pi r^2$

**Sol.:**  $A = 3.14 \times 1.21 \times 1.21$

$$= 4.597274 \text{ m}^2$$

$$= 4.60 \text{ m}^2 \text{ (Round-off to three significant digits).}$$

33. Answer (3)

**Hint and Sol.:** Weak nuclear force is having very short range of nearly  $10^{-16}$  m.

34. Answer (2)

**Hint:** Principle of homogeneity

$$\text{Sol.: } Y = a \cos \left( \omega^2 t - \frac{x}{\sqrt{K}} \right)$$

$\omega^2 t$  and  $\frac{x}{\sqrt{K}}$  are dimensionless quantity.

$$[\omega^2 t] = [M^0 L^0 T^0]$$

$$\omega = [T^{-1/2}]$$

$$\left[ \frac{x}{\sqrt{K}} \right] = [M^0 L^0 T^0]$$

$$\Rightarrow \frac{L}{\sqrt{K}} = [M^0 L^0 T^0] \Rightarrow [K] = [L^2]$$

$$\left[ \frac{\omega}{K} \right] = \left[ \frac{T^{-1/2}}{L^2} \right] = [M^0 L^{-2} T^{-1/2}]$$

35. Answer (3)

**Hint:** 1 parsec = 3.26 ly

**Sol.:** 2 parsec =  $2 \times 3.26$  ly

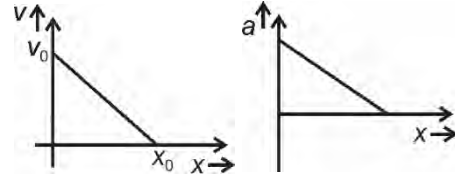
$$= 6.52 \text{ ly}$$

SECTION - B

36. Answer (1)

**Hint:**  $a = \frac{v dv}{dx}$

**Sol.:** Let equation of v is



$$v = -\frac{v_0 x}{x_0} + v_0$$

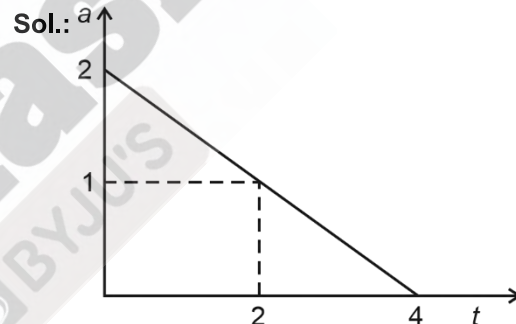
$$\frac{dv}{dx} = \frac{-v_0}{x_0}$$

$$a = v \frac{dv}{dx} = \frac{v^2}{x_0^2} (x - x_0)$$

$$\text{at } x = 0, a = \frac{-v_0^2}{x_0}$$

37. Answer (1)

**Hint:** Area under a - t graph = change in velocity.



Area under a - t graph

$$= \frac{1}{2} (2+1) \times 2 = v - 6$$

$$\Rightarrow 3 = v - 6$$

$$v = 9 \text{ m/s}$$

38. Answer (3)

**Hint and Sol.:**  $\eta = \frac{\text{Force} \times \text{distance}}{\text{Area} \times \text{velocity}}$

$$[\eta] = [ML^{-1} T^{-1}]$$

$$[\eta^{3/2}] = [M^{3/2} L^{-3/2} T^{-3/2}]$$

39. Answer (2)

**Hint:** When x is very small  $(1+x)^n \approx 1+nx$

**Sol.:**  $(9998)^{1/4} = (10000 - 2)^{1/4}$

$$= (10000)^{1/4} \times \left( 1 - \frac{2}{10000} \right)^{1/4}$$

$$= 10(1 - 0.0002)^{1/4}$$

$$\approx 10(1 - 0.00005)$$

$$= 10(0.99995)$$

$$= 9.9995$$

40. Answer (2)

**Hint:**  $R_{eq} = \frac{R_1 R_2}{R_1 + R_2}$

$$\Rightarrow \frac{\Delta R_{eq}}{R_{eq}} = \left( \frac{\Delta R_1}{R_1^2} + \frac{\Delta R_2}{R_2^2} \right) R_{eq}$$

**Sol.:**  $R_{eq} = \frac{100 \times 200}{100 + 200} = \frac{200}{3} \Omega$

$$\frac{\Delta R_{eq}}{R_{eq}} = \left( \frac{2}{100^2} + \frac{3}{200^2} \right) \times \frac{200}{3}$$

$$\frac{\Delta R_{eq}}{R_{eq}} = \left( \frac{2}{100} + \frac{3}{400} \right) \times \frac{2}{3}$$

$$= \frac{11}{600}$$

41. Answer (1)

**Hint:**  $|\vec{v}_{av}| = \frac{\text{Displacement}}{\text{time}}$

**Sol.:** For first 12 seconds

$$|\vec{v}_{av}| = \frac{\frac{1}{2} \times 10 \times 12}{12} = 5 \text{ m/s}$$

For first 24 seconds

$$|\vec{v}_{av}| = \frac{\frac{1}{2} \times 10 \times 24}{24} = 5 \text{ m/s}$$

42. Answer (4)

**Hint:** Use division rule of differentiation

**Sol.:**  $y = \frac{\log_e x}{x}$

$$\frac{dy}{dx} = \frac{x \frac{d}{dx}(\log_e x) - \log_e x \frac{d}{dx}(x)}{x^2}$$

