All India Aakash Test Series for NEET-2025

TEST - 1 (Code-C)

Test Date : 20/08/2023

ANSWERS

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

HINTS & SOLUTIONS

[PHYSICS]

SECTION - A

1. Answer (2)

Hint & Sol.: Celestial and terrestrial mechanics was unified by Issac Newton.

2. Answer (3)

Hint & Sol.: Sir C.V. Raman won Nobel Prize for physics in 1930.

3. Answer (3)

Hint: Area of circle = πr^2

Sol.: Area = $\pi(1.21)^2 = 4.5972\ m^2$

Since the number 1.21 has three significant figures, therefore the answer should have three significant figures. Hence, the answer will be $4.60\ m^2$

4. Answer (1)

Hint & Sol.: Unit of energy = $kg\ m^2\ s^{-2}$

$\therefore$ $[KE] = [ML^2T^{-2}]$

5. Answer (3)

Hint: Perimeter of square plate = 4 × side length

Sol.:

$P = (4 \times 3.2) \pm (4 \times 0.1)$

$P = (12.8 \pm 0.4)\ m$

6. Answer (4)

Hint & Sol.: Precision is related to least count.

7. Answer (2)

Hint: $\vec{a} = \dfrac{\vec{v} - \vec{u}}{\Delta t}$

Sol.: $a = \dfrac{\left(36 \times 5/18\right) - \left(54 \times 5/18\right)}{25} = \dfrac{10 - 15}{25}$

$a = -\dfrac{1}{5}\ m/s^2$

8. Answer (3)

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

Sol.: $\Delta v = \int a dt$ = Area under *a-t* graph

$v - 0 = (3 \times 4) - (3 \times 1)$

$v = 12 - 3 = 9\ m/s$

9. Answer (1)

Hint: $\vec{a}_{A/B} = \vec{a}_{A/g} - \vec{a}_{B/g}$

Sol.: $\vec{a}_{A/B} = 3 - (-4) = 7 m/s^2$

10. Answer (4)

Hint: Relative velocity of the given trains = $v_1 + v_2$

Sol.: Time $= \dfrac{\text{Sum of lengths of two trains}}{\text{relative speed of trains}}$

$t = \dfrac{l_1 + l_2}{v_1 + v_2}$

11. Answer (2)

Hint & Sol.: $[M] = [MLT^{-2}]^x\ [LT^{-1}]^y\ [T]^z$

$[M] = [M^x]\ [L^{x+y}]\ [T^{-2x-y+z}]$

Comparing both sides,

$x = 1$ and $x + y = 0$

$\therefore$ $y = -1$

Also, $-2x - y + z = 0$

$(-2 \times 1) - (-1) + z = 0$

$z = 1$

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

12. Answer (1)

Hint: $V = \dfrac{4}{3}\pi R^3$

Sol.: $\dfrac{\Delta V}{V} \times 100 = 3\left(\dfrac{\Delta R}{R} \times 100\right)$

$\dfrac{\Delta V}{V} \times 100 = 3 \times 3\%$

$\therefore$ Percentage error in volume determination is 9%

13. Answer (3)

Hint & Sol.:

Least count = 1 MSD – 1 VSD

LC = 1 MSD $- \dfrac{n_2}{n_1}$ MSD

LC = $\dfrac{(n_1 - n_2)}{n_1} \times 1\,mm$

14. Answer (4)

Hint & Sol.: $V = 0.2350 \times 10^{-2}\ m^3$

Leading zeroes are always insignificant and trailing zeroes after decimal are significant

Hence there are four significant figures in the given measurement.

15. Answer (2)

Hint: $n_1u_1 = n_2u_2$; $[E] = [ML^2T^{-2}]$

Sol.: $1 = n_2 \left(\frac{100\text{ kg}}{1\text{kg}}\right)\left(\frac{10\text{ m}}{1\text{m}}\right)^2\left(\frac{30\text{ s}}{1\text{s}}\right)^{-2}$

$1 = n_2 \times \frac{10^2 \times 10^2}{30 \times 30} \Rightarrow n_2 = \frac{9}{100}$

16. Answer (2)

Hint & Sol.: Relation containing product of different physical quantities can be deduced by the dimensional analysis.

Constant of proportionality cannot be deduced by this method.

17. Answer (3)

Hint: Instantaneous velocity $\Rightarrow v = \frac{dx}{dt}$

Sol.: $v = \frac{d}{dt}(t + 3t^2 + 2) \Rightarrow v = 1 + 6t$

$v\,(t = 4) = 1 + (6 \times 4) = 25$ m/s

18. Answer (1)

Hint: Total time of flight = Time of ascent + time of descent

Also Time of ascent = Time of descent

Sol.: Time of ascent :-

$v = u + at \Rightarrow 0 = 40 - 10 \times t$

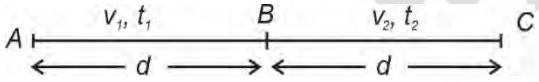
$t = 4$ s

Time of flight $= 4 \times 2 = 8$ s

19. Answer (1)

Hint: Mean speed $= \frac{\text{Total distance}}{\text{Total time}}$

Sol.:



$\langle v \rangle = \frac{d + d}{\frac{d}{v_1} + \frac{d}{v_2}}$

$\langle v \rangle = \frac{2v_1v_2}{v_1 + v_2}$

20. Answer (3)

Hint: $\int dv = \int a\,dt$

Sol.: $\int_0^v dv = \int_0^t \frac{t^3}{3}dt \Rightarrow v = \frac{1}{3} \times \frac{t^4}{4}\Big|_0^t$

$v = \frac{t^4}{12}$

21. Answer (3)

Hint: Slope of velocity-time graph gives instantaneous acceleration

Sol.: Only in graph (3) slope is positive at every point, hence it shows positive acceleration.

22. Answer (2)

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

Sol.: $S_{3^{rd}} = 5 + \frac{4}{2}(2 \times 3 - 1)$

$= 5 + 2(5) = 15$ m

23. Answer (1)

Hint: Relative acceleration: $\vec{a}_{B/A} = \vec{a}_{B/g} - \vec{a}_{A/g}$

Sol.: Acceleration of B w.r.t. A

$a_{B/A} = a_{B/g} - a_{A/g}$

$a_{B/A} = 4 - 1 = 3\text{ m/s}^2$ ...(1)

Since the relative acceleration is constant, hence equations of motion are applicable.

$S_{B/A} = u_{B/A}t + \frac{1}{2}a_{B/A}t^2$

$5400 = 0 + \frac{1}{2} \times 3 \times t^2$

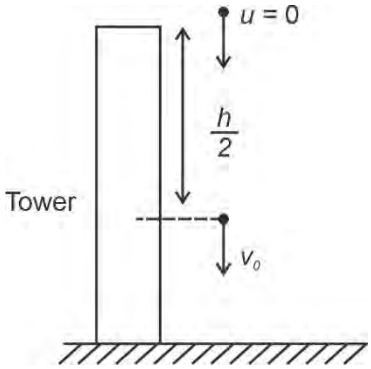
$t^2 = \frac{5400 \times 2}{3} = 3600$

$t = 60$ second

24. Answer (1)

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

Sol.: Let the height of the tower is h



$2 \times g \times \frac{h}{2} = v_0^2 - 0^2$

$h = \frac{v_0^2}{g}$

25. Answer (4)

Hint: $< v > = \dfrac{\int_{t_1}^{t_2} v\,dt}{\int_{t_1}^{t_2} dt}$

Sol.: Given, $v = \alpha t^2 + \beta t$

$$< v > = \frac{\int_0^t (\alpha t^2 + \beta t)\,dt}{\int_0^t dt}$$

$$= \frac{\alpha\frac{t^3}{3} + \beta\frac{t^2}{2}}{t} = \frac{\alpha t^2}{3} + \beta\frac{t}{2}$$

26. Answer (2)

Hint: Average speed = $\dfrac{\text{Total distance}}{\text{Total time}}$

Sol.: $t_1 = \dfrac{100}{4} = 25$ s; $t_2 = \dfrac{200}{10} = 20$ s;

$t_3 = \dfrac{300}{5} = 60$ s

$\therefore <v> = \dfrac{100 + 200 + 300}{25 + 20 + 60} = \dfrac{600}{105} = 5.7$ m/s

27. Answer (2)

Hint & Sol.: Gravitational force is the weakest force in nature.

28. Answer (3)

Hint & Sol.:

- The trailing zeroes are significant only when the number has decimal point.
- All zeroes appearing between two non-zero digits are significant.
- Non-zero digits in a number are always significant.

29. Answer (1)

Hint: $P = mv$

Sol.: Unit of linear momentum = kg m s^{-1}

$\therefore$ [P] = $[MLT^{-1}]$

30. Answer (2)

Hint: $\sin(\omega t)$ and e^{-2t} are dimensionless.

Sol.: [v] = [α] = [β]

Since v is velocity, there α and β also have dimensions of velocity.

$\therefore \alpha\beta = (\text{m s}^{-1})(\text{m s}^{-1}) = \text{m}^2\text{s}^{-2}$

31. Answer (2)

Hint: Absolute error

= |True value – measured value|

Mean absolute error =

$$\frac{\text{Summation of absolute errors}}{\text{Number of observations}}$$

Sol.: $a_{mean} = \dfrac{1.72+1.69+1.70+1.73}{4} = 1.71$ g

$\Delta a_1 = |1.71 - 1.72| = 0.01$

$\Delta a_2 = |1.71 - 1.69| = 0.02$

$\Delta a_3 = |1.71 - 1.70| = 0.01$

$\Delta a_4 = |1.71 - 1.73| = 0.02$

$\Delta a_m = \dfrac{\Delta a_1 + \Delta a_2 + \Delta a_3 + \Delta a_4}{4}$

$= \dfrac{0.01 + 0.02 + 0.01 + 0.02}{4} = 0.015$

Rounding off to two decimal places, the answer will be 0.02 g

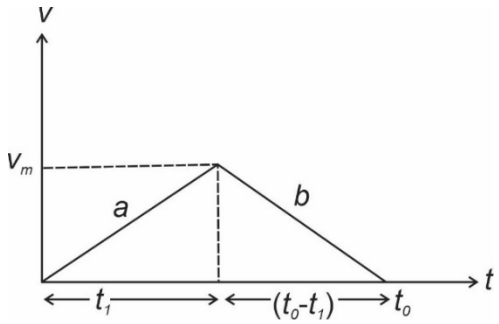
32. Answer (3)

Hint & Sol.: |Displacement| $\leq$ Distance

33. Answer (2)

Hint: Draw velocity-time graph for the given situation

Sol.:



$v = u + at \Rightarrow v_m = at_1$ ...(i)

$0 = v_m - b(t_0 - t_1) \Rightarrow v_m = b\,(t_0 - t_1)$ ...(ii)

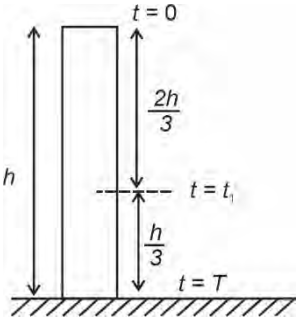
Eliminate t_1 from equation (i) and (ii),

$$v_m = b\left(t_0 - \frac{v_m}{a}\right) \Rightarrow v_m = \frac{ab\,t_0}{(a+b)}$$

34. Answer (1)

Hint: use equation of motion

Sol.:



Total time of flight; $T = \sqrt{\frac{2h}{g}}$ ...(i)

Time taken to cover $\frac{2h}{3}$ distance

$t_1 = \sqrt{\frac{2}{g} \times \frac{2h}{3}}$ ...(ii)

$\therefore$ Time taken to cover last $\frac{h}{3}$ distance

$t' = T - t_1 = \sqrt{\frac{2h}{g}} - \sqrt{\frac{4h}{3g}}$

$t' = \sqrt{\frac{2h}{g}}\left(1 - \frac{\sqrt{2}}{\sqrt{3}}\right) = \sqrt{\frac{2h}{3g}}\left(\sqrt{3} - \sqrt{2}\right)$

35. Delete

Hint: In one dimensional motion, a body can only move in a line.

Sol.:

- A body can have non-zero acceleration when its velocity is zero. For example, motion under gravity
- Instantaneous velocity is always equal to instantaneous speed. Average velocity and average speed may or may not be equal.
- In one dimensional motion, acceleration always changes speed.

SECTION - B

36. Answer (1)

Hint & Sol.: A vernier calliper is more precise than a meter scale.

Lower value of least count results in less error.

37. Answer (1)

Hint: CGS unit of mass is g and length is cm.

Sol.: $n_1u_1 = n_2u_2$

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

$700 = n_2\left[\frac{g}{kg}\right]\left[\frac{cm}{m}\right]^{-3}$

$700 = n_2\left[\frac{g}{1000\ g}\right]\left[\frac{cm}{100\ cm}\right]^{-3}$

$700 = n_2\ (10^{-3})\ (10^6)$

$n_2 = \frac{700}{10^3} \Rightarrow n_2 = 0.7$

$\therefore$ Density in CGS unit is 0.7 g/cc

38. Answer (4)

Hint: $\frac{\Delta p}{p} = x\frac{\Delta M}{M} + y\frac{\Delta L}{L} + z\frac{\Delta T}{T}$

Sol.: $\frac{\Delta p}{p} = (x \times a) + (y \times b) + (z \times c)$

39. Answer (1)

Hint: Assume that the brakes cause same constant retardation in both the cases.

Sol.: Apply equation of motion

$2as = v^2 - u^2$

$2 \times a \times 81 = 0^2 - 30^2$ ...(i)

$2 \times a \times s = 0^2 - 20^2$ ...(ii)

$\frac{2a \times 81}{2a \times s} = \frac{30 \times 30}{20 \times 20}$

$s = \frac{81 \times 4}{9} = 36$ m

40. Answer (2)

Hint: Muzzle velocity of a bullet is the velocity of bullet w.r.t. the gun.

Sol.: Velocity of bullet w.r.t. ground ($v_{b/g}$) is

200 + 80 = 280 m/s

Velocity of bullet as seen by the thief:

$\vec{v}_{b/T} = \vec{v}_{b/g} - \vec{v}_{T/g}$

$v_{b/T} = 280 - 50 = 230$ m/s

41. Answer (1)

Hint & Sol.: Velocity of the lift is downwards but its magnitude is decreasing, it means the lift is retarding. Hence its acceleration is upwards.

