

## All India Aakash Test Series for NEET-2024

**TEST - I (Code-E)**

Test Date : 05/11/2023

**ANSWERS**

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

# HINTS & SOLUTIONS

## [PHYSICS]

### SECTION - A

1. Answer (2)

**Hint:** Displacement is change in position with time.

**Sol.:** Displacement =  $(4\hat{i} - 3\hat{j})$  km

|Displacement| = 5 km

$\therefore$  Displacement = 5 km,  $37^\circ$  S of E

2. Answer (1)

**Hint:**  $v_{\text{avg}} = \frac{v_1 + v_2}{2}$

**Sol.:**  $v_{\text{avg}} = \frac{s_1 + s_2}{t_1 + t_2} = \frac{[v_1 + v_2]t}{2t}$

$v_{\text{avg}}$  is arithmetic mean of two speeds

$\Rightarrow v_{\text{avg}} = 5$  m/s

3. Answer (1)

**Hint:** Use  $v = \sqrt{v_x^2 + v_y^2}$  and  $a = \sqrt{a_x^2 + a_y^2}$

**Sol.:**  $x = 2t^2$ ,  $y = 3t$

$v_x = 4t$   $v_y = 3$

$a_x = 4$   $a_y = 0$

At  $t = 1$  s,  $v_x = 4$  m/s and  $v_y = 3$  m/s

$\therefore v = \sqrt{4^2 + 3^2} = 5$  m/s

$a = 4$  m/s<sup>2</sup>

4. Answer (3)

**Hint:**  $v = 25 - 2 \times 10 = 5$  m/s (velocity after 2 s)

**Sol.:**  $0 = 25 - 10t$ ,  $t = 2.5$

$0 = 5^2 - 2 \times 10 \times s$

$s = 1.25$  m

Distance covered in third second =  $2$  s = 2.5 m

5. Answer (1)

**Hint & Sol.:** All the non-zero digits are significant.

If a number is less than 1, zeroes on the right of the decimal point but to the left of the first non-zero digit are non-significant.

6. Answer (4)

**Hint:** Acceleration  $\bar{a} = \frac{d\bar{v}}{dt}$

**Sol.:**  $\bar{v} = \frac{d\bar{s}}{dt} = 6t^2 + 6t + 2$

$\bar{a} = \frac{d\bar{v}}{dt} = 12t + 6$

$a = 0 \Rightarrow 12t + 6 = 0$

$12t = -6$

$t = -\frac{1}{2}$  which is impossible

7. Answer (4)

**Hint & Sol.:** [Energy] = [E] = [M L<sup>2</sup> T<sup>-2</sup>]

[P] = [M L T<sup>-1</sup>]

Area [A] = [L<sup>2</sup>]

$\therefore [E] = [M L T^{-1}] [L T^{-1}]$

= [P A<sup>1/2</sup> T<sup>-1</sup>]

8. Answer (3)

**Hint & Sol.:** Both the statements given in question are correct with regard to significant figures.

9. Answer (3)

**Hint:** Acceleration in terms of velocity and displacement  $a = v \frac{dv}{ds}$

**Sol.:**  $\frac{dv}{ds} = 2Ks$

$a = Ks^2 \times 2Ks$

$a = 2K^2s^3$

$a \propto s^3$

10. Answer (1)

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

**Sol.:** Let it takes 't' time to strike the ground

$s_t - s_{t-1} = 25$

$\frac{1}{2}gt^2 - \frac{1}{2}g(t-1)^2 = 25$

On solving  $t = 3$  s

$h = \frac{1}{2}g(t^2)$

$h = 45$  m

11. Answer (2)

**Hint:** Use equation  $v = u + at$

**Sol.:**  $v = a_0 \times t = 4 \times 5$   
 $= 20 \text{ m/s}$

12. Answer (3)

**Hint:** Use equation of trajectory  $y = x \tan\theta \left[1 - \frac{x}{R}\right]$

**Sol.:**  $y = \sqrt{3}x - \frac{1}{2}x^2 = \sqrt{3}x \left[1 - \frac{x}{2\sqrt{3}}\right]$

$\tan\theta = \sqrt{3}$

$\theta = 60^\circ$

13. Answer (3)

**Hint and Sol.:**  $\vec{A} - 2\vec{B}$

$= (\hat{i} + \hat{j} + \hat{k}) - 2(\hat{i} + \hat{j} + 2\hat{k})$

$\vec{A} - 2\vec{B} = -\hat{i} - \hat{j} - 3\hat{k}$

$|\vec{A} - 2\vec{B}| = \sqrt{1+1+9} = \sqrt{11}$

14. Answer (3)

**Hint:**  $KE = \frac{1}{2}mv^2$

**Sol.:** Unit of KE = Mass  $\left[\frac{\text{Length}}{\text{Time}}\right]^2$

$= 100\text{g} \times \left(\frac{1\text{cm}}{10\text{s}}\right)^2$

$= 1 \text{ g cm}^2/\text{s}^2 = 1 \text{ erg}$

15. Answer (1)

**Hint:** Relative error in  $v =$  Relative error in  $s +$  Relative error in  $t$

**Sol.:** We know,  $v = \frac{s}{t} = \frac{100}{10} = 10 \text{ m/s}$

Also,  $\frac{\Delta v}{v} = \frac{\Delta s}{s} + \frac{\Delta t}{t}$

$\frac{\Delta v}{10} = \frac{0.1}{100} + \frac{0.1}{10}$

$\Delta v = 10 \left(\frac{0.1}{100} + \frac{1}{100}\right)$

$\Delta v = \frac{1.1}{10} = 0.11$

$\therefore v = (10 \pm 0.11) \text{ m/s}$

16. Answer (3)

**Hint & Sol.:** In a number with decimal, all trailing zeroes are significant and zeroes between two non-zero digits are significant.

$\therefore$  Number of significant zeroes will be 3.

17. Answer (2)

**Hint & Sol.:**

Instantaneous velocity  $v = \frac{dx}{dt} = \sqrt{\alpha} \times x^{1/2}$

$\frac{dx}{\sqrt{x}} = \sqrt{\alpha} dt$

On integration

$\int_0^x \frac{1}{\sqrt{x}} dx = \int_0^t \sqrt{\alpha} dt$

$x = \frac{1}{4} \alpha t^2$

18. Answer (1)

**Hint:**  $R = u_x \times T$

**Sol.:**  $800 = u_x(40)$

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

19. Answer (4)

**Hint & Sol.:** Initial velocity of object  $v = 0$

$\therefore$  Initial acceleration  $a = \alpha - (\beta \times 0) = \alpha$

20. Answer (2)

**Hint:** Area under  $a-t$  curve give change in velocity.

**Sol.:** At  $t = 0, u = 0$

$v = u + at \Rightarrow v = 0 + 2 \times 2 = 4 \text{ m/s} \quad \dots(i)$

from  $t = 2 \text{ s}$  to  $t = 4 \text{ s}$

$v = u + at \Rightarrow v = 4 + (-2) \times 2 = 0 \quad \dots(ii)$

from  $t = 4 \text{ s}$  to  $t = 6 \text{ s}$

$v = u + at \Rightarrow v = 0 + (-2) \times 2 = -4$

but  $|\vec{v}| = 4 \text{ m/s}$

Also, since acceleration is constant for  $t = 0$  to  $t = 2$  and for  $t = 2$  to  $t = 6$ , therefore slope of  $v-t$  curve will also be constant.

21. Answer (2)

**Hint:** Lest count = 1 MSD – 1 VSD

**Sol.:**  $n \text{ VSD} = (n - 2) \text{ MSD}$

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

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

$$\frac{2}{n} \text{MSD} = \frac{2}{n} \times (a \text{ mm})$$

$$= \frac{2a}{n} \text{ mm}$$

22. Answer (3)

**Hint & Sol.:**  $S_{n^{\text{th}}} = u + \frac{a}{2}(2n-1)$

$$S_{5^{\text{th}}} = 0 + \frac{2}{2}(2 \times 5 - 1) = 9 \text{ m}$$

23. Answer (1)

**Hint:** Displacement in y-direction is

$$s_y = u_y t + \frac{1}{2} a_y t^2$$

**Sol.:**  $s_y = 2t - \frac{1}{2} \times 10t^2$

$$y = s_y = 2t - 5t^2$$

$$\text{and } x = u_x t = t$$

$$\text{So, equation } 5x^2 - 2x + y = 0$$

24. Answer (2)

**Hint & Sol.:** Torque and work have same dimensional formula.  $[ML^2T^{-2}]$

25. Answer (2)

**Hint:** Use equations of uniformly accelerated motion.

**Sol.:**  $v = u + at$ ,  $v = 0$ ,  $u = 12$ ,  $a = (10 + x)$

$$\Rightarrow 12 = (10 + x) \times 1 \Rightarrow x = 2 \text{ m/s}^2$$

$$H_{\text{max}} = \frac{u^2}{2a} = \frac{12 \times 12}{2 \times 12} = 6 \text{ m}$$

26. Answer (2)

**Hint & Sol.:** Area under acceleration-time graph gives change in velocity.

27. Answer (2)

**Hint & Sol.:**

- Distance  $\geq$  |Displacement|
- Speed of a particle can never be negative.

28. Answer (2)

**Hint & Sol.:** In non uniform circular motion, velocity changes continuously.

29. Answer (1)

**Hint & Sol.:** Path of one projectile as seen from another projectile is a straight line.

30. Answer (3)

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

**Sol.:**  $a = 15 \times 5 = 75 \text{ m/s}^2$

31. Answer (3)

**Hint:**  $\bar{a} = \frac{d\bar{v}}{dt}$

**Sol.:** Acceleration = Slope of  $v-t$  curve

32. Answer (3)

**Hint:** For maximum range condition,  $\theta = 45^\circ$

**Sol.:**  $R = 4H \cot\theta$

$$R = 4H \cot 45^\circ$$

$$H = \frac{R}{4} = \frac{500}{4} = 125 \text{ m}$$

33. Answer (2)

**Hint:**  $R = \frac{2u_x u_y}{g}$  and  $H = \frac{u_y^2}{2g}$

**Sol.:**  $\frac{2u_x u_y}{g} = n \frac{u_y^2}{2g}$

$$4(u \cos\theta) = n u \sin\theta$$

$$\frac{4}{n} = \tan\theta$$

$$\theta = \tan^{-1}\left(\frac{4}{n}\right)$$

34. Answer (4)

**Hint:** Comparing with equation of trajectory

$$y = x \tan\theta - \frac{g \cdot x^2}{2u^2 \cos^2\theta}$$

**Sol.:** We get  $\tan\theta = \sqrt{3}$  and  $u^2 \cos\theta = 1$

$$\Rightarrow u \cos\theta = 1$$

$$\therefore \theta = 60^\circ \text{ and } u = 2 \text{ m/s}$$

$$T = \frac{2u \sin\theta}{g} = \frac{2 \times 2 \times \sqrt{3}}{2 \times 10} = \frac{\sqrt{3}}{5} \text{ s}$$

35. Answer (4)

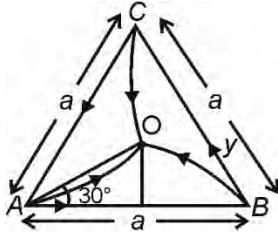
**Hint & Sol.:** Angular speed remains constant in uniform circular motion.

### SECTION - B

36. Answer (3)

**Hint:** Use concept of relative velocity

Sol.:



$$t = \frac{a}{v + v \cos 60^\circ} = \frac{a}{v + \frac{v}{2}} = \frac{a}{\frac{3v}{2}} = \frac{2a}{3v}$$

37. Answer (2)

Hint & Sol.:

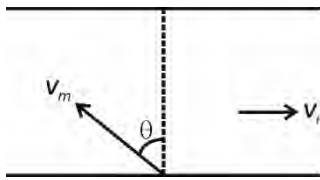
$$\frac{\Delta Z}{Z} \times 100\% = 3 \left( \frac{\Delta A}{A} \times 100\% \right) + \frac{1}{2} \left( \frac{\Delta B}{B} \times 100\% \right) + \left( \frac{\Delta C}{C} \times 100\% \right) + 2 \left( \frac{\Delta D}{D} \times 100\% \right)$$

$$\frac{\Delta Z}{Z} \times 100\% = 3 \times (1) + \frac{1}{2} \times (2) + (3) + 2 \times (1) = 3 + 1 + 3 + 2 = 9\%$$

38. Answer (3)

Hint: To cross a river along shortest path, the velocity of the man w.r.t. ground should be perpendicular to the river flow.

Sol.:



$$v_m \sin \theta = v_r \Rightarrow 2 \sin \theta = 1 \Rightarrow \sin \theta = \frac{1}{2}$$

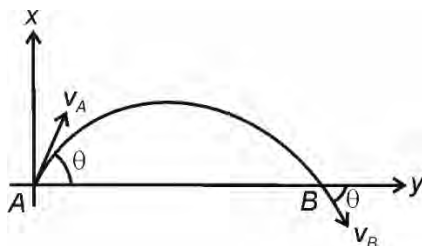
$$\therefore \theta = 30^\circ$$

Time to cross the river

$$t = \frac{d}{v_m \cos \theta} = \frac{1}{2 \cos 30^\circ} = \frac{1}{\sqrt{3}} \text{ h}$$

39. Answer (4)

Hint & Sol.:



$$\vec{v}_A = (\hat{i} + 3\hat{j}) \text{ m/s}$$

$$\vec{v}_B = (\hat{i} - 3\hat{j}) \text{ m/s}$$

40. Answer (3)

Hint: According to direction cosines

$$\cos \gamma = \frac{a_z}{|\vec{a}|}$$

$$\text{Sol.: } \cos \gamma = \frac{5}{\sqrt{3^2 + 4^2 + 5^2}} = \frac{5}{\sqrt{50}}$$

$$= \frac{5}{5\sqrt{2}} = \frac{1}{\sqrt{2}}$$

$$\gamma = 45^\circ$$

41. Answer (3)

Hint: Energy [E] = [M L<sup>2</sup> T<sup>-2</sup>]

$$\text{Sol.: } [M L^2 T^{-2}] = M^x (T^{-1})^y (L)^z$$

$$\Rightarrow x = 1, z = 2, y = 2$$

$$\therefore 2x + y + z = 6$$

42. Answer (3)

Hint & Sol.: Change in either direction or magnitude of velocity or both means non-zero acceleration.

43. Answer (2)

Hint & Sol.: Unit of acceleration is m/s<sup>2</sup>

$$\therefore [a] = [M^0 L T^{-2}]$$

44. Answer (2)

$$\text{Hint: Time} = \frac{\text{Separation}}{\text{Relative speed}}$$

$$\text{Sol.: } t = \frac{45}{40 + 50} \Rightarrow t = \frac{1}{2} \text{ s}$$

45. Answer (1)

Hint: Change in velocity = Area under a-t graph

$$\text{Sol.: } v_{\text{final}} - v_{\text{initial}} = 20$$

$$v_f = 23 \text{ m/s}$$

46. Answer (2)

Hint: According to Galileo's law of odd numbers, the distances traversed during equal intervals of time by freely falling body is in the ratio of odd numbers.

$$\therefore d_1 : d_2 : d_3 = 1 : 3 : 5$$

47. Answer (3)

**Hint & Sol.:** Speed  $|\vec{v}| = \frac{dx}{dt} = 13 \text{ m/s}$

48. Answer (4)

**Hint & Sol.:** The time taken to reach ground depends on height from which the bodies are dropped. It is independent of mass of body.

49. Answer (2)

**Hint:** Displacement in  $n^{\text{th}}$  second is given by

$$S_{n^{\text{th}}} = u + \frac{a}{2}(2n - 1)$$

**Sol.:**  $S_{n^{\text{th}}} = u + \frac{a}{2}(2n - 1)$

$$S_{6^{\text{th}}} = 57 - \frac{10}{2}(2 \times 6 - 1)$$

$$= 57 - 55 = 2 \text{ m}$$

50. Answer (2)

**Hint & Sol.:** At maximum height, velocity becomes zero due to retardation but acceleration due to gravity remains unchanged *i.e.*,  $g$  downwards.