$$\frac{dy}{dx} = \frac{x \left( \frac{1}{x} \right) - \log_e x (1)}{x^2}$$

$$\frac{dy}{dx} = \frac{1 - \log_e x}{x^2}$$

43. Answer (1)

**Hint:** Distance = speed  $\times$  time

**Sol.:**  $\frac{4}{v} + \frac{4}{v} = 1$

$$v = 8 \text{ km/h}$$

$$t = \frac{4}{8+4} + \frac{4}{8-4}$$

$$= \frac{1}{3} + 1 = \frac{4}{3} \text{ h}$$

$$= 80 \text{ minutes}$$

44. Answer (2)

**Hint:**  $a = \frac{v dv}{dx}$

**Sol.:**  $v = 2x^{3/2} \Rightarrow \frac{dv}{dx} = 3x^{1/2}$

$$a = \frac{v dv}{dx}$$

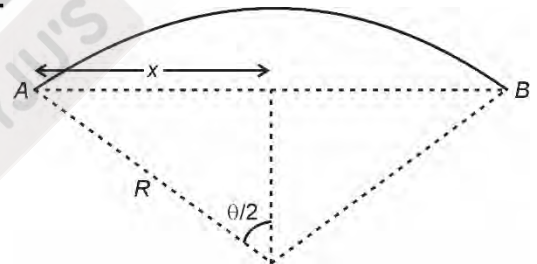
$$a = 2x^{3/2} \times 3x^{1/2}$$

$$= 6x^2$$

45. Answer (3)

**Hint:** Use geometry

**Sol.:**



$$\frac{x}{R} = \sin\left(\frac{\theta}{2}\right)$$

$$x = R \sin\left(\frac{\theta}{2}\right)$$

$$\text{Displacement } AB = 2x$$

$$= 2R \sin\frac{\theta}{2}$$

46. Answer (2)

**Hint:** Principle of homogeneity

**Sol.:** (a) LHS =  $[v_{av}] = [LT^{-1}]$

$$\text{RHS} = \left[ \frac{v+u}{3} \right] = [LT^{-1}]$$

(b)  $LHS = [s] = [L]$

$RHS = [ut] + [at^2]$

$= [LT^{-1}T] + [LT^{-2}T^2]$

$= [L] + [L] = [L]$

(c)  $LHS = [v^2 - u^2] = [L^2T^{-2}]$

$RHS = \left[\frac{2a}{s}\right] = \left[\frac{LT^{-2}}{L}\right] = [T^{-2}]$

$[LHS] \neq [RHS]$

47. Answer (2)

**Hint and Sol.:**

$[G] = [M^{-1}L^3T^{-2}]$

$[\rho] = [ML^{-3}T^0]$

$[\text{Poisson's ratio}] = [M^0L^0T^0]$

$\left[\frac{W}{t}\right] = [ML^2T^{-3}]$

48. Answer (4)

**Hint:** When relative error is least, then reading is most accurate

**Sol.:** Relative error =  $\frac{\Delta m}{m}$

For 1.01 kg,  $\frac{\Delta m}{m} = \frac{0.01}{1.01}$

For 3.52 kg,  $\frac{\Delta m}{m} = \frac{0.01}{3.52}$

For 1.510 kg,  $\frac{\Delta m}{m} = \frac{0.001}{1.510}$

For 1.542 kg,  $\frac{\Delta m}{m} = \frac{0.001}{1.542}$

 $\therefore$  1.542 kg is most accurate.

49. Answer (1)

**Hint and Sol.:**  $t = R_2 - R_1$ ,  $\Delta t = \Delta R_1 + \Delta R_2$ 

$= (0.34 \pm 0.02) \text{ cm}$

50. Answer (4)

**Hint and Sol.:** [Surface tension] =  $[MT^{-2}]$ 

[Tension] =  $[MLT^{-2}]$

## [CHEMISTRY]

### SECTION - A

51. Answer (4)

**Hint:** Electronic configuration of  $Cl^-$  is  $1s^2 2s^2 2p^6 3s^2 3p^6$ .**Sol.:** Number of 's' electrons in  $Cl^-$  is 6.

- d electrons in  $Co^{3+}$  is 6
- p electrons in Ne is 6
- s electrons in  $K^+$  is 6
- p electrons in F is 5

52. Answer (4)

**Hint and Sol.:** Heisenberg's uncertainty principle can be expressed in following ways.

$$\Delta E \times \Delta t \geq \frac{h}{4\pi}$$

$$\Delta p \times \Delta x \geq \frac{h}{4\pi}$$

$$\Delta x \times \Delta v \geq \frac{h}{4\pi m}$$

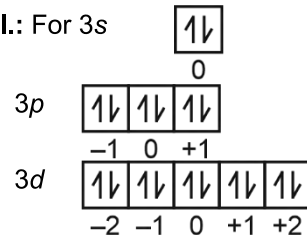
53. Answer (3)

**Hint:** According to Hund's rule, pairing of electrons in the orbitals belonging to the same subshell does not take place until each orbital belonging to that subshell has got one electron each having same spin.**Sol.:** In  $\uparrow\downarrow \uparrow \uparrow \downarrow \uparrow$  all singly occupied electrons don't have same spin. Hence, Hund's rule is not followed.

54. Answer (3)

**Hint:** Metals having low work function, ejects electron easily.**Sol.:** K has minimum work function, so easily ejects the electron.

55. Answer (4)

**Hint:** Subshell for  $n = 3$  are 3s, 3p and 3d**Sol.:** For 3sTotal electrons having  $m_l = 1$  are 4.

56. Answer (2)

**Hint:** de-Broglie's wavelength  $\lambda = \frac{h}{p}$ **Sol.:**

On increasing momentum four times, wavelength decreases four times.

57. Answer (4)

**Hint:** Bohr's model is applicable to one electron species.**Sol.:**  $\text{Li}^+$  has 2 electrons and hence Bohr's model is not applicable to it.

58. Answer (1)

**Hint:**  $\text{IE} = 13.6 \times \frac{Z^2}{n^2} \text{ eV atom}^{-1}$ **Sol.:**  $\text{IE} = 13.6 \times \frac{2^2}{1^2} \text{ eV atom}^{-1}$   
 $= 54.4 \text{ eV atom}^{-1}$ 

59. Answer (1)

**Hint:** Energy of photon emitted is given by

$$\Delta E = 13.6 Z^2 \left[ \frac{1}{n_1^2} - \frac{1}{n_2^2} \right] \text{ eV}$$

**Sol.:** For  $3 \rightarrow 1$   $\Delta E = 12.08 \text{ eV}$ For  $6 \rightarrow 2$   $\Delta E = 3.022 \text{ eV}$ For  $5 \rightarrow 4$   $\Delta E = 0.306 \text{ eV}$ For  $\infty \rightarrow 4$   $\Delta E = 0.85 \text{ eV}$ 

60. Answer (3)

**Hint:** Electronic configuration of  $\text{Cu}^{2+}$  is  $1s^2 2s^2 2p^6 3s^2 3p^6 3d^9$ .**Sol.:** Number of unpaired electron in  $\text{Cu}^{2+}$  is 1.

