

**AIM - 720***(Advanced INTENSIVE Mastery for 720)*

MM : 720

**CST-9**

Time : 3 Hrs. 20 Min.

**Answers**

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

16/04/2024



CODE-A



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## AIM - 720

**(Advanced INTENSIVE Mastery for 720)**

**CST-9**

Time : 3 Hrs. 20 Min.

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### Answers & Solutions

#### PHYSICS

##### SECTION-A

1. Answer (2)

$$E = \frac{5}{2} K_B T \text{ and } K_B = \frac{R}{N_A}$$

$$\Rightarrow E = \frac{5}{2} \times \frac{R}{N_A} \times T \Rightarrow N_A = \frac{5RT}{2E}$$

2. Answer (3)

Assume the observer to be sitting in elevator

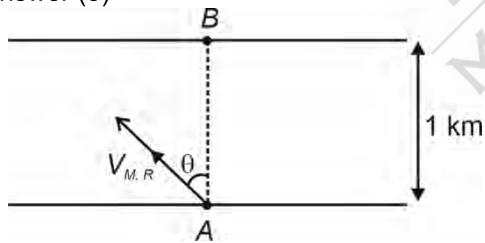
$$\Rightarrow \text{For block } m_1 \Rightarrow T - m_1 g - m_1 a_0 = m_1 a$$

$$\text{For block } m_2 \Rightarrow m_2 g + m_2 a_0 - T = m_2 a$$

$$\Rightarrow g(m_2 - m_1) + a_0(m_2 - m_1) = a(m_1 + m_2)$$

$$\Rightarrow a = \frac{m_2 - m_1}{m_1 + m_2}(g + a_0)$$

3. Answer (3)



$\Rightarrow$  If the man wants to reach point B then

$$\Rightarrow |\vec{V}_{MR}| \sin \theta = |\vec{V}_R|$$

$$\Rightarrow 5 \times \sin \theta = 3 \Rightarrow \sin \theta = \frac{3}{5} \Rightarrow \theta = 37^\circ$$

i.e.  $127^\circ$  with direction of river flow.

4. Answer (4)

Using vector law of triangle addition

$$\text{From } \triangle OPS \Rightarrow \vec{P} + b\vec{R} = \vec{S}$$

$$\text{From } \triangle OPA \Rightarrow \vec{P} + \vec{R} = \vec{Q}$$

5. Answer (4)

$$V_L = -\frac{di}{dt}$$

The induced emf and current through inductor will be sinusoidal. So its average value will be zero for one cycle.

6. Answer (2)

$$\phi = BA$$

$$\frac{d\phi}{dt} = \frac{B}{dt} dA + A \frac{dB}{dt} = 0$$

The increasing area and decreasing magnetic field may give constant flux.

7. Answer (1)

$$F = -\frac{du}{dx} = -12x^2 + 12$$

Equilibrium will be at

$$x = -1 \text{ or } x = 1 \text{ m}$$

$$\frac{dF}{dx} = -24x$$

at  $x = 1$

$$\frac{dF}{dx} < 0$$

So it is minima. Hence  $x = 1$  is a point of stable equilibrium.

8. Answer (3)

Minimum potential will be at  $x = +1 \text{ m}$

$$U = 4(1 + 1)^3 - 12(+1)$$

$$U = (4 - 12) J$$

$$U = -8$$

$KE + PE = 12$

$$\frac{1}{2} \times 2 \times V^2 - 8 = 12$$

$$V^2 = 20$$

$$V = 2\sqrt{5} \text{ m s}^{-1}$$

9. Answer (3)

In simple microscope, image formed is  
Erect, magnified and virtual.

10. Answer (1)

$$\sin \theta_c = \frac{\mu_a}{\mu_m}$$

$$\sin 53^\circ = \frac{1}{\mu}$$

$$\Rightarrow \frac{4}{5} = \frac{1}{\mu}$$

$$\Rightarrow \mu = \frac{5}{4}$$

11. Answer (1)

According to electromagnetic spectrum, order of wavelength is given by

$$\lambda_{\text{microwave rays}} > \lambda_{\text{infrared rays}} > \lambda_{\text{UV rays}} > \lambda_{\text{X-rays}}$$