42. Answer (2)

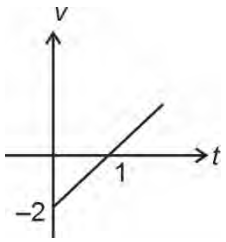
Hint: $v = \frac{ds}{dt}$

Sol.: $v = \frac{d}{dt}(t^2 - 2t - 1) \Rightarrow v = 2t - 2$

At $t = 0 \Rightarrow v = -2$; At t = 1 $\Rightarrow v = 0$

And the slope is constant equal to 2.

Hence the graph will be



43. Answer (3)

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

Sol.: For particle X: $S_{5^{th}} = \frac{3}{2}(2\times5-1)$ ...(i)

For particle Y: $S_{3^{rd}} = \frac{a}{2}(2\times3-1)$ ...(ii)

Given, $S_{5^{th}} = S_{3^{rd}}$

$\frac{3}{2}(9) = \frac{a}{2}(5)$

$a_0 = \frac{27}{5}$ m/s^2

44. Answer (4)

Hint: $K = \frac{1}{2}mv^2$; $\frac{\Delta K}{K} = \frac{\Delta m}{m} + 2\frac{\Delta v}{v}$

Sol.: $K = \frac{1}{2}\times 2\times 10^2 = 100$ J

$\frac{\Delta K}{K} = \left(\frac{0.1}{2} + 2\times\frac{0.2}{10}\right)$

$\Delta K = \left(\frac{0.1}{2}\times100\right) + \left(2\times\frac{0.2}{10}\times100\right)$

$\Delta K = 5 + 4 = 9$

$\therefore$ Kinetic energy = (100 ± 9) J

45. Answer (2)

Hint & Sol.: $\frac{Pa}{s} = \frac{N}{m^2 s} = \frac{kg\ ms^{-2}}{m^2 s} = kg\ m^{-1}\ s^{-3}$

$\therefore$ The dimensional formula is $[ML^{-1}T^{-3}]$

46. Answer (2)

Hint & Sol.: The least count is 0.01

47. Answer (3)

Hint: Average velocity = $\frac{\text{Total displacement}}{\text{Total time}}$

Sol.: $\langle v\rangle = \frac{x+2x}{\frac{x}{v_1}+\frac{2x}{v_2}} = \frac{3x\times v_1v_2}{v_2x + v_1 2x}$

$v = \frac{3v_1v_2}{2v_1+v_2}$

48. Answer (2)

Hint: Apply $v = u + at$

Sol.: $20 = 80 + (-4)\times t$

$t = \frac{20-80}{-4} = 15$ s

49. Answer (3)

Hint: Area under velocity-time graph give displacement of the body.

Sol.: Displacement = $(2\times1) + (6\times1) + (1\times-4) + (\frac{1}{2}\times1\times-4)$

$= 2 + 6 - 4 - 2 = 2$ m

Distance = $|2\times1| + |6\times1| + |1\times-4| + |\frac{1}{2}\times1\times-4|$

$= 2 + 6 + 4 + 2 = 14$ m

$\frac{\text{Distance}}{\text{Displacement}} = \frac{14}{2} = 7$

50. Answer (3)

Hint & Sol.: Since displacement only depends on initial and final points, therefore displacement of both the balls is equal.

While the distance covered will be more for the second ball.

[CHEMISTRY]

SECTION - A

51. Answer (4)

Hint: 2 mole of NH_3 formation require one mole N_2 gas

Sol.: $N_2(g) + 3H_2(g) \longrightarrow 2NH_3(g)$

Number of moles of NH_3 = 85/17 = 5 mole

2 mole of NH_3 is produced by 1 mole of N_2

5 mole of NH_3 is produced by 5/2 mole of N_2

= 2.5 mole N_2

52. Answer (2)

Hint: Number of atoms = moles × atomicity × N_A

where N_A = Avogadro's number

Sol.: Number of atoms in 1 g of Na

$= \frac{1}{23} \times 1 \times N_A = \frac{N_A}{23}$

Number of atoms in 1 g of H_2

$= \frac{1}{2} \times 2 \times N_A = N_A$

Number of atoms in 1 g of H_2O

$= \frac{1}{18} \times 3 \times N_A = \frac{N_A}{6}$

Number of atoms in 1 g of Ca

$= \frac{1}{40} \times 1 \times N_A = \frac{N_A}{40}$

53. Answer (1)

Hint: At STP, volume of 1 mole of a gas = 22.4 L

Sol.: $C_3H_8(g) + 5O_2(g) \longrightarrow 3CO_2(g) + 4H_2O(l)$

1 mole C_3H_8 requires 5 mole of O_2

$\therefore$ 1 mole C_3H_8 requires 5 × 22.4 L of O_2 at STP = 112 L

54. Answer (1)

Hint: Number of moles = $\frac{\text{Given mass}}{\text{Molar mass}}$

Sol.: $\frac{n_{SO_2}}{n_{O_2}} = \frac{2/64}{3/32} = \frac{1}{3}$

55. Answer (2)

Hint: Molarity = $\frac{\text{Number of moles of solute}}{\text{Volume of solution in litre}}$

Sol.: 1 mole urea (NH_2CONH_2) contain = 6.023×10^{23} molecules

Moles of urea = $\frac{3.011 \times 10^{22}}{6.022 \times 10^{23}}$ = 0.05 mol

Molarity = $\frac{0.05 \times 1000}{200}$ = 0.25 M

56. Answer (3)

Hint: $\chi_{CH_3OH} = \frac{n_{CH_3OH}}{n_{CH_3OH} + n_{C_2H_5OH}}$

Sol.: Let mass of CH_3OH and C_2H_5OH taken is w gram

$$X_{CH_3OH} = \frac{\frac{w}{32}}{\frac{w}{32} + \frac{w}{46}} = \frac{\frac{w}{32}}{\frac{23w + 16w}{736}}$$

$$= \frac{w}{32} \times \frac{736}{39w} = \frac{23}{39}$$

57. Answer (1)

Hint: Orbital angular momentum of an electron in an orbital = $\sqrt{\ell(\ell+1)}\frac{h}{2\pi}$

Sol.: For *f*-orbital, value of l = 3

Orbital angular momentum

$= \sqrt{3(3+1)}\frac{h}{2\pi} = \sqrt{12}\frac{h}{2\pi} = \sqrt{3}\frac{h}{\pi}$

58. Answer (4)

Hint: Cr (Z = 24) has its electronic configuration; $[Ar]3d^5 4s^1$

Sol.:

Element	Number of unpaired electrons
Ar	0
Mn	5
Ca	0
Cr	6

59. Answer (4)

Hint: For a value of n, the value of l ranges from 0 to n –1

Sol.: For a value of l, the value of m ranges from –l to +l

$\therefore$ for l = 2, m_l = –2, –1, 0, +1, +2

For n = 1, l = 0

60. Answer (2)

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

Sol.: Since $\lambda \propto \frac{1}{Z^2}$

$\therefore$ λ will be minimum for Be^{3+} (Z = 4)

61. Answer (2)

Hint: An orbital can accommodate maximum two electrons.

Sol.: n + l = 3 for the orbitals 2*p* and 3*s*

$\therefore$ Total number of electrons associated in these orbitals = 8

62. Answer (2)

Hint & Sol.: The number of electrons ejected in photoelectric effect is proportional to the intensity or brightness of light.

63. Answer (1)

Hint: 1 amu = 1.66×10^{-24} g

Sol.: Mass of 1 He atom = 4 amu

Mass of 2 He atoms = 2 × 4 amu

= $8 \times 1.66 \times 10^{-24}$ g = 1.33×10^{-23} g

64. Answer (1)

Hint: Mass percentage of oxygen

$= \frac{\text{Mass of oxygen}}{\text{Mass of compound}} \times 100$

Sol.: Mass percentage of oxygen

$= \frac{3 \times 16}{63} \times 100$ [Molar mass of HNO_3 = 63 g]

$= 76.1\% \simeq 76\%$

65. Answer (4)

Hint: 70% (w/w) H_2SO_4 means 70 g H_2SO_4 is present in 100 g of solution

Sol.: Molarity

$= \frac{\text{Mass of } H_2SO_4 \text{ required}}{\text{Molar mass of } H_2SO_4} \times \frac{1000}{\text{Vol. of solution (ml)}}$

Mass of H_2SO_4 required = $\frac{1 \times 98 \times 500}{1000} = 49\,g$

Mass of H_2SO_4 required from 70% (w/w)

$= \frac{100}{70} \times 49 = 70\,g$

66. Answer (2)

Hint: One mole of Cl^- ion contain 18 N_A electrons where N_A is Avogadro's number.

Sol.: Number of moles of Cl^- ion = $\frac{71 \times 10^{-3}}{35.5}$

$= 2 \times 10^{-3}$ mol

Number of electrons in 2×10^{-3} mole Cl^- ion

$= 2 \times 10^{-3} \times 18 \times N_A = 3.6 \times 10^{-2}\ N_A$

67. Answer (3)

Hint: The concentration terms containing volume are temperature dependent

Sol.: Molality and mole fraction does not contain any volume term, therefore, are temperature independent.

68. Answer (2)

Hint: 2 molal glucose solution means 2 mole glucose is present in 1 kg of solvent.

Sol.: 1000 g solvent = 2 × 180 g = 360 g glucose

Mass of solution = 1000 + 360 = 1360 g

$\because$ 1360 g solution contain = 360 g glucose

1000 g solution contain

$= \frac{360}{1360} \times 1000 = 264.7$ g

$\simeq 265$ g

69. Answer (3)

Hint: Molecular formula = n × empirical formula

Sol.: H_3PO_3 has the simplest whole number ratio.

Molecular formula	Empirical formula
$H_2C_2O_4$	HCO_2
$H_2S_2O_8$	HSO_4
C_6H_6	CH

70. Answer (4)

Hint & Sol.:

Lyman	–	1 and 2, 3, …
Brackett	–	4 and 5, 6, …
Balmer	–	2 and 3, 4, …
Paschen	–	3 and 4, 5, …

71. Answer (2)

Hint: $r_n = 52.9\frac{n^2}{Z}$ pm

Sol.: $\frac{r_1(He^+)}{r_2(Be^{3+})} = \frac{(1)^2}{2} \times \frac{4}{(2)^2} = \frac{1}{2}$

72. Answer (4)

Hint: Total number of nodes = n – 1

Sol.: For 3*d* orbital, n = 3, l = 2

Total nodes = 3 – 1 = 2

73. Answer (4)

Hint: For any subshell, 2l + 1 values of m_l are possible.

Sol.: Magnetic quantum number defines the spatial orientation of the orbital with respect to standard set of co-ordinate axis.

74. Answer (1)

Hint: Heisenberg's uncertainty principle:

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

Sol.: $\because\ \Delta x = 2\Delta p_x$

$2\Delta p_x \times \Delta p_x = \frac{h}{4\pi}$

$(m\Delta v_x)^2 = \frac{h}{8\pi}$

$\Delta v_x = \frac{1}{m}\sqrt{\frac{h}{8\pi}}$

$\Delta v_x = \frac{1}{2m}\sqrt{\frac{h}{2\pi}}$

75. Answer (2)

Hint: Isoelectronic species contain same number of electrons.

Sol.:

Species	Number of electrons
H	1
Li^{2+}	1
H^+	0
Be^{2+}	2
He	2
Be^{3+}	1
He^+	1

76. Answer (2)

Hint: 1 mole $CaCO_3$ produces 1 mole CO_2 upon heating

Sol.: $CaCO_3 \xrightarrow{\Delta} CaO + CO_2$

Moles of $CaCO_3$ = $\frac{200}{100}$ = 2 mole

[Molar mass of $CaCO_3$ = 100 g]

Moles of CO_2 produced = $\frac{44}{44}$ = 1 mole

$\because$ 1 mole $CaCO_3$ produces 1 mole CO_2

$\therefore$ Amount of $CaCO_3$ used = 100 g

% purity = $\frac{100}{200} \times 100$ = 50%

77. Answer (3)

Hint: Number of atoms

= Number of moles × Atomicity × N_A

Sol.: Number of moles of S_8 = 0.5 mole

Number of S atoms = $0.5 \times 8 \times 6.022 \times 10^{23}$

= 2.41×10^{24} atoms

78. Answer (1)

Hint: Mole fraction of NaOH = $\frac{n_{NaOH}}{n_{NaOH} + n_{H_2O}}$

Sol.: Mass of solvent (H_2O) present = 81 g

$$x_{NaOH} = \frac{0.5}{0.5 + \frac{81}{18}} = \frac{0.5}{0.5 + 4.5} = \frac{0.5}{5} = \frac{1}{10}$$

79. Answer (2)

Hint: Aluminium sulphate is $Al_2(SO_4)_3$

Sol.: 1 mole $Al_2(SO_4)_3$ contains 2 mole of Al atoms, 3 mole of S atoms and 12 mole of O atoms.

80. Answer (3)

Hint:

$$\overline{M}_{av} = \frac{\%\text{ of isotope 1} \times M_1 + \%\text{ of isotope 2} \times M_2}{100}$$

Sol.: $\overline{M}_{av} = \frac{30 \times 100 + 70 \times 101}{100} = 100.7$

81. Answer (4)

Hint: $\Delta E = 2.18 \times 10^{-18} \times Z^2 \left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$ J

Sol.: For ΔE_2 ; $n_1 = 2$, $n_2 = \infty$

$\Delta E_2 = 2.18 \times 10^{-18} \times (1)^2 \left(\frac{1}{2^2}\right)$

Similarly, ΔE_3 ; $n_1 = 3$, $n_2 = \infty$

$\Delta E_3 = 2.18 \times 10^{-18} \times (1)^2 \left(\frac{1}{3^2}\right)$

$$\frac{\Delta E_2}{\Delta E_3} = \frac{1/4}{1/9} = \frac{9}{4}$$

82. Answer (4)

Hint: Blackbody radiation is the nature of emission of radiation from the hot bodies.

Sol.: Interference can be explained by the wave nature of the electromagnetic radiation.

83. Answer (1)

Hint: l = 1 corresponds to *p*-subshell

Sol.: 3*p* subshell can accommodate maximum 6 electrons.

84. Answer (4)

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

Sol.: $\lambda = \frac{6.6 \times 10^{-34}}{0.132 \times 2 \times 10^5}$ = 2.5×10^{-38} m

85. Answer (1)

Hint: Number of waves of an electron in an orbital = principal quantum number

Sol.: For n = 4, the total number of waves will be four.