61. Answer (4)

**Hint and Sol.:** Maximum number of orbitals in a subshell is calculated by  $2l + 1$ .

62. Answer (4)

**Hint:** Magnetic moment =  $\sqrt{n(n+2)}$  B.M. $n$  = Number of unpaired electrons**Sol.:**

	Number of unpaired electrons	$\mu$ (B.M.)
$\text{Fe}^{2+}$	4	4.89
$\text{Mn}^{2+}$	5	5.91
$\text{V}^{5+}$	0	0
$\text{Cr}^{3+}$	3	3.87

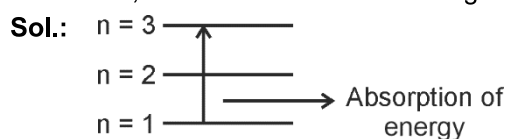
63. Answer (2)

**Hint:**  $r_n = 0.529 \frac{n^2}{Z} \text{ \AA}$ 

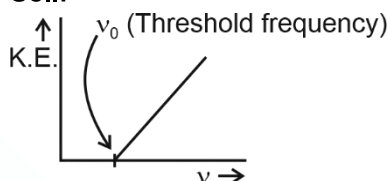
**Sol.:**  $\frac{r_{\text{He}^+}}{r_{\text{Li}^{2+}}} = \frac{0.529 \left( \frac{2^2}{2} \right)}{0.529 \left( \frac{3^2}{3} \right)}$

$$\frac{r_{\text{He}^+}}{r_{\text{Li}^{2+}}} = \frac{2}{3}$$

64. Answer (4)

**Hint:** Absorption of energy results when transitions occur from lower level to higher level.

65. Answer (3)

**Hint:**  $\text{KE} = h\nu - h\nu_0$ **Sol.:**

66. Answer (4)

**Hint:** Energy of a quanta =  $\frac{1240}{\lambda(\text{nm})} \text{ eV}$ 

**Sol.:**  $62 = \frac{1240}{\lambda(\text{nm})}$

$\lambda = 20 \text{ nm}$

67. Answer (2)

**Hint:** Electronic configuration of 'O' is  $1s^2 2s^2 2p^4$ **Sol.:** Last electron of 'O' enters in  $2p$  orbitals.

Possible set of quantum numbers

$n = 2, l = 1, m_l = -1, s = +\frac{1}{2}$

68. Answer (4)

**Hint:** Isoelectronic species have same number of electrons.**Sol.:**  $\text{F}^-$  and  $\text{O}^{2-}$  have 10 electrons $\text{Al}^{3+}$  and  $\text{Ne}$  have 10 electrons $\text{CO}$  and  $\text{NO}^+$  have 14 electrons $\text{NO}$  has 15 electrons and  $\text{N}_2$  has 14 electrons

69. Answer (4)

**Hint:** Angular momentum =  $\frac{nh}{2\pi}$ Where  $n = 1, 2, 3 \dots$ 

**Sol.:**  $\frac{nh}{2\pi} = 0.5 \frac{h}{\pi} \Rightarrow n = 1$  (Permissible)

$\frac{nh}{2\pi} = \frac{h}{\pi} \Rightarrow n = 2$  (Permissible)

$\frac{nh}{2\pi} = 1.5 \frac{h}{\pi} \Rightarrow n = 3$  (Permissible)

$\frac{nh}{2\pi} = 1.25 \frac{h}{\pi} \Rightarrow n = 2.5$  (Not Permissible)

70. Answer (3)

**Hint:** Number of angular nodes =  $l$ **Sol.:** Number of angular nodes in  $d_{xy} = 2$ 

71. Answer (4)

**Hint:** Cathode rays are beam of electrons.**Sol.:**

- Cathode rays being beam of electrons are negatively charged particles.
- Electrons are fundamental particles, independent of material of electrodes and nature of gas present in the cathode ray tube.

72. Answer (1)

**Hint and Sol.:** Energies of the orbitals in the same subshell decrease with increase in atomic number.

$$E_{2s}(\text{H}) > E_{2s}(\text{Li}) > E_{2s}(\text{Na}) > E_{2s}(\text{K})$$

73. Answer (4)

**Hint:** Normality of acid = Basicity  $\times$   $\frac{\text{moles}}{\text{Volume (L)}}$ 

$$\text{Sol.} \quad n_{\text{H}_2\text{SO}_4} = \frac{9.8}{98} = 0.1$$

$$N_{\text{H}_2\text{SO}_4} = 2 \times \frac{0.1}{2} = 0.1 \text{ N}$$

74. Answer (2)

**Hint:** 1 mole  $\text{H}_3\text{PO}_4$  contains 4 mol oxygen atoms**Sol.:** 0.1 mole  $\text{H}_3\text{PO}_4$  contains 0.4 mol oxygen atoms

75. Answer (1)

**Hint:** mole fraction of A =  $\frac{\text{moles of A}}{\text{total moles}}$ 

$$\text{Sol.} \quad x_{\text{H}_2} = \frac{\frac{w}{2}}{\frac{w}{2} + \frac{w}{32}} = \frac{16}{17}$$

76. Answer (4)

**Hint:**  $1 \text{ u} = 1.66 \times 10^{-24} \text{ g}$ **Sol.:** Mass of one molecule of  $\text{MgCO}_3 = 84 \text{ u}$ 

$$= 84 \times 1.66 \times 10^{-24} \text{ g}$$

$$= 1.39 \times 10^{-22} \text{ g}$$

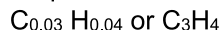
77. Answer (2)

**Hint:** Empirical formula is simple whole number ratio of elements present in a compound.

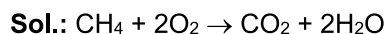
$$\text{Sol.} \quad n_{\text{CO}_2} = \frac{1.32}{44} = 0.03 \Rightarrow n_{\text{C}} = 0.03$$

$$n_{\text{H}_2\text{O}} = \frac{0.36}{18} = 0.02 \Rightarrow n_{\text{H}} = 2 \times 0.02 = 0.04$$

Empirical formula of the compound:



78. Answer (4)

**Hint:** Under same conditions, for gaseous species stoichiometry can be used for volume calculation400 ml of  $\text{O}_2$  is required completely to react with 200 ml of  $\text{CH}_4$ .