## [CHEMISTRY]

### SECTION - A

51. Answer (1)

**Hint:** Mol of sucrose =  $400 \times 0.5 \times 10^{-3} = 2 \times 10^{-1}$

**Sol.:** Number of sucrose molecules

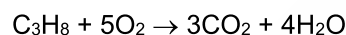
$$= 2 \times 10^{-1} \times 6.02 \times 10^{23}$$

$$= 12.04 \times 10^{22}$$

$$= 1.2 \times 10^{23}$$

52. Answer (4)

**Hint:** Combustion of propane takes place as:-

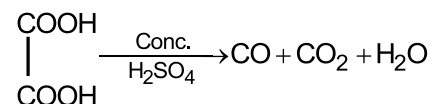
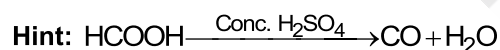


**Sol.:** Mole of  $\text{C}_3\text{H}_8 = \frac{176}{44} = 4$

Mole of  $\text{O}_2$  reacted =  $5 \times 4 = 20$

$\therefore$  Volume of  $\text{O}_2$  required at STP =  $20 \times 22.4 = 448 \text{ L}$

53. Answer (4)



**Sol.:** Mole of oxalic acid =  $\frac{18}{90} = 0.2$

Mole of formic acid =  $\frac{4.6}{46} = 0.1$

KOH pellets absorbs  $\text{CO}_2$

Mole of  $\text{CO}$  evolved =  $0.2 + 0.1 = 0.3$

Mass of  $\text{CO} = 0.3 \times 28 = 8.4 \text{ g}$

54. Answer (3)

**Hint:** Strength ( $\text{gL}^{-1}$ ) is mass of solute in gram present in 1000 ml solution.

**Sol.:** 4 mole of  $\text{NaOH}$  is present in 1000 mL of solution

Mass of  $\text{NaOH} = 40 \times 4 = 160 \text{ g}$

Hence Strength =  $160 \text{ gL}^{-1}$

55. Answer (2)

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

**Sol.:**

Species	No. of electrons
$\text{B}^{3+}$	2
$\text{H}^+$	0
$\text{Li}^+$	2
$\text{He}^+$	1
$\text{Mg}^{2+}$	10

56. Answer (3)

**Hint:** Orbital angular momentum =  $\sqrt{\ell(\ell+1)}\hbar$

**Sol.:** Orbital angular momentum of electron in  $3p$  orbital =  $\sqrt{1(1+1)}\hbar$

$$= \sqrt{2}\hbar$$

57. Answer (4)

**Hint & Sol.:** As per Dalton's atomic theory all atoms of a given element have identical properties, including identical mass. Atoms of different elements differ in mass.

58. Answer (3)

**Hint:** For neutral atom, number of protons = number of electrons

**Sol.:** Number of protons = 90

Number of electrons = 90

Number of neutrons = 231 – 90 = 141

59. Answer (3)

**Hint:** Energy of radiation is given as:

$$E = \frac{hc}{\lambda}$$

$$E \propto \frac{1}{\lambda}$$

$$\text{Sol.}: \frac{E_1}{E_2} = \frac{\lambda_2}{\lambda_1}$$

$$\Rightarrow \frac{10}{40} = \frac{\lambda_2}{\lambda_1}$$

$$\Rightarrow \lambda_1 = 4\lambda_2$$

60. Answer (3)

**Hint:** According to the de Broglie hypothesis,

$$\lambda = \frac{h}{mv}$$

$$\text{Sol.}: \text{Velocity } (v) = \frac{1800 \times 10^3 \text{ m}}{3600 \text{ s}}$$

$$= 500 \text{ ms}^{-1}$$

$$\lambda = \frac{h}{mv}$$

$$\lambda = \frac{6.6 \times 10^{-34}}{4 \times 10^{-6} \times 500}$$

$$\lambda = 3.3 \times 10^{-31} \text{ m}$$

61. Answer (4)

**Hint:** Azimuthal quantum number ( $\ell$ ) defines the three-dimensional shape of the orbital.

**Sol.:** For a given value of  $n$ ,  $\ell$  can have  $n$  values ranging from 0 to  $n - 1$ .

62. Answer (3)

$$\text{Hint: } \frac{1}{\lambda} = R_H \left( \frac{1}{n_1^2} - \frac{1}{n_2^2} \right)$$

**Sol.:** For longest wavelength in Paschen series,  $n_1 = 3$  and  $n_2 = 4$

$$\bar{\nu} = \frac{1}{\lambda} = R_H \left( \frac{1}{3^2} - \frac{1}{4^2} \right)$$

$$\bar{\nu} = R_H \left( \frac{16 - 9}{9 \times 16} \right)$$

$$\bar{\nu} = \frac{7R_H}{144}$$

63. Answer (4)

**Hint:** X-rays have highest frequency among the given options.

**Sol.:** Energy of radiations

X rays > UV > IR > Microwave

Wavelength of radiations :

Microwave > IR > UV > X rays

64. Answer (3)

**Hint:** Mole of a gas =  $\frac{\text{Mass of gas}}{\text{Molar mass of gas}}$

**Sol.:**

- Mole of methane ( $\text{CH}_4$ ) =  $\frac{1}{16}$

$$\text{Mole of atoms of } \text{CH}_4 = \frac{1}{16} \times 5 = \frac{5}{16}$$

$$\text{Number of atoms of } \text{CH}_4 = \frac{5}{16} N_A$$

- Mole of sulphur dioxide ( $\text{SO}_2$ ) =  $\frac{2}{64} = \frac{1}{32}$

$$\text{Mole of atoms of } \text{SO}_2 = \frac{3}{32}$$

$$\text{Number of atoms of } \text{SO}_2 = \frac{3}{32} N_A$$

$$\frac{\text{Number of atoms of } \text{CH}_4}{\text{Number of atoms of } \text{SO}_2} = \frac{5}{16} N_A \times \frac{32}{3N_A}$$

$$= 10 : 3$$

65. Answer (2)

**Hint:** Number of angular nodes =  $\ell$

Number of radial nodes =  $(n - \ell - 1)$

**Sol.:** For  $4f$  orbital number of angular nodes = 3

Number of radial nodes =  $4 - 3 - 1 = 0$

66. Answer (4)

**Hint:** Mole fraction of solute

$$= \frac{\text{Mole of solute}}{\text{Mole of solute} + \text{Mole of solvent}}$$

**Sol.:** Mole of solute = 9.45

$$\text{Mole of H}_2\text{O (Solvent)} = \frac{1000}{18} = 55.55$$

Mole fraction of solute

$$= \frac{9.45}{55.55 + 9.45} = \frac{9.45}{65} = 0.145$$

67. Answer (1)

**Hint:** Mole of  $\text{HNO}_3$  present in 800 mL of 4 M  $\text{HNO}_3 = 800 \times 4 \times 10^{-3} = 3.2$

**Sol.:** Mass of  $\text{HNO}_3 = 3.2 \times 63 = 201.6$  g

70 g of  $\text{HNO}_3$  is present in 100 g of  $\text{HNO}_3$

1 g of  $\text{HNO}_3$  is present in  $\frac{100}{70}$  g of  $\text{HNO}_3$

201.6 g  $\text{HNO}_3$  is present in  $\frac{100}{70} \times 201.6$  g of  $\text{HNO}_3$

= 288 g

68. Answer (1)

**Hint:** Average atomic mass of 'X'

$$= \frac{\sum \text{Isotopic mass} \times \text{percentage}}{100}$$

**Sol.:** Average atomic mass of 'X'

$$= \frac{144 \times 40 + 142 \times 20 + 146 \times 40}{100}$$

$$= \frac{5760 + 2840 + 5840}{100} = 144.4 \text{ u}$$

69. Answer (4)

**Hint:**

$$\text{Mole of atom (element)} = \frac{\text{Mass percentage of atom}}{\text{Molar mass of atom}}$$

**Sol.:**

Element	Mass percentage	Mole	Relative no. of mole
C	67.9%	$\frac{67.9}{12} = 5.66$	3
H	5.7%	$\frac{5.7}{1} = 5.7$	3
N	26.4%	$\frac{26.4}{14} = 1.88$	1

Empirical formula of organic compound =  $\text{C}_3\text{H}_3\text{N}$

70. Answer (2)

**Hint:** • For multielectron species, higher is the value of  $(n + \ell)$ , higher is the energy of orbital.

• For same value of  $(n + \ell)$ , higher is the value of  $n$ , higher is the energy of orbital.

**Sol.:** •  $(n + \ell)$  for  $5d$  and  $4f$  are 7, hence the orbital with higher value of  $n$  has higher energy.

• Correct order of energy of given orbitals :  
 $5d > 4f > 5p > 5s$

71. Answer (4)

**Hint:** Cathode rays start from cathode and move towards anode.

**Sol.:** The characteristics of cathode rays (electrons) do not depend upon the material of the electrodes and the nature of the gas present in the cathode ray tube.

72. Answer (2)

**Hint:**  $n\lambda = 2\pi r_n$

$$r_n = a_0 n^2 \text{ [for H atom]}$$

**Sol.:**  $r_3 = a_0 n^2$

$$n\lambda = 2\pi r_n$$

$$\lambda = \frac{2\pi r_n}{n}$$

$$\lambda = \frac{2\pi \times 52.9 \times 3 \times 3}{3}$$

$$\lambda = 317.4\pi$$

73. Answer (3)

**Hint:**  $\ell = 3$  corresponds to  $f$  orbital.

**Sol.:** For  $\ell = 3$ , the total number of orbitals

$$= (2\ell + 1) = 2 \times 3 + 1 = 7$$

74. Answer (3)

**Hint:** For  $\ell = 2$ , the value of  $m$  can be  $-2, -1, 0, +1, +2$

**Sol.:** For  $\ell = 0, m = 0$

For  $n = 1, \ell = 0$

Hence incorrect set is (b), (c) and (d)

75. Answer (1)

**Hint:**  $E = hv$ 

**Sol.:**  $v = \frac{E}{h}$

$$v = \frac{3 \times 1.6 \times 10^{-19}}{6.6 \times 10^{-34}}$$

$$v = 0.727 \times 10^{15}$$

$$= 7.3 \times 10^{14} \text{ Hz}$$

76. Answer (3)

**Hint:** Closer is the electron to the nucleus, difficult it is to remove it from the atom.**Sol.:** • The number of electrons ejected is proportional to the intensity of light used.

- Outer electron in sodium is more close to nucleus hence it is difficult to remove electron from it as compared to potassium.

77. Answer (3)

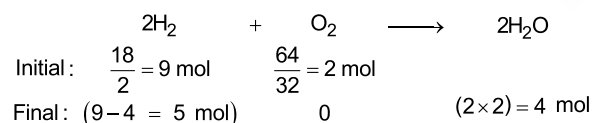
**Hint:** For minimum molar mass, one molecule of enzyme should contain one atom of selenium.**Sol.:** 0.2 g of selenium is present in 100 g of enzyme.79 g of selenium is present in  $\frac{100 \times 79}{0.2}$  g of

enzyme

$$= 39500$$

$$\text{Molar mass of enzyme} = 39500 \text{ g mol}^{-1}$$

78. Answer (3)

**Hint:**  $2 \text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$ 2 moles of  $\text{H}_2$  react with one mole of  $\text{O}_2$  to give 2 moles of  $\text{H}_2\text{O}$ **Sol.:**

79. Answer (3)

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

**Sol.:** Number of atoms of  $\text{CaCO}_3 = \frac{10}{100} \times 5 \times N_A$

$$= 0.5 N_A$$

Number of atoms of  $\text{SO}_3 = \frac{20}{80} \times 4 \times N_A = N_A$

Number of atoms of  $\text{CH}_4 = \frac{6.72}{22.4} \times 5 \times N_A = 1.5 N_A$

Number of atoms of  $\text{NH}_3 = \frac{4.48}{22.4} \times 4 N_A = 0.8 N_A$

80. Answer (4)

**Hint:** 100 g solution contains 98 g  $\text{H}_2\text{SO}_4$ 

**Sol.:** Volume of concentrated acid =  $\frac{100}{1.7}$  mL

Molarity of acid =  $\frac{98 \times 1000}{98 \times \frac{100}{1.7}}$

$$= \frac{1000 \times 1.7}{100} = 17 \text{ M}$$

Let volume of concentrated acid required is V mL

$$V \times 17 = 2500 \times 0.5$$

$$V = \frac{2500 \times 0.5}{17} = 73.5 \text{ mL}$$

81. Answer (1)

**Hint:** 100 L of air contains 78 L of  $\text{N}_2$  at STP

**Sol.:** Volume of  $\text{N}_2$  in 5 L air at STP =  $\frac{78 \times 5}{100} = 3.9 \text{ L}$

Number of atoms of nitrogen =  $\frac{3.9 \times 2 \times N_A}{22.4} = 0.35 N_A$

82. Answer (4)

**Hint:**  $\text{MgCO}_3 \xrightarrow{\Delta} \text{MgO} + \text{CO}_2(\text{g})$ 

**Sol.:** Mole of  $\text{CO}_2 = \frac{5.6}{22.4} = 0.25$

Mole of  $\text{MgCO}_3$  reacted = 0.25

Mass of  $\text{MgCO}_3 = 0.25 \times 84 = 21 \text{ g}$

Percentage purity =  $\frac{21}{25} \times 100 = 84\%$

83. Answer (4)

**Hint:**  $p$  orbitals,  $d_{x^2-y^2}$  and  $d_{z^2}$  orbitals have electron density along the axes.**Sol.:**  $d_{xy}$ ,  $d_{yz}$  and  $d_{zx}$  orbitals, electron density lie in between the axis.

84. Answer (2)

**Hint:** Electronic configuration of  $\text{Cr}(Z = 24) : [\text{Ar}]3d^5 4s^1$ .

Sol.:

Ions		Electronic Configuration
Mn <sup>3+</sup>	→	[Ar]3d <sup>4</sup>
Cr <sup>3+</sup>	→	[Ar]3d <sup>3</sup>
Co <sup>3+</sup>	→	[Ar]3d <sup>6</sup>
Ni <sup>3+</sup>	→	[Ar]3d <sup>7</sup>

85. Answer (2)

$$\text{Hint: } r_n = a_0 \frac{n^2}{Z}$$

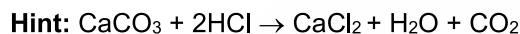
$$\text{Sol.: } r_{\text{He}^+} \propto \frac{1}{2}$$

$$r_{\text{Li}^{2+}} \propto \frac{(2)^2}{3}$$

$$\frac{r_{\text{He}^+}}{r_{\text{Li}^{2+}}} = \frac{1/2}{4/3} = \frac{1}{2} \times \frac{3}{4} = \frac{3}{8}$$

## SECTION - B

86. Answer (4)



Sol.: Mole of HCl = 4 × 2 = 8

Mole of CaCO<sub>3</sub> required = 4Mass of CaCO<sub>3</sub> required = 4 × 100 = 400 g

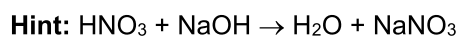
87. Answer (2)

Hint: One Mg<sup>2+</sup> ion contains 10 electrons

$$\text{Sol.: Mole of Mg}^{2+} \text{ ions} = \frac{4.8 \times 10^{-3}}{24} = 0.2 \times 10^{-3}$$

$$\begin{aligned} \text{Number of electrons} &= 0.2 \times 10^{-3} \times 6.02 \times 10^{23} \times 10 \\ &= 12.04 \times 10^{20} \\ &= 1.2 \times 10^{21} \end{aligned}$$

88. Answer (2)

HNO<sub>3</sub> is limiting reagent

Sol.:

	HNO <sub>3</sub>	+	NaOH	→	H <sub>2</sub> O	+	NaNO <sub>3</sub>
Initial	100 × 0.4		400 × 0.2		0		0
	= 40 m mol		80 m mol				
Final	0		40 m mol		40 m mol		40 m mol

Let resultant molarity of solution be M

$$M \times 500 = 40$$

$$M = \frac{40}{500} = 0.08$$

89. Answer (3)

Hint: Most of the space in atom is empty.

Sol.: Most of the α-particles passed through the gold foil undeflected as most of the space in atom is empty.

90. Answer (2)

$$\text{Hint: Energy of one photon (E)} = h\nu = \frac{hc}{\lambda}$$

Power of bulb = 36 watt = 36 Js<sup>-1</sup>

$$\text{Sol.: } E = \frac{hc}{\lambda}$$

$$= \frac{6.6 \times 10^{-34} \times 3 \times 10^8}{220 \times 10^{-9}}$$

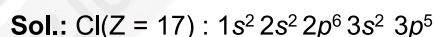
$$= 0.09 \times 10^{-17}$$

$$= 9.0 \times 10^{-19}$$

$$\text{Number of photons emitted} = \frac{36}{9 \times 10^{-19}} = 4 \times 10^{19}$$

91. Answer (4)

Hint: Atomic number of chlorine is 17



Number of electrons in p orbitals = 6 + 5 = 11

92. Answer (2)

Hint: Ionisation energy per atom of hydrogen

$$= 2.18 \times 10^{-18} \text{ J}$$

$$\text{Sol.: Number of hydrogen atoms} = \frac{0.05}{1} \times 6.02 \times 10^{23}$$

$$= 0.301 \times 10^{23}$$

$$= 3.01 \times 10^{22}$$

Energy required to ionise the hydrogen gas

$$= 3.01 \times 10^{22} \times 2.18 \times 10^{-18} \text{ J}$$

$$= 6.56 \times 10^4 \text{ J}$$

$$= 65.6 \times 10^3 \text{ J}$$

$$= 65.6 \text{ kJ}$$

93. Answer (1)

Hint: KE = hν - hν<sub>0</sub>

$$\text{Sol.: } KE = \frac{hc}{\lambda} - h\nu_0$$

$$KE = \frac{6.6 \times 10^{-34} \times 3 \times 10^8}{2.2 \times 10^{-7}} - 2 \times 1.6 \times 10^{-19}$$

$$= 9 \times 10^{-19} - 3.2 \times 10^{-19}$$

$$= 5.8 \times 10^{-19} \text{ J}$$

94. Answer (3)

**Hint:** After dilution, number of moles of solute remains same, hence

$$M_1V_1 = M_2V_2$$

$$\text{Sol.: } M_1V_1 = M_2V_2$$

$$V_2 = \frac{M_1V_1}{M_2} = \frac{100 \times 5}{0.25} = 2000 \text{ mL}$$

$$\text{Water added} = 2000 - 100 = 1.9 \text{ L}$$

95. Answer (1)

**Hint:** Let atomic weight of X is x and atomic weight of Y is y then

$$0.2(x + 3y) = 18.5$$

and

$$0.1(x + 5y) = 13.05$$

**Sol.:**

$$x + 3y = \frac{18.5}{0.2} = 92.5 \quad \dots(i)$$

$$x + 5y = \frac{13.05}{0.1} = 130.5 \quad \dots(ii)$$

Subtraction (i) from (ii)

$$(x + 5y) - (x + 3y) = 130.5 - 92.5$$

$$\Rightarrow 2y = 38$$

$$y = 19$$

Putting y in (i)

$$x + 3 \times 19 = 92.5$$

$$x = 92.5 - 57 = 35.5$$

96. Answer (4)

**Hint:** • Zeros preceding to first non-zero digit are not significant.

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

- Significant figure in 0.0012 is 2 and in 300.0 is 4.