12. Answer (3)

Path difference corresponds to dark fringe is given by

$$\Delta x = (2n-1) \frac{\lambda}{2}, \quad n = 1, 2, 3, \dots$$

For 5<sup>th</sup> dark fringe

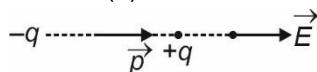
$$\Delta x = \frac{9\lambda}{2}$$

$$\Delta \phi = \frac{2\pi}{\lambda} \Delta x$$

$$= \frac{2\pi}{\lambda} \times \frac{9\lambda}{2}$$

$$= 9\pi$$

13. Answer (1)



Angle between  $\vec{p}$  and  $\vec{E}$  is zero

14. Answer (2)

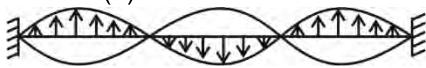
$$V = \frac{\sum q_i}{4\pi\epsilon_0 R} = \frac{q}{4\pi\epsilon_0 R}$$

15. Answer (4)

$$y = 4\sin 2\pi (t + 4)$$

$$\text{Time period of oscillation} = \frac{2\pi}{\omega} = \frac{2\pi}{2\pi} = 1 \text{ s}$$

16. Answer (1)



The particle between two consecutive nodes vibrate in same phase while particles on either side of node vibrate in the opposite phase.

17. Answer (3)

$$n = \frac{I}{E} = \frac{l/\lambda}{hc}$$

$$n = \frac{2.776 \times 10^3 \times 650 \times 10^{-9}}{6.6 \times 10^{-34} \times 3 \times 10^8}$$

$$= 91.1 \times 10^{20} \approx 9 \times 10^{21}$$

18. Answer (4)

$$\Delta m = 0.4\% \text{ of } 2 \text{ kg}$$

$$= \frac{0.4}{100} \times 2 \text{ kg} = 8 \times 10^{-3} \text{ kg}$$

$$E = (\Delta m)c^2 = 8 \times 10^{-3} \times (3 \times 10^8)^2$$

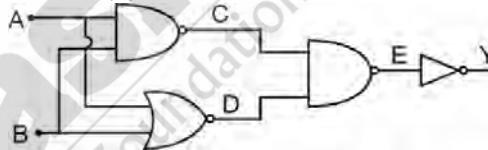
$$= 72 \times 10^{13} \text{ J}$$

19. Answer (1)

$$\lambda = \frac{1240}{4.8} \text{ nm}$$

$$\lambda = 258 \text{ nm}$$

20. Answer (3)



A	B	C = A · B	D = A + B	E = C · D	Y = Ē
0	0	1	1	0	1
0	1	1	0	1	0
1	0	1	0	1	0
1	1	0	0	1	0

21. Answer (2)

Work  $\rightarrow [ML^2T^{-2}]$

Force  $\rightarrow [MLT^{-2}]$

Energy  $\rightarrow [ML^2T^{-2}]$

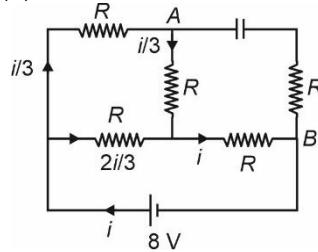
Ratio of change in linear momentum  $\rightarrow [MLT^{-2}]$

Acceleration  $\rightarrow [LT^{-2}]$

22. Answer (3)

Potentiometer is a voltage measuring device which does not draw any current from the source of which it intend to measure potential difference.

23. Answer (4)



$$i = \frac{V}{R_{\text{eq}}}$$

$$R_{\text{eq}} = \frac{5R}{3}$$

$$i = \frac{\frac{8}{5}}{\frac{3}{5}} = \frac{24}{5} \text{ A}$$

$$V_A - \frac{i}{3}R - iR = V_B$$

$$V_A - \frac{24}{5} \times \frac{4}{3} = V_B$$

$$\Rightarrow V_A - V_B = \frac{32}{5}V$$

$$Q = CV \Rightarrow Q = 5 \times \frac{32}{5} = 32 \mu\text{C}$$

24. Answer (4)

- Magnetic field does not remain constant along a magnetic field line.
- Direction of  $\vec{B}$  is tangential to magnetic field line.

25. Answer (1)

Since neutron has no charge, it will move undeflected in the magnetic field.

Proton and  $\alpha$ -particle both are positively charged and their radius of curvature is given by

$$R = \frac{mv}{qB}$$

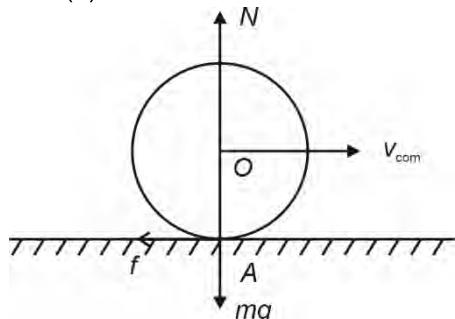
$$R_P = \frac{m_0 v}{q_0 B}, R_\alpha = \frac{4m_0 v}{2q_0 B} = 2R_P$$

$\therefore$  Radius of curvature is less for proton and hence path (1) is the trajectory for proton

26. Answer (1)

Paramagnetic substance get weakly attracted towards a magnet. Its magnetic permeability is greater than 1 but does not have very high value.