79. Answer (4)

**Hint:** Minimum mass of sulphur possible in a molecule is 32 u.

$$\text{Sol.} \quad \% \text{ of element} = \frac{\text{Weight of element}}{\text{Molecular weight}} \times 100$$

$$4 = \frac{32}{M} \times 100$$

$$M = 800 \text{ u}$$

80. Answer (2)

**Hint:** Number of neutron =  $A - Z$ 

$$\text{Sol.} \quad \text{Neutron in } {}^{40}_{20}\text{Ca} = 40 - 20 = 20$$

$$\text{Neutron in } {}^{55}_{25}\text{Mn} = 55 - 25 = 30$$

$$\text{Neutron in } {}^{35}_{17}\text{Cl} = 35 - 17 = 18$$

$$\text{Neutron in } {}^{24}_{12}\text{Mg} = 24 - 12 = 12$$

81. Answer (2)

**Hint:** Average atomic mass

$$= \frac{(\%)_1 M_1 + (\%)_2 M_2 + \dots}{100}$$

**Sol.:** Average atomic mass

$$= \frac{(20 \times 10) + (80 \times 11)}{100}$$

$$= 10.8 \text{ u}$$

82. Answer (3)

**Hint:** Zeros at the end or right of a number are significant, provided they are on the right side of decimal point.**Sol.:** Significant digits in 1.220 kg are 4.

83. Answer (4)

**Hint:** Law of multiple proportions is valid only for the different compounds made up of atoms of same elements.**Sol.:**  $\text{H}_2\text{O}$  and  $\text{H}_2\text{S}$  do not follow law of multiple proportions as both the molecules contain different elements.

84. Answer (4)

**Hint:** Number of atoms = Atomicity  $\times$  Moles of molecule  $\times N_A$

**Sol.:** •  $n_{\text{H}_2\text{SO}_4} = \frac{1}{98}$

Total atoms =  $\frac{7 N_A}{98}$

•  $n_{\text{H}_2\text{O}} = \frac{1}{18}$

Total atoms =  $\frac{3}{18} N_A = \frac{N_A}{6}$

•  $n_{\text{O}_3} = \frac{1}{48}$

Total atoms =  $\frac{3}{48} \times N_A = \frac{N_A}{16}$

•  $n_{\text{H}_2} = \frac{1}{2}$

Total atoms =  $\frac{2}{2} \times N_A = N_A$

∴ Maximum number of atoms is in 1 g H<sub>2</sub>

85. Answer (3)

**Hint:** 1 mol contains  $N_A$  particles

**Sol.:** Number of electrons in 9.1 kg =  $10^{31}$

$$\begin{aligned} \text{Moles of electrons in 9.1 kg} &= \frac{10^{31}}{6.022 \times 10^{23}} \\ &= 1.66 \times 10^7 \end{aligned}$$

### SECTION - B

86. Answer (4)

**Hint:** moles = Molarity × volume (L)

**Sol.:**  $n_{\text{NaOH}} = 0.2 \times 0.5 = 0.1 \text{ M}$

$$\begin{aligned} m_{\text{NaOH}} &= 0.1 \times 40 \text{ g} \\ &= 4 \text{ g} \end{aligned}$$

87. Answer (4)

**Hint:** Formula mass is used for ionic solids.

**Sol.:** NaCl is ionic solid and formula mass is 58.5 u.

88. Answer (3)

**Hint:**  $M_1V_1 = M_2V_2$

**Sol.:**  $\text{AgNO}_3 + \text{NaCl} \rightarrow \text{AgCl} + \text{NaNO}_3$

$$t = 0 \quad 20 \text{ mmol} \quad 20 \text{ mmol}$$

$$t = \infty \quad 0 \quad 0 \quad 20 \text{ mmol} \quad 20 \text{ mmol}$$

$$\left[ \text{NO}_3^- \right] = \frac{20}{400} = 0.05 \text{ M}$$

89. Answer (4)

**Hint:** Limiting reagent gets consumed completely and excess reagent is calculated stoichiometrically.

**Sol.:**  $n_{\text{N}_2} = \frac{56}{28} \times 10^3 = 2 \times 10^3$

$$n_{\text{H}_2} = \frac{4.8}{2} \times 10^3 = 2.4 \times 10^3$$



$$t = 0 \quad 2 \times 10^3 \quad 2.4 \times 10^3$$

$$t = \infty \quad \left( 2 - \frac{1}{3} \times 2.4 \right) \times 10^3 \quad 0 \quad \frac{2}{3} \times 2.4 \times 10^3$$

Moles of N<sub>2</sub> left =  $1.2 \times 10^3$

$$\begin{aligned} \text{Mass of N}_2 \text{ left} &= 1.2 \times 10^3 \times 28 \text{ g} \\ &= 33.6 \text{ kg} \end{aligned}$$

90. Answer (2)

**Hint and Sol.:** Volume changes with temperature so the molarity.

91. Answer (1)

**Hint:**  $\% (w/w) = \frac{\text{mass of solute (g)} \times 100}{\text{mass of solution (g)}}$

**Sol.:**  $\% (w/w) = \frac{4.9}{14.9} \times 100 = 32.88 \%$

% (w/w) is a unitless quantity.

92. Answer (4)

**Hint:** Number of moles =  $\frac{\text{mass in g}}{\text{molar mass}}$

**Sol.:**  $\frac{w_{\text{Cl}_2}}{w_{\text{F}_2}} = \frac{1}{76}$

$$\frac{n_{\text{Cl}_2}}{n_{\text{F}_2}} = \frac{\frac{1}{71}}{\frac{1}{76}} = \frac{1}{142}$$

93. Answer (2)

**Hint:** moles =  $\frac{\text{mass in g}}{\text{molar mass}}$

**Sol.:** If a and b are molar mass of 'A' and 'B'

$$(a + b) \times 0.1 = 5$$

$$a + b = 50 \quad \dots (1)$$

$$(2a + 3b) \times 0.25 = 30$$

$$2a + 3b = 120 \quad \dots (2)$$

On solving b = 20, a = 30

94. Answer (4)

**Hint and Sol.:**

	Gives idea for
Principal quantum number	Size and energy of orbit
Azimuthal quantum number	Shape of orbital
Magnetic quantum number	Orientation of orbital
Spin quantum number	Spin of electron in orbital