97. Answer (3)

**Hint & Sol.:**

- Energies of the orbitals in the same subshell decrease with increase in atomic number (Z).
- Energy of 2s orbital of hydrogen is greater than energy of 2s orbital of lithium.

98. Answer (4)

**Hint:** Wave nature of electromagnetic radiation can be explained by interference.

**Sol.:** Particle nature of electromagnetic radiation can be explained by photoelectric effect and Black-body radiation.

99. Answer (4)

**Hint:** For  $n = 3$ ,  $\ell = 0, 1, 2$

**Sol.:** Total number of orbitals for  $n = 3$  is  $1 + 3 + 5 = 9$   
Therefore, maximum number of electrons possible for  $m_s = -\frac{1}{2}$  is 9.

100. Answer (3)

$$\text{Hint: } \Delta x \times \Delta p_x \geq \frac{h}{4\pi}$$

**Sol.:** Given

$$\Delta x = m\Delta v$$

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

$$\Rightarrow m^2 (\Delta v)^2 \geq \frac{h}{4\pi}$$

$$\Rightarrow (\Delta v)^2 \geq \frac{h}{m^2 \times 4\pi}$$

$$\Rightarrow \Delta v \geq \frac{1}{2m} \sqrt{\frac{h}{\pi}}$$

## [BOTANY]

### SECTION - A

101. Answer (2)

**Hint:** In ascending order, species is the smallest and kingdom is largest taxonomic category.

**Sol.:** Correct ascending order of taxonomic categories is species, genus, family, order, class, phylum, kingdom.

102. Answer (3)

**Hint:** Binomial nomenclature is a system that provides scientific name to organisms.

**Sol.:** Binomial nomenclature was given by Carolus Linnaeus.

103. Answer (3)

**Hint:** Monographs contain information on any one taxon.

**Sol.:** Zoological parks are the places where wild animals are kept in protected environments under human care.

Herbarium is a store house of collected plant specimens.

Museum is a place having collection of preserved plant and animal specimens.

Flora contains the actual account of habitat and distribution of plants of a given area.

104. Answer (2)

**Hint:** Zygotene involves synapsis of homologous chromosomes and pachytene involves crossing over between homologous chromosomes.

**Sol.:** Diplotene stage of meiosis I can last for months or years in the oocytes of some vertebrates.

Diakinesis is the transition to metaphase I.

105. Answer (1)

**Hint:** Recombinase enzyme is involved in crossing over.

**Sol.:** Crossing over occurs in pachytene. Crossing over is exchange of genetic material between two homologous chromosomes which is an enzyme mediated process and the enzyme involved is recombinase.

106. Answer (3)

**Hint:** M-phase represents the phase where the actual cell division or mitosis occurs.

**Sol.:** S-phase involves centriole duplication in cytoplasm.

G<sub>2</sub>-phase involves tubulin protein synthesis.

G<sub>1</sub>-phase involves duplication of most of the cell organelles except mitochondria, chloroplast and golgi complex.

107. Answer (2)

**Hint:** M-phase is the phase of actual cell division.

**Sol.:** Synthesis of DNA occurs in S-phase which is a part of interphase.

Assembly of mitotic apparatus, dissolution of nuclear envelope and reformation of nucleolus are features of M-phase.

108. Answer (4)

**Hint:** Mesosomes are formed by the extensions of plasma membrane into the cell.

**Sol.:** Mesosomes increase the surface area of plasma membrane and enzymatic content. They help in cell wall formation, DNA replication and distribution to daughter cells. They also help in respiration and secretion process.

109. Answer (3)

**Hint:** It contains materials not useful for cell.

**Sol.:** Vacuole is bound by a single membrane called tonoplast. Nucleus, chloroplast and mitochondria are double membrane bound cell organelles.

110. Answer (2)

**Hint:** They are rich in all types of hydrolytic enzymes.

**Sol.:** Lysosomes are membrane bound vesicular structures formed by the process of packaging in the golgi apparatus and contain acid hydrolases which are capable of digesting carbohydrates, proteins, lipids and nucleic acids.

111. Answer (4)

**Hint:** The middle lamella is a layer mainly of calcium pectate.

**Sol.:** The middle lamella holds or glues the different neighbouring cells together. It is present on the outer side of the cell.

The cell wall of a young plant cell, the primary wall is capable of growth.

112. Answer (4)

**Hint:** Thylakoids and grana are found in chloroplasts.

**Sol.:** The inner mitochondrial membrane forms a number of infoldings called cristae. Cisterane are found in Golgi apparatus.

113. Answer (4)

**Hint:** Period of cell cycle varies from organism to organism.

**Sol.:** Yeast can progress through the cell cycle in about 90 minutes.

114. Answer (3)

**Hint:** It is divided into G<sub>1</sub>, S and G<sub>2</sub> phases.

**Sol.:** M-phase starts with nuclear division.

115. Answer (4)

**Hint:** During S-phase the existing DNA molecule acts as a template to synthesise new DNA molecule. The new DNA molecule forms the new chromatin fibres which remain attached in pairs.

**Sol.:** Even after S-phase the number of chromosomes remains the same because during S-phase content of DNA is doubled but the chromatin material condenses to form two sister chromatids which remain attached to each other through a centromere, thus, the number of chromosomes remains unchanged.

116. Answer (2)

**Hint:** It is the phase of actual cell division.

**Sol.:** M-phase is the most dramatic phase of the cell cycle.

G<sub>1</sub> phase, G<sub>2</sub> phase and S-phase are parts of interphase which was earlier termed as resting phase.

117. Answer (3)

**Hint:** One homologous pair of chromosomes is one bivalent.

**Sol.:** During zygotene stage of meiosis-I, synapsis occurs (*i.e.*, pairing of homologous chromosomes)

- The complex formed by a pair of synapsed chromosome is a bivalent.
- It is also termed as a tetrad because the four chromatids of each bivalent are visible.

Thus, one homologous chromosome pair = one bivalent = one tetrad.

If the cell has  $2n = 8$ , then number of bivalent or tetrad = 4.

118. Answer (3)

**Hint:** Meiosis is the reductional division.

**Sol.:** Meiosis occurs in diploid parent cell (Meiocyte) to form four haploid cells.

Pollen grain, embryo sac and conidia are haploid structures.

119. Answer (1)

**Hint:** Contractile vacuole helps in excretion in *Amoeba*.

Amyloplast is a type of leucoplast storing starch.

**Sol.:** Cytoskeleton helps in mobility as it forms cilia and flagella.

Centrioles give rise to spindle apparatus during cell division in plants.

120. Answer (2)

**Hint:** The space enclosed by the inner membrane of chloroplast is called the stroma. It contains small double stranded circular DNA molecules, 70 S type of ribosomes and enzymes for carbohydrate synthesis.

**Sol.:** Stroma contains a large number of flattened membranous sacs called thylakoids, which are arranged in stack called grana.

The thylakoids of different grana are connected by flat membranous tubules called stroma lamellae.

121. Answer (4)

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

**Sol.:** Lysosomes show polymorphism.

122. Answer (3)

**Hint:** Trans face of golgi apparatus is concave or the maturing face.

**Sol.:** Trans face or the maturing face releases modified, packaged proteins to be secreted in the form of golgian vacuoles or vesicles.

Cis face or the forming face is convex face, receives materials to be modified from ER in the form of transitional vesicles.

123. Answer (3)

**Hint:** The fungal cell wall is made up of chitin.

**Sol.:** The algal cell wall is made up of cellulose, galactans, mannans and minerals like calcium carbonate while in other plants it consists of cellulose, hemicellulose, pectins and proteins.

124. Answer (4)

**Hint:** The ratio of proteins and lipids varies considerably in different cell types.

**Sol.:** In human beings, the membrane of the erythrocyte has approximately 52 percent proteins and 40 percent lipids.

125. Answer (4)

**Hint:** Plasmids are usually found in bacteria.

**Sol.:** Bacteria are prokaryotes which lack nuclear envelope thus, these plasmids are not enveloped by nuclear envelope.

126. Answer (1)

**Hint:** Chloroplasts are sites of photosynthesis.

**Sol.:** Both mitochondria and chloroplasts are semi-autonomous organelles as they have their own DNA and proteins synthesising machinery.

Mitochondria are the sites of aerobic respiration.

127. Answer (4)

**Hint:** Chloroplasts and chromoplasts are plastids present only in eukaryotes.

**Sol.:** In some photosynthetic prokaryotes like cyanobacteria, and purple bacteria, there are some other membranous extensions into the cytoplasm which contain pigments, they are called chromatophores.

Chromatin is highly extended and elaborates nucleoprotein fibre present in nucleus.

128. Answer (4)

**Hint:** Glycocalyx layer of bacterial cell envelope differs in thickness and chemical composition. It can be loose sheath called slime layer, which protects the cell from loss of water and nutrients.

**Sol.:** Capsule of a bacterial cell is a thick, tough covering which is responsible for giving gummy and sticky character to the cell.

Cell wall determines the shape of the cell.

129. Answer (4)

**Hint:** The fluid mosaic model of plasma membrane suggests that the cell membrane is composed of lipids that are arranged in a bilayer having two components.

(i) Polar, hydrophilic heads

(ii) Non-polar, hydrophobic tails

**Sol.:** Phospholipids of plasma membrane are arranged as

(i) Polar, hydrophilic heads towards the outer side to interact with water.

(ii) Non-polar, hydrophobic tails towards the inner side to protect them from aqueous environment.

130. Answer (4)

**Hint:** Crossing over is exchange of genetic materials between homologous chromosomes.

**Sol.:** Crossing over occurs between non-sister chromatids of homologous chromosomes.

131. Answer (3)

**Hint:** Number of meiotic divisions required to produce 'n' number of pollens =  $n/4$ .

**Sol.:** Number of meiotic divisions to produce '32' pollens =  $32/4 = 8$ .

132. Answer (3)

**Hint:** In this stage crossing over takes place.

**Sol.:** The four chromatids of each bivalent or the homologous chromosomes become distinct and clearly appear as tetrad in pachytene stage of prophase-I.

133. Answer (1)

**Hint:** This organelle forms basal body of cilia or flagella in eukaryotes.

**Sol.:** Centriole gives a cartwheel appearance.

134. Answer (1)

**Hint:** Dictyosomes are golgi apparatus of plants with unconnected units.

**Sol.:** During protein synthesis, many ribosomes form a chain on a common messenger RNA and form polyribosomes.

Centriole is surrounded by massule.

Residual bodies are secondary lysosomes containing undigested substances.

135. Answer (2)

**Hint:** Ribosomes are composed of rRNA and proteins.

**Sol.:** In plants, the vacuoles can occupy up to 90 percent of the volume of the cell.

The mitochondrial matrix contains enzymes for TCA cycle.

## SECTION - B

136. Answer (3)

**Hint:** Keys are used for identification of plants and animals based on similarities and dissimilarities.

**Sol.:** Separate taxonomic keys are required for each taxonomic category such as family, genus and species.

The keys are based on the contrasting characters generally in pair called couplet.

Keys are generally analytical in nature.

137. Answer (2)

**Hint:** Mango is an angiosperm and dicot.

**Sol.:** Poales is order of wheat. Sapindales is order of mango.

138. Answer (2)

**Hint:** Cells in  $G_0$  phase can perform all the functions except division unless called on to do so.

**Sol.:** Cells that do not divide further exit  $G_1$  phase to enter an inactive stage called quiescent stage ( $G_0$ ) of the cell cycle.

Cells in this stage remain metabolically active but no longer proliferate unless called on to do so.

139. Answer (3)

**Hint:** Bivalents separate from each other except at the sites of crossovers forming X-shaped structures called chiasmata.

**Sol.:** Terminalisation of chiasmata is a feature of diakinesis.

140. Answer (1)

**Hint:** Prophase is characterised by the beginning of condensation of chromatin material and telophase is characterised by reassembly of nuclear envelope.

**Sol.:** (a) Condensation of genetic material

→ Prophase

(d) Arrangement of chromosomes at equator

→ Metaphase

(b) Splitting of centromere → Anaphase

(e) Segregation of sister chromatids

→ Anaphase

(c) Reassembly of nuclear envelope

→ Telophase

In mitosis, correct sequence of phases is

Prophase → metaphase → anaphase → telophase

Thus, correct sequence of events will be

(a) → (d) → (b) → (e) → (c)

141. Answer (3)

**Hint:** Smooth endoplasmic reticulum (SER) are the sites of lipid synthesis.

**Sol.:** Rough endoplasmic reticulum (RER) is present in eukaryotes only. It is membrane bound and contains ribosomes attached to its extra luminal surface.

142. Answer (1)

**Hint:** Telocentric chromosomes have centromere at the terminal end.

**Sol.:** Metacentric chromosomes have centromere in the middle forming two equal arms of chromosomes.

Sub-metacentric chromosomes have centromere slightly away from the middle forming one shorter arm and one longer arm.

Telocentric chromosomes have centromere at the terminal end.

Acrocentric chromosomes have the centromere situated close to the end forming one extremely short and one very long arm.

143. Answer (1)

**Hint:** Every chromosome has a primary constriction or the centromere on the sides of which disc shaped structure called kinetochores are present.

**Sol.:** Sometimes a few chromosomes have non-staining secondary constrictions at a constant location. This gives the appearance of a small fragment called the satellite.

144. Answer (3)

**Hint:** Cell growth, repair, regeneration and healing are significance of mitosis.

**Sol.:** Genetic variations are introduced via crossing over and recombination during meiosis.

145. Answer (1)

**Hint:** Ribosomes are the sites of formation of proteins.

**Sol.:** Golgi bodies are the sites of formation of glycoproteins and glycoproteins in eukaryotes.

Peroxisomes are involved in photorespiration.

Mesosomes are found in prokaryotic cells.

146. Answer (4)

**Hint:** Protein synthesis is done by ribosomes in cytoplasm.

**Sol.:** Nucleolus is not a membrane bound structure, it is spherical structure present in nucleoplasm of eukaryotes and is site for active ribosomal RNA synthesis.

147. Answer (2)

**Hint:** Rudolf Virchow modified cell theory by explaining "*Omnis cellula-e-cellula*".

**Sol.:** Schwann reported that cells had a thin outer layer which is plasma membrane. He also concluded that the presence of cell wall is a unique character of the plant cells.

He proposed the hypothesis that the bodies of animals and plants are composed of cells and products of cells.

148. Answer (3)

**Hint:** Glycocalyx could be loose sheath called the slime layer or thick and tough called the capsule.

**Sol.:** The cell wall determines the shape of the cell and provides a strong structural support to prevent the bacterium from bursting and collapsing.

149. Answer (1)

**Hint:** This condition is found in liquid endosperm in coconut.

**Sol.:** In some organisms karyokinesis is not followed by cytokinesis as a result of which multinucleate condition arises leading to the formation of syncytium (e.g. liquid endosperm in coconut).

150. Answer (3)

**Hint:** Pili are elongated tubular structure.

**Sol.:** Bacterial flagellum has three parts– filament, hook and basal body.

Pili are not the part of flagella instead it is a surface structure of bacteria which has no role in motility.

## [ZOOLOGY]

### SECTION - A

151. Answer (2)

**Hint:** Hydra

**Sol.:** The body of a simple organism like *Hydra* is made of different types of cells and the number of cells in each type can be in thousands. Porifers exhibit cellular level of organisation.

152. Answer (4)

**Hint:** Function of compound epithelium

**Sol.:** Simple epithelium is composed of a single layer of cells and functions as a lining for body cavities, ducts and tubes. The compound epithelium consists of two or more cell layers and has protective function as it does in our skin.

153. Answer (3)

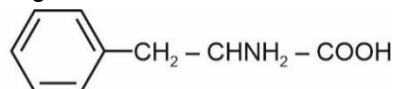
**Hint:** Present in ducts of glands

**Sol.:** The cuboidal epithelium is composed of a single layer of cube-like cells. This is commonly found in ducts of glands and tubular parts of nephrons in kidneys and its main functions are secretion and absorption. The epithelium of proximal convoluted tubule (PCT) of a nephron in the kidney has microvilli.

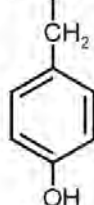
154. Answer (3)

**Hint:** Basic amino acid

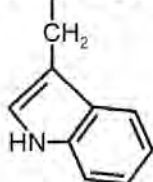
**Sol.:** Phenylalanine, tyrosine and tryptophan are aromatic amino acids having aromatic rings. Arginine is a basic amino acid without aromatic ring.