SECTION - B

86. Answer (3)

Hint: $\frac{M_1V_1 + M_2V_2}{V_1 + V_2} = M_{final}$

Sol.: $M_f = \frac{0.5 \times 400 + 1.5 \times 200}{400 + 200} = \frac{500}{600} = 0.83$ M

87. Answer (4)

Hint: % of Fe = $\frac{\text{Mass of Fe}}{\text{Mass of compound}} \times 100$

Sol.: $0.5 = \frac{56}{\text{Mass of compound}} \times 100$

Mass of compound $= \frac{56}{0.5} \times 100$ = 11,200 u

88. Answer (2)

Hint: Vapour density = $\frac{\text{Molecular weight}}{2}$

Sol.: $\frac{\text{V.D.}_{O_2}}{\text{V.D.}_{CH_4}} = \frac{\text{Mol. wt. of } O_2/2}{\text{Mol. wt. of } CH_4/2}$

$= \frac{32}{16} = \frac{2}{1}$

89. Answer (1)

Hint: Empirical formula is the simplest whole number ratio of various atoms present in a compound

Sol.:

Element	%	Molar ratio	Simple whole number ratio
C	40	$\frac{40}{12} = 3.33$	$\frac{3.33}{3.33} = 1$
H	6.66	$\frac{6.66}{1} = 6.66$	$\frac{6.66}{3.33} = 2$
O	53.4	$\frac{53.4}{16} = 3.33$	$\frac{3.33}{3.33} = 1$

The empirical formula of the compound is CH_2O

90. Answer (1)

Hint: At STP, 1 mole of a gas contain 22.4 L

Sol.: $n_{C_3H_8} = \frac{11.2}{22.4} = 0.5$ mole

n_{carbon} = 3 × 0.5 = 1.5 mole

Mass of carbon = 1.5 × 12 = 18 g

91. Answer (4)

Hint: Number of orbitals in nth shell = n^2

Sol.: The value of n for M shell = 3

$\therefore$ Number of orbitals = $(3)^2 = 9$

92. Answer (3)

Hint: $\overline{\nu} = \frac{\nu}{c}$

Sol.: $\overline{\nu} = \frac{4 \times 10^{-12}}{3 \times 10^8}$ = 1.33 × 10^{-20} m^{-1}

93. Answer (2)

Hint & Sol.:

List I	List II
2*s*	2
3*p*	4
4*d*	6
3*d*	5

94. Answer (4)

Hint: *d* subshell contains five *d* orbitals i.e. d_{xy}, d_{yz}, d_{zx}, $d_{x^2-y^2}$ and d_{z^2} in which three orbitals lie in between the axis and two lies along the axis.

Sol.: d_{xy}, d_{yz} and d_{zx} lie in between the axis, however $d_{x^2-y^2}$ and d_{z^2} lie along the axis.

Each *d* orbital contains two nodal planes except d_{z^2}.

95. Answer (4)

Hint: For multielectron species, the orbital with greater (n + l) value have higher energy and for same (n + l) value, the orbital with greater n values has higher energy.

Sol.:

	3*p*	4*s*	3*d*	4*d*
n + l value:	4	4	5	6
Increasing order of Energy:	→			

96. Answer (3)

Hint: 1 mole SO_2 occupy 22.4 L at STP

Sol.: Density = $\frac{\text{Mass}}{\text{Volume}}$

$d(SO_2) = \frac{64}{22.4}$ at STP [1 mole SO_2 = 64 g]

= 2.85 gL^{-1}

97. Answer (1)

Hint: Zeros between the non-zero digits are significant.

Sol.: Zeros preceding to first non-zero digit are not significant. *e.g.*, 0.0064 has only two significant figures.

98. Answer (3)

Hint: Number of protons = Atomic number

Number of neutrons

= Mass number – Atomic number

Sol.: For S^{2-} ions

Number of protons = 16

Number of electrons = 16 + 2 = 18

Number of neutrons = 32 – 16 = 16

99. Answer (1)

Hint: Radio waves has the largest wavelength and smallest frequency

Sol.: Decreasing order of frequency: γ-rays > UV rays > Microwaves > Radio waves

100. Answer (2)

Hint: Energy of one photon = $h\nu$

Sol.: Power of bulb= 150 watt = 150 J s^{-1}

Energy of a photon = $h\nu = \frac{hc}{\lambda}$

$= \frac{6.626 \times 10^{-34} \times 3 \times 10^{8}}{300 \times 10^{-9}}$

$= 6.626 \times 10^{-19}$ J s^{-1}

Number of photons emitted = $\frac{150}{6.626 \times 10^{-19}}$

$= 2.3 \times 10^{20}$

[BOTANY]

SECTION - A

101. Answer (3)

Hint: During mitosis splitting of centromere takes place in Anaphase.

Sol.: During meiosis, splitting of centromere takes place in anaphase II.

102. Answer (4)

Hint: Prophase I is the first stage of meiosis, which is further divided into five sub phases.

Sol.: Moving of chromosomes towards opposite poles takes place in anaphase I.

103. Answer (3)

Hint: During S phase, centriole as well as DNA duplicates.

Sol.: G_1 – It takes place between M and S phase

G_0 – It is an inactive stage

G_2 – Proteins and RNA molecules are synthesised here.

104. Answer (1)

Hint: Quiescent stage is G_0 phase.

Sol.: Cell is metabolically active in G_0 phase. DNA replication occurs in S phase. In G_0 phase cell does not divide.

105. Answer (3)

Hint: This stage is marked by complete disintegration of nuclear membrane.

Sol.: Spindle fibres attach to kinetochores in metaphase.

106. Answer (1)

Hint: Crossing over takes place in reduction division.

Sol.: Meiosis is called reduction division. Crossing over takes place in meiosis I.

107. Answer (2)

Hint: Crossing over takes place between non sister chromatids of homologous chromosomes

Sol.: BC are non-sister chromatids. AB and CD are sister chromatids.

108. Answer (1)

Sol.: The best stage to study the shape of the chromosomes is Anaphase.

109. Answer (2)

Hint: Chromosome number does not change in interphase.

Sol.: G_1, S and G_2 are parts of interphase. So chromosome number remains same.

110. Answer (1)

Hint: A bivalent has four chromatids.

Sol.: A bivalent consists of two homologous chromosomes.

111. Answer (4)

Hint: Aster is seen in mitotic cells.

Sol.: It is formed during mitosis in animal cells. Plant cells lack centrosome. They show anastral mitosis.

112. Answer (4)

Hint: Reductional division brings variations.

Sol.: Meiosis is called reductional division.

113. Answer (1)

Hint: Recombinase is required for recombination.

Sol.: Recombination takes place in pachytene stage.

114. Answer (2)

Hint: DNA replication takes place only once during entire M phase.

Sol.: DNA should be doubled once only during meiosis as daughter cells are haploid.

115. Answer (1)

Hint: Restriction check point is major check point.

Sol.: $G_1 \rightarrow S$ is major check point.

116. Answer (2)

Hint: Robert Hooke studied and described the cell from a thin slice of cork but that was the dead cells.

Sol.: Anton van Leeuwenhoek first saw and described a live cell.

117. Answer (1)

Hint: Secondary constriction is seen in SAT chromosome.

Sol.: The chromosomes that have non-staining secondary constrictions at a constant location gives the appearance of a small fragment called the satellite.

118. Answer (4)

Hint: Rudolf Virchow first explained that cells divide and new cells are formed from pre-existing cells.

Sol.: According to cell theory, all cells arise from pre-existing cells and all living organisms are composed of cells and product of cells.

119. Answer (4)

Hint: The smallest cell known is a prokaryote.

Sol.: *Mycoplasma* is the smallest cell. They lack cell wall.

120. Answer (4)

Hint: Nucleolus is present in the nucleoplasm.

Sol.: Chromatin contains DNA, histones, non-histone proteins and RNA.

121. Answer (2)

Hint: Mitochondria are the power house of the cell.

Sol.: Mesosome in bacteria has enzyme that help in respiration to produce ATP as mitochondria do.

122. Answer (3)

Hint: The fimbriae are small bristle-like fibres in bacteria that help in attaching to the host tissue.

Sol.: Chromatophores are membranous structures containing photosynthetic pigments. Plasmid is small circular DNA that provide certain phenotypic character such as resistant to antibiotics to such bacteria. Gas vacuoles are considered to be inclusion bodies.

123. Answer (1)

Hint: Some organelles function in a coordinate manner and constitute an endomembrane system.

Sol.: Cell organelles such as mitochondria, chloroplast and peroxisome are not considered as a part of the endomembrane system.

124. Answer (4)

Hint: Cell wall is the non-living, rigid structure of the cell.

Sol.: Uphill transport of material occurs through plasma membrane by the mechanism of active transport.

125. Answer (4)

Hint: Cell membrane is mainly made up of phospholipid bilayer and proteins.

Sol.: In human beings, the membrane of the erythrocyte has approximately 52 per cent protein and 40 per cent lipids.

126. Answer (4)

Hint: Plasmodesmata is lined by plasma membrane and contains a fine tubule called desmotubule.

Sol.: Endoplasmic reticulum plays a role in origin of plasmodesmata.

127. Answer (2)

Hint: The nucleus is bound by double membrane with space 10 to 50 nm in width.

Sol.: The two membrane of the nuclear envelope are separated by a space known as perinuclear space.

128. Answer (3)

Hint: Mitochondria and chloroplasts are semi-autonomous cell organelles.

Sol.: Mitochondria and chloroplasts have 70S ribosomes which have the subunits 50S and 30S.

129. Answer (3)

Hint: *Cis* and *trans* faces of a Golgi apparatus are interconnected.

Sol.: Vesicles are discharged from *trans* face of the Golgi apparatus.

130. Answer (3)

Hint: Tonoplast is membrane of a cell organelle that is a part of endomembrane system.

Sol.: The vacuole is bound by a single membrane called tonoplast.

131. Answer (1)

Hint: Hydrolases of lysosome are optimally active at the acidic pH.

Sol.: The pH less than 7 is said to be acidic.

132. Answer (2)

Hint: Mitochondria are semiautonomous cell organelles as they can synthesize some of their own proteins.

Sol.: Mitochondria can synthesize their proteins because they have DNA, RNA, ribosomes and components required for protein synthesis.

133. Answer (1)

Hint: Fundamental structure of both eukaryotic cilia and flagella is the same.

Sol.: Cilia are smaller structures whereas flagella are comparatively longer.

134. Answer (4)

Hint: Centrioles have an organisation like the cartwheel.

Sol.: Centrioles give rise to spindle apparatus during cell division.

135. Answer (2)

Hint: Elaioplasts store fats and oils.

Sol.: Elaioplast is a type of leucoplast, i.e., colourless plastid that stores fats and oils.

SECTION - B

136. Answer (1)

Hint: Most dramatic phase of cell cycle is M phase.

Sol.: Chromosomes align at equator in metaphase.

137. Answer (4)

Hint: Diplotene is called dictyotene stage in oocytes of some vertebrates.

Sol.: Diplotene may last for many years in oocytes of vertebrates.

138. Answer (1)

Hint: Disc shaped structure is proteinaceous.

Sol.: It is called kinetochore.

139. Answer (2)

Hint: Disappearance of nucleolus, Golgi and ER occurs in first phase of karyokinesis.

Sol.: Prophase is first phase of karyokinesis.

140. Answer (1)

Hint: Phragmoplast is precursor of cell wall.

Sol.: Phragmoplast is formed by Golgi. It is seen during cytokinesis in plant cells.

141. Answer (2)

Hint: Eukaryotic cells have both membrane bound and non-membrane bound cell organelles.

Sol.: Prokaryotic cells have only 70S ribosomes as cell organelles, whereas eukaryotic cells have both 70S and 80S ribosomes.

142. Answer (4)

Hint: Telocentric chromosome appear I-shaped during anaphase.

Sol.: Centromere in telocentric chromosome is present at the terminal end and thus the chromosomes appears to have single arm.

143. Answer (3)

Hint: Human RBCs are round and biconcave and nerve cells are long and branched.

Sol.: The bacterium bacillus is rod shaped and coccus is spherical.

144. Answer (1)

Hint: The outermost layer in the cell envelope of bacteria is the glycocalyx.

Sol.: The outermost layer, *i.e.*, glycocalyx in bacteria can be in the form of loose sheath called the slime layer or may be thick and tough called capsule.

145. Answer (3)

Hint: Endoplasmic reticulum can be free of ribosomes, *i.e.*, smooth endoplasmic reticulum (SER) or can bear ribosomes, *i.e.*, rough endoplasmic reticulum (RER).

Sol.: SER is associated with lipid and steroid synthesis. RER is associated with the synthesis of proteins and enzymes.

146. Answer (1)

Hint: Cellulose is present in cell walls of all groups of plants.

Sol.: Algal cell wall is composed of cellulose, galactans, mannans and minerals like calcium carbonate.

147. Answer (3)

Hint: Gas vacuole is found in prokaryotes.

Sol.: In *Amoeba* the contractile vacuole is important for osmoregulation and excretion.

148. Answer (2)

Hint: Cristae are present towards the matrix of mitochondria.

Sol.: The inner membrane of mitochondria forms a number of infoldings called the cristae.

149. Answer (3)

Hint: Thylakoids are arranged in stacks called grana.

Sol.: The flat membranous tubules called stroma lamellae connecting the thylakoids of the different grana.

150. Answer (3)

Hint: Microtubules are made up of tubulin proteins which are non-contractile proteins.

Sol.: Microfilaments help in pseudopodia formation.

[ZOOLOGY]

SECTION - A

151. Answer (1)

Hint: Cellulose gives a negative iodine test.

Sol.: Starch and cellulose are homopolymers of glucose. Starch forms helical secondary structures and can hold I_2 molecules in the helical portion.

Cellulose does not contain complex helices and hence, cannot hold I_2.

152. Answer (3)

Hint: Neurons are part of this tissue.

Sol.: Neural tissue exerts the greatest control over the body's responsiveness to changing conditions.

Connective tissue links and supports other tissues/organs of the body.

Epithelial tissue provides a covering or a lining for parts of the body.

153. Answer (4)

Hint: Enzymes catalysing the transfer of a group.

Sol.: Enzymes catalysing the transfer of a group, G (other than hydrogen) between a pair of substrate S and S' are called transferases *e.g.*

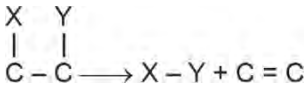
$S - G + S' \longrightarrow S + S' - G$

Oxidoreductases/dehydrogenases: Enzymes which catalyse oxidoreduction between two substrates S and S' *e.g.*,

S reduced + S' oxidised $\rightarrow$ S oxidised + S' reduced.