95. Answer (1)

**Hint:** Radial nodes =  $n - l - 1$ **Sol.:**For  $4d_{xy}$ : Radial nodes =  $4 - 2 - 1 = 1$ For  $2p_x$ : Radial nodes =  $2 - 1 - 1 = 0$ 

96. Answer (3)

**Hint:** For hydrogen atom, energy of orbitals depends on 'n' only.**Sol.:** Energy order of orbitals of H-atom $6p > 5d = 5s > 4f$ 

97. Answer (4)

**Hint:**  $\lambda = \frac{h}{mv}$  (de-Broglie's wavelength)

$$\text{Sol.: } \lambda = \frac{6.626 \times 10^{-34}}{(10 \times 10^{-3})(1000)}$$

$$\lambda = 6.626 \times 10^{-35} \text{ m}$$

98. Answer (1)

**Hint:**  $\Delta x \cdot \Delta p \geq \frac{h}{4\pi}$ **Sol.:** If  $\Delta x = \Delta p$ 

$$(\Delta x)^2 = \frac{h}{4\pi}$$

$$\Delta x = \sqrt{\frac{h}{4\pi}}$$

99. Answer (4)

**Hint:** Smaller the energy gap between two energy levels, higher will be the wavelength.**Sol.:** In Lyman series, smallest energy gap is in between  $n = 2$  to  $n = 1$ , hence wavelength of photon emitted is highest.

100. Answer (4)

**Hint:** For g orbitals,  $l = 4$ **Sol.:** g orbitals are possible from  $n = 5$  onwards.**[BOTANY]****SECTION - A**

101. Answer (2)

**Hint:** APC is responsible for transition from metaphase to anaphase.**Sol.:** It checks chromatids separation and trigger the cell to move from metaphase to anaphase.

102. Answer (1)

**Hint:** Number of bivalents = Half of the total number of chromosomes and each bivalent has 4 chromatids.**Sol.:**  $2n = 20$ 

Bivalents = 10

Chromatids =  $10 \times 4 = 40$ .

103. Answer (1)

**Hint:** Meiosis II occurs after meiosis I.**Sol.:** Meiosis II always occurs in haploid cells.

104. Answer (3)

**Hint:** Interkinesis is the stage between telophase I and prophase II.**Sol.:** There is no replication of DNA in interkinesis.

105. Answer (1)

**Hint:** First phase of meiosis I is the longest phase.**Sol.:** Prophase I is the longest phase as it has 5 sub stages.

106. Answer (4)

**Hint:** Double metaphasic plates have homologous chromosomes.**Sol.:** Double metaphasic plates are seen during metaphase I.

107. Answer (4)

**Hint:** Total number of mitotic divisions can be calculated by formula  $(n - 1)$  where 'n' is total number of daughter cells.**Sol.:** Total number of mitotic divisions =  $(n - 1) = 128 - 1 = 127$ .

108. Answer (3)

**Hint:** Mitosis is equational division where crossing over does not take place.**Sol.:** Mitosis does not introduce variations in progeny.

109. Answer (4)

**Hint:** Splitting of centromere takes place in second last stage of karyokinesis.

**Sol.:** Anaphase is second last stage of karyokinesis where splitting of centromere takes place.

110. Answer (2)

**Hint:** Leptotene is the first stage and Diakinesis is the last stage of prophase I.

**Sol.:** The correct sequence is

Leptotene → Zygotene → Pachytene → Diplotene → Diakinesis.

111. Answer (4)

**Hint:** Mitochondria and chloroplast are semi-autonomous organelles.

**Sol.:** Mitochondria and chloroplast duplicate during G<sub>2</sub> phase.

112. Answer (3)

**Hint:** DNA replication begins in the nucleus and centriole duplication in the cytoplasm.

**Sol.:** In S phase, the number of chromosomes remains the same.

113. Answer (4)

**Hint:** Interphase is the phase where a cell prepares itself for division.

**Sol.:** M phase is actual phase of cell division.

114. Answer (1)

**Hint:** In acrocentric chromosome, one arm is very short and another is very long.

**Sol.:** In acrocentric chromosomes, the centromere is situated close to its one end.

115. Answer (3)

**Hint:** Cilia are found many in number as compared to flagella.

**Sol.:** Cilia are smaller in size as compared to flagella.

116. Answer (3)

**Hint:** Chlorophyll pigments are present in thylakoid membrane.

**Sol.:** Stroma contains proteins, DNA, RNA and ribosomes.

117. Answer (3)

**Hint:** Aleurone layer of maize has aleuroplasts to store proteins.

**Sol.:** Elaioplast stores oils and fats as in castor seeds.

118. Answer (1)

**Hint:** Nucleolus is membraneless structure helps in synthesis of a type of RNA which is a component of ribosome.

**Sol.:** Nucleolus is site for synthesis of rRNA.

119. Answer (3)

**Hint:** Lysosome is single membrane bound organelle.

**Sol.:** Centriole is membraneless.

120. Answer (4)

**Hint:** Chloroplast is seen in green cells of the plants.

**Sol.:** Chloroplast synthesizes glucose but mitochondria oxidises it.

121. Answer (4)

**Hint:** Mitochondria produce energy in the form of ATP.

**Sol.:** Mitochondria is not the part of endomembrane system. Endomembrane system has Golgi, ER, vacuole and lysosome.

122. Answer (2)

**Hint:** Plant cell wall has cellulose, hemicellulose, pectin.

**Sol.:** Algal cell wall has cellulose, mannans, galactans and minerals like calcium carbonate.

Cellulose is common between algal and plant cell wall.