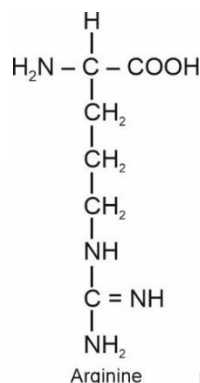
Phenylalanine



Tyrosine



Tryptophan



155. Answer (2)

**Hint:** Component of sugars

**Sol.:**

Element	% Weight of	
	Earth's crust	Human body
Hydrogen (H)	0.14	0.5
Carbon (C)	0.03	18.5
Oxygen (O)	46.6	65.0
Nitrogen (N)	very little	3.3
Sulphur (S)	0.03	0.3
Sodium (Na)	2.8	0.2
Calcium (Ca)	3.6	1.5
Magnesium (Mg)	2.1	0.1
Silicon (Si)	27.7	negligible

156. Answer (3)

**Hint:** Identify an organic compound

**Sol.:** Elemental analysis gives elemental composition of living tissues in the form of hydrogen, oxygen, chlorine, carbon, etc., while analysis for compounds gives an idea of the kind of organic and inorganic constituents present in living tissues.

157. Answer (2)

**Hint:** Also includes ricin**Sol.:**

Pigments	Carotenoids, Anthocyanins, etc.
Alkaloids	Morphine, Codeine, etc.
Terpenoides	Monoterpenes, Diterpenes etc.
Essential oils	Lemon grass oil, etc.
Toxins	Abrin, Ricin
Lectins	Concanavalin A
Drugs	Vinblastin, curcumin, etc.
Polymeric substances	Rubber, gums, cellulose

158. Answer (1)

**Hint:** Present in acid-insoluble pool

**Sol.:** The acid-soluble pool represents roughly the cytoplasmic composition. The macromolecules from cytoplasm and organelles become the acid-insoluble fraction. Together they represent the entire chemical composition of living tissues or organisms. Lipids are not strictly macromolecules but found in retentate along with macromolecules.

159. Answer (1)

**Hint:** Different from fetal haemoglobin

**Sol.:** Adult haemoglobin consists of four subunits. Two of these are identical to each other. Hence, two subunits of  $\alpha$  types and two subunits of  $\beta$  types together constitute the adult human haemoglobin (Hb).

160. Answer (2)

**Hint:** Possess an additional amino group

**Sol.:** Glutamic acid – Acidic amino acid  
Valine, Glycine – Neutral amino acids  
Arginine and lysine – Basic amino acids

161. Answer (3)

**Hint:** Equal to the number of fingers in forelimbs of man

**Sol.:** One full turn of the helical strands of B-DNA involves ten steps or ten base pairs.

162. Answer (4)

**Hint:** All types of tissues are present in an organ.

**Sol.:** All complex animals consist of only four basic types of tissues. These tissues are organised in specific proportion and pattern to form an organ like stomach, lungs, heart and kidneys. When two or more organs perform a common function by their physical and/or chemical interaction, they together form organ system. e.g., digestive system, respiratory system etc.

163. Answer (3)

**Hint:** Located in upper left portion of the abdominal cavity

**Sol.:** The columnar epithelium is composed of a single layer of tall and slender cells. Their nuclei are located at the base. Free surface may have microvilli. Brush-bordered columnar epithelium is present in the lining of intestine and helps in absorption and secretion.

164. Answer (3)

**Hint:** Made up of more than one layers of cells

**Sol.:** Compound epithelium covers the dry surface of the skin, the moist surface of buccal cavity, pharynx, inner lining of ducts of salivary glands and of pancreatic ducts. Their main function is to provide protection against chemical and mechanical stresses.

Simple squamous epithelium forms a diffusion boundary.

Ciliated epithelium functions to move particle or mucus in a specific direction over the epithelium.

165. Answer (2)

**Hint:** Helps in absorption and secretion

**Sol.:** Some of the columnar or cuboidal cells get specialised for secretion and are called glandular epithelium.

The columnar epithelium is composed of a single layer of tall and slender cells. Their nuclei are located at the base. Free surface may have microvilli. They are found in the lining of stomach and intestine and help in secretion and absorption.

The squamous epithelium is made of a single thin layer of flattened cells with irregular boundaries.

166. Answer (1)

**Hint:** Unicellular gland

**Sol.:** Unicellular glands consist of isolated glandular cells, which function as glands e.g., Goblet cells of the alimentary canal. These glandular cells secrete mucus, so they are also known as mucus neck cells or mucocytes.

Mammary glands, sweat glands, gastric glands and salivary glands are examples of multicellular glands. HCl and pepsinogen are secreted from gastric gland.

167. Answer (3)

**Hint:** Little material in between the cells

**Sol.:** The 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 parts of the body. The cells are compactly packed with little intercellular matrix. In nearly all animal tissues, specialized junctions provide both structural and functional links between its individual cells.

Tight junctions, gap junctions and adhering junctions are found in the epithelium and other tissues.

168. Answer (2)

**Hint:** Adipose tissue is found beneath the skin.

**Sol.:**

Areolar tissue	–	Serves as support framework for epithelium
Adipose tissue	–	Specialised to store fats
Tendons	–	Attach skeletal muscles to bones
Ligaments	–	Attach one bone to another bone

169. Answer (3)

**Hint:** Bone is not flexible.

**Sol.:** The intercellular material for cartilage is solid and pliable and resists compression.

Bones have a hard and non-pliable ground substance rich in calcium salts and collagen fibres which give bones its strength. It is the main tissue that provides structural frame to the body.

170. Answer (3)

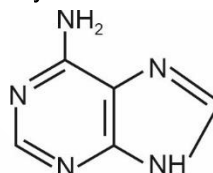
**Hint:** Equals to the number of fingers in each hand of man.

**Sol.:** Living organisms have a number of carbon compounds in which heterocyclic rings can be found. Some of these are nitrogen bases—adenine, guanine, cytosine, uracil and thymine. Cholesterol possesses homocyclic ring. Lecithin does not show a ring structure.

171. Answer (3)

**Hint:** Adenine

**Sol.:** Adenine forms two hydrogen bonds with thymine.



Adenine

172. Answer (1)

**Hint:** It is a phospholipid

**Sol.:** Lecithin possesses one polar head group and two non-polar tails. It is a phospholipid present in cell membrane.

Cellulose and inulin are polysaccharides and insulin is a protein.

173. Answer (3)

**Hint:** Thymidine is present in DNA.

**Sol.:** There are four different bases commonly found in DNA : adenine (A), guanine (G), thymine (T) and cytosine (C). RNA also contains adenine, guanine and cytosine but instead of thymine it has uracil. Adenine and guanine are double-ring nitrogenous bases called purines. Cytosine, thymine and uracil are single-ring nitrogenous bases called pyrimidines. Pentose sugar in nucleosides of DNA is deoxyribose and of RNA is ribose.

174. Answer (4)

**Hint:** Competitive inhibition

**Sol.:** Inhibition of succinic dehydrogenase by malonate which closely resembles the substrate 'succinate' in structure is an example of competitive inhibition.

175. Answer (2)

**Hint:** DNA follows base pairing rule.

**Sol.:** DNA exists as a double helix. The two strands of polynucleotides are antiparallel and complementary. 'A' and 'G' of one strand compulsorily pairs with 'T' and 'C' respectively on the other strand.

As per Chargaff's rule:  $A + G = T + C$

$G = C$  i.e., 12%

$A = T = (50 - 12)\%$

= 38%

176. Answer (2)

**Hint:** Lowers the minimum amount of energy required for a reaction to occur.

**Sol.:** Enzymes increase the rate of reaction by lowering the activation energy of the reaction. Without an enzyme, reaction requires a higher input of activation energy to reach the transition state.

177. Answer (3)

**Hint:** RNA is the genetic material of viruses.

**Sol.:** Nucleic acids exhibit a wide variety of secondary structures. One of the secondary structures exhibited by B-DNA is the famous Watson-Crick model. This model says that DNA exists as a double helix.

178. Answer (1)

**Hint:** One pitch/turn of B-DNA = 34 Å

**Sol.:** The distance between consecutive nitrogenous base pairs is 3.4 Å. 68 Å means the DNA strand has  $68 \div 3.4 = 20$  base pairs. Each bp has 2 bases, hence, there are 40 bases.

179. Answer (2)

**Hint:** Absent in skeletal and smooth muscle fibres.

**Sol.:**

Skeletal Muscle Fibres	Smooth Muscle Fibres	Cardiac Muscle Fibres
1. Occur in the limbs, body wall, face, neck, etc.	1. Occur in posterior part of oesophagus, urinogenital tract, iris of eye etc.	1. Occur in the walls of heart.
2. Cylindrical in shape.	2. Spindle-shaped.	2. Cylindrical in shape.
3. Multinucleated muscle fibres	3. Uninucleate muscle fibres.	3. Uninucleate muscle fibres.
4. Nuclei are peripheral.	4. Nucleus is central.	4. Nucleus is central.
5. Myofibrils show distinct alternate light and dark bands (striations).	5. Myofibrils are without light and dark bands.	5. Myofibrils show faint light and dark bands (striations).
6. Fibres are unbranched.	6. Fibres are unbranched.	6. Fibres are branched.
7. Intercalated discs are absent.	7. Intercalated discs are absent.	7. Intercalated discs are present.
8. They soon get fatigued.	8. They do not get fatigued.	8. They never get fatigued.
9. Voluntary in action.	9. Involuntary in action.	9. Involuntary in action.

180. Answer (3)

**Hint:** Component of plant cell wall

**Sol.:** Cellulose is a secondary metabolite belonging to the category of polymeric substances. Plant cell walls are made of cellulose. Paper made from plant pulp and cotton fibres is cellulosic. Cellulose does not contain complex helices and hence cannot hold  $I_2$ .

181. Answer (1)

**Hint:** Collagen is the most abundant protein in animal world.

**Sol.:**

Inulin	–	Polymer of fructose
Collagen	–	Intercellular ground substance
Glycogen	–	Storehouse of energy in animal tissues
RuBisCO	–	Most abundant protein in the whole of the biosphere

182. Answer (1)

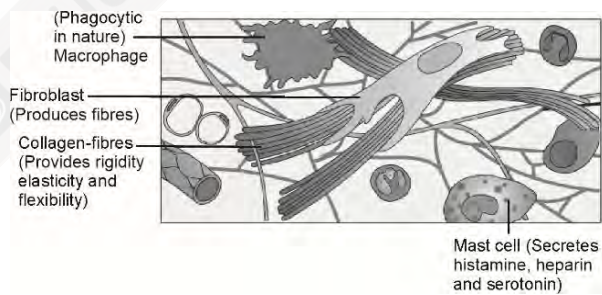
**Hint:** Involuntary muscle fibres

**Sol.:** The smooth muscle fibres taper at both ends (fusiform) and do not show striations. Cell junctions hold them together and they are bundled together in a connective tissue sheath. The wall of internal organs such as stomach, small intestine possess this type of muscles and their functioning cannot be directly controlled. We usually are not able to make it contract merely by thinking about it as we can do with skeletal muscles.

183. Answer (2)

**Hint:** Fibroblasts

**Sol.:**



184. Answer (3)

**Hint:** Prosthetic group

**Sol.:** There are three kinds of co-factors—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 the apoenzyme. For example, in peroxidase and catalase, which catalyse the breakdown of hydrogen peroxide to water and oxygen, haem is the prosthetic group and it is a part of active site of the enzyme. Zinc is a co-factor for the proteolytic enzyme carboxypeptidase.

185. Answer (2)

**Hint:** Hydrolases and ligases

**Sol.:** Hydrolases are the enzymes that catalyse the breakdown of larger molecules into smaller molecules with the addition of water. They catalyse hydrolysis of ester, ether, peptide, glycosidic, C-C, C-halide or P-N bonds.

Ligases are the enzymes that catalyse covalent bonding of two substrates to form a large molecule. They catalyse joining of C-O, C-S, C-N, P-O *etc.* bonds by using energy of ATP.

### SECTION - B

186. Answer (3)

**Hint:** Cells have short and branched processes

**Sol.:** Neural tissue consists of highly specialized cells called nerve cells or neurons. The neuroglial cells which constitute the rest of the neural system protect and support neurons.

Each neuron has cyton or cell body or perikaryon, dendrites, axon or nerve fibre.

187. Answer (1)

**Hint:** Chitin

**Sol.:** Fungal cell wall and exoskeleton of arthropods are formed by a complex polysaccharide named chitin which is a homopolymer of N-acetyl glucosamine.

Starch, inulin and glycogen are reserve food materials.

Cellulose is the most abundant organic compound in biosphere.

188. Answer (2)

**Hint:** Alcohol dehydrogenase

**Sol.:** Class-I of enzymes is oxidoreductases/dehydrogenases-catalyses oxidation-reduction between substrates, S and S'.

Hydrolases, lyases and transferases enzymes belong to class III, IV and II respectively.

189. Answer (4)

**Hint:** Active sites of enzymes get saturated at  $V_{max}$ .

**Sol.:** With the increase in substrate concentration, the velocity of the enzymatic reaction rises at first. The reaction reaches a maximum velocity ( $V_{max}$ ) which is not exceeded by any further rise in concentration of the substrate. This is because the enzyme molecules are fewer than the substrate

molecules and after saturation of these molecules, there are no free enzyme molecules to bind with the additional substrate molecules.

190. Answer (4)

**Hint:** Cavity present around osteocytes

**Sol.:** Cells of both, cartilages (chondrocytes) and bones (osteocytes) are enclosed in small cavities within the matrix secreted by them called lacunae.

Bone's matrix is arranged in the form of concentric lamellae.

Bone marrow in some bones is the site of production of blood cells.

191. Answer (2)

**Hint:** Fluid connective tissue

**Sol.:** In all connective tissues, except blood and lymph, the cells secrete fibres of structural proteins called collagen or elastin.

Adipose tissue and areolar tissue are loose connective tissues.

192. Answer (2)

**Hint:** Tendons belong to same category

**Sol.:** Loose connective tissue has cells and fibres loosely arranged in a semi-fluid ground substance, for example areolar tissue and adipose tissue.

Examples of dense regular connective tissue are tendons and ligaments. Tendon attaches skeletal muscles to bones and ligaments attach one bone to another.

Cartilage, bone and blood are specialised connective tissues.

193. Answer (3)

**Hint:** Communication junction

**Sol.:** Tight junctions help to stop substances from leaking across a tissue.

Adhering junctions perform cementing to keep neighbouring cells together.

Gap junctions also known as communication junctions facilitate the cells to communicate with each other by connecting the cytoplasm of adjoining cells, for rapid transfer of ions, small molecules and sometimes big molecules.

194. Answer (4)

**Hint:** Endocrine glands are ductless glands.

**Sol.:** Exocrine glands secrete mucus, saliva, earwax, oil, milk, digestive enzymes and other cell

products. These products are released through ducts or tubes. In contrast, endocrine glands do not have ducts and their products are called hormones and are secreted directly into the fluid bathing the gland.

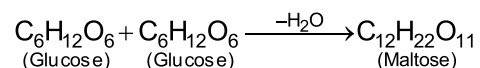
Connective tissues are the most abundant and widely distributed tissues in the body of complex animals.

195. Answer (4)

**Hint:** Maltose

**Sol.:** Synthesis of one molecule of maltose from two molecules of glucose by elimination of one molecule of water occurs by dehydration reaction.

So,



196. Answer (4)

**Hint:**  $2^n$

**Sol.:** A general rule of thumb is that reaction rate doubles or decreases by half for every  $10^\circ\text{C}$  change in temperature in either direction.

The increase in the rate of reaction, if the temperature rises from  $30^\circ\text{C}$  to  $80^\circ\text{C} = 2^5$

= 32 times

197. Answer (3)

**Hint:** Glycine

**Sol.:** Glycerol is present in lecithin which forms the cell membrane.

Palmitic acid ( $\text{CH}_3-(\text{CH}_2)_{14}-\text{COOH}$ ) is a saturated fatty acid that does not possess double bond.

Glycine is the simplest amino acid.

Ribose is the pentose sugar of RNA.

198. Answer (3)

**Hint:** Vitamin  $\text{B}_1$

**Sol.:** Adenosine, thymidine, uridine and cytidine are nucleosides while thiamine is vitamin  $\text{B}_1$ .

199. Answer (1)

**Hint:** Includes pigment and alkaloid

**Sol.:**

Pigments	Carotenoids, Anthocyanins, etc.
Alkaloids	Morphine, Codeine, etc.
Terpenoides	Monoterpenes, Diterpenes etc.
Essential oils	Lemon grass oil, etc.
Toxins	Abrin, Ricin
Lectins	Concanavalin A
Drugs	Vinblastin, curcumin, etc.
Polymeric substances	Rubber, gums, cellulose

200. Answer (1)

**Hint:** Site of fertilisation

**Sol.:** Ciliated epithelium is mainly present in the inner surface of hollow organs like bronchioles and fallopian tubes.

Simple squamous epithelium is present in alveoli of lungs and endothelium of blood vessels.