Hydrolases: Enzymes catalysing hydrolysis of ester, ether, peptide, glycosidic, C-C, C-halide or P-N bonds.

Lyases: Enzymes that catalyse removal of groups from substrates by mechanisms other than hydrolysis leaving double bonds.



154. Answer (2)

Hint: Adenine + Ribose

Sol.: Adenosine, guanosine, thymidine, uridine and cytidine are nucleosides.

Adenylic acid, thymidylic acid, guanylic acid, uridylic acid and cytidylic acid are nucleotides.

155. Answer (4)

Hint: Most abundant protein in the animal world.

Sol.:

Protein	Functions
Collagen	Intercellular ground substance
Trypsin	Enzyme
Insulin	Hormone
Antibody	Fights infectious agents
Receptor	Sensory reception (smell, taste, hormone, *etc.*)
GLUT-4	Enables glucose transport into cells

156. Answer (2)

Hint: Twisted ladder

Sol.: One of the secondary structures exhibited by DNA is the famous Watson and Crick model. This model says that DNA exists as a double helix . The two strands of polynucleotides are antiparallel, *i.e.*, run in the opposite direction.

157. Answer (2)

Hint: Identify a basic amino acid.

Sol.:

Basic amino acid – Lysine

Aromatic amino acids – Tyrosine, Phenylalanine, Tryptophan

158. Answer (3)

Hint: Contains RBCs, WBCs, and platelets

Sol.: Blood is one of the specialised connective tissues.

It is a fluid connective tissue which contains plasma, red blood cells (RBCs), white blood cells (WBCs) and platelets. It is the main circulating fluid that helps in transport of various substances.

In all connective tissues except blood, the cells secrete fibres of structural proteins called collagen or elastin.

159. Answer (2)

Hint: Consists of cluster of cells

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

They are of two types– unicellular, like goblet cells of the alimentary canal and multicellular, like salivary glands.

Inner lining of ducts of salivary glands is lined by compound epithelium.

160. Answer (3)

Hint: Two main types of cells in Islets of Langerhans

Sol.: Adult haemoglobin consists of 4 subunits. Two of these are identical to each other. Hence, two subunits of α-type and two subunits of β-type together constitute the human haemoglobin.

161. Answer (2)

Hint: 'W' is a competitive inhibitor.

Sol.: 'P' is succinic dehydrogenase.

'Q' is succinate.

'W' is the competitive inhibitor of succinate, which is malonate. When the inhibitor closely resembles the substrate in its molecular structure and inhibits the activity of the enzyme, then it is known as a competitive inhibitor.

162. Answer (3)

Hint: Concanavalin A is a lectin.

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	Vinblastine, Curcumin, *etc*
Polymeric Substances	Rubber, Gums, Cellulose

163. Answer (4)

Hint: Holoenzyme = Apoenzyme + Co-factor

Sol.: Non-protein constituents called co-factors are bound to the enzyme to make the enzyme catalytically active.

The protein portion of the enzymes is the apoenzyme.

164. Answer (1)

Hint: This structure represents protein as a line.

Sol.: Primary structure of a protein gives the positional information of amino acids in a protein- which is the first amino acid, which is second, and so on.

Tertiary structure is absolutely necessary for many biological activities of proteins.

165. Answer (2)

Hint: The tissue that links and supports other tissues and organs.

Sol.: Connective tissues are the most abundant and widely distributed in the body of complex animals. They are named connective tissues because of their special function of linking and supporting other tissues/ organs of the body.

The neural tissue exerts greatest control over the body's responsiveness to changing conditions.

166. Answer (4)

Hint: Gap junctions connect the cytoplasm of neighbouring cells.

Sol.:

Tight junctions: Help to stop substances from leaking across a tissue

Adhering junctions: Perform cementing to keep neighbouring cells together

Gap junctions: Facilitate the cells to communicate with each other by connecting cytoplasm of adjoining cells.

167. Answer (4)

Hint: Neurons are excitable cells.

Sol.: Neurons are the units of neural system and are excitable in nature.

The neuroglial cells are non-excitable and they protect and support the neurons.

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

168. Answer (3)

Hint: Peroxidase and catalase have the same co-factor.

Sol.: Haem is the prosthetic group for the enzymes peroxidase and catalase.

Zinc is the co-factor for the proteolytic enzyme carboxypeptidase and carbonic anhydrase.

Co-enzyme NAD and NADP contain the vitamin niacin.

169. Answer (4)

Hint: Tertiary structure of proteins makes them biologically active.

Sol.: An enzyme like any protein has a primary, secondary and tertiary structure.

The tertiary structure of an enzyme has crevices or pockets into which the substrate fits. These crevices are called active sites which make the enzymes catalytically active.

170. Answer (1)

Hint: Rate of a physical or chemical process.

Sol.: Rate of a physical or chemical process refers to the amount of product formed per unit time. It can be expressed as:

$$\text{Rate} = \frac{\delta P}{\delta t}$$

171. Answer (3)

Hint: Arteries carry oxygenated blood.

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

They are found in the walls of blood vessels and air sacs of lungs and are involved in functions like forming a diffusion boundary.

The columnar epithelium is found in the lining of stomach and intestine.

The inner lining of pharynx is lined by compound epithelium.

172. Answer (1)

Hint: Adipose tissue is a modified areolar tissue.

Sol.: Areolar tissue is a type of loose connective tissue present beneath the skin. It contains fibroblasts that secrete yellow fibres (elastin) and white fibres (collagen). It also has macrophages, mast cells and adipocytes.

Adipose tissue is a modified areolar tissue to store fats. Hence, the components of adipose tissue and areolar tissue are the same except that adipocytes are more in adipose connective tissue.

173. Answer (1)

Hint: Example of dense regular connective tissue

Sol.: Fibres and fibroblasts are compactly packed in the dense connective tissues.

In the dense regular connective tissues, the collagen fibres are present in rows between many bundles of fibres.

Tendons (dense regular connective tissue) attach skeletal muscles to bones.

Blood is the carrier of respiratory gases.

Loose connective tissue has cells and fibres loosely arranged in a semi-fluid ground substance.

174. Answer (2)

Hint: Monomer of chitin

Sol.: Chitin, a homopolysaccharide, is present in the exoskeleton of arthropods. The monomer of chitin is N-acetyl glucosamine (NAG).

Fructose is the monomer of inulin.

175. Answer (3)

Hint: Communication junctions

Sol.: Cardiac muscle tissue is a contractile tissue present only in the heart. Communication junctions (intercalated discs) at some fusion points allow the cells to contract as a unit, *i.e.* when one cell receives a signal to contract, its neighbours are also stimulated to contract.

176. Answer (3)

Hint: Insulin is secreted by an endocrine gland.

Sol.: Exocrine glands secrete mucus, saliva, earwax, oil, milk, digestive enzymes and other cell products. These products are released through ducts or tubes.

Endocrine glands (ductless glands) secrete hormones.

177. Answer (4)

Hint: Bones are non-pliable.

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

178. Answer (2)

Hint: Adenine pairs with thymine.

Sol.: A and G of one strand compulsorily base pair with T and C, respectively, on the other strand. Hence, if cytosine content is 20% then guanine will also be 20%; adenine and thymine will be 30% each.

179. Answer (1)

Hint: Trichloroacetic acid

Sol.: To perform a chemical analysis we can take any living tissue (a vegetable or a piece of liver, *etc.*) and grind it in trichloroacetic acid (Cl_3CCOOH) using a mortar and a pestle.

180. Answer (3)

Hint: Less than 3

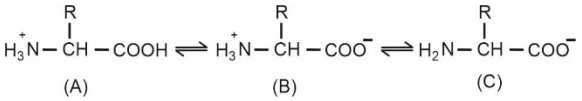
Sol.: In all connective tissues except blood, the cells secrete fibres of structural proteins called collagen or elastin. The fibres provide strength, elasticity and flexibility to the tissue.

181. Answer (4)

Hint: Zwitterions have both a positive and a negative charge.

Sol.: A particular property of amino acids is the ionizable nature of $–NH_2$ and –COOH groups. Hence, in solutions of different pHs, the structure of

amino acids changes. These fully ionized species known as zwitterions have both a positive and a negative charge.



(B) is called zwitterionic form.

182. Answer (1)

Hint: Cells which secrete fibres.

Sol.: Fibroblasts are the cells which secrete fibres of structural proteins called collagen or elastin. These fibres provide strength, elasticity and flexibility to the tissue. These cells secrete modified polysaccharides which accumulate between cells and fibres and act as matrix (ground substance).

Mast cells secrete histamine, serotonin and heparin. Adipocytes are specialised to store fats. Macrophages are phagocytic cells.

183. Answer (4)

Hint: Compound epithelium

Sol.: Compound epithelium is made of more than one layer (multi-layered) of cells and thus has a limited role in secretion and absorption. They cover the dry surface of the skin, the moist surface of buccal cavity, pharynx, inner lining of ducts of salivary glands and of pancreatic ducts. PCT is lined by brush bordered cuboidal epithelium.

184. Answer (2)

Hint: Palmitic acid has 16 carbons including the carboxyl carbon.

Sol.: Palmitic acid has 16 carbon atoms including the carboxyl carbon. Arachidonic acid has 20 carbon atoms including the carboxyl carbon.

185. Answer (2)

Hint: Tissue with osteocytes

Sol.: Bones are a type of specialised connective tissue. The bone cells (osteocytes) are present in ring shaped fluid filled spaces called lacunae.

The red bone marrow in some bones is the site of production of blood cells. Chondrocytes are present in lacunae of cartilages.

SECTION - B

186. Answer (2)

Hint: Acid-soluble pool has compounds with low molecular weights.

Sol.: Acid-soluble pool has compounds which have molecular weights ranging from 18 to around 800 daltons.

These are micromolecules. The acid-soluble pool represents roughly the cytoplasmic composition.

187. Answer (2)

Hint: Leucine belongs to this category.

Sol.: There are 20 types of amino acids.

The amino acids which can't be synthesized by our body have to be supplied through our diet. These are called essential amino acids.

The amino acids which our body can make are non-essential amino acids.

188. Answer (1)

Hint: Photosynthetic enzyme

Sol.: Collagen is the most abundant protein in the animal world.

Ribulose Bisphosphate Carboxylase - Oxygenase (RuBisCO) is the most abundant protein in the whole of biosphere.

Cellulose is a homopolymer of glucose.

189. Answer (3)

Hint: Arrangement of fibres

Sol.: Dense connective tissues are of two types, namely, dense regular and dense irregular tissues.

The collagen fibres are present in rows between many parallel bundles of fibres in dense regular connective tissues. Tendons and ligaments are examples of dense regular connective tissue.

Dense irregular connective tissue has fibroblasts and many fibres that are oriented differently. This tissue is present in the skin.

190. Answer (4)

Hint: $E + S \rightleftharpoons ES \longrightarrow EP \longrightarrow E + P$

Sol.: The catalytic cycle of an enzyme action can be described in the following steps:

(i) Substrate binds to the active site of the enzyme

(ii) The chemical bonds of the substrate break

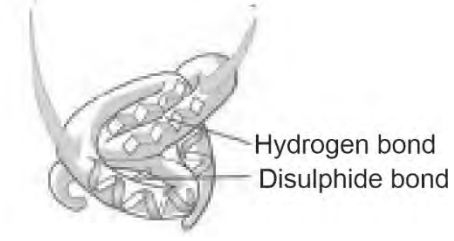
(iii) New enzyme-product complex is formed

(iv) Enzyme releases the products and free enzyme is ready to bind to another molecule of the substrate

191. Answer (4)

Hint: 3-dimensional view of a protein

Sol.: Tertiary structure of protein



192. Answer (1)

Hint: The building block of nucleic acids is a nucleotide.

Sol.: Heterocyclic compounds in nucleic acids are the nitrogenous bases named adenine, guanine, uracil, cytosine and thymine.

The sugar found in polynucleotides is either ribose or 2' deoxyribose.

Phosphoric acid or phosphate is the third component of a nucleotide.

193. Answer (2)

Hint: Smooth muscle fibres are involuntary.

Sol.: Ramachandran plot is used to confirm the structure of proteins.

Smooth muscle fibres are present in the wall of blood vessels.

194. Answer (2)

Hint: Adrenaline is other name of this compound.

Sol.: Mast cells are present in the connective tissue. They secrete histamine, heparin and serotonin. Histamine is responsible for an inflammatory response.

Heparin is an anticoagulant. Serotonin is a vasoconstrictor.

195. Answer (1)

Hint: A = T

Sol.: In a DNA molecule, A and G of one strand compulsorily base pair with T and C respectively, on the other strand.

There are two hydrogen bonds between A and T and three hydrogen bonds between G and C.

196. Answer (3)

Hint: Proteins are denatured by heat.

Sol.: High temperature destroys proteins. Hence, enzymes do not show any enzymatic activity at a high temperature.

197. Answer (3)

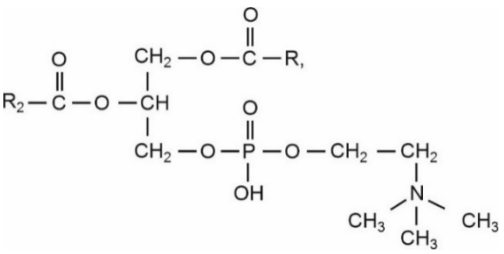
Hint: Cardiac muscle fibres are branched.

Sol.:

Skeletal muscle fibres	–	Striated, cylindrical in shape, multinucleated, unbranched and voluntary
Smooth muscle fibres	–	Unstriated, fusiform in shape, uninucleated, unbranched and involuntary

198. Answer (3)

Hint:



Sol.: Some lipids have phosphorus and a phosphorylated organic compound in them. These are phospholipids. They are found in cell membrane. Lecithin is one example. Some tissues especially the neural tissues have lipids with more complex structures.

199. Answer (3)

Hint: Enzyme molecules are fewer than substrate molecules.

Sol.: When the substrate concentration increases, the velocity of the enzymatic reaction increases at first. After reaching the maximum velocity (V_{max}), the velocity stays stationary in spite of an increase in the concentration of 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.

200. Answer (4)

Hint: Enzymes catalysing isomerisation.

Sol.: The 6 classes of enzymes based on their commission number are:

(1) Oxidoreductases

(2) Transferases

(3) Hydrolases

(4) Lyases

(5) Isomerases

(6) Ligases

❑ ❑ ❑

All India Aakash Test Series for NEET-2025

TEST - 1 (Code-D)

Test Date : 20/08/2023

ANSWERS

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

HINTS & SOLUTIONS

[PHYSICS]

SECTION - A

1. **Delete**

Hint: In one dimensional motion, a body can only move in a line.