27. Answer (2)



$\Sigma \tau = 0$  (About point of contact

i.e. point A)

Thus  $\vec{L} = \text{constant}$  (About A)

28. Answer (2)

According to parallel axis theorem

$$I = I_{\text{COM}} + md^2$$

$$I = I_0 + \frac{ML^2}{4}$$

29. Answer (2)

According to law of areas (Kepler's second law)

Angular momentum  $L = \text{constant}$

$$\therefore 2m \frac{dA}{dt} = \text{constant} \Rightarrow \frac{dA}{dt} = \text{constant}$$

Hence, area swept in equal interval is equal

30. Answer (1)

$$\text{We know, } Y = \frac{Fl}{Ax}$$

$$\therefore x_{\text{cu}} = \frac{Fl_{\text{Cu}}}{AY_{\text{Cu}}} = \frac{(500)(4)}{(0.25 \times 10^{-4})(10^{11})} = 0.8 \text{ mm}$$

Similarly

$$x_{\text{steel}} = \frac{Fl_{\text{steel}}}{AY_{\text{steel}}} = \frac{500(2)}{(0.25 \times 10^{-4})(2 \times 10^{11})} = 0.2 \text{ mm}$$

$$\therefore \text{Total elongation} = 0.8 + 0.2 = 1 \text{ mm}$$

31. Answer (1)

According to principle of continuity, the velocity of fluid increases as the cross-sectional area decreases.

32. Answer (2)

$$\begin{aligned} \Delta L &= \alpha L \Delta T \\ &= 5 \times 10^{-5} \times 1 \times 100 \times 100 \\ &= 0.5 \text{ cm} \end{aligned}$$

33. Answer (3)

In an isothermal process,  $PV$  is constant. If volume is reduced to  $\left(\frac{1}{4}\right)^{\text{th}}$  the pressure must increase by a factor of 4.

34. Answer (2)

$$v = 4t - t^2, a = \frac{dv}{dt} = 4 - 2t \Rightarrow a = 4 - 2t$$

$$\text{at } t = 1 \text{ s, } a = 2 \text{ m s}^{-2}$$

35. Answer (2)

Water has a higher specific heat capacity compared to other substances listed.

## SECTION-B

36. Answer (3)

Since, there are two free surfaces of equal area formed on a ring hence, the total surface energy of the film is  $= 2 \times S \times A$

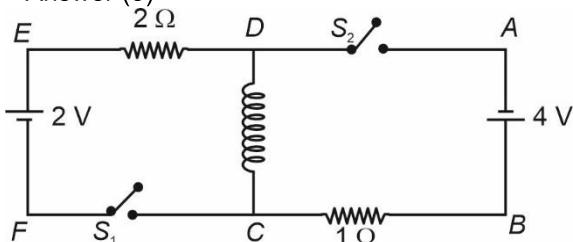
37. Answer (3)

The temperature remains constant in an isothermal process, leading to no change in internal energy.

38. Answer (1)

Since there is no tendency for the relative motion hence no frictional force would be acting.

39. Answer (3)



After a very long time inductor can be replaced by a conducting wire.

Assume potential at point A to be zero.

$$\Rightarrow V_B = 4 \text{ V}, V_D = V_A = V_C = 0 \text{ V}, \text{ also } V_F = 0 \text{ V}$$