## All India Aakash Test Series for NEET-2024

**TEST - I (Code-F)**

Test Date : 05/11/2023

**ANSWERS**

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

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

1. Answer (4)

**Hint & Sol.:** Angular speed remains constant in uniform circular motion.

2. Answer (4)

**Hint:** Comparing with equation of trajectory

$$y = x \tan \theta - \frac{g \cdot x^2}{2u^2 \cos^2 \theta}$$

**Sol.:** We get  $\tan \theta = \sqrt{3}$  and  $u^2 \cos^2 \theta = 1$

$$\Rightarrow u \cos \theta = 1$$

$$\therefore \theta = 60^\circ \text{ and } u = 2 \text{ m/s}$$

$$T = \frac{2u \sin \theta}{g} = \frac{2 \times 2 \times \sqrt{3}}{2 \times 10} = \frac{\sqrt{3}}{5} \text{ s}$$

3. Answer (2)

**Hint:**  $R = \frac{2u_x u_y}{g}$  and  $H = \frac{u_y^2}{2g}$

**Sol.:**  $\frac{2u_x u_y}{g} = n \frac{u_y^2}{2g}$

$$4(u \cos \theta) = n u \sin \theta$$

$$\frac{4}{n} = \tan \theta$$

$$\theta = \tan^{-1} \left( \frac{4}{n} \right)$$

4. Answer (3)

**Hint:** For maximum range condition,  $\theta = 45^\circ$

**Sol.:**  $R = 4H \cot \theta$

$$R = 4H \cot 45^\circ$$

$$H = \frac{R}{4} = \frac{500}{4} = 125 \text{ m}$$

5. Answer (3)

**Hint:**  $\bar{a} = \frac{d\bar{v}}{dt}$

**Sol.:** Acceleration = Slope of  $v$ - $t$  curve

6. Answer (3)

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

**Sol.:**  $a = 15 \times 5 = 75 \text{ m/s}^2$

7. Answer (1)

**Hint & Sol.:** Path of one projectile as seen from another projectile is a straight line.

8. Answer (2)

**Hint & Sol.:** In non uniform circular motion, velocity changes continuously.

9. Answer (2)

**Hint & Sol.:**

- Distance  $\geq$  |Displacement|

- Speed of a particle can never be negative.

10. Answer (2)

**Hint & Sol.:** Area under acceleration-time graph gives change in velocity.

11. Answer (2)

**Hint:** Use equations of uniformly accelerated motion.

**Sol.:**  $v = u + at$ ,  $v = 0$ ,  $u = 12$ ,  $a = (10 + x)$

$$\Rightarrow 12 = (10 + x) \times 1 \Rightarrow x = 2 \text{ m/s}^2$$

$$H_{\max} = \frac{(u)^2}{2a} = \frac{12 \times 12}{2 \times 12} = 6 \text{ m}$$

12. Answer (2)

**Hint & Sol.:** Torque and work have same dimensional formula.  $[ML^2T^{-2}]$

13. Answer (1)

**Hint:** Displacement in  $y$ -direction is

$$s_y = u_y t + \frac{1}{2} a_y t^2$$

**Sol.:**  $s_y = 2t - \frac{1}{2} \times 10t^2$

$$y = s_y = 2t - 5t^2$$

$$\text{and } x = u_x t = t$$

$$\text{So, equation } 5x^2 - 2x + y = 0$$

14. Answer (3)

**Hint & Sol.:**  $S_{n^{\text{th}}} = u + \frac{a}{2}(2n-1)$

$$S_{5^{\text{th}}} = 0 + \frac{2}{2}(2 \times 5 - 1) = 9 \text{ m}$$

15. Answer (2)

**Hint:** Least count = 1 MSD – 1 VSD

**Sol.:**  $n$  VSD =  $(n - 2)$  MSD

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

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

$$\frac{2}{n} \text{ MSD} = \frac{2}{n} \times (a \text{ mm})$$

$$= \frac{2a}{n} \text{ mm}$$

16. Answer (2)

**Hint:** Area under  $a-t$  curve give change in velocity.

**Sol.:** At  $t = 0$ ,  $u = 0$

$$v = u + at \Rightarrow v = 0 + 2 \times 2 = 4 \text{ m/s} \quad \dots(i)$$

from  $t = 2 \text{ s}$  to  $t = 4 \text{ s}$

$$v = u + at \Rightarrow v = 4 + (-2) \times 2 = 0 \quad \dots(ii)$$

from  $t = 4 \text{ s}$  to  $t = 6 \text{ s}$

$$v = u + at \Rightarrow v = 0 + (-2) \times 2 = -4$$

but  $|\vec{v}| = 4 \text{ m/s}$

Also, since acceleration is constant for  $t = 0$  to  $t = 2$  and for  $t = 2$  to  $t = 6$ , therefore slope of  $v-t$  curve will also be constant.

17. Answer (4)

**Hint & Sol.:** Initial velocity of object  $v = 0$

$\therefore$  Initial acceleration  $a = \alpha - (\beta \times 0) = \alpha$

18. Answer (1)

**Hint:**  $R = u_x \times T$

**Sol.:**  $800 = u_x(40)$

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

19. Answer (2)

**Hint & Sol.:**

$$\text{Instantaneous velocity } v = \frac{dx}{dt} = \sqrt{\alpha} \times x^{1/2}$$

$$\frac{dx}{\sqrt{x}} = \sqrt{\alpha} dt$$

On integration

$$\int_0^x \frac{1}{\sqrt{x}} dx = \int_0^t \sqrt{\alpha} dt$$

$$x = \frac{1}{4} \alpha t^2$$

20. Answer (3)

**Hint & Sol.:** In a number with decimal, all trailing zeroes are significant and zeroes between two non-zero digits are significant.

$\therefore$  Number of significant zeroes will be 3.

21. Answer (1)

**Hint:** Relative error in  $v$  = Relative error in  $s$  + Relative error in  $t$

$$\text{Sol.: We know,  $v = \frac{s}{t} = \frac{100}{10} = 10 \text{ m/s}$$$

$$\text{Also, } \frac{\Delta v}{v} = \frac{\Delta s}{s} + \frac{\Delta t}{t}$$

$$\frac{\Delta v}{10} = \frac{0.1}{100} + \frac{0.1}{10}$$

$$\Delta v = 10 \left( \frac{0.1}{100} + \frac{1}{100} \right)$$

$$\Delta v = \frac{1.1}{10} = 0.11$$

$$\therefore v = (10 \pm 0.11) \text{ m/s}$$

22. Answer (3)

$$\text{Hint: } KE = \frac{1}{2} mv^2$$

$$\text{Sol.: Unit of KE = Mass  $\left[ \frac{\text{Length}}{\text{Time}} \right]^2$$$

$$= 100 \text{ g} \times \left( \frac{1 \text{ cm}}{10 \text{ s}} \right)^2$$

$$= 1 \text{ g cm}^2/\text{s}^2 = 1 \text{ erg}$$

23. Answer (3)

**Hint and Sol.:**  $\vec{A} - 2\vec{B}$

$$= (\hat{i} + \hat{j} + \hat{k}) - 2(\hat{i} + \hat{j} + 2\hat{k})$$

$$\vec{A} - 2\vec{B} = -\hat{i} - \hat{j} - 3\hat{k}$$

$$|\vec{A} - 2\vec{B}| = \sqrt{1+1+9} = \sqrt{11}$$

24. Answer (3)

**Hint:** Use equation of trajectory  $y = x \tan \theta \left[ 1 - \frac{x}{R} \right]$

$$\text{Sol.:  $y = \sqrt{3}x - \frac{1}{2}x^2 = \sqrt{3}x \left[ 1 - \frac{x}{2\sqrt{3}} \right]$$$

$$\tan \theta = \sqrt{3}$$

$$\theta = 60^\circ$$

25. Answer (2)

**Hint:** Use equation  $v = u + at$ 

$$\text{Sol.: } v = a_0 \times t = 4 \times 5 \\ = 20 \text{ m/s}$$

26. Answer (1)

**Hint:** Use equation of motion  $s = ut + \frac{1}{2}at^2$ **Sol.:** Let it takes 't' time to strike the ground

$$s_t - s_{t-1} = 25$$

$$\frac{1}{2}gt^2 - \frac{1}{2}g(t-1)^2 = 25$$

On solving  $t = 3$  s

$$h = \frac{1}{2}g(t^2)$$

$$\boxed{h = 45\text{m}}$$

27. Answer (3)

**Hint:** Acceleration in terms of velocity and displacement  $a = v \frac{dv}{ds}$ 

$$\text{Sol.: } \frac{dv}{ds} = 2Ks$$

$$a = Ks^2 \times 2Ks$$

$$a = 2K^2s^3$$

$$a \propto s^3$$

28. Answer (3)

**Hint & Sol.:** Both the statements given in question are correct with regard to significant figures.

29. Answer (4)

**Hint & Sol.:**  $[Energy] = [E] = [M L^2 T^{-2}]$ 

$$[P] = [M L T^{-1}]$$

$$\text{Area } [A] = [L^2]$$

$$\therefore [E] = [M L T^{-1}] [L T^{-1}]$$

$$= [P A^{1/2} T^{-1}]$$

30. Answer (4)

**Hint:** Acceleration  $\bar{a} = \frac{d\bar{v}}{dt}$ 

$$\text{Sol.: } \bar{v} = \frac{d\bar{s}}{dt} = 6t^2 + 6t + 2$$

$$\bar{a} = \frac{d\bar{v}}{dt} = 12t + 6$$

$$a = 0 \Rightarrow 12t + 6 = 0$$

$$12t = -6$$

$$t = -\frac{1}{2} \text{ which is impossible}$$

31. Answer (1)

**Hint & Sol.:** All the non-zero digits are significant.

If a number is less than 1, zeroes on the right of the decimal point but to the left of the first non-zero digit are non-significant.

32. Answer (3)

**Hint:**  $v = 25 - 2 \times 10 = 5$  m/s (velocity after 2 s)

$$\text{Sol.: } 0 = 25 - 10t, t = 2.5$$

$$0 = 5^2 - 2 \times 10 \times s$$

$$s = 1.25 \text{ m}$$

$$\text{Distance covered in third second} = 2 \text{ s} = 2.5 \text{ m}$$

33. Answer (1)

**Hint:** Use  $v = \sqrt{v_x^2 + v_y^2}$  and  $a = \sqrt{a_x^2 + a_y^2}$ 

$$\text{Sol.: } x = 2t^2, \quad y = 3t$$

$$v_x = 4t \quad v_y = 3$$

$$a_x = 4 \quad a_y = 0$$

At  $t = 1$  s,  $v_x = 4$  m/s and  $v_y = 3$  m/s

$$\therefore v = \sqrt{4^2 + 3^2} = 5 \text{ m/s}$$

$$a = 4 \text{ m/s}^2$$

34. Answer (1)

$$\text{Hint: } v_{\text{avg}} = \frac{v_1 + v_2}{2}$$

$$\text{Sol.: } v_{\text{avg}} = \frac{s_1 + s_2}{t_1 + t_2} = \frac{[v_1 + v_2]t}{2t}$$

 $v_{\text{avg}}$  is arithmetic mean of two speeds

$$\Rightarrow v_{\text{avg}} = 5 \text{ m/s}$$

35. Answer (2)

**Hint:** Displacement is change in position with time.

$$\text{Sol.: Displacement} = (4\hat{i} - 3\hat{j}) \text{ km}$$

$$|\text{Displacement}| = 5 \text{ km}$$

$$\therefore \text{Displacement} = 5 \text{ km, } 37^\circ \text{ S of E}$$

**SECTION - B**

36. Answer (2)

**Hint & Sol.:** At maximum height, velocity becomes zero due to retardation but acceleration due to gravity remains unchanged *i.e.*,  $g$  downwards.

37. Answer (2)

**Hint:** Displacement in  $n^{\text{th}}$  second is given by

$$S_{n^{\text{th}}} = u + \frac{a}{2}(2n-1)$$

**Sol.:**  $S_{n^{\text{th}}} = u + \frac{a}{2}(2n-1)$

$$S_{6^{\text{th}}} = 57 - \frac{10}{2}(2 \times 6 - 1)$$

$$= 57 - 55 = 2 \text{ m}$$

38. Answer (4)

**Hint & Sol.:** The time taken to reach ground depends on height from which the bodies are dropped. It is independent of mass of body.

39. Answer (3)

**Hint & Sol.:** Speed  $|\vec{v}| = \frac{dx}{dt} = 13 \text{ m/s}$

40. Answer (2)

**Hint:** According to Galileo's law of odd numbers, the distances traversed during equal intervals of time by freely falling body is in the ratio of odd numbers.

$$\therefore d_1 : d_2 : d_3 = 1 : 3 : 5$$

41. Answer (1)

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

**Sol.:**  $v_{\text{final}} - v_{\text{initial}} = 20$

$$v_f = 23 \text{ m/s}$$

42. Answer (2)

**Hint:** Time =  $\frac{\text{Separation}}{\text{Relative speed}}$

**Sol.:**  $t = \frac{45}{40+50} \Rightarrow t = \frac{1}{2} \text{ s}$

43. Answer (2)

**Hint & Sol.:** Unit of acceleration is  $\text{m/s}^2$

$$\therefore [a] = [M^0 L T^{-2}]$$

44. Answer (3)

**Hint & Sol.:** Change in either direction or magnitude of velocity or both means non-zero acceleration.

45. Answer (3)

**Hint:** Energy  $[E] = [M L^2 T^{-2}]$

**Sol.:**  $[M L^2 T^{-2}] = M^x(T^{-1})^y(L)^z$

$$\Rightarrow x = 1, z = 2, y = 2$$

$$\therefore 2x + y + z = 6$$

46. Answer (3)

**Hint:** According to direction cosines

$$\cos \gamma = \frac{a_z}{|\vec{a}|}$$

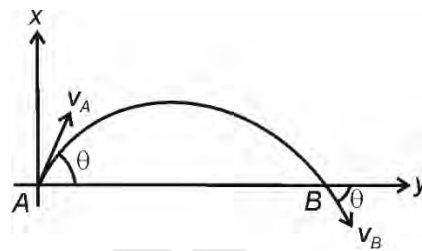
**Sol.:**  $\cos \gamma = \frac{5}{\sqrt{3^2 + 4^2 + 5^2}} = \frac{5}{\sqrt{50}}$

$$= \frac{5}{5\sqrt{2}} = \frac{1}{\sqrt{2}}$$

$$\gamma = 45^\circ$$

47. Answer (4)

**Hint & Sol.:**



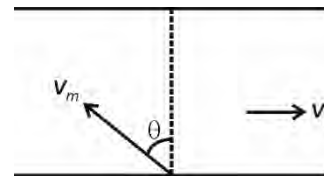
$$\vec{v}_A = (\hat{i} + 3\hat{j}) \text{ m/s}$$

$$\vec{v}_B = (\hat{i} - 3\hat{j}) \text{ m/s}$$

48. Answer (3)

**Hint:** To cross a river along shortest path, the velocity of the man w.r.t. ground should be perpendicular to the river flow.

**Sol.:**



$$v_m \sin \theta = v_r \Rightarrow 2 \sin \theta = 1 \Rightarrow \sin \theta = \frac{1}{2}$$

$$\therefore \theta = 30^\circ$$

Time to cross the river

$$t = \frac{d}{v_m \cos \theta} = \frac{1}{2 \cos 30^\circ} = \frac{1}{\sqrt{3}} \text{ h}$$

49. Answer (2)

**Hint & Sol.:**

$$\frac{\Delta Z}{Z} \times 100\% = 3 \left( \frac{\Delta A}{A} \times 100\% \right) + \frac{1}{2} \left( \frac{\Delta B}{B} \times 100\% \right) + \left( \frac{\Delta C}{C} \times 100\% \right) + 2 \left( \frac{\Delta D}{D} \times 100\% \right)$$

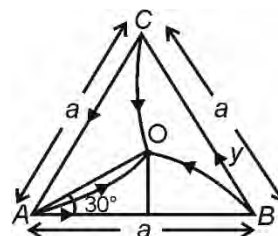
$$\frac{\Delta Z}{Z} \times 100\% = 3 \times (1) + \frac{1}{2} \times (2) + (3) + 2 \times (1)$$

$$= 3 + 1 + 3 + 2 = 9\%$$

50. Answer (3)

**Hint:** Use concept of relative velocity

**Sol.:**



$$t = \frac{a}{v + v \cos 60^\circ} = \frac{a}{v + \frac{v}{2}} = \frac{a}{\frac{3v}{2}} = \frac{2a}{3v}$$

## [CHEMISTRY]

### SECTION - A

51. Answer (2)

**Hint:**  $r_n = a_0 \frac{n^2}{Z}$

**Sol.:**  $r_{\text{He}^+} \propto \frac{1}{2}$

$$r_{\text{Li}^{2+}} \propto \frac{(2)^2}{3}$$

$$\frac{r_{\text{He}^+}}{r_{\text{Li}^{2+}}} = \frac{\frac{1}{2}}{\frac{4}{3}} = \frac{1}{2} \times \frac{3}{4} = \frac{3}{8}$$

52. Answer (2)

**Hint:** Electronic configuration of Cr (Z = 24) : [Ar]3d<sup>5</sup>4s<sup>1</sup>.

**Sol.:**

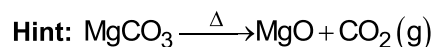
Ions		Electronic Configuration
Mn <sup>3+</sup>	→	[Ar]3d <sup>4</sup>
Cr <sup>3+</sup>	→	[Ar]3d <sup>3</sup>
Co <sup>3+</sup>	→	[Ar]3d <sup>6</sup>
Ni <sup>3+</sup>	→	[Ar]3d <sup>7</sup>

53. Answer (4)

**Hint:** p orbitals, d<sub>x<sup>2</sup>-y<sup>2</sup></sub> and d<sub>z<sup>2</sup></sub> orbitals have electron density along the axes.