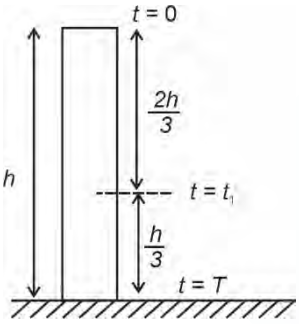
Sol.:

- A body can have non-zero acceleration when its velocity is zero. For example, motion under gravity
- Instantaneous velocity is always equal to instantaneous speed. Average velocity and average speed may or may not be equal.
- In one dimensional motion, acceleration always changes speed.

2. Answer (1)

Hint: use equation of motion

Sol.:



Total time of flight; $T = \sqrt{\frac{2h}{g}}$ ...(i)

Time taken to cover $\frac{2h}{3}$ distance

$t_1 = \sqrt{\frac{2}{g} \times \frac{2h}{3}}$ ...(ii)

$\therefore$ Time taken to cover last $\frac{h}{3}$ distance

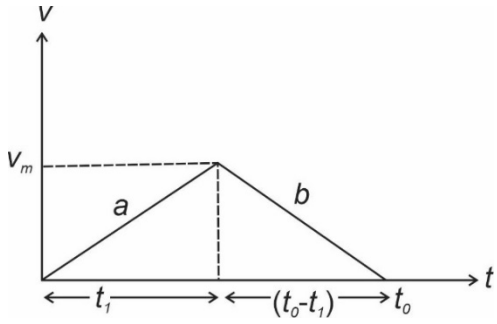
$t' = T - t_1 = \sqrt{\frac{2h}{g}} - \sqrt{\frac{4h}{3g}}$

$t' = \sqrt{\frac{2h}{g}}\left(1 - \frac{\sqrt{2}}{\sqrt{3}}\right) = \sqrt{\frac{2h}{3g}}\left(\sqrt{3} - \sqrt{2}\right)$

3. Answer (2)

Hint: Draw velocity-time graph for the given situation

Sol.:



$v = u + at \Rightarrow v_m = at_1$ ...(i)

$0 = v_m - b(t_0 - t_1) \Rightarrow v_m = b(t_0 - t_1)$ ...(ii)

Eliminate t_1 from equation (i) and (ii),

$v_m = b\left(t_0 - \frac{v_m}{a}\right) \Rightarrow v_m = \frac{ab\,t_0}{(a+b)}$

4. Answer (3)

Hint & Sol.: |Displacement| $\leq$ Distance

5. Answer (2)

Hint: Absolute error

= |True value – measured value|

Mean absolute error =

$$\frac{\text{Summation of absolute errors}}{\text{Number of observations}}$$

Sol.: $a_{mean} = \frac{1.72+1.69+1.70+1.73}{4} = 1.71$ g

$\Delta a_1 = |1.71 - 1.72| = 0.01$

$\Delta a_2 = |1.71 - 1.69| = 0.02$

$\Delta a_3 = |1.71 - 1.70| = 0.01$

$\Delta a_4 = |1.71 - 1.73| = 0.02$

$\Delta a_m = \frac{\Delta a_1 + \Delta a_2 + \Delta a_3 + \Delta a_4}{4}$

$= \frac{0.01 + 0.02 + 0.01 + 0.02}{4} = 0.015$

Rounding off to two decimal places, the answer will be 0.02 g

6. Answer (2)

Hint: $\sin(\omega t)$ and e^{-2t} are dimensionless.

Sol.: $[v] = [\alpha] = [\beta]$

Since v is velocity, there α and β also have dimensions of velocity.

$\therefore \alpha\beta = (m\ s^{-1})(m\ s^{-1}) = m^2 s^{-2}$

7. Answer (1)

Hint: $P = mv$

Sol.: Unit of linear momentum = kg m s^{-1}

$\therefore$ [P] = [MLT^{-1}]

8. Answer (3)

Hint & Sol.:

- The trailing zeroes are significant only when the number has decimal point.
- All zeroes appearing between two non-zero digits are significant.
- Non-zero digits in a number are always significant.

9. Answer (2)

Hint & Sol.: Gravitational force is the weakest force in nature.

10. Answer (2)

Hint: Average speed = $\frac{\text{Total distance}}{\text{Total time}}$

Sol.: $t_1 = \frac{100}{4}$ = 25 s; $t_2 = \frac{200}{10}$ = 20 s;

$t_3 = \frac{300}{5}$ = 60 s

$\therefore \langle v \rangle = \frac{100 + 200 + 300}{25 + 20 + 60} = \frac{600}{105}$ = 5.7 m/s

11. Answer (4)

Hint: $\langle v \rangle = \frac{\int_{t_1}^{t_2} v\,dt}{\int_{t_1}^{t_2} dt}$

Sol.: Given, $v = \alpha t^2 + \beta t$

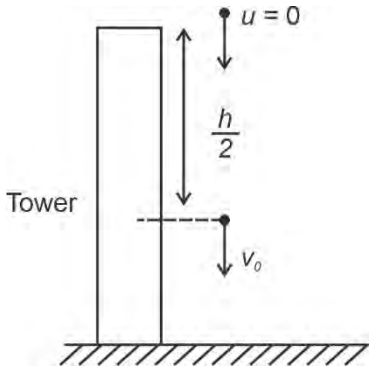
$$\langle v \rangle = \frac{\int_0^t (\alpha t^2 + \beta t)\,dt}{\int_0^t dt}$$

$$= \frac{\alpha\frac{t^3}{3} + \beta\frac{t^2}{2}}{t} = \frac{\alpha t^2}{3} + \beta\frac{t}{2}$$

12. Answer (1)

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

Sol.: Let the height of the tower is h



$2 \times g \times \frac{h}{2} = v_0^2 - 0^2$

$h = \frac{v_0^2}{g}$

13. Answer (1)

Hint: Relative acceleration: $\vec{a}_{B/A} = \vec{a}_{B/g} - \vec{a}_{A/g}$

Sol.: Acceleration of B w.r.t. A

$a_{B/A} = a_{B/g} - a_{A/g}$

$a_{B/A}$ = 4 – 1 = 3 m/s^2 ...(1)

Since the relative acceleration is constant, hence equations of motion are applicable.

$S_{B/A} = u_{B/A}t + \frac{1}{2}a_{B/A}t^2$

$5400 = 0 + \frac{1}{2} \times 3 \times t^2$

$t^2 = \frac{5400 \times 2}{3} = 3600$

t = 60 second

14. Answer (2)

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

Sol.: $S_{3^{rd}} = 5 + \frac{4}{2}(2 \times 3 - 1)$

= 5 + 2(5) = 15 m

15. Answer (3)

Hint: Slope of velocity-time graph gives instantaneous acceleration

Sol.: Only in graph (3) slope is positive at every point, hence it shows positive acceleration.

16. Answer (3)

Hint: $\int dv = \int a dt$

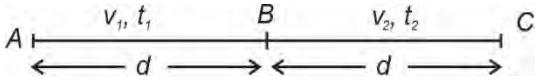
Sol.: $\int_0^v dv = \int_0^t \frac{t^3}{3} dt \Rightarrow v = \frac{1}{3} \times \frac{t^4}{4}\Big|_0^t$

$v = \frac{t^4}{12}$

17. Answer (1)

Hint: Mean speed = $\frac{\text{Total distance}}{\text{Total time}}$

Sol.:



$\langle v \rangle = \frac{d+d}{\frac{d}{v_1} + \frac{d}{v_2}}$

$\langle v \rangle = \frac{2v_1 v_2}{v_1 + v_2}$

18. Answer (1)

Hint: Total time of flight = Time of ascent + time of descent

Also Time of ascent = Time of descent

Sol.: Time of ascent :-

$v = u + at \Rightarrow 0 = 40 - 10 \times t$

$t = 4$ s

Time of flight = 4 × 2 = 8 s

19. Answer (3)

Hint: Instantaneous velocity $\Rightarrow v = \frac{dx}{dt}$

Sol.: $v = \frac{d}{dt}(t + 3t^2 + 2) \Rightarrow v = 1 + 6t$

$v\,(t = 4) = 1 + (6 \times 4) = 25$ m/s

20. Answer (2)

Hint & Sol.: Relation containing product of different physical quantities can be deduced by the dimensional analysis.

Constant of proportionality cannot be deduced by this method.

21. Answer (2)

Hint: $n_1u_1 = n_2u_2$; $[E] = [ML^2T^{-2}]$

Sol.: $1 = n_2 \left(\frac{100\text{ kg}}{1\text{kg}}\right)\left(\frac{10\text{ m}}{1\text{m}}\right)^2\left(\frac{30\text{ s}}{1\text{s}}\right)^{-2}$

$1 = n_2 \times \frac{10^2 \times 10^2}{30 \times 30} \Rightarrow n_2 = \frac{9}{100}$

22. Answer (4)

Hint & Sol.: $V = 0.2350 \times 10^{-2}$ m^3

Leading zeroes are always insignificant and trailing zeroes after decimal are significant

Hence there are four significant figures in the given measurement.

23. Answer (3)

Hint & Sol.:

Least count = 1 MSD – 1 VSD

LC = 1 MSD – $\frac{n_2}{n_1}$ MSD

LC = $\frac{(n_1 - n_2)}{n_1} \times 1\text{mm}$

24. Answer (1)

Hint: $V = \frac{4}{3}\pi R^3$

Sol.: $\frac{\Delta V}{V} \times 100 = 3\left(\frac{\Delta R}{R} \times 100\right)$

$\frac{\Delta V}{V} \times 100 = 3 \times 3\%$

$\therefore$ Percentage error in volume determination is 9%

25. Answer (2)

Hint & Sol.: $[M] = [MLT^{-2}]^x [LT^{-1}]^y [T]^z$

$[M] = [M^x] [L^{x+y}] [T^{-2x-y+z}]$

Comparing both sides,

$x = 1$ and $x + y = 0$

$\therefore y = -1$

Also, $-2x - y + z = 0$

$(-2\times1)-(-1) + z = 0$

$z = 1$

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

26. Answer (4)

Hint: Relative velocity of the given trains = $v_1 + v_2$

Sol.: Time = $\frac{\text{Sum of lengths of two trains}}{\text{relative speed of trains}}$

$t = \frac{l_1 + l_2}{v_1 + v_2}$

27. Answer (1)

Hint: $\vec{a}_{A/B} = \vec{a}_{A/g} - \vec{a}_{B/g}$

Sol.: $\vec{a}_{A/B} = 3 - (-4) = 7\text{m/s}^2$

28. Answer (3)
Hint: Area under *a-t* graph gives change in velocity
Sol.: $\Delta v = \int a dt$ = Area under *a-t* graph
$v - 0 = (3 \times 4) - (3 \times 1)$
$v = 12 - 3 = 9$ m/s

29. Answer (2)
Hint: $\vec{a} = \frac{\vec{v} - \vec{u}}{\Delta t}$
Sol.: $a = \frac{\left(36 \times 5/18\right) - \left(54 \times 5/18\right)}{25} = \frac{10 - 15}{25}$
$a = -\frac{1}{5}$ m/s^2

30. Answer (4)
Hint & Sol.: Precision is related to least count.

31. Answer (3)
Hint: Perimeter of square plate = 4 × side length
Sol.:
$P = (4 \times 3.2) \pm (4 \times 0.1)$
$P = (12.8 \pm 0.4)$ m

32. Answer (1)
Hint & Sol.: Unit of energy = kg m^2 s^{-2}
$\therefore$ [KE] = [ML^{2}T^{-2}]

33. Answer (3)
Hint: Area of circle = πr^2
Sol.: Area = $\pi(1.21)^2 = 4.5972$ m^2
Since the number 1.21 has three significant figures, therefore the answer should have three significant figures. Hence, the answer will be 4.60 m^2

34. Answer (3)
Hint & Sol.: Sir C.V. Raman won Nobel Prize for physics in 1930.

35. Answer (2)
Hint & Sol.: Celestial and terrestrial mechanics was unified by Issac Newton.

SECTION - B

36. Answer (3)
Hint & Sol.: Since displacement only depends on initial and final points, therefore displacement of both the balls is equal.
While the distance covered will be more for the second ball.

37. Answer (3)
Hint: Area under velocity-time graph give displacement of the body.
Sol.: Displacement = (2×1) + (6×1) + (1× –4) + $(\frac{1}{2} \times 1 \times -4)$
= 2 + 6 – 4 – 2 = 2 m
Distance = $|2 \times 1| + |6 \times 1| + |1 \times -4| + |\frac{1}{2} \times 1 \times -4|$
= 2 + 6 + 4 + 2 = 14 m
$\frac{\text{Distance}}{\text{Displacement}} = \frac{14}{2} = 7$

38. Answer (2)
Hint: Apply $v = u + at$
Sol.: 20 = 80 + (–4) × t
$t = \frac{20 - 80}{-4} = 15$ s

39. Answer (3)
Hint: Average velocity = $\frac{\text{Total displacement}}{\text{Total time}}$
Sol.: $\langle v \rangle = \frac{x + 2x}{\frac{x}{v_1} + \frac{2x}{v_2}} = \frac{3x \times v_1 v_2}{v_2 x + v_1 2x}$
$v = \frac{3v_1 v_2}{2v_1 + v_2}$

40. Answer (2)
Hint & Sol.: The least count is 0.01

41. Answer (2)
Hint & Sol.: $\frac{\text{Pa}}{\text{s}} = \frac{\text{N}}{\text{m}^2\text{s}} = \frac{\text{kg ms}^{-2}}{\text{m}^2\text{s}} = \text{kg m}^{-1}\text{ s}^{-3}$
$\therefore$ The dimensional formula is [ML^{-1}T^{-3}]

42. Answer (4)
Hint: $K = \frac{1}{2}mv^2$; $\frac{\Delta K}{K} = \frac{\Delta m}{m} + 2\frac{\Delta v}{v}$
Sol.: $K = \frac{1}{2} \times 2 \times 10^2 = 100$ J
$\frac{\Delta K}{K} = \left(\frac{0.1}{2} + 2 \times \frac{0.2}{10}\right)$
$\Delta K = \left(\frac{0.1}{2} \times 100\right) + \left(2 \times \frac{0.2}{10} \times 100\right)$
$\Delta K = 5 + 4 = 9$
$\therefore$ Kinetic energy = (100 ± 9) J

43. Answer (3)
Hint: $S_{n^{th}} = u + \frac{a}{2}(2n - 1)$
Sol.: For particle X: $S_{5^{th}} = \frac{3}{2}(2 \times 5 - 1)$ ...(i)

For particle Y: $S_{3rd} = \frac{a}{2}(2\times3-1)$ ...(ii)

Given, $S_{5th} = S_{3rd}$

$\frac{3}{2}(9) = \frac{a}{2}(5)$

$a_0 = \frac{27}{5}$ m/s^2

44. Answer (2)

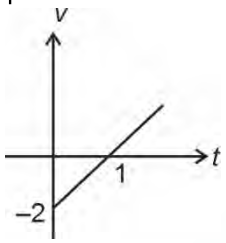
Hint: $v = \frac{ds}{dt}$

Sol.: $v = \frac{d}{dt}(t^2 - 2t - 1) \Rightarrow v = 2t - 2$

At $t = 0 \Rightarrow v = -2$; At t = 1 $\Rightarrow v = 0$

And the slope is constant equal to 2.