$$V_E = 2 \text{ V}$$

$$I_1 = 1 \text{ A}$$

$$I_2 = 4 \text{ A}$$

$$I_2 - I_1 = 4 \text{ A} - 1 \text{ A} = 3 \text{ A}$$

40. Answer (2)

$$P_0 = V_2 I_2 = 0.8 V_1 I_1$$

$$P_{\text{in}} = V_1 I_1$$

$$V_2 I_2 = 0.8 \times 200 \times 1$$

$$V_2 I_2 = 160$$

$$\frac{V_2}{V_1} = 10 \Rightarrow V_2 = 2000 \text{ V}$$

$$2000 I_2 = 160$$

$$I_2 = \frac{160}{2000} = 80 \text{ mA}$$

41. Answer (4)

$$\frac{1}{f_{\text{eq}}} = \frac{1}{f} + \frac{1}{f} = \frac{2}{f}$$

$$\Rightarrow f_{\text{eq}} = \frac{f}{2}$$

$$f_{\text{eq}} = \frac{40}{2} = 20 \text{ cm}$$

So, to get same size of image, object must be placed at  $2f$  i.e. at 40 cm

42. Answer (2)

For noncoherent sources

$$I_{\text{net}} = I + 2I$$

$$= 3I$$

43. Answer (2)

Initial condition

$$C_{\text{eq}} = 2 \mu\text{F}$$

$$V = 8 \text{ V}$$

$$\Rightarrow Q_i = 16 \mu\text{C}$$

Final condition

$$\frac{Q_F}{4} = 8 \Rightarrow Q_F = 32 \mu\text{C}$$

$$\text{Charge flown } (Q_F - Q_i) = 32 - 16 = 16 \mu\text{C}$$

44. Answer (3)

Charge can be assumed to be enclosed by a cube of side  $a$ .

$$\phi_{\text{one surface}} = \frac{q_{\text{en}}}{6\epsilon_0} = \frac{Q}{6\epsilon_0}$$

45. Answer (2)

$$\text{Energy of photon absorbed } (E) = E_2 - E_1$$

$$= -\frac{13.6}{(3)^2} + \frac{13.6}{(1)^2}$$

$$= -1.51 + 13.6 = 12.09 \text{ eV}$$

$$\lambda = \frac{hc}{E_2 - E_1} = \frac{12400}{12.09} \text{ Å}$$

$$\lambda = 1026 \text{ Å}$$

46. Answer (2)

$$V_A - V_B - 0.5 = (6 + 4) \times 10^3 \times 0.3 \times 10^{-3}$$

$$V_A - V_B - 0.5 = 3$$

$$V_A - V_B = 3.5 \text{ V}$$

47. Answer (3)

Least count of the instrument used should be 0.01 cm.

48. Answer (4)

According to law of conservation of angular momentum

$$I_A \omega_A + I_B \omega_B = (I_A + I_B) \omega$$

$$\therefore I_A (2) + (10^{-3}) (5) = (I_A + 10^{-3}) 4$$

$$I_A = 0.5 \times 10^{-3} \text{ kg m}^2$$

49. Answer (4)

$$\text{PE of satellite} = \frac{-GMm}{R+h}$$

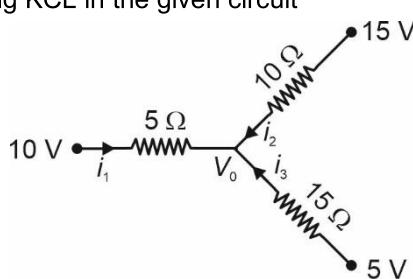
$$\text{KE of satellite} = \frac{GMm}{2(R+h)}$$

$$\therefore \text{TE of satellite} = \frac{-GMm}{2(R+h)}$$

Hence on increasing height of satellite its potential energy increases but KE decreases and orbital velocity of satellite depends upon the density of planet.

50. Answer (2)

Using KCL in the given circuit



$$i_1 + i_2 + i_3 = 0 \Rightarrow \frac{10 - V_0}{5} + \frac{15 - V_0}{10} + \frac{5 - V_0}{15} = 0$$

$$\frac{6(10 - V_0) + 3(15 - V_0) + 2(5 - V_0)}{30} = 0$$

$$60 - 6V_0 + 45 - 3V_0 + 10 - 2V_0 = 0$$

$$11V_0 = 115 \Rightarrow V_0 = \frac{115}{11} \text{ V}$$

$$\therefore i_3 = \frac{\frac{115}{11} - 5}{\frac{15}{15}}$$

$$= \frac{115 - 55}{11 \times 15}$$

$$= \frac{4}{11} \text{ A}$$

**CHEMISTRY****SECTION-A**

51. Answer (2)

2 g atoms (2 mol) of NaOH =  $2 \times 40 = 80 \text{ g NaOH}$ Mass of solution =  $d \times V$ 

$$= 1.24 \times 2000$$

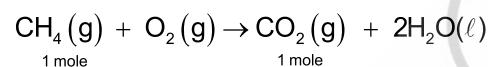
$$= 2480 \text{ g}$$

 $\therefore$  Mass of water (solvent) =  $2480 - 80 = 2400 \text{ g}$ 

$$\text{molality} = \frac{\text{moles of solute}}{\text{mass of solvent(kg)}} = \frac{2 \times 1000}{2400}$$