123. Answer (3)

**Hint:** In active transport, molecules move against the concentration gradient.

**Sol.:** Active transport requires energy in the form of ATP.

124. Answer (4)

**Hint:** Heads of lipids in membrane are water loving or hydrophilic.

**Sol.:** Non-polar tails of saturated hydrocarbons in plasma membrane are protected from aqueous environment.

125. Answer (3)

**Hint:** Cell membrane is found in all cells.

**Sol.:** Cell wall, plastids and large-central vacuole are seen in plant cells. They all are absent in animal cells.

126. Answer (3)

**Hint:** Sap vacuoles are found in plant cells.

**Sol.:** Sap vacuoles are not inclusion bodies. They store excretory products of plant cell.

127. Answer (3)

**Hint:** Ribosomes help in protein synthesis.

**Sol.:** The ribosomes of polysome translate the mRNA into proteins.

128. Answer (4)

**Hint:** The structure in bacteria which plays role in motility is made up of flagellin protein.

**Sol.:** Flagella in prokaryotes are made up of flagellin protein and help in locomotion.

129. Answer (4)

**Hint:** Cell membrane is selectively permeable and made up of phospholipids.

**Sol.:** Cell wall prevents bacterial cell from bursting or collapsing.

130. Answer (2)

**Hint:** Bacterial cells have three layered cell envelope.

**Sol.:** Glycocalyx is the outermost and cell membrane is the innermost layer.

131. Answer (4)

**Hint:** Mesosome is infolding of plasma membrane, seen in prokaryotes.

**Sol.:** Mesosome helps in replication, cell wall formation etc. Chromatophores store pigments in photosynthetic prokaryotes.

132. Answer (1)

**Hint:** Genetic material is naked in prokaryotes.

**Sol.:** Blue green algae are prokaryotes. They have cell wall and ribosomes but they lack nuclear membrane.

133. Answer (3)

**Hint:** PPLO are smallest organisms.

**Sol.:** The largest single cell is the egg of an ostrich.

134. Answer (2)

**Hint:** Sub-metacentric chromosome has centromere slightly away from middle.

**Sol.:** Here p and q arms are small and large respectively. These chromosomes are heterobrachial chromosomes.

135. Answer (3)

**Hint:** Protein synthesis occurs in all types of cells.

**Sol.:** Ribosomes help in protein synthesis. They are seen in both types of cells. In prokaryotes, they are 70S type and in eukaryotes they are 80S type.

### SECTION - B

136. Answer (3)

**Hint:** Most of the cell organelles duplicate during Gap 1 phase.

**Sol.:** G<sub>1</sub> phase is Gap 1 phase where most of the cell organelles duplicate

137. Answer (3)

**Hint:** Best stage to study morphology of chromosomes is metaphase.

**Sol.:** To study shape of the chromosomes, the best stage is anaphase.

138. Answer (3)

**Hint:** Nucleic acid is synthesized in S phase.

**Sol.:** A bivalent is a pair of synapsed chromosomes.

139. Answer (2)

**Hint:** Centromere splits in anaphase II.

**Sol.:** Separation of homologous chromosomes takes place in anaphase I.

140. Answer (2)

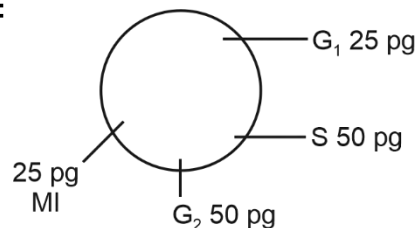
**Hint:** In zygotene, synapsis occurs.

**Sol.:** In pachytene, crossing over takes place. In Diakinesis, terminalisation of chiasmata occurs.

141. Answer (2)

**Hint:** Meiosis I products have half the number of DNA as compared to meiocyte in G<sub>2</sub> phase.

**Sol.:**



142. Answer (4)

**Sol.:** Dissolution of synaptonemal complex takes place during diplotene.

143. Answer (3)

**Hint:** Chromatin contains DNA and histones.

**Sol.:** Polyribosomes refers to the chain of ribosomes attached to the single mRNA.

144. Answer (4)

**Hint:** These are proteinaceous structures.

**Sol.:** Kinetochores are disc shaped structures present on the sides of the centromere.

145. Answer (4)

**Hint:** The cytoskeleton which is made up of tubulin proteins helps in spindle formation.

**Sol.:** Microtubules help in spindle and astral rays formation.

146. Answer (3)

**Hint:** The functions of peroxisomes are not coordinated with the organelles of endomembrane system.

**Sol.:** Peroxisome is not included in endomembrane system.

147. Answer (2)

**Hint:** Terminal part of chromosome seals the ends of a chromosome.

**Sol.:** Telomere is terminal part of chromosome which seals the ends of the chromosome.

148. Answer (1)

**Hint:** The number of doublets in flagella are 9.

**Sol.:** The number of triplets in centrioles are also 9.

149. Answer (4)

**Hint:** Glyoxysomes are found in plant cells.

**Sol.:** Glyoxysomes contain enzymes which convert fats into carbohydrates.

150. Answer (2)

**Hint:** The space between cell membrane and nuclear membrane is main arena of cellular activities.

**Sol.:** Cytoplasm is the space between cell membrane and nuclear membrane.

## [ZOOLOGY]

### SECTION - A

151. Answer (3)

**Hint:** Glycosidic bond is present in carbohydrates

**Sol.:** In proteins, amino acids are linked by peptide bond.

In polysaccharides, monosaccharides are linked by glycosidic bond.

In nucleic acid, successive nucleotides are joined by phosphodiester bond.

Ester bonds are reported in lipids.

152. Answer (3)

**Hint:** Gives 3-dimensional view of a protein

**Sol.:** Tertiary structure gives us a three dimensional view of proteins. In quaternary structure, linear strings of spheres, spheres arranged one upon each other in the form of a cube or plate is observed eg. haemoglobin.

153. Answer (3)

**Hint:** This component is also present in fungal cell wall.

**Sol.:** Cellulose and inulin are polysaccharides. Chitin is a complex polysaccharide made up of N-acetyl glucosamine.

154. Answer (1)

**Hint:** Starch holds I<sub>2</sub> due to helices

**Sol.:** In a polysaccharide chain, the right end is called the reducing end and the left end is called the non-reducing end. Eg. glycogen and starch.

155. Answer (2)

**Hint:** Proteins are heteropolymers of amino acids.

**Sol.:** RuBisCO is an enzyme. Collagen is the most abundant protein in animal world, and RuBisCO is the most abundant protein in the whole of the biosphere. Inulin is a polymer of fructose.

GLUT-4 enable glucose transport into cells.