Hence the graph will be



45. Answer (1)

Hint & Sol.: Velocity of the lift is downwards but its magnitude is decreasing, it means the lift is retarding. Hence its acceleration is upwards.

46. Answer (2)

Hint: Muzzle velocity of a bullet is the velocity of bullet w.r.t. the gun.

Sol.: Velocity of bullet w.r.t. ground ($v_{b/g}$) is

200 + 80 = 280 m/s

Velocity of bullet as seen by the thief:

$\vec{v}_{b/T} = \vec{v}_{b/g} - \vec{v}_{T/g}$

$v_{b/T}$ = 280 – 50 = 230 m/s

47. Answer (1)

Hint: Assume that the brakes cause same constant retardation in both the cases.

Sol.: Apply equation of motion

$2as = v^2 - u^2$

$2 \times a \times 81 = 0^2 - 30^2$ ...(i)

$2 \times a \times s = 0^2 - 20^2$ ...(ii)

$\frac{2a\times81}{2a\times s} = \frac{30\times30}{20\times20}$

$s = \frac{81\times4}{9} = 36$ m

48. Answer (4)

Hint: $\frac{\Delta p}{p} = x\frac{\Delta M}{M} + y\frac{\Delta L}{L} + z\frac{\Delta T}{T}$

Sol.: $\frac{\Delta p}{p} = (x \times a) + (y \times b) + (z \times c)$

49. Answer (1)

Hint: CGS unit of mass is g and length is cm.

Sol.: $n_1u_1 = n_2u_2$

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

$700 = n_2\left[\frac{g}{kg}\right]\left[\frac{cm}{m}\right]^{-3}$

$700 = n_2\left[\frac{g}{1000\ g}\right]\left[\frac{cm}{100\ cm}\right]^{-3}$

$700 = n_2\ (10^{-3})\ (10^6)$

$n_2 = \frac{700}{10^3} \Rightarrow n_2 = 0.7$

$\therefore$ Density in CGS unit is 0.7 g/cc

50. Answer (1)

Hint & Sol.: A vernier calliper is more precise than a meter scale.

Lower value of least count results in less error.

[CHEMISTRY]

SECTION - A

51. Answer (1)

Hint: Number of waves of an electron in an orbital = principal quantum number

Sol.: For n = 4, the total number of waves will be four.

52. Answer (4)

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

Sol.: $\lambda = \frac{6.6\times10^{-34}}{0.132\times2\times10^5}$ = 2.5 × 10^{-38} m

53. Answer (1)

Hint: l = 1 corresponds to *p*-subshell

Sol.: 3*p* subshell can accommodate maximum 6 electrons.

54. Answer (4)

Hint: Blackbody radiation is the nature of emission of radiation from the hot bodies.

Sol.: Interference can be explained by the wave nature of the electromagnetic radiation.

55. Answer (4)

Hint: $\Delta E = 2.18\times10^{-18}\times Z^2\left(\frac{1}{n_1^2}-\frac{1}{n_2^2}\right)$ J

Sol.: For ΔE_2 ; $n_1 = 2$, $n_2 = \infty$

$\Delta E_2 = 2.18 \times 10^{-18} \times (1)^2 \left(\frac{1}{2^2}\right)$

Similarly, ΔE_3 ; $n_1 = 3$, $n_2 = \infty$

$\Delta E_3 = 2.18 \times 10^{-18} \times (1)^2 \left(\frac{1}{3^2}\right)$

$\frac{\Delta E_2}{\Delta E_3} = \frac{1/4}{1/9} = \frac{9}{4}$

56. Answer (3)

Hint:

$\overline{M}_{av} = \frac{\%\text{ of isotope 1} \times M_1 + \%\text{ of isotope 2} \times M_2}{100}$

Sol.: $\overline{M}_{av} = \frac{30\times100+70\times101}{100} = 100.7$

57. Answer (2)

Hint: Aluminium sulphate is $Al_2(SO_4)_3$

Sol.: 1 mole $Al_2(SO_4)_3$ contains 2 mole of Al atoms, 3 mole of S atoms and 12 mole of O atoms.

58. Answer (1)

Hint: Mole fraction of NaOH = $\frac{n_{NaOH}}{n_{NaOH}+n_{H_2O}}$

Sol.: Mass of solvent (H_2O) present = 81 g

$x_{NaOH} = \frac{0.5}{0.5+\frac{81}{18}} = \frac{0.5}{0.5+4.5} = \frac{0.5}{5} = \frac{1}{10}$

59. Answer (3)

Hint: Number of atoms

= Number of moles × Atomicity × N_A

Sol.: Number of moles of S_8 = 0.5 mole

Number of S atoms = $0.5 \times 8 \times 6.022 \times 10^{23}$

= 2.41×10^{24} atoms

60. Answer (2)

Hint: 1 mole $CaCO_3$ produces 1 mole CO_2 upon heating

Sol.: $CaCO_3 \xrightarrow{\Delta} CaO + CO_2$

Moles of $CaCO_3$ = $\frac{200}{100}$ = 2 mole

[Molar mass of $CaCO_3$ = 100 g]

Moles of CO_2 produced = $\frac{44}{44}$ = 1 mole

$\because$ 1 mole $CaCO_3$ produces 1 mole CO_2

$\therefore$ Amount of $CaCO_3$ used = 100 g

% purity = $\frac{100}{200}\times100$ = 50%

61. Answer (2)

Hint: Isoelectronic species contain same number of electrons.

Sol.:

Species	Number of electrons
H	1
Li^{2+}	1
H^+	0
Be^{2+}	2
He	2
Be^{3+}	1
He^+	1

62. Answer (1)

Hint: Heisenberg's uncertainty principle:

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

Sol.: $\because$ $\Delta x = 2\Delta p_x$

$2\Delta p_x \times \Delta p_x = \frac{h}{4\pi}$

$(m\Delta v_x)^2 = \frac{h}{8\pi}$

$\Delta v_x = \frac{1}{m}\sqrt{\frac{h}{8\pi}}$

$\Delta v_x = \frac{1}{2m}\sqrt{\frac{h}{2\pi}}$

63. Answer (4)

Hint: For any subshell, 2l + 1 values of m_l are possible.

Sol.: Magnetic quantum number defines the spatial orientation of the orbital with respect to standard set of co-ordinate axis.

64. Answer (4)

Hint: Total number of nodes = n – 1

Sol.: For 3*d* orbital, n = 3, l = 2

Total nodes = 3 – 1 = 2

65. Answer (2)

Hint: $r_n = 52.9\frac{n^2}{Z}$ pm

Sol.: $\frac{r_1(He^+)}{r_2(Be^{3+})} = \frac{(1)^2}{2}\times\frac{4}{(2)^2} = \frac{1}{2}$

66. Answer (4)

Hint & Sol.:

Lyman	–	1 and 2, 3, …
Brackett	–	4 and 5, 6, …
Balmer	–	2 and 3, 4, …
Paschen	–	3 and 4, 5, …

67. Answer (3)

Hint: Molecular formula = n × empirical formula

Sol.: H_3PO_3 has the simplest whole number ratio.

Molecular formula	Empirical formula
$H_2C_2O_4$	HCO_2
$H_2S_2O_8$	HSO_4
C_6H_6	CH

68. Answer (2)

Hint: 2 molal glucose solution means 2 mole glucose is present in 1 kg of solvent.

Sol.: 1000 g solvent = 2 × 180 g = 360 g glucose

Mass of solution = 1000 + 360 = 1360 g

$\because$ 1360 g solution contain = 360 g glucose

1000 g solution contain

$= \frac{360}{1360} \times 1000 = 264.7$ g

$\simeq 265$ g

69. Answer (3)

Hint: The concentration terms containing volume are temperature dependent

Sol.: Molality and mole fraction does not contain any volume term, therefore, are temperature independent.

70. Answer (2)

Hint: One mole of Cl^- ion contain 18 N_A electrons where N_A is Avogadro's number.

Sol.: Number of moles of Cl^- ion $= \frac{71 \times 10^{-3}}{35.5}$

$= 2 \times 10^{-3}$ mol

Number of electrons in 2×10^{-3} mole Cl^- ion

$= 2 \times 10^{-3} \times 18 \times N_A = 3.6 \times 10^{-2} N_A$

71. Answer (4)

Hint: 70% (w/w) H_2SO_4 means 70 g H_2SO_4 is present in 100 g of solution

Sol.: Molarity

$= \frac{\text{Mass of } H_2SO_4 \text{ required}}{\text{Molar mass of } H_2SO_4} \times \frac{1000}{\text{Vol. of solution (ml)}}$

Mass of H_2SO_4 required $= \frac{1 \times 98 \times 500}{1000} = 49$ g

Mass of H_2SO_4 required from 70% (w/w)

$= \frac{100}{70} \times 49 = 70$ g

72. Answer (1)

Hint: Mass percentage of oxygen

$= \frac{\text{Mass of oxygen}}{\text{Mass of compound}} \times 100$

Sol.: Mass percentage of oxygen

$= \frac{3 \times 16}{63} \times 100$ [Molar mass of HNO_3 = 63 g]

$= 76.1\% \simeq 76\%$

73. Answer (1)

Hint: 1 amu = 1.66×10^{-24} g

Sol.: Mass of 1 He atom = 4 amu

Mass of 2 He atoms = 2 × 4 amu

$= 8 \times 1.66 \times 10^{-24}$ g $= 1.33 \times 10^{-23}$ g

74. Answer (2)

Hint & Sol.: The number of electrons ejected in photoelectric effect is proportional to the intensity or brightness of light.

75. Answer (2)

Hint: An orbital can accommodate maximum two electrons.

Sol.: n + l = 3 for the orbitals 2*p* and 3*s*

$\therefore$ Total number of electrons associated in these orbitals = 8

76. Answer (2)

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

Sol.: Since $\lambda \propto \frac{1}{Z^2}$

$\therefore$ λ will be minimum for Be^{3+} (Z = 4)

77. Answer (4)

Hint: For a value of n, the value of l ranges from 0 to n –1

Sol.: For a value of l, the value of m ranges from –l to +l

$\therefore$ for l = 2, m_l = –2, –1, 0, +1, +2

For n = 1, l = 0

78. Answer (4)

Hint: Cr (Z = 24) has its electronic configuration; $[Ar]3d^5 4s^1$

Sol.:

Element	Number of unpaired electrons
Ar	0
Mn	5
Ca	0
Cr	6

79. Answer (1)

Hint: Orbital angular momentum of an electron in an orbital = $\sqrt{\ell(\ell+1)}\frac{h}{2\pi}$

Sol.: For *f*-orbital, value of l = 3

Orbital angular momentum

$= \sqrt{3(3+1)}\frac{h}{2\pi} = \sqrt{12}\frac{h}{2\pi} = \sqrt{3}\frac{h}{\pi}$

80. Answer (3)

Hint: $\chi_{CH_3OH} = \frac{n_{CH_3OH}}{n_{CH_3OH} + n_{C_2H_5OH}}$

Sol.: Let mass of CH_3OH and C_2H_5OH taken is w gram

$$X_{CH_3OH} = \frac{\frac{w}{32}}{\frac{w}{32}+\frac{w}{46}} = \frac{\frac{w}{32}}{\frac{23w+16w}{736}}$$

$$= \frac{w}{32}\times\frac{736}{39w} = \frac{23}{39}$$

81. Answer (2)

Hint: Molarity = $\frac{\text{Number of moles of solute}}{\text{Volume of solution in litre}}$

Sol.: 1 mole urea (NH_2CONH_2) contain = 6.023×10^{23} molecules

Moles of urea = $\frac{3.011\times10^{22}}{6.022\times10^{23}}$ = 0.05 mol

Molarity = $\frac{0.05\times1000}{200}$ = 0.25 M

82. Answer (1)

Hint: Number of moles = $\frac{\text{Given mass}}{\text{Molar mass}}$

Sol.: $\frac{n_{SO_2}}{n_{O_2}} = \frac{2/64}{3/32} = \frac{1}{3}$

83. Answer (1)

Hint: At STP, volume of 1 mole of a gas = 22.4 L

Sol.: $C_3H_8(g) + 5O_2(g) \longrightarrow 3CO_2(g) + 4H_2O(l)$

1 mole C_3H_8 requires 5 mole of O_2

$\therefore$ 1 mole C_3H_8 requires 5×22.4 L of O_2 at STP = 112 L

84. Answer (2)

Hint: Number of atoms = moles × atomicity × N_A

where N_A = Avogadro's number

Sol.: Number of atoms in 1 g of Na

$= \frac{1}{23}\times1\times N_A = \frac{N_A}{23}$

Number of atoms in 1 g of H_2

$= \frac{1}{2}\times2\times N_A = N_A$

Number of atoms in 1 g of H_2O

$= \frac{1}{18}\times3\times N_A = \frac{N_A}{6}$

Number of atoms in 1 g of Ca

$= \frac{1}{40}\times1\times N_A = \frac{N_A}{40}$

85. Answer (4)

Hint: 2 mole of NH_3 formation require one mole N_2 gas

Sol.: $N_2(g) + 3H_2(g) \longrightarrow 2NH_3(g)$

Number of moles of NH_3 = 85/17 = 5 mole

2 mole of NH_3 is produced by 1 mole of N_2

5 mole of NH_3 is produced by 5/2 mole of N_2

= 2.5 mole N_2

SECTION - B

86. Answer (2)

Hint: Energy of one photon = $h\nu$

Sol.: Power of bulb= 150 watt = 150 J s^{-1}

Energy of a photon = $h\nu = \frac{hc}{\lambda}$

$= \frac{6.626\times10^{-34}\times3\times10^{8}}{300\times10^{-9}}$

$= 6.626 \times 10^{-19}$ J s^{-1}

Number of photons emitted = $\frac{150}{6.626\times10^{-19}}$

$= 2.3 \times 10^{20}$

87. Answer (1)

Hint: Radio waves has the largest wavelength and smallest frequency

Sol.: Decreasing order of frequency: γ-rays > UV rays > Microwaves > Radio waves

88. Answer (3)

Hint: Number of protons = Atomic number

Number of neutrons

= Mass number – Atomic number

Sol.: For S^{2-} ions

Number of protons = 16

Number of electrons = 16 + 2 = 18

Number of neutrons = 32 – 16 = 16

89. Answer (1)

Hint: Zeros between the non-zero digits are significant.