**Sol.:** d<sub>xy</sub>, d<sub>yz</sub> and d<sub>zx</sub> orbitals, electron density lie in between the axis.

54. Answer (4)



**Sol.:** Mole of CO<sub>2</sub> =  $\frac{5.6}{22.4} = 0.25$

Mole of MgCO<sub>3</sub> reacted = 0.25

Mass of MgCO<sub>3</sub> = 0.25 × 84 = 21 g

Percentage purity =  $\frac{21}{25} \times 100 = 84\%$

55. Answer (1)

**Hint:** 100 L of air contains 78 L of N<sub>2</sub> at STP

**Sol.:** Volume of N<sub>2</sub> in 5 L air at STP =  $\frac{78 \times 5}{100} = 3.9 \text{ L}$

Number of atoms of nitrogen =  $\frac{3.9 \times 2 \times N_A}{22.4} = 0.35 N_A$

56. Answer (4)

**Hint:** 100 g solution contains 98 g H<sub>2</sub>SO<sub>4</sub>

**Sol.:** Volume of concentrated acid =  $\frac{100}{1.7} \text{ mL}$

Molarity of acid =  $\frac{98 \times 1000}{98 \times \frac{100}{1.7}}$

=  $\frac{1000 \times 1.7}{100} = 17 \text{ M}$

Let volume of concentrated acid required is V mL

$V \times 17 = 2500 \times 0.5$

$V = \frac{2500 \times 0.5}{17} = 73.5 \text{ mL}$

57. Answer (3)

**Hint:** Number of atoms = Mole of molecule × Atomicity × N<sub>A</sub>

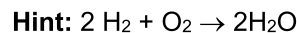
**Sol.:** Number of atoms of CaCO<sub>3</sub> =  $\frac{10}{100} \times 5 \times N_A$   
= 0.5 N<sub>A</sub>

$$\text{Number of atoms of SO}_3 = \frac{20}{80} \times 4 \times N_A = N_A$$

$$\text{Number of atoms of CH}_4 = \frac{6.72}{22.4} \times 5 \times N_A = 1.5 N_A$$

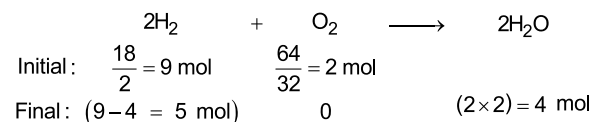
$$\text{Number of atoms of NH}_3 = \frac{4.48}{22.4} \times 4 N_A = 0.8 N_A$$

58. Answer (3)



2 moles of  $\text{H}_2$  react with one mole of  $\text{O}_2$  to give 2 moles of  $\text{H}_2\text{O}$

**Sol.:**



59. Answer (3)

**Hint:** For minimum molar mass, one molecule of enzyme should contain one atom of selenium.

**Sol.:** 0.2 g of selenium is present in 100 g of enzyme.

$$79 \text{ g of selenium is present in } \frac{100 \times 79}{0.2} \text{ g of}$$

enzyme

$$= 39500$$

$$\text{Molar mass of enzyme} = 39500 \text{ g mol}^{-1}$$

60. Answer (3)

**Hint:** Closer is the electron to the nucleus, difficult it is to remove it from the atom.

**Sol.:** • The number of electrons ejected is proportional to the intensity of light used.

- Outer electron in sodium is more close to nucleus hence it is difficult to remove electron from it as compared to potassium.

61. Answer (1)

**Hint:**  $E = h\nu$

**Sol.:**  $\nu = \frac{E}{h}$

$$\nu = \frac{3 \times 1.6 \times 10^{-19}}{6.6 \times 10^{-34}}$$

$$\nu = 0.727 \times 10^{15}$$

$$= 7.3 \times 10^{14} \text{ Hz}$$

62. Answer (3)

**Hint:** For  $\ell = 2$ , the value of  $m$  can be  $-2, -1, 0, +1, +2$

**Sol.:** For  $\ell = 0, m = 0$

For  $n = 1, \ell = 0$

Hence incorrect set is (b), (c) and (d)

63. Answer (3)

**Hint:**  $\ell = 3$  corresponds to  $f$  orbital.

**Sol.:** For  $\ell = 3$ , the total number of orbitals

$$= (2\ell + 1) = 2 \times 3 + 1 = 7$$

64. Answer (2)

**Hint:**  $n\lambda = 2\pi r_n$

$$r_n = a_0 n^2 \text{ [for H atom]}$$

**Sol.:**  $r_3 = a_0 n^2$

$$n\lambda = 2\pi r_n$$

$$\lambda = \frac{2\pi r_n}{n}$$

$$\lambda = \frac{2\pi \times 52.9 \times 3 \times 3}{3}$$

$$\lambda = 317.4\pi$$

65. Answer (4)

**Hint:** Cathode rays start from cathode and move towards anode.

**Sol.:** The characteristics of cathode rays (electrons) do not depend upon the material of the electrodes and the nature of the gas present in the cathode ray tube.

66. Answer (2)

**Hint:** • For multielectron species, higher is the value of  $(n + \ell)$ , higher is the energy of orbital.

- For same value of  $(n + \ell)$ , higher is the value of  $n$ , higher is the energy of orbital.

**Sol.:** •  $(n + \ell)$  for  $5d$  and  $4f$  are 7, hence the orbital with higher value of  $n$  has higher energy.

- Correct order of energy of given orbitals :

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

67. Answer (4)

**Hint:**

$$\text{Mole of atom (element)} = \frac{\text{Mass percentage of atom}}{\text{Molar mass of atom}}$$

**Sol.:**

Element	Mass percentage	Mole	Relative no. of mole
C	67.9%	$\frac{67.9}{12} = 5.66$	3
H	5.7%	$\frac{5.7}{1} = 5.7$	3
N	26.4%	$\frac{26.4}{14} = 1.88$	1

Empirical formula of organic compound = C<sub>3</sub>H<sub>3</sub>N

68. Answer (1)

**Hint:** Average atomic mass of 'X'

$$= \frac{\sum \text{Isotopic mass} \times \text{percentage}}{100}$$

**Sol.:** Average atomic mass of 'X'

$$= \frac{144 \times 40 + 142 \times 20 + 146 \times 40}{100}$$

$$= \frac{5760 + 2840 + 5840}{100} = 144.4 \text{ u}$$

69. Answer (1)

**Hint:** Mole of HNO<sub>3</sub> present in 800 mL of 4 M HNO<sub>3</sub> = 800 × 4 × 10<sup>-3</sup> = 3.2**Sol.:** Mass of HNO<sub>3</sub> = 3.2 × 63 = 201.6 g70 g of HNO<sub>3</sub> is present in 100 g of HNO<sub>3</sub>1 g of HNO<sub>3</sub> is present in  $\frac{100}{70}$  g of HNO<sub>3</sub>201.6 g HNO<sub>3</sub> is present in  $\frac{100}{70} \times 201.6$  g of HNO<sub>3</sub>

= 288 g

70. Answer (4)

**Hint:** Mole fraction of solute

$$= \frac{\text{Mole of solute}}{\text{Mole of solute} + \text{Mole of solvent}}$$

**Sol.:** Mole of solute = 9.45

$$\text{Mole of H}_2\text{O (Solvent)} = \frac{1000}{18} = 55.55$$

Mole fraction of solute

$$= \frac{9.45}{55.55 + 9.45} = \frac{9.45}{65} = 0.145$$

71. Answer (2)

**Hint:** Number of angular nodes =  $\ell$ Number of radial nodes =  $(n - \ell - 1)$ **Sol.:** For 4f orbital number of angular nodes = 3Number of radial nodes =  $4 - 3 - 1 = 0$ 

72. Answer (3)

**Hint:** Mole of a gas =  $\frac{\text{Mass of gas}}{\text{Molar mass of gas}}$ **Sol.:**

- Mole of methane (CH<sub>4</sub>) =  $\frac{1}{16}$

$$\text{Mole of atoms of CH}_4 = \frac{1}{16} \times 5 = \frac{5}{16}$$

$$\text{Number of atoms of CH}_4 = \frac{5}{16} N_A$$

- Mole of sulphur dioxide (SO<sub>2</sub>) =  $\frac{2}{64} = \frac{1}{32}$

$$\text{Mole of atoms of SO}_2 = \frac{3}{32}$$

$$\text{Number of atoms of SO}_2 = \frac{3}{32} N_A$$

$$\frac{\text{Number of atoms of CH}_4}{\text{Number of atoms of SO}_2} = \frac{5}{16} N_A \times \frac{32}{3 N_A}$$

= 10 : 3

73. Answer (4)

**Hint:** X-rays have highest frequency among the given options.**Sol.:** Energy of radiations

X rays &gt; UV &gt; IR &gt; Microwave

Wavelength of radiations :

Microwave &gt; IR &gt; UV &gt; X rays

74. Answer (3)

$$\text{Hint: } \frac{1}{\lambda} = R_H \left( \frac{1}{n_1^2} - \frac{1}{n_2^2} \right)$$

**Sol.:** For longest wavelength in Paschen series,  $n_1 = 3$  and  $n_2 = 4$ 

$$\bar{\nu} = \frac{1}{\lambda} = R_H \left( \frac{1}{3^2} - \frac{1}{4^2} \right)$$

$$\bar{\nu} = R_H \left( \frac{16-9}{9 \times 16} \right)$$

$$\bar{\nu} = \frac{7R_H}{144}$$

75. Answer (4)

**Hint:** Azimuthal quantum number ( $\ell$ ) defines the three-dimensional shape of the orbital.

**Sol.:** For a given value of  $n$ ,  $\ell$  can have  $n$  values ranging from 0 to  $n-1$ .

76. Answer (3)

**Hint:** According to the de Broglie hypothesis,

$$\lambda = \frac{h}{mv}$$

**Sol.:** Velocity ( $v$ ) =  $\frac{1800 \times 10^3 \text{ m}}{3600 \text{ s}}$   
 $= 500 \text{ ms}^{-1}$

$$\lambda = \frac{h}{mv}$$

$$\lambda = \frac{6.6 \times 10^{-34}}{4 \times 10^{-6} \times 500}$$

$$\lambda = 3.3 \times 10^{-31} \text{ m}$$

77. Answer (3)

**Hint:** Energy of radiation is given as:

$$E = \frac{hc}{\lambda}$$

$$E \propto \frac{1}{\lambda}$$

**Sol.:**  $\frac{E_1}{E_2} = \frac{\lambda_2}{\lambda_1}$

$$\Rightarrow \frac{10}{40} = \frac{\lambda_2}{\lambda_1}$$

$$\Rightarrow \lambda_1 = 4\lambda_2$$

78. Answer (3)

**Hint:** For neutral atom, number of protons = number of electrons

**Sol.:** Number of protons = 90

Number of electrons = 90

Number of neutrons =  $231 - 90 = 141$

79. Answer (4)

**Hint & Sol.:** As per Dalton's atomic theory all atoms of a given element have identical properties, including identical mass. Atoms of different elements differ in mass.

80. Answer (3)

**Hint:** Orbital angular momentum =  $\sqrt{\ell(\ell+1)}\hbar$

**Sol.:** Orbital angular momentum of electron in  $3p$  orbital =  $\sqrt{1(1+1)}\hbar$   
 $= \sqrt{2}\hbar$

81. Answer (2)

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

**Sol.:**

Species	No. of electrons
$B^{3+}$	2
$H^+$	0
$Li^+$	2
$He^+$	1
$Mg^{2+}$	10

82. Answer (3)

**Hint:** Strength ( $\text{gL}^{-1}$ ) is mass of solute in gram present in 1000 ml solution.

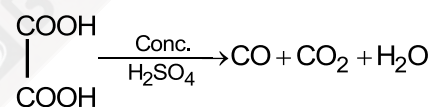
**Sol.:** 4 mole of NaOH is present in 1000 mL of solution

Mass of NaOH =  $40 \times 4 = 160 \text{ g}$

Hence Strength =  $160 \text{ gL}^{-1}$

83. Answer (4)

**Hint:**  $\text{HCOOH} \xrightarrow{\text{Conc. H}_2\text{SO}_4} \text{CO} + \text{H}_2\text{O}$



**Sol.:** Mole of oxalic acid =  $\frac{18}{90} = 0.2$

Mole of formic acid =  $\frac{4.6}{46} = 0.1$

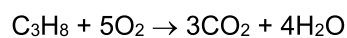
KOH pellets absorbs  $\text{CO}_2$

Mole of CO evolved =  $0.2 + 0.1 = 0.3$

Mass of CO =  $0.3 \times 28 = 8.4 \text{ g}$

84. Answer (4)

**Hint:** Combustion of propane takes place as:-



**Sol.:** Mole of  $\text{C}_3\text{H}_8 = \frac{176}{44} = 4$

Mole of  $\text{O}_2$  reacted =  $5 \times 4 = 20$

$\therefore$  Volume of  $O_2$  required at STP =  $20 \times 22.4$   
= 448 L

85. Answer (1)

**Hint:** Mol of sucrose =  $400 \times 0.5 \times 10^{-3} = 2 \times 10^{-1}$

**Sol.:** Number of sucrose molecules

$$= 2 \times 10^{-1} \times 6.02 \times 10^{23}$$

$$= 12.04 \times 10^{22}$$

$$= 1.2 \times 10^{23}$$

### SECTION - B

86. Answer (3)

**Hint:**  $\Delta x \times \Delta p_x \geq \frac{h}{4\pi}$

**Sol.:** Given

$$\Delta x = m\Delta v$$

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

$$\Rightarrow m^2(\Delta v)^2 \geq \frac{h}{4\pi}$$

$$\Rightarrow (\Delta v)^2 \geq \frac{h}{m^2 \times 4\pi}$$

$$\Rightarrow \Delta v \geq \frac{1}{2m} \sqrt{\frac{h}{\pi}}$$

87. Answer (4)

**Hint:** For  $n = 3$ ,  $\ell = 0, 1, 2$

**Sol.:** Total number of orbitals for  $n = 3$  is  $1 + 3 + 5 = 9$

Therefore, maximum number of electrons possible

for  $m_s = -\frac{1}{2}$  is 9.

88. Answer (4)

**Hint:** Wave nature of electromagnetic radiation can be explained by interference.

**Sol.:** Particle nature of electromagnetic radiation can be explained by photoelectric effect and Black-body radiation.

89. Answer (3)

**Hint & Sol.:**

- Energies of the orbitals in the same subshell decrease with increase in atomic number (Z).
- Energy of 2s orbital of hydrogen is greater than energy of 2s orbital of lithium.

90. Answer (4)

**Hint:** • Zeros preceding to first non-zero digit are not significant.

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

- Significant figure in 0.0012 is 2 and in 300.0 is 4.

91. Answer (1)

**Hint:** Let atomic weight of X is x and atomic weight of Y is y then

$$0.2(x + 3y) = 18.5$$

and

$$0.1(x + 5y) = 13.05$$

**Sol.:**

$$x + 3y = \frac{18.5}{0.2} = 92.5 \quad \dots(i)$$

$$x + 5y = \frac{13.05}{0.1} = 130.5 \quad \dots(ii)$$

Subtraction (i) from (ii)

$$(x + 5y) - (x + 3y) = 130.5 - 92.5$$

$$\Rightarrow 2y = 38$$

$$y = 19$$

Putting y in (i)

$$x + 3 \times 19 = 92.5$$

$$x = 92.5 - 57 = 35.5$$

92. Answer (3)

**Hint:** After dilution, number of moles of solute remains same, hence

$$M_1V_1 = M_2V_2$$

**Sol.:**  $M_1V_1 = M_2V_2$

$$V_2 = \frac{M_1V_1}{M_2} = \frac{100 \times 5}{0.25} = 2000 \text{ mL}$$

$$\text{Water added} = 2000 - 100 = 1.9 \text{ L}$$

93. Answer (1)

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

**Sol.:**  $KE = \frac{hc}{\lambda} - h\nu_0$

$$KE = \frac{6.6 \times 10^{-34} \times 3 \times 10^8}{2.2 \times 10^{-7}} - 2 \times 1.6 \times 10^{-19}$$

$$= 9 \times 10^{-19} - 3.2 \times 10^{-19}$$

$$= 5.8 \times 10^{-19} \text{ J}$$

94. Answer (2)

**Hint:** Ionisation energy per atom of hydrogen  
 $= 2.18 \times 10^{-18} \text{ J}$

$$\text{Sol.: Number of hydrogen atoms} = \frac{0.05}{1} \times 6.02 \times 10^{23}$$

$$= 0.301 \times 10^{23}$$

$$= 3.01 \times 10^{22}$$

Energy required to ionise the hydrogen gas

$$= 3.01 \times 10^{22} \times 2.18 \times 10^{-18} \text{ J}$$

$$= 6.56 \times 10^4 \text{ J}$$

$$= 65.6 \times 10^3 \text{ J}$$

$$= 65.6 \text{ kJ}$$

95. Answer (4)

**Hint:** Atomic number of chlorine is 17

**Sol.:** Cl(Z = 17) :  $1s^2 2s^2 2p^6 3s^2 3p^5$

Number of electrons in p orbitals = 6 + 5 = 11

96. Answer (2)

**Hint:** Energy of one photon (E) =  $h\nu = \frac{hc}{\lambda}$

Power of bulb = 36 watt = 36 Js<sup>-1</sup>

$$\text{Sol.: } E = \frac{hc}{\lambda}$$

$$= \frac{6.6 \times 10^{-34} \times 3 \times 10^8}{220 \times 10^{-9}}$$

$$= 0.09 \times 10^{-17}$$

$$= 9.0 \times 10^{-19}$$

$$\text{Number of photons emitted} = \frac{36}{9 \times 10^{-19}} = 4 \times 10^{19}$$

97. Answer (3)

**Hint:** Most of the space in atom is empty.

**Sol.:** Most of the  $\alpha$ -particles passed through the gold foil undeflected as most of the space in atom is empty.