156. Answer (4)

**Hint:** Equals to number of fingers in each limb of man

**Sol.:**

Component	% of the total cellular mass
Water	70-90
Proteins	10-15
Lipids	2
Nucleic acids	5-7

157. Answer (4)

**Hint:** Carbohydrate binding proteins.

**Sol.:**

Alkaloids	—	Morphine, codeine
Terpenoides	—	Monoterpenes, diterpenes
Polymeric substances	—	Rubber, gums, cellulose
Lectins	—	Concanavalin A

158. Answer (3)

**Hint:** ATP is a primary metabolite.**Sol.:** The compounds other than primary metabolites (have identifiable functions) are called secondary metabolites. Secondary metabolites are derived from plant, fungi and microbial cells but not animals. Nucleotides are not secondary metabolite. Some secondary metabolites have ecological importance.

159. Answer (3)

**Hint:** It is a purine**Sol.:** Purines are of two types: adenine and guanine. Adenine and guanine are substituted purines, whereas thymine, cytosine and uracil are substituted pyrimidines.

160. Answer (2)

**Hint:** Enzymes responsible for breakdown of molecules without water**Sol.:** Lyases. eg. Aldolase.

Dehydrogenases catalyses oxidation-reduction reactions.

Transferases catalyse the transfer of specific groups other than hydrogen from one substrate to another.

161. Answer (3)

**Hint:** If a phosphate group is found esterified to sugar of nucleoside they are called nucleotides.**Sol.:**

- Lecithin is a phospholipid found in cell membrane.
- Arachidonic acid has 20 carbon atoms including the carboxyl carbon.
- Uracil is a nitrogen base (pyrimidine).
- Phosphate + sugar + nitrogenous base = Nucleotide.

162. Answer (4)

**Hint:** In amino acids, R-group is variable.**Sol.:** In  $\alpha$ -amino acids, there are four substituent groups occupying the four valency positions in which a variable group is designated as 'R'-group.

R-group is hydrogen for glycine.

R-group is methyl for alanine.

R-group is hydroxy methyl for serine.

163. Answer (1)

**Hint:** Exclude carbon compounds**Sol.:** Several inorganic compounds like carbonates, phosphates, sulphates are seen in acid soluble fraction. $C_6H_{12}O_6$  (glucose) and  $C_5H_{10}O_5$  (ribose) are organic compounds.

164. Answer (1)

**Hint:** The acid soluble pool represents roughly the cytoplasmic composition.**Sol.:** If the tissue is fully burnt, all the carbon compounds are oxidized to gaseous form and the remaining substance is called 'ash'.

165. Answer (4)

**Hint:** Present in both filtrate and retentate**Sol.:** Biomolecules, on the basis of molecular weight can be classified as macromolecules and micromolecules. Carbohydrates are biomolecules but all biomolecules are not carbohydrates.

166. Answer (1)

**Hint:** Highest percent weight of element in humans as well as in earth crust.**Sol.:**

Element	% weight in	
	Earth's crust	Human body
Na	2.8	0.2
Mg	2.1	0.1
Si	27.7	Negligible

167. Answer (3)

**Hint:**  $Cl_3COOH$ **Sol.:** Glycerol is trihydroxy propane. Palmitic acid is a fatty acid which has 16 carbon atoms including carboxyl carbon. Stearic acid is a saturated fatty acid.

168. Answer (3)

**Hint:** Constitutes 70-90% of the total cellular mass**Sol.:** If we perform chemical analysis on a plant tissue, animal tissue or a microbial paste we obtain a list of several elements (C, H, O, etc) and their respective content (almost similar) per unit mass of living tissue.

Water is the most abundant chemical in living organisms.

169. Answer (1)

**Hint:** It is an unstable structure**Sol.:** During the state where the substrate is bound to the active site of enzyme, a new structure of the substrate called transition state structure is formed.

170. Answer (1)

**Hint:** Enzymes are biochemical catalysts.**Sol.:** Almost all enzymes are proteins. There are some nucleic acids that behave like enzymes. These are called ribozymes.

171. Answer (2)

**Hint:** The main function is to move particles in specific direction.

**Sol.:** The main function of ciliated epithelium is to move particles or mucus in a specific direction. They are mainly present in the inner surface of hollow organs.

Transitional epithelium lines the inner surface of the urinary bladders and ureters.

Compound epithelium is made up of more than one layers of cells.

172. Answer (4)

**Hint:** *Hydra* is a simple organism

**Sol.:** Cells, tissues, organs and organ systems split up the work in a way that exhibits division of labour and contribute to the survival of body as a whole.

173. Answer (4)

**Hint:** Complex animals consist of only four types of tissue

**Sol.:** Cells, tissues, organs and organ systems split-up the work in a way that exhibits division of labour and contributes to the survival of the body as a whole. Epithelial tissue has a free surface, which faces either a body fluid or the outside environment and thus provides a covering or a lining for some part of the body.

174. Answer (1)

**Hint:** Bone-forming cells

**Sol.:** Bones have special bone-forming cells called osteoblasts that produce new osteocytes.

Lacunae are fluid-filled spaces present in cartilage as well as bones.

Long bones possess a cavity which is filled with bone marrow. Ground substance of tissues is called the matrix.

175. Answer (3)

**Hint:** Structures which form the contractile tissue

**Sol.:** Skeletal muscle fibres together form the skeletal muscle tissue.

Adipose tissue is a type of loose connective tissue located mainly beneath the skin.

Ligament is a type of dense regular connective tissue.

Blood is a specialised connective tissue.

176. Answer (4)

**Hint:** Neuroglia are non-excitabile cells of neural tissue.

**Sol.:** Simple epithelium is composed of a single layer of cells.

Cuboidal epithelium is composed of a single layer of cube-like cells found in tubular parts of nephrons, PCT, DCT, etc.

Neuroglia make up more than one half the volume of neural tissue in our body.

Smooth muscle fibres taper at both ends, do not show striations and are involuntary.

177. Answer (2)

**Hint:** Unique feature of cardiac muscle

**Sol.:** In cardiac muscle, junctions at fusion points allow the cells to contract as a unit. Cell junctions fuse the plasma membranes of cardiac muscle cells and make them stick together. Communication junctions at some fusion points allow movement of ions in between adjacent cells, so they function as a unit.

Neurons and neuroglia constitute neural tissue.

178. Answer (4)

**Hint:** Chemical messengers

**Sol.:** The endocrine glands are involved in the secretion of hormones whereas enzymes, earwax and saliva are the secretions of glands with ducts *i.e.*, exocrine glands.