Sol.: Zeros preceding to first non-zero digit are not significant. *e.g.*, 0.0064 has only two significant figures.

90. Answer (3)

Hint: 1 mole SO_2 occupy 22.4 L at STP

Sol.: $\text{Density} = \dfrac{\text{Mass}}{\text{Volume}}$

$d(SO_2) = \dfrac{64}{22.4}$ at STP [1 mole SO_2 = 64 g]

= 2.85 gL^{-1}

91. Answer (4)

Hint: For multielectron species, the orbital with greater (n + l) value have higher energy and for same (n + l) value, the orbital with greater n values has higher energy.

Sol.:

	3*p*	4*s*	3*d*	4*d*
n + l value:	4	4	5	6
Increasing order of Energy:	⟶			

92. Answer (4)

Hint: *d* subshell contains five *d* orbitals i.e. d_{xy}, d_{yz}, d_{zx}, $d_{x^2-y^2}$ and d_{z^2} in which three orbitals lie in between the axis and two lies along the axis.

Sol.: d_{xy}, d_{yz} and d_{zx} lie in between the axis, however $d_{x^2-y^2}$ and d_{z^2} lie along the axis.

Each *d* orbital contains two nodal planes except d_{z^2}.

93. Answer (2)

Hint & Sol.:

List I	List II
2*s*	2
3*p*	4
4*d*	6
3*d*	5

94. Answer (3)

Hint: $\bar{\nu} = \dfrac{\nu}{c}$

Sol.: $\bar{\nu} = \dfrac{4\times10^{-12}}{3\times10^{8}}$ = 1.33 × 10^{-20} m^{-1}

95. Answer (4)

Hint: Number of orbitals in nth shell = n^2

Sol.: The value of n for M shell = 3

$\therefore$ Number of orbitals = $(3)^2$ = 9

96. Answer (1)

Hint: At STP, 1 mole of a gas contain 22.4 L

Sol.: $n_{C_3H_8} = \dfrac{11.2}{22.4} = 0.5$ mole

n_{carbon} = 3 × 0.5 = 1.5 mole

Mass of carbon = 1.5 × 12 = 18 g

97. Answer (1)

Hint: Empirical formula is the simplest whole number ratio of various atoms present in a compound

Sol.:

Element	%	Molar ratio	Simple whole number ratio
C	40	$\dfrac{40}{12} = 3.33$	$\dfrac{3.33}{3.33} = 1$
H	6.66	$\dfrac{6.66}{1} = 6.66$	$\dfrac{6.66}{3.33} = 2$
O	53.4	$\dfrac{53.4}{16} = 3.33$	$\dfrac{3.33}{3.33} = 1$

The empirical formula of the compound is CH_2O

98. Answer (2)

Hint: Vapour density = $\dfrac{\text{Molecular weight}}{2}$

Sol.: $\dfrac{\text{V.D.}_{O_2}}{\text{V.D.}_{CH_4}} = \dfrac{\text{Mol. wt. of } O_2/2}{\text{Mol. wt. of } CH_4/2}$

$= \dfrac{32}{16} = \dfrac{2}{1}$

99. Answer (4)

Hint: % of Fe = $\frac{\text{Mass of Fe}}{\text{Mass of compound}} \times 100$

Sol.: $0.5 = \frac{56}{\text{Mass of compound}} \times 100$

Mass of compound $= \frac{56}{0.5} \times 100$ = 11,200 u

100. Answer (3)

Hint: $\frac{M_1V_1 + M_2V_2}{V_1 + V_2} = M_{final}$

Sol.: $M_f = \frac{0.5 \times 400 + 1.5 \times 200}{400 + 200} = \frac{500}{600} = 0.83$ M

[BOTANY]

SECTION - A

101. Answer (2)

Hint: Elaioplasts store fats and oils.

Sol.: Elaioplast is a type of leucoplast, i.e., colourless plastid that stores fats and oils.

102. Answer (4)

Hint: Centrioles have an organisation like the cartwheel.

Sol.: Centrioles give rise to spindle apparatus during cell division.

103. Answer (1)

Hint: Fundamental structure of both eukaryotic cilia and flagella is the same.

Sol.: Cilia are smaller structures whereas flagella are comparatively longer.

104. Answer (2)

Hint: Mitochondria are semiautonomous cell organelles as they can synthesize some of their own proteins.

Sol.: Mitochondria can synthesize their proteins because they have DNA, RNA, ribosomes and components required for protein synthesis.

105. Answer (1)

Hint: Hydrolases of lysosome are optimally active at the acidic pH.

Sol.: The pH less than 7 is said to be acidic.

106. Answer (3)

Hint: Tonoplast is membrane of a cell organelle that is a part of endomembrane system.

Sol.: The vacuole is bound by a single membrane called tonoplast.

107. Answer (3)

Hint: *Cis* and *trans* faces of a Golgi apparatus are interconnected.

Sol.: Vesicles are discharged from *trans* face of the Golgi apparatus.

108. Answer (3)

Hint: Mitochondria and chloroplasts are semi-autonomous cell organelles.

Sol.: Mitochondria and chloroplasts have 70S ribosomes which have the subunits 50S and 30S.

109. Answer (2)

Hint: The nucleus is bound by double membrane with space 10 to 50 nm in width.

Sol.: The two membrane of the nuclear envelope are separated by a space known as perinuclear space.

110. Answer (4)

Hint: Plasmodesmata is lined by plasma membrane and contains a fine tubule called desmotubule.

Sol.: Endoplasmic reticulum plays a role in origin of plasmodesmata.

111. Answer (4)

Hint: Cell membrane is mainly made up of phospholipid bilayer and proteins.

Sol.: In human beings, the membrane of the erythrocyte has approximately 52 per cent protein and 40 per cent lipids.

112. Answer (4)

Hint: Cell wall is the non-living, rigid structure of the cell.

Sol.: Uphill transport of material occurs through plasma membrane by the mechanism of active transport.

113. Answer (1)

Hint: Some organelles function in a coordinate manner and constitute an endomembrane system.

Sol.: Cell organelles such as mitochondria, chloroplast and peroxisome are not considered as a part of the endomembrane system.

114. Answer (3)

Hint: The fimbriae are small bristle-like fibres in bacteria that help in attaching to the host tissue.

Sol.: Chromatophores are membranous structures containing photosynthetic pigments. Plasmid is

small circular DNA that provide certain phenotypic character such as resistant to antibiotics to such bacteria. Gas vacuoles are considered to be inclusion bodies.

115. Answer (2)

Hint: Mitochondria are the power house of the cell.

Sol.: Mesosome in bacteria has enzyme that help in respiration to produce ATP as mitochondria do.

116. Answer (4)

Hint: Nucleolus is present in the nucleoplasm.

Sol.: Chromatin contains DNA, histones, non-histone proteins and RNA.

117. Answer (4)

Hint: The smallest cell known is a prokaryote.

Sol.: *Mycoplasma* is the smallest cell. They lack cell wall.

118. Answer (4)

Hint: Rudolf Virchow first explained that cells divide and new cells are formed from pre-existing cells.

Sol.: According to cell theory, all cells arise from pre-existing cells and all living organisms are composed of cells and product of cells.

119. Answer (1)

Hint: Secondary constriction is seen in SAT chromosome.

Sol.: The chromosomes that have non-staining secondary constrictions at a constant location gives the appearance of a small fragment called the satellite.

120. Answer (2)

Hint: Robert Hooke studied and described the cell from a thin slice of cork but that was the dead cells.

Sol.: Anton van Leeuwenhoek first saw and described a live cell.

121. Answer (1)

Hint: Restriction check point is major check point.

Sol.: $G_1 \rightarrow S$ is major check point.

122. Answer (2)

Hint: DNA replication takes place only once during entire M phase.

Sol.: DNA should be doubled once only during meiosis as daughter cells are haploid.

123. Answer (1)

Hint: Recombinase is required for recombination.

Sol.: Recombination takes place in pachytene stage.

124. Answer (4)

Hint: Reductional division brings variations.

Sol.: Meiosis is called reductional division.

125. Answer (4)

Hint: Aster is seen in mitotic cells.

Sol.: It is formed during mitosis in animal cells. Plant cells lack centrosome. They show anastral mitosis.

126. Answer (1)

Hint: A bivalent has four chromatids.

Sol.: A bivalent consists of two homologous chromosomes.

127. Answer (2)

Hint: Chromosome number does not change in interphase.

Sol.: G_1, S and G_2 are parts of interphase. So chromosome number remains same.

128. Answer (1)

Sol.: The best stage to study the shape of the chromosomes is Anaphase.

129. Answer (2)

Hint: Crossing over takes place between non sister chromatids of homologous chromosomes

Sol.: BC are non-sister chromatids. AB and CD are sister chromatids.

130. Answer (1)

Hint: Crossing over takes place in reduction division.

Sol.: Meiosis is called reduction division. Crossing over takes place in meiosis I.

131. Answer (3)

Hint: This stage is marked by complete disintegration of nuclear membrane.

Sol.: Spindle fibres attach to kinetochores in metaphase.

132. Answer (1)

Hint: Quiescent stage is G_0 phase.

Sol.: Cell is metabolically active in G_0 phase. DNA replication occurs in S phase. In G_0 phase cell does not divide.

133. Answer (3)

Hint: During S phase, centriole as well as DNA duplicates.

Sol.: G_1 – It takes place between M and S phase

G_0 – It is an inactive stage

G_2 – Proteins and RNA molecules are synthesised here.

134. Answer (4)

Hint: Prophase I is the first stage of meiosis, which is further divided into five sub phases.

Sol.: Moving of chromosomes towards opposite poles takes place in anaphase I.

135. Answer (3)

Hint: During mitosis splitting of centromere takes place in Anaphase.

Sol.: During meiosis, splitting of centromere takes place in anaphase II.

SECTION - B

136. Answer (3)

Hint: Microtubules are made up of tubulin proteins which are non-contractile proteins.

Sol.: Microfilaments help in pseudopodia formation.

137. Answer (3)

Hint: Thylakoids are arranged in stacks called grana.

Sol.: The flat membranous tubules called stroma lamellae connecting the thylakoids of the different grana.

138. Answer (2)

Hint: Cristae are present towards the matrix of mitochondria.

Sol.: The inner membrane of mitochondria forms a number of infoldings called the cristae.

139. Answer (3)

Hint: Gas vacuole is found in prokaryotes.

Sol.: In *Amoeba* the contractile vacuole is important for osmoregulation and excretion.

140. Answer (1)

Hint: Cellulose is present in cell walls of all groups of plants.

Sol.: Algal cell wall is composed of cellulose, galactans, mannans and minerals like calcium carbonate.

141. Answer (3)

Hint: Endoplasmic reticulum can be free of ribosomes, *i.e.*, smooth endoplasmic reticulum (SER) or can bear ribosomes, *i.e.*, rough endoplasmic reticulum (RER).

Sol.: SER is associated with lipid and steroid synthesis. RER is associated with the synthesis of proteins and enzymes.

142. Answer (1)

Hint: The outermost layer in the cell envelope of bacteria is the glycocalyx.

Sol.: The outermost layer, *i.e.*, glycocalyx in bacteria can be in the form of loose sheath called the slime layer or may be thick and tough called capsule.

143. Answer (3)

Hint: Human RBCs are round and biconcave and nerve cells are long and branched.

Sol.: The bacterium bacillus is rod shaped and coccus is spherical.

144. Answer (4)

Hint: Telocentric chromosome appear I-shaped during anaphase.

Sol.: Centromere in telocentric chromosome is present at the terminal end and thus the chromosomes appears to have single arm.

145. Answer (2)

Hint: Eukaryotic cells have both membrane bound and non-membrane bound cell organelles.

Sol.: Prokaryotic cells have only 70S ribosomes as cell organelles, whereas eukaryotic cells have both 70S and 80S ribosomes.

146. Answer (1)

Hint: Phragmoplast is precursor of cell wall.

Sol.: Phragmoplast is formed by Golgi. It is seen during cytokinesis in plant cells.

147. Answer (2)

Hint: Disappearance of nucleolus, Golgi and ER occurs in first phase of karyokinesis.

Sol.: Prophase is first phase of karyokinesis.

148. Answer (1)

Hint: Disc shaped structure is proteinaceous.

Sol.: It is called kinetochore.

149. Answer (4)

Hint: Diplotene is called dictyotene stage in oocytes of some vertebrates.

Sol.: Diplotene may last for many years in oocytes of vertebrates.

150. Answer (1)

Hint: Most dramatic phase of cell cycle is M phase.

Sol.: Chromosomes align at equator in metaphase.

[ZOOLOGY]

SECTION - A

151. Answer (2)

Hint: Tissue with osteocytes

Sol.: Bones are a type of specialised connective tissue. The bone cells (osteocytes) are present in ring shaped fluid filled spaces called lacunae.

The red bone marrow in some bones is the site of production of blood cells. Chondrocytes are present in lacunae of cartilages.

152. Answer (2)

Hint: Palmitic acid has 16 carbons including the carboxyl carbon.

Sol.: Palmitic acid has 16 carbon atoms including the carboxyl carbon. Arachidonic acid has 20 carbon atoms including the carboxyl carbon.

153. Answer (4)

Hint: Compound epithelium

Sol.: Compound epithelium is made of more than one layer (multi-layered) of cells and thus has a limited role in secretion and absorption. They cover the dry surface of the skin, the moist surface of buccal cavity, pharynx, inner lining of ducts of salivary glands and of pancreatic ducts. PCT is lined by brush bordered cuboidal epithelium.

154. Answer (1)

Hint: Cells which secrete fibres.