98. Answer (2)

**Hint:**  $\text{HNO}_3 + \text{NaOH} \rightarrow \text{H}_2\text{O} + \text{NaNO}_3$

$\text{HNO}_3$  is limiting reagent

**Sol.:**

	$\text{HNO}_3$	+	$\text{NaOH}$	$\longrightarrow$	$\text{H}_2\text{O}$	+	$\text{NaNO}_3$
Initial	$100 \times 0.4$		$400 \times 0.2$		0		0
	$= 40 \text{ m mol}$		$80 \text{ m mol}$				
Final	0		$40 \text{ m mol}$		$40 \text{ m mol}$		$40 \text{ m mol}$

Let resultant molarity of solution be M

$$M \times 500 = 40$$

$$M = \frac{40}{500} = 0.08$$

99. Answer (2)

**Hint:** One  $\text{Mg}^{2+}$  ion contains 10 electrons

$$\text{Sol.: Mole of } \text{Mg}^{2+} \text{ ions} = \frac{4.8 \times 10^{-3}}{24} = 0.2 \times 10^{-3}$$

$$\text{Number of electrons} = 0.2 \times 10^{-3} \times 6.02 \times 10^{23} \times 10$$

$$= 12.04 \times 10^{20}$$

$$= 1.2 \times 10^{21}$$

100. Answer (4)

**Hint:**  $\text{CaCO}_3 + 2\text{HCl} \rightarrow \text{CaCl}_2 + \text{H}_2\text{O} + \text{CO}_2$

**Sol.:** Mole of HCl =  $4 \times 2 = 8$

Mole of  $\text{CaCO}_3$  required = 4

Mass of  $\text{CaCO}_3$  required =  $4 \times 100 = 400 \text{ g}$

## [BOTANY]

### SECTION - A

101. Answer (2)

**Hint:** Ribosomes are composed of rRNA and proteins.

**Sol.:** In plants, the vacuoles can occupy up to 90 percent of the volume of the cell.

The mitochondrial matrix contains enzymes for TCA cycle.

102. Answer (1)

**Hint:** Dictyosomes are golgi apparatus of plants with unconnected units.

**Sol.:** During protein synthesis, many ribosomes form a chain on a common messenger RNA and form polyribosomes.

Centriole is surrounded by massule.

Residual bodies are secondary lysosomes containing undigested substances.

103. Answer (1)

**Hint:** This organelle forms basal body of cilia or flagella in eukaryotes.

**Sol.:** Centriole gives a cartwheel appearance.

104. Answer (3)

**Hint:** In this stage crossing over takes place.

**Sol.:** The four chromatids of each bivalent or the homologous chromosomes become distinct and clearly appear as tetrad in pachytene stage of prophase-I.

105. Answer (3)

**Hint:** Number of meiotic divisions required to produce 'n' number of pollens =  $n/4$ .

**Sol.:** Number of meiotic divisions to produce '32' pollens =  $32/4 = 8$ .

106. Answer (4)

**Hint:** Crossing over is exchange of genetic materials between homologous chromosomes.

**Sol.:** Crossing over occurs between non-sister chromatids of homologous chromosomes.

107. Answer (4)

**Hint:** The fluid mosaic model of plasma membrane suggests that the cell membrane is composed of lipids that are arranged in a bilayer having two components.

(i) Polar, hydrophilic heads

(ii) Non-polar, hydrophobic tails

**Sol.:** Phospholipids of plasma membrane are arranged as

(i) Polar, hydrophilic heads towards the outer side to interact with water.

(ii) Non-polar, hydrophobic tails towards the inner side to protect them from aqueous environment.

108. Answer (4)

**Hint:** Glycocalyx layer of bacterial cell envelope differs in thickness and chemical composition. It can be loose sheath called slime layer, which protects the cell from loss of water and nutrients.

**Sol.:** Capsule of a bacterial cell is a thick, tough covering which is responsible for giving gummy and sticky character to the cell.

Cell wall determines the shape of the cell.

109. Answer (4)

**Hint:** Chloroplasts and chromoplasts are plastids present only in eukaryotes.

**Sol.:** In some photosynthetic prokaryotes like cyanobacteria, and purple bacteria, there are some other membranous extensions into the cytoplasm which contain pigments, they are called chromatophores.

Chromatin is highly extended and elaborates nucleoprotein fibre present in nucleus.

110. Answer (1)

**Hint:** Chloroplasts are sites of photosynthesis.

**Sol.:** Both mitochondria and chloroplasts are semi-autonomous organelles as they have their own DNA and proteins synthesising machinery.

Mitochondria are the sites of aerobic respiration.

111. Answer (4)

**Hint:** Plasmids are usually found in bacteria.

**Sol.:** Bacteria are prokaryotes which lack nuclear envelope thus, these plasmids are not enveloped by nuclear envelope.

112. Answer (4)

**Hint:** The ratio of proteins and lipids varies considerably in different cell types.

**Sol.:** In human beings, the membrane of the erythrocyte has approximately 52 percent proteins and 40 percent lipids.

113. Answer (3)

**Hint:** The fungal cell wall is made up of chitin.

**Sol.:** The algal cell wall is made up of cellulose, galactans, mannans and minerals like calcium carbonate while in other plants it consists of cellulose, hemicellulose, pectins and proteins.

114. Answer (3)

**Hint:** Trans face of golgi apparatus is concave or the maturing face.

**Sol.:** Trans face or the maturing face releases modified, packaged proteins to be secreted in the form of golgian vacuoles or vesicles.

Cis face or the forming face is convex face, receives materials to be modified from ER in the form of transitional vesicles.

115. Answer (4)

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

**Sol.:** Lysosomes show polymorphism.

116. Answer (2)

**Hint:** The space enclosed by the inner membrane of chloroplast is called the stroma. It contains small double stranded circular DNA molecules, 70 S type of ribosomes and enzymes for carbohydrate synthesis.

**Sol.:** Stroma contains a large number of flattened membranous sacs called thylakoids, which are arranged in stack called grana.

The thylakoids of different grana are connected by flat membranous tubules called stroma lamellae.

117. Answer (1)

**Hint:** Contractile vacuole helps in excretion in *Amoeba*.

Amyloplast is a type of leucoplast storing starch.

**Sol.:** Cytoskeleton helps in mobility as it forms cilia and flagella.

Centrioles give rise to spindle apparatus during cell division in plants.

118. Answer (3)

**Hint:** Meiosis is the reductional division.

**Sol.:** Meiosis occurs in diploid parent cell (Meiocyte) to form four haploid cells.

Pollen grain, embryo sac and conidia are haploid structures.

119. Answer (3)

**Hint:** One homologous pair of chromosomes is one bivalent.

**Sol.:** During zygotene stage of meiosis-I, synapsis occurs (*i.e.*, pairing of homologous chromosomes)

- The complex formed by a pair of synapsed chromosome is a bivalent.
- It is also termed as a tetrad because the four chromatids of each bivalent are visible.

Thus, one homologous chromosome pair = one bivalent = one tetrad.

If the cell has  $2n = 8$ , then number of bivalent or tetrad = 4.

120. Answer (2)

**Hint:** It is the phase of actual cell division.

**Sol.:** M-phase is the most dramatic phase of the cell cycle.

$G_1$  phase,  $G_2$  phase and S-phase are parts of interphase which was earlier termed as resting phase.

121. Answer (4)

**Hint:** During S-phase the existing DNA molecule acts as a template to synthesise new DNA molecule. The new DNA molecule forms the new chromatin fibres which remain attached in pairs.

**Sol.:** Even after S-phase the number of chromosomes remains the same because during S-phase content of DNA is doubled but the chromatin material condenses to form two sister chromatids which remain attached to each other through a centromere, thus, the number of chromosomes remains unchanged.

122. Answer (3)

**Hint:** It is divided into  $G_1$ , S and  $G_2$  phases.

**Sol.:** M-phase starts with nuclear division.

123. Answer (4)

**Hint:** Period of cell cycle varies from organism to organism.

**Sol.:** Yeast can progress through the cell cycle in about 90 minutes.

124. Answer (4)

**Hint:** Thylakoids and grana are found in chloroplasts.

**Sol.:** The inner mitochondrial membrane forms a number of infoldings called cristae. Cisterane are found in Golgi apparatus.

125. Answer (4)

**Hint:** The middle lamella is a layer mainly of calcium pectate.

**Sol.:** The middle lamella holds or glues the different neighbouring cells together. It is present on the outer side of the cell.

The cell wall of a young plant cell, the primary wall is capable of growth.

126. Answer (2)

**Hint:** They are rich in all types of hydrolytic enzymes.

**Sol.:** Lysosomes are membrane bound vesicular structures formed by the process of packaging in the golgi apparatus and contain acid hydrolases which are capable of digesting carbohydrates, proteins, lipids and nucleic acids.

127. Answer (3)

**Hint:** It contains materials not useful for cell.

**Sol.:** Vacuole is bound by a single membrane called tonoplast. Nucleus, chloroplast and mitochondria are double membrane bound cell organelles.

128. Answer (4)

**Hint:** Mesosomes are formed by the extensions of plasma membrane into the cell.

**Sol.:** Mesosomes increase the surface area of plasma membrane and enzymatic content. They help in cell wall formation, DNA replication and distribution to daughter cells. They also help in respiration and secretion process.

129. Answer (2)

**Hint:** M-phase is the phase of actual cell division.

**Sol.:** Synthesis of DNA occurs in S-phase which is a part of interphase.

Assembly of mitotic apparatus, dissolution of nuclear envelope and reformation of nucleolus are features of M-phase.

130. Answer (3)

**Hint:** M-phase represents the phase where the actual cell division or mitosis occurs.

**Sol.:** S-phase involves centriole duplication in cytoplasm.

G<sub>2</sub>-phase involves tubulin protein synthesis.

G<sub>1</sub>-phase involves duplication of most of the cell organelles except mitochondria, chloroplast and golgi complex.

131. Answer (1)

**Hint:** Recombinase enzyme is involved in crossing over.

**Sol.:** Crossing over occurs in pachytene. Crossing over is exchange of genetic material between two homologous chromosomes which is an enzyme mediated process and the enzyme involved is recombinase.

132. Answer (2)

**Hint:** Zygotene involves synapsis of homologous chromosomes and pachytene involves crossing over between homologous chromosomes.

**Sol.:** Diplotene stage of meiosis I can last for months or years in the oocytes of some vertebrates.

Diakinesis is the transition to metaphase I.

133. Answer (3)

**Hint:** Monographs contain information on any one taxon.

**Sol.:** Zoological parks are the places where wild animals are kept in protected environments under human care.

Herbarium is a store house of collected plant specimens.

Museum is a place having collection of preserved plant and animal specimens.

Flora contains the actual account of habitat and distribution of plants of a given area.

134. Answer (3)

**Hint:** Binomial nomenclature is a system that provides scientific name to organisms.

**Sol.:** Binomial nomenclature was given by Carolus Linnaeus.

135. Answer (2)

**Hint:** In ascending order, species is the smallest and kingdom is largest taxonomic category.

**Sol.:** Correct ascending order of taxonomic categories is species, genus, family, order, class, phylum, kingdom.

### SECTION - B

136. Answer (3)

**Hint:** Pili are elongated tubular structure.

**Sol.:** Bacterial flagellum has three parts— filament, hook and basal body.

Pili are not the part of flagella instead it is a surface structure of bacteria which has no role in motility.

137. Answer (1)

**Hint:** This condition is found in liquid endosperm in coconut.

**Sol.:** In some organisms karyokinesis is not followed by cytokinesis as a result of which multinucleate condition arises leading to the formation of syncytium (e.g. liquid endosperm in coconut).

138. Answer (3)

**Hint:** Glycocalyx could be loose sheath called the slime layer or thick and tough called the capsule.

**Sol.:** The cell wall determines the shape of the cell and provides a strong structural support to prevent the bacterium from bursting and collapsing.

139. Answer (2)

**Hint:** Rudolf Virchow modified cell theory by explaining "*Omnis cellula-e-cellula*".

**Sol.:** Schwann reported that cells had a thin outer layer which is plasma membrane. He also concluded that the presence of cell wall is a unique character of the plant cells.

He proposed the hypothesis that the bodies of animals and plants are composed of cells and products of cells.

140. Answer (4)

**Hint:** Protein synthesis is done by ribosomes in cytoplasm.

**Sol.:** Nucleolus is not a membrane bound structure, it is spherical structure present in nucleoplasm of eukaryotes and is site for active ribosomal RNA synthesis.

141. Answer (1)

**Hint:** Ribosomes are the sites of formation of proteins.

**Sol.:** Golgi bodies are the sites of formation of glycoproteins and glycoproteins in eukaryotes.

Peroxisomes are involved in photorespiration.

Mesosomes are found in prokaryotic cells.

142. Answer (3)

**Hint:** Cell growth, repair, regeneration and healing are significance of mitosis.

**Sol.:** Genetic variations are introduced via crossing over and recombination during meiosis.

143. Answer (1)

**Hint:** Every chromosome has a primary constriction or the centromere on the sides of which disc shaped structure called kinetochores are present.

**Sol.:** Sometimes a few chromosomes have non-staining secondary constrictions at a constant location. This gives the appearance of a small fragment called the satellite.

144. Answer (1)

**Hint:** Telocentric chromosomes have centromere at the terminal end.

**Sol.:** Metacentric chromosomes have centromere in the middle forming two equal arms of chromosomes.

Sub-metacentric chromosomes have centromere slightly away from the middle forming one shorter arm and one longer arm.

Telocentric chromosomes have centromere at the terminal end.

Acrocentric chromosomes have the centromere situated close to the end forming one extremely short and one very long arm.

145. Answer (3)

**Hint:** Smooth endoplasmic reticulum (SER) are the sites of lipid synthesis.

**Sol.:** Rough endoplasmic reticulum (RER) is present in eukaryotes only. It is membrane bound and contains ribosomes attached to its extra luminal surface.

146. Answer (1)

**Hint:** Prophase is characterised by the beginning of condensation of chromatin material and telophase is characterised by reassembly of nuclear envelope.

**Sol.:** (a) Condensation of genetic material

→ Prophase

(d) Arrangement of chromosomes at equator

→ Metaphase

(b) Splitting of centromere → Anaphase

(e) Segregation of sister chromatids

→ Anaphase

(c) Reassembly of nuclear envelope

→ Telophase

In mitosis, correct sequence of phases is

Prophase → metaphase → anaphase → telophase

Thus, correct sequence of events will be

(a) → (d) → (b) → (e) → (c)

147. Answer (3)

**Hint:** Bivalents separate from each other except at the sites of crossovers forming X-shaped structures called chiasmata.

**Sol.:** Terminalisation of chiasmata is a feature of diakinesis.

148. Answer (2)

**Hint:** Cells in  $G_0$  phase can perform all the functions except division unless called on to do so.

**Sol.:** Cells that do not divide further exit  $G_1$  phase to enter an inactive stage called quiescent stage ( $G_0$ ) of the cell cycle.

Cells in this stage remain metabolically active but no longer proliferate unless called on to do so.

149. Answer (2)

**Hint:** Mango is an angiosperm and dicot.

**Sol.:** Poales is order of wheat. Sapindales is order of mango.

150. Answer (3)

**Hint:** Keys are used for identification of plants and animals based on similarities and dissimilarities.

**Sol.:** Separate taxonomic keys are required for each taxonomic category such as family, genus and species.

The keys are based on the contrasting characters generally in pair called couplet.

Keys are generally analytical in nature.

**[ZOOLOGY]****SECTION - A**

151. Answer (2)

**Hint:** Hydrolases and ligases

**Sol.:** Hydrolases are the enzymes that catalyse the breakdown of larger molecules into smaller molecules with the addition of water. They catalyse hydrolysis of ester, ether, peptide, glycosidic, C-C, C-halide or P-N bonds.

Ligases are the enzymes that catalyse covalent bonding of two substrates to form a large molecule. They catalyse joining of C-O, C-S, C-N, P-O *etc.* bonds by using energy of ATP.