179. Answer (3)

**Hint:** Sites for digestion

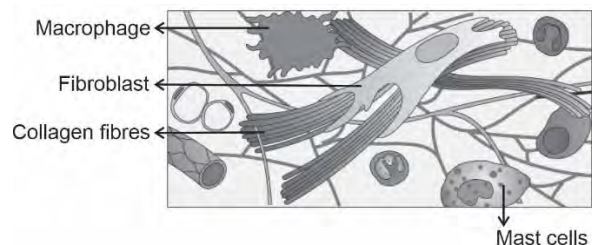
**Sol.:** Columnar epithelium is found in the lining of stomach and intestine and helps in secretion and absorption.

Wall of blood vessels	Squamous epithelium
Tubular parts of nephron	Cuboidal epithelium
Bronchioles and fallopian tube	Ciliated epithelium

180. Answer (4)

**Hint:** Involved in allergic reactions

**Sol.:** Mast cells are involved in the secretion of heparin, histamine and serotonin.



Histamine – Vasodilator

Heparin – Anti-coagulant

Serotonin – Vasoconstrictor

181. Answer (4)

**Hint:** Tissue which links and supports other tissues/organs

**Sol.:** Connective tissues are named so, because of their special function of linking and supporting other tissues/organs of the body. They range from soft connective tissues to specialized types, which include cartilage, bone, adipose and blood.

182. Answer (2)

**Hint:** Bones are rich in  $\text{Ca}^{2+}$  ions.

**Sol.:** Bones have a hard and non-pliable ground substance. The bone marrow in some bones is the site of production of blood cells. Bone also interact with skeletal muscles attached to them to bring about movements.

183. Answer (2)

**Hint:** This tissue has cells and fibres loosely arranged in semifluid ground substance.

**Sol.:** Tissues are classified into four types:

(i) Epithelial, (ii) Connective, (iii) Muscular and (iv) Neural.

Connective tissues are named so because of their special function of linking and supporting other tissues/organs of the body.

184. Answer (2)

**Hint:** This epithelium is mainly present in the inner surface of hollow organs.

**Sol.:** The function of ciliated epithelium is to move particles or mucus in a specific direction over the epithelium.

They are mainly present in the inner surface of hollow organs like bronchioles and fallopian tubes

185. Answer (2)

**Hint:** CNS is mainly formed by this tissue

**Sol.:** Nervous tissue is concerned with control and co-ordination.

Epithelial tissue is involved in secretion and absorption. Muscular tissue is responsible for movement of body parts. Connective tissue links and supports other tissues/organs of the body.

### SECTION - B

186. Answer (4)

**Hint:** According to Chargaff's rule ( $[A] = [T]$ ,  $[G] \equiv [C]$ )

**Sol.:** G is 40% of 500 = 200

So,  $(G = C)$  i.e.,  $C = 200$

10% A = 50, 10% T = 50.

187. Answer (2)

**Hint:** Inhibitor which resembles the substrate.

**Sol.:** Malonate closely resembles the substrate succinate in structure. Such competitive inhibitors are often used for the control of bacterial pathogens.

In non-competitive inhibition,  $V_{\text{max}}$  changes and  $K_m$  remains the same.

188. Answer (3)

**Hint:** Enzymes increase the rate of reaction

**Sol.:** In catalysed reactions, the rate of reaction would be vastly higher than the same but uncatalyzed reaction. Carbonic anhydrase accelerates the reaction rate by 10 million times.

189. Answer (2)

**Hint:** Living organisms work continuously.

**Sol.:** The living state is a non-equilibrium steady-state to be able to perform work. Without metabolism there cannot be a living state.

190. Answer (4)

**Hint:** Identify a nucleotide

**Sol.:** Living organisms have learnt to trap energy liberated during degradation and store it in the form of chemical bonds as in ATP.

191. Answer (2)

**Hint:** A component of haemoglobin

**Sol.:** Haem is the prosthetic group for peroxidase and catalase. NAD and NADP are co-enzymes.

192. Answer (3)

**Hint:** Apoenzyme is the protein portion of the enzyme.

**Sol.:** Co-factors may be identified as—

Prosthetic groups, co-enzymes and metal ions. Prosthetic groups are organic compounds and are distinguished from other co-factors in that they are tightly bound to apoenzyme.

193. Answer (4)

**Hint:** Pentose sugar

**Sol.:** When oxygen is absent at the 2<sup>nd</sup> carbon of ribose, it is known as deoxyribose (present in DNA).

Glucose and fructose are hexoses.

Ribose is a pentose sugar.

194. Answer (4)

**Hint:** Proteins secreted by B-lymphocytes

**Sol.:** Antibodies (immunoglobulins) are synthesized by plasma cells, which are modified B-lymphocytes. Heparin, histamine and serotonin are secretions of mast cells.

195. Answer (2)

**Hint:** Fallopian tubes

**Sol.:**

Lining of duct of salivary glands	Compound epithelium
Tubular part of nephrons	Simple cuboidal epithelium
Inner surface of bronchioles and oviducts	Ciliated epithelium

196. Answer (4)

**Hint:** Stomach, lung, heart and kidney

**Sol.:** When two or more organs perform a common function by their physical and /or chemical interaction, they together form the organ system.

197. Answer (3)

**Hint:** Given muscle fibres are spindle shaped

**Sol.:** The smooth muscle fibres taper at both ends (fusiform) and do not show striations. These muscles are involuntary.

198. Answer (4)

**Hint:** Fluid connective tissue

**Sol.:** Blood is a fluid connective tissue, containing plasma, RBCs and WBCs. Fibres and fibroblasts are absent in blood.

Smooth muscles are reported in the wall of blood vessels, stomach and intestine.

199. Answer (1)

**Hint:** Gap junction responsible for connecting cytoplasm of adjacent cells

**Sol.:**

Adhering junctions	Keep neighbouring cells together
Gap junctions	For rapid transport of ions
Tight junctions	Help to stop substances from leaking across a tissue

200. Answer (3)

**Hint:** Epithelium which has limited role in secretion and absorption.

**Sol.:** Main function of compound epithelium is to provide protection against chemical and mechanical stresses.

Simple epithelium is composed of a single layer of cells and functions as a lining for body cavities, ducts and tubes.