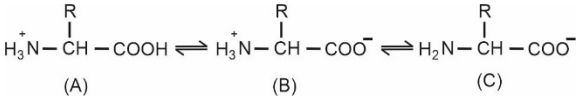
Sol.: Fibroblasts are the cells which secrete fibres of structural proteins called collagen or elastin. These fibres provide strength, elasticity and flexibility to the tissue. These cells secrete modified polysaccharides which accumulate between cells and fibres and act as matrix (ground substance).

Mast cells secrete histamine, serotonin and heparin. Adipocytes are specialised to store fats. Macrophages are phagocytic cells.

155. Answer (4)

Hint: Zwitterions have both a positive and a negative charge.

Sol.: A particular property of amino acids is the ionizable nature of $-NH_2$ and $-COOH$ groups. Hence, in solutions of different pHs, the structure of amino acids changes. These fully ionized species known as zwitterions have both a positive and a negative charge.



(A) (B) (C)

(B) is called zwitterionic form.

156. Answer (3)

Hint: Less than 3

Sol.: In all connective tissues except blood, the cells secrete fibres of structural proteins called collagen or elastin. The fibres provide strength, elasticity and flexibility to the tissue.

157. Answer (1)

Hint: Trichloroacetic acid

Sol.: To perform a chemical analysis we can take any living tissue (a vegetable or a piece of liver, *etc.*) and grind it in trichloroacetic acid (Cl_3CCOOH) using a mortar and a pestle.

158. Answer (2)

Hint: Adenine pairs with thymine.

Sol.: A and G of one strand compulsorily base pair with T and C, respectively, on the other strand. Hence, if cytosine content is 20% then guanine will also be 20%; adenine and thymine will be 30% each.

159. Answer (4)

Hint: Bones are non-pliable.

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

160. Answer (3)

Hint: Insulin is secreted by an endocrine gland.

Sol.: Exocrine glands secrete mucus, saliva, earwax, oil, milk, digestive enzymes and other cell products. These products are released through ducts or tubes.

Endocrine glands (ductless glands) secrete hormones.

161. Answer (3)

Hint: Communication junctions

Sol.: Cardiac muscle tissue is a contractile tissue present only in the heart. Communication junctions (intercalated discs) at some fusion points allow the cells to contract as a unit, *i.e.* when one cell receives a signal to contract, its neighbours are also stimulated to contract.

162. Answer (2)

Hint: Monomer of chitin

Sol.: Chitin, a homopolysaccharide, is present in the exoskeleton of arthropods. The monomer of chitin is N-acetyl glucosamine (NAG).

Fructose is the monomer of inulin.

163. Answer (1)

Hint: Example of dense regular connective tissue

Sol.: Fibres and fibroblasts are compactly packed in the dense connective tissues.

In the dense regular connective tissues, the collagen fibres are present in rows between many bundles of fibres.

Tendons (dense regular connective tissue) attach skeletal muscles to bones.

Blood is the carrier of respiratory gases.

Loose connective tissue has cells and fibres loosely arranged in a semi-fluid ground substance.

164. Answer (1)

Hint: Adipose tissue is a modified areolar tissue.

Sol.: Areolar tissue is a type of loose connective tissue present beneath the skin. It contains fibroblasts that secrete yellow fibres (elastin) and white fibres (collagen). It also has macrophages, mast cells and adipocytes.

Adipose tissue is a modified areolar tissue to store fats. Hence, the components of adipose tissue and areolar tissue are the same except that adipocytes are more in adipose connective tissue.

165. Answer (3)

Hint: Arteries carry oxygenated blood.

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

They are found in the walls of blood vessels and air sacs of lungs and are involved in functions like forming a diffusion boundary.

The columnar epithelium is found in the lining of stomach and intestine.

The inner lining of pharynx is lined by compound epithelium.

166. Answer (1)

Hint: Rate of a physical or chemical process.

Sol.: Rate of a physical or chemical process refers to the amount of product formed per unit time. It can be expressed as:

$$\text{Rate} = \frac{\delta P}{\delta t}$$

167. Answer (4)

Hint: Tertiary structure of proteins makes them biologically active.

Sol.: An enzyme like any protein has a primary, secondary and tertiary structure.

The tertiary structure of an enzyme has crevices or pockets into which the substrate fits. These crevices are called active sites which make the enzymes catalytically active.

168. Answer (3)

Hint: Peroxidase and catalase have the same co-factor.

Sol.: Haem is the prosthetic group for the enzymes peroxidase and catalase.

Zinc is the co-factor for the proteolytic enzyme carboxypeptidase and carbonic anhydrase.

Co-enzyme NAD and NADP contain the vitamin niacin.

169. Answer (4)

Hint: Neurons are excitable cells.

Sol.: Neurons are the units of neural system and are excitable in nature.

The neuroglial cells are non-excitable and they protect and support the neurons.

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

170. Answer (4)

Hint: Gap junctions connect the cytoplasm of neighbouring cells.

Sol.:

Tight junctions: Help to stop substances from leaking across a tissue

Adhering junctions: Perform cementing to keep neighbouring cells together

Gap junctions: Facilitate the cells to communicate with each other by connecting cytoplasm of adjoining cells.

171. Answer (2)

Hint: The tissue that links and supports other tissues and organs.

Sol.: Connective tissues are the most abundant and widely distributed in the body of complex animals. They are named connective tissues because of their special function of linking and supporting other tissues/ organs of the body.

The neural tissue exerts greatest control over the body's responsiveness to changing conditions.

172. Answer (1)

Hint: This structure represents protein as a line.

Sol.: Primary structure of a protein gives the positional information of amino acids in a protein- which is the first amino acid, which is second, and so on.

Tertiary structure is absolutely necessary for many biological activities of proteins.

173. Answer (4)

Hint: Holoenzyme = Apoenzyme + Co-factor

Sol.: Non-protein constituents called co-factors are bound to the enzyme to make the enzyme catalytically active.

The protein portion of the enzymes is the apoenzyme.

174. Answer (3)

Hint: Concanavalin A is a lectin.

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	Vinblastine, Curcumin, *etc*
Polymeric Substances	Rubber, Gums, Cellulose

175. Answer (2)

Hint: 'W' is a competitive inhibitor.

Sol.: 'P' is succinic dehydrogenase.

'Q' is succinate.

'W' is the competitive inhibitor of succinate, which is malonate. When the inhibitor closely resembles the substrate in its molecular structure and inhibits the activity of the enzyme, then it is known as a competitive inhibitor.

176. Answer (3)

Hint: Two main types of cells in Islets of Langerhans

Sol.: Adult haemoglobin consists of 4 subunits. Two of these are identical to each other. Hence, two subunits of α-type and two subunits of β-type together constitute the human haemoglobin.

177. Answer (2)

Hint: Consists of cluster of cells

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

They are of two types– unicellular, like goblet cells of the alimentary canal and multicellular, like salivary glands.

Inner lining of ducts of salivary glands is lined by compound epithelium.

178. Answer (3)

Hint: Contains RBCs, WBCs, and platelets

Sol.: Blood is one of the specialised connective tissues.

It is a fluid connective tissue which contains plasma, red blood cells (RBCs), white blood cells (WBCs) and platelets. It is the main circulating fluid that helps in transport of various substances.

In all connective tissues except blood, the cells secrete fibres of structural proteins called collagen or elastin.

179. Answer (2)

Hint: Identify a basic amino acid.

Sol.:

Basic amino acid – Lysine

Aromatic amino acids – Tyrosine, Phenylalanine, Tryptophan

180. Answer (2)

Hint: Twisted ladder

Sol.: One of the secondary structures exhibited by DNA is the famous Watson and Crick model. This model says that DNA exists as a double helix . The two strands of polynucleotides are antiparallel, *i.e.*, run in the opposite direction.

181. Answer (4)

Hint: Most abundant protein in the animal world.

Sol.:

Protein	**Functions**
Collagen	Intercellular ground substance
Trypsin	Enzyme
Insulin	Hormone
Antibody	Fights infectious agents
Receptor	Sensory reception (smell, taste, hormone, *etc.*)
GLUT-4	Enables glucose transport into cells

182. Answer (2)

Hint: Adenine + Ribose

Sol.: Adenosine, guanosine, thymidine, uridine and cytidine are nucleosides.

Adenylic acid, thymidylic acid, guanylic acid, uridylic acid and cytidylic acid are nucleotides.

183. Answer (4)

Hint: Enzymes catalysing the transfer of a group.

Sol.: Enzymes catalysing the transfer of a group, G (other than hydrogen) between a pair of substrate S and S' are called transferases *e.g.*

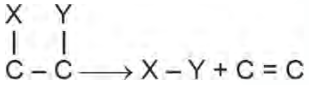
$S - G + S' \longrightarrow S + S' - G$

Oxidoreductases/dehydrogenases: Enzymes which catalyse oxidoreduction between two substrates S and S' *e.g.*,

S reduced + S' oxidised $\rightarrow$ S oxidised + S' reduced.

Hydrolases: Enzymes catalysing hydrolysis of ester, ether, peptide, glycosidic, C-C, C-halide or P-N bonds.

Lyases: Enzymes that catalyse removal of groups from substrates by mechanisms other than hydrolysis leaving double bonds.



184. Answer (3)

Hint: Neurons are part of this tissue.

Sol.: Neural tissue exerts the greatest control over the body's responsiveness to changing conditions.

Connective tissue links and supports other tissues/organs of the body.

Epithelial tissue provides a covering or a lining for parts of the body.

185. Answer (1)

Hint: Cellulose gives a negative iodine test.

Sol.: Starch and cellulose are homopolymers of glucose. Starch forms helical secondary structures and can hold I_2 molecules in the helical portion.

Cellulose does not contain complex helices and hence, cannot hold I_2.

SECTION - B

186. Answer (4)

Hint: Enzymes catalysing isomerisation.

Sol.: The 6 classes of enzymes based on their commission number are:

(1) Oxidoreductases
(2) Transferases
(3) Hydrolases
(4) Lyases
(5) Isomerases
(6) Ligases

187. Answer (3)

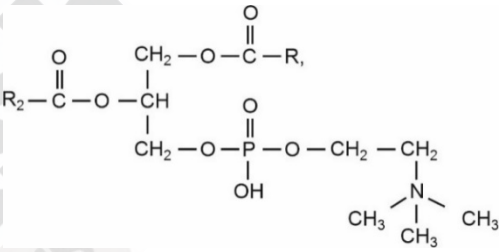
Hint: Enzyme molecules are fewer than substrate molecules.

Sol.: When the substrate concentration increases, the velocity of the enzymatic reaction increases at first. After reaching the maximum velocity (V_{max}), the velocity stays stationary in spite of an increase in the concentration of 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.

188. Answer (3)

Hint:



Sol.: Some lipids have phosphorus and a phosphorylated organic compound in them. These are phospholipids. They are found in cell membrane. Lecithin is one example. Some tissues especially the neural tissues have lipids with more complex structures.

189. Answer (3)

Hint: Cardiac muscle fibres are branched.

Sol.:

Skeletal muscle fibres	–	Striated, cylindrical in shape, multinucleated, unbranched and voluntary
Smooth muscle fibres	–	Unstriated, fusiform in shape, uninucleated, unbranched and involuntary

190. Answer (3)

Hint: Proteins are denatured by heat.

Sol.: High temperature destroys proteins. Hence, enzymes do not show any enzymatic activity at a high temperature.

191. Answer (1)

Hint: A = T

Sol.: In a DNA molecule, A and G of one strand compulsorily base pair with T and C respectively, on the other strand.

There are two hydrogen bonds between A and T and three hydrogen bonds between G and C.

192. Answer (2)

Hint: Adrenaline is other name of this compound.

Sol.: Mast cells are present in the connective tissue. They secrete histamine, heparin and serotonin. Histamine is responsible for an inflammatory response.

Heparin is an anticoagulant. Serotonin is a vasoconstrictor.

193. Answer (2)

Hint: Smooth muscle fibres are involuntary.

Sol.: Ramachandran plot is used to confirm the structure of proteins.

Smooth muscle fibres are present in the wall of blood vessels.

194. Answer (1)

Hint: The building block of nucleic acids is a nucleotide.

Sol.: Heterocyclic compounds in nucleic acids are the nitrogenous bases named adenine, guanine, uracil, cytosine and thymine.

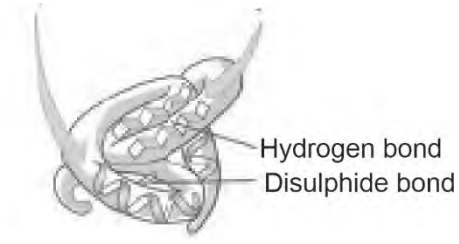
The sugar found in polynucleotides is either ribose or 2' deoxyribose.

Phosphoric acid or phosphate is the third component of a nucleotide.

195. Answer (4)

Hint: 3-dimensional view of a protein

Sol.: Tertiary structure of protein



196. Answer (4)

Hint: $E + S \rightleftharpoons ES \longrightarrow EP \longrightarrow E + P$

Sol.: The catalytic cycle of an enzyme action can be described in the following steps:

(i) Substrate binds to the active site of the enzyme

(ii) The chemical bonds of the substrate break

(iii) New enzyme-product complex is formed

(iv) Enzyme releases the products and free enzyme is ready to bind to another molecule of the substrate

197. Answer (3)

Hint: Arrangement of fibres

Sol.: Dense connective tissues are of two types, namely, dense regular and dense irregular tissues.

The collagen fibres are present in rows between many parallel bundles of fibres in dense regular connective tissues. Tendons and ligaments are examples of dense regular connective tissue.

Dense irregular connective tissue has fibroblasts and many fibres that are oriented differently. This tissue is present in the skin.

198. Answer (1)

Hint: Photosynthetic enzyme

Sol.: Collagen is the most abundant protein in the animal world.

Ribulose Bisphosphate Carboxylase - Oxygenase (RuBisCO) is the most abundant protein in the whole of biosphere.

Cellulose is a homopolymer of glucose.

199. Answer (2)

Hint: Leucine belongs to this category.

Sol.: There are 20 types of amino acids.

The amino acids which can't be synthesized by our body have to be supplied through our diet. These are called essential amino acids.

The amino acids which our body can make are non-essential amino acids.

200. Answer (2)

Hint: Acid-soluble pool has compounds with low molecular weights.

Sol.: Acid-soluble pool has compounds which have molecular weights ranging from 18 to around 800 daltons.

These are micromolecules. The acid-soluble pool represents roughly the cytoplasmic composition.

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