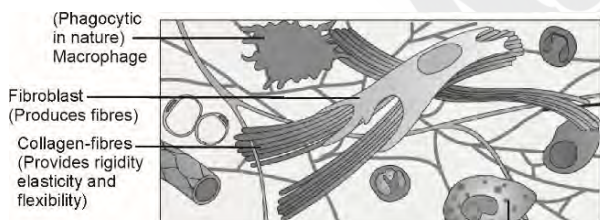
152. Answer (3)

**Hint:** Prosthetic group

**Sol.:** There are three kinds of co-factors—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 the apoenzyme. For example, in peroxidase and catalase, which catalyse the breakdown of hydrogen peroxide to water and oxygen, haem is the prosthetic group and it is a part of active site of the enzyme. Zinc is a co-factor for the proteolytic enzyme carboxypeptidase.

153. Answer (2)

**Hint:** Fibroblasts**Sol.:**

154. Answer (1)

**Hint:** Involuntary muscle fibres

**Sol.:** The smooth muscle fibres taper at both ends (fusiform) and do not show striations. Cell junctions hold them together and they are bundled together in a connective tissue sheath. The wall of internal organs such as stomach, small intestine possess this type of muscles and their functioning cannot be directly controlled. We usually are not able to make

it contract merely by thinking about it as we can do with skeletal muscles.

155. Answer (1)

**Hint:** Collagen is the most abundant protein in animal world.

**Sol.:**

Inulin	–	Polymer of fructose
Collagen	–	Intercellular ground substance
Glycogen	–	Storehouse of energy in animal tissues
RuBisCO	–	Most abundant protein in the whole of the biosphere

156. Answer (3)

**Hint:** Component of plant cell wall

**Sol.:** Cellulose is a secondary metabolite belonging to the category of polymeric substances. Plant cell walls are made of cellulose. Paper made from plant pulp and cotton fibres is cellulosic. Cellulose does not contain complex helices and hence cannot hold  $I_2$ .

157. Answer (2)

**Hint:** Absent in skeletal and smooth muscle fibres.**Sol.:**

Skeletal Muscle Fibres	Smooth Muscle Fibres	Cardiac Muscle Fibres
1. Occur in the limbs, body wall, face, neck, etc.	1. Occur in posterior part of oesophagus, urinogenital tract, iris of eye etc.	1. Occur in the walls of heart.
2. Cylindrical in shape.	2. Spindle-shaped.	2. Cylindrical in shape.
3. Multinucleated muscle fibres.	3. Uninucleate muscle fibres.	3. Uninucleate muscle fibres.
4. Nuclei are peripheral.	4. Nucleus is central.	4. Nucleus is central.
5. Myofibrils show distinct alternate light and dark bands (striations).	5. Myofibrils are without light and dark bands.	5. Myofibrils show faint light and dark bands (striations).
6. Fibres are unbranched.	6. Fibres are unbranched.	6. Fibres are branched.
7. Intercalated discs are absent.	7. Intercalated discs are absent.	7. Intercalated discs are present.
8. They soon get fatigued.	8. They do not get fatigued.	8. They never get fatigued.
9. Voluntary in action.	9. Involuntary in action.	9. Involuntary in action.

158. Answer (1)

**Hint:** One pitch/turn of B-DNA = 34 Å

**Sol.:** The distance between consecutive nitrogenous base pairs is 3.4 Å. 68 Å means the DNA strand has  $68 \div 3.4 = 20$  base pairs. Each bp has 2 bases, hence, there are 40 bases.

159. Answer (3)

**Hint:** RNA is the genetic material of viruses.

**Sol.:** Nucleic acids exhibit a wide variety of secondary structures. One of the secondary

structures exhibited by B-DNA is the famous Watson-Crick model. This model says that DNA exists as a double helix.

160. Answer (2)

**Hint:** Lowers the minimum amount of energy required for a reaction to occur.

**Sol.:** Enzymes increase the rate of reaction by lowering the activation energy of the reaction. Without an enzyme, reaction requires a higher input of activation energy to reach the transition state.

161. Answer (2)

**Hint:** DNA follows base pairing rule.

**Sol.:** DNA exists as a double helix. The two strands of polynucleotides are antiparallel and complementary. 'A' and 'G' of one strand compulsorily pairs with 'T' and 'C' respectively on the other strand.

As per Chargaff's rule:  $A + G = T + C$

$G = C$  i.e., 12%

$A = T = (50 - 12)\%$   
= 38%

162. Answer (4)

**Hint:** Competitive inhibition

**Sol.:** Inhibition of succinic dehydrogenase by malonate which closely resembles the substrate 'succinate' in structure is an example of competitive inhibition.

163. Answer (3)

**Hint:** Thymidine is present in DNA.

**Sol.:** There are four different bases commonly found in DNA : adenine (A), guanine (G), thymine (T) and cytosine (C). RNA also contains adenine, guanine and cytosine but instead of thymine it has uracil. Adenine and guanine are double-ring nitrogenous bases called purines. Cytosine, thymine and uracil are single-ring nitrogenous bases called pyrimidines. Pentose sugar in nucleosides of DNA is deoxyribose and of RNA is ribose.

164. Answer (1)

**Hint:** It is a phospholipid

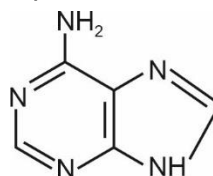
**Sol.:** Lecithin possesses one polar head group and two non-polar tails. It is a phospholipid present in cell membrane.

Cellulose and inulin are polysaccharides and insulin is a protein.

165. Answer (3)

**Hint:** Adenine

**Sol.:** Adenine forms two hydrogen bonds with thymine.



Adenine

166. Answer (3)

**Hint:** Equals to the number of fingers in each hand of man.

**Sol.:** Living organisms have a number of carbon compounds in which heterocyclic rings can be found. Some of these are nitrogen bases—adenine, guanine, cytosine, uracil and thymine. Cholesterol possesses homocyclic ring. Lecithin does not show a ring structure.

167. Answer (3)

**Hint:** Bone is not flexible.

**Sol.:** The intercellular material for cartilage is solid and pliable and resists compression.

Bones have a hard and non-pliable ground substance rich in calcium salts and collagen fibres which give bones its strength. It is the main tissue that provides structural frame to the body.

168. Answer (2)

**Hint:** Adipose tissue is found beneath the skin.

**Sol.:**

Areolar tissue	–	Serves as support framework for epithelium
Adipose tissue	–	Specialised to store fats
Tendons	–	Attach skeletal muscles to bones
Ligaments	–	Attach one bone to another bone

169. Answer (3)

**Hint:** Little material in between the cells

**Sol.:** The 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 parts of the body. The cells are compactly packed with little intercellular matrix. In nearly all animal tissues, specialized junctions provide both

structural and functional links between its individual cells.

Tight junctions, gap junctions and adhering junctions are found in the epithelium and other tissues.

170. Answer (1)

**Hint:** Unicellular gland

**Sol.:** Unicellular glands consist of isolated glandular cells, which function as glands e.g., Goblet cells of the alimentary canal. These glandular cells secrete mucus, so they are also known as mucus neck cells or mucocytes.

Mammary glands, sweat glands, gastric glands and salivary glands are examples of multicellular glands. HCl and pepsinogen are secreted from gastric gland.

171. Answer (2)

**Hint:** Helps in absorption and secretion

**Sol.:** Some of the columnar or cuboidal cells get specialised for secretion and are called glandular epithelium.

The columnar epithelium is composed of a single layer of tall and slender cells. Their nuclei are located at the base. Free surface may have microvilli. They are found in the lining of stomach and intestine and help in secretion and absorption.

The squamous epithelium is made of a single thin layer of flattened cells with irregular boundaries.

172. Answer (3)

**Hint:** Made up of more than one layers of cells

**Sol.:** Compound epithelium covers the dry surface of the skin, the moist surface of buccal cavity, pharynx, inner lining of ducts of salivary glands and of pancreatic ducts. Their main function is to provide protection against chemical and mechanical stresses.

Simple squamous epithelium forms a diffusion boundary.

Ciliated epithelium functions to move particle or mucus in a specific direction over the epithelium.

173. Answer (3)

**Hint:** Located in upper left portion of the abdominal cavity

**Sol.:** The columnar epithelium is composed of a single layer of tall and slender cells. Their nuclei

are located at the base. Free surface may have microvilli. Brush-bordered columnar epithelium is present in the lining of intestine and helps in absorption and secretion.

174. Answer (4)

**Hint:** All types of tissues are present in an organ.

**Sol.:** All complex animals consist of only four basic types of tissues. These tissues are organised in specific proportion and pattern to form an organ like stomach, lungs, heart and kidneys. When two or more organs perform a common function by their physical and/or chemical interaction, they together form organ system. e.g., digestive system, respiratory system etc.

175. Answer (3)

**Hint:** Equal to the number of fingers in forelimbs of man

**Sol.:** One full turn of the helical strands of B-DNA involves ten steps or ten base pairs.

176. Answer (2)

**Hint:** Possess an additional amino group

**Sol.:** Glutamic acid – Acidic amino acid

Valine, Glycine – Neutral amino acids

Arginine and lysine – Basic amino acids

177. Answer (1)

**Hint:** Different from fetal haemoglobin

**Sol.:** Adult haemoglobin consists of four subunits. Two of these are identical to each other. Hence, two subunits of  $\alpha$  types and two subunits of  $\beta$  types together constitute the adult human haemoglobin (Hb).

178. Answer (1)

**Hint:** Present in acid-insoluble pool

**Sol.:** The acid-soluble pool represents roughly the cytoplasmic composition. The macromolecules from cytoplasm and organelles become the acid-insoluble fraction. Together they represent the entire chemical composition of living tissues or organisms. Lipids are not strictly macromolecules but found in retentate along with macromolecules.

179. Answer (2)

**Hint:** Also includes ricin

**Sol.:**

Pigments	Carotenoids, Anthocyanins, etc.
Alkaloids	Morphine, Codeine, etc.
Terpenoides	Monoterpenes, Diterpenes etc.
Essential oils	Lemon grass oil, etc.
Toxins	Abrin, Ricin
Lectins	Concanavalin A
Drugs	Vinblastin, curcumin, etc.
Polymeric substances	Rubber, gums, cellulose

180. Answer (3)

**Hint:** Identify an organic compound

**Sol.:** Elemental analysis gives elemental composition of living tissues in the form of hydrogen, oxygen, chlorine, carbon, etc., while analysis for compounds gives an idea of the kind of organic and inorganic constituents present in living tissues.

181. Answer (2)

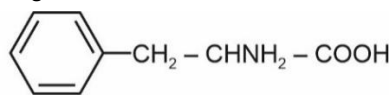
**Hint:** Component of sugars**Sol.:**

Element	% Weight of	
	Earth's crust	Human body
Hydrogen (H)	0.14	0.5
Carbon (C)	0.03	18.5
Oxygen (O)	46.6	65.0
Nitrogen (N)	very little	3.3
Sulphur (S)	0.03	0.3
Sodium (Na)	2.8	0.2
Calcium (Ca)	3.6	1.5
Magnesium (Mg)	2.1	0.1
Silicon (Si)	27.7	negligible

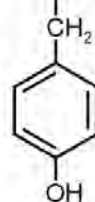
182. Answer (3)

**Hint:** Basic amino acid

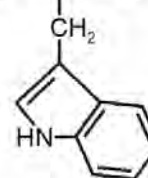
**Sol.:** Phenylalanine, tyrosine and tryptophan are aromatic amino acids having aromatic rings. Arginine is a basic amino acid without aromatic ring.



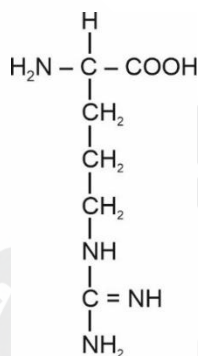
Phenylalanine



Tyrosine



Tryptophan



Arginine

183. Answer (3)

**Hint:** Present in ducts of glands

**Sol.:** The cuboidal epithelium is composed of a single layer of cube-like cells. This is commonly found in ducts of glands and tubular parts of nephrons in kidneys and its main functions are secretion and absorption. The epithelium of proximal convoluted tubule (PCT) of a nephron in the kidney has microvilli.

184. Answer (4)

**Hint:** Function of compound epithelium

**Sol.:** Simple epithelium is composed of a single layer of cells and functions as a lining for body cavities, ducts and tubes. The compound epithelium consists of two or more cell layers and has protective function as it does in our skin.

185. Answer (2)

**Hint:** Hydra

**Sol.:** The body of a simple organism like *Hydra* is made of different types of cells and the number of cells in each type can be in thousands. Porifers exhibit cellular level of organisation.

## SECTION - B

186. Answer (1)

**Hint:** Site of fertilisation**Sol.:** Ciliated epithelium is mainly present in the inner surface of hollow organs like bronchioles and fallopian tubes.

Simple squamous epithelium is present in alveoli of lungs and endothelium of blood vessels.

187. Answer (1)

**Hint:** Includes pigment and alkaloid**Sol.:**

Pigments	Carotenoids, Anthocyanins, etc.
Alkaloids	Morphine, Codeine, etc.
Terpenoides	Monoterpenes, Diterpenes etc.
Essential oils	Lemon grass oil, etc.
Toxins	Abrin, Ricin
Lectins	Concanavalin A
Drugs	Vinblastin, curcumin, etc.
Polymeric substances	Rubber, gums, cellulose

188. Answer (3)

**Hint:** Vitamin B<sub>1</sub>**Sol.:** Adenosine, thymidine, uridine and cytidine are nucleosides while thiamine is vitamin B<sub>1</sub>.

189. Answer (3)

**Hint:** Glycine**Sol.:** Glycerol is present in lecithin which forms the cell membrane.Palmitic acid (CH<sub>3</sub>-(CH<sub>2</sub>)<sub>14</sub> - COOH) is a saturated fatty acid that does not possess double bond.

Glycine is the simplest amino acid.

Ribose is the pentose sugar of RNA.

190. Answer (4)

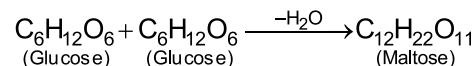
**Hint:** 2<sup>n</sup>**Sol.:** A general rule of thumb is that reaction rate doubles or decreases by half for every 10°C change in temperature in either direction.The increase in the rate of reaction, if the temperature rises from 30°C to 80°C = 2<sup>5</sup>

= 32 times

191. Answer (4)

**Hint:** Maltose**Sol.:** Synthesis of one molecule of maltose from two molecules of glucose by elimination of one molecule of water occurs by dehydration reaction.

So,



192. Answer (4)

**Hint:** Endocrine glands are ductless glands.**Sol.:** Exocrine glands secrete mucus, saliva, earwax, oil, milk, digestive enzymes and other cell products. These products are released through ducts or tubes. In contrast, endocrine glands do not have ducts and their products are called hormones and are secreted directly into the fluid bathing the gland.

Connective tissues are the most abundant and widely distributed tissues in the body of complex animals.

193. Answer (3)

**Hint:** Communication junction**Sol.:** Tight junctions help to stop substances from leaking across a tissue.

Adhering junctions perform cementing to keep neighbouring cells together.

Gap junctions also known as communication junctions facilitate the cells to communicate with each other by connecting the cytoplasm of adjoining cells, for rapid transfer of ions, small molecules and sometimes big molecules.

194. Answer (2)

**Hint:** Tendons belong to same category**Sol.:** Loose connective tissue has cells and fibres loosely arranged in a semi-fluid ground substance, for example areolar tissue and adipose tissue.

Examples of dense regular connective tissue are tendons and ligaments. Tendon attaches skeletal muscles to bones and ligaments attach one bone to another.

Cartilage, bone and blood are specialised connective tissues.

195. Answer (2)

**Hint:** Fluid connective tissue

**Sol.:** In all connective tissues, except blood and lymph, the cells secrete fibres of structural proteins called collagen or elastin.

Adipose tissue and areolar tissue are loose connective tissues.

196. Answer (4)

**Hint:** Cavity present around osteocytes

**Sol.:** Cells of both, cartilages (chondrocytes) and bones (osteocytes) are enclosed in small cavities within the matrix secreted by them called lacunae.

Bone's matrix is arranged in the form of concentric lamellae.

Bone marrow in some bones is the site of production of blood cells.

197. Answer (4)

**Hint:** Active sites of enzymes get saturated at  $V_{max}$ .

**Sol.:** With the increase in substrate concentration, the velocity of the enzymatic reaction rises at first. The reaction reaches a maximum velocity ( $V_{max}$ ) which is not exceeded by any further rise in concentration of the substrate. This is because the enzyme molecules are fewer than the substrate molecules and after saturation of these molecules, there are no free enzyme molecules to bind with the additional substrate molecules.

198. Answer (2)

**Hint:** Alcohol dehydrogenase

**Sol.:** Class-I of enzymes is oxidoreductases/dehydrogenases-catalyses oxidation-reduction between substrates, S and S'.

Hydrolases, lyases and transferases enzymes belong to class III, IV and II respectively.

199. Answer (1)

**Hint:** Chitin

**Sol.:** Fungal cell wall and exoskeleton of arthropods are formed by a complex polysaccharide named chitin which is a homopolymer of N-acetyl glucosamine.

Starch, inulin and glycogen are reserve food materials.

Cellulose is the most abundant organic compound in biosphere.

200. Answer (3)

**Hint:** Cells have short and branched processes

**Sol.:** Neural tissue consists of highly specialized cells called nerve cells or neurons. The neuroglial cells which constitute the rest of the neural system protect and support neurons.

Each neuron has cyton or cell body or perikaryon, dendrites, axon or nerve fibre.