$$= 0.833 \text{ m}$$

52. Answer (3)

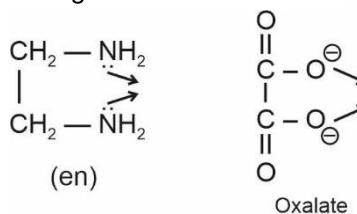


$$\text{Number of moles of CH}_4 = \frac{8}{16} = 0.5 \text{ mole}$$

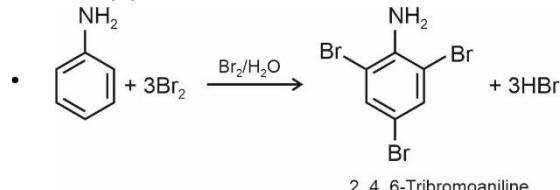
0.5 mole of  $\text{CH}_4$  liberates 11.2 litres of  $\text{CO}_2$  at STP.

53. Answer (3)

Ethylene diamine (en) and oxalate ions are chelating ligands as these ligands can bind through two donor atoms.



54. Answer (2)



- The lone pair of electrons on nitrogen of acetanilide interacts with oxygen atom due to resonance.



55. Answer (1)

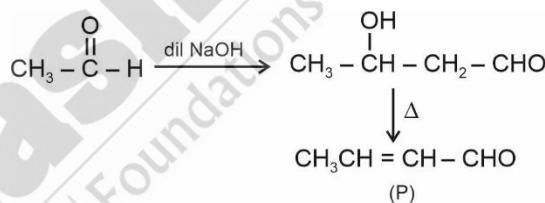
1° alkyl halides undergo  $S_N2$  reaction faster.  
 $\therefore$  will react faster in  $S_N2$  mechanism.

56. Answer (4)

A racemic mixture contains two enantiomers in equal proportions due to which optical rotation of one isomer will be cancelled by the rotation due to other isomer. Hence, resultant optical rotation of the mixture becomes zero.

57. Answer (3)

This is aldol condensation



58. Answer (1)

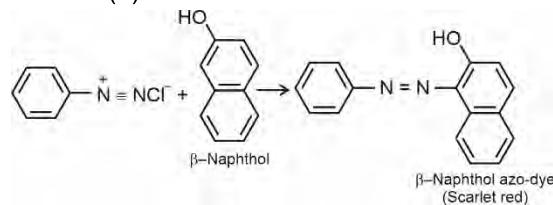
Acetophenone will give yellow iodoform with  $\text{I}_2 + \text{NaOH}$  but benzophenone will not

59. Answer (3)

$$T_{87.5\%} = 3 \times t_{1/2}$$

$$= 3 \times 40 = 120 \text{ s}$$

60. Answer (3)



61. Answer (3)

Compound	Hybridisation	Shape
a $\text{I}_3^-$	$sp^3d$	Linear
b $\text{BF}_3$	$sp^2$	Trigonal planar
c $\text{XeO}_3$	$sp^3$	Trigonal pyramidal
d $\text{ClF}_3$	$sp^3d$	T-shaped

62. Answer (1)

The electron in  $O_2^-$  adds to  $\pi^*$  orbitals.

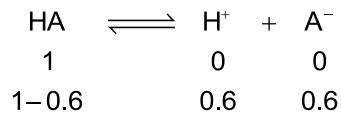
63. Answer (2)

According to Henry's law,

$$P = K_h x$$

Higher the value of  $K_h$  at a given pressure, lower is the solubility of gas.

64. Answer (1)



$$i = 1 - 0.6 + 0.6 + 0.6 = 1.6$$

$$\begin{aligned} \Delta T_b &= i \times m \times K_b \\ &= 1.6 \times 0.4 \times 0.52 = 0.3328 \end{aligned}$$

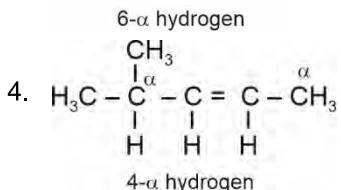
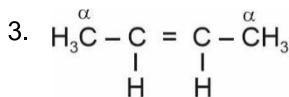
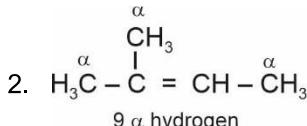
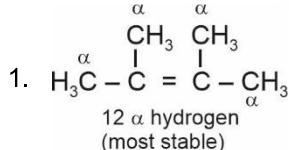
$$T_b = 100 + 0.3328 = 100.33^\circ C$$

65. Answer (4)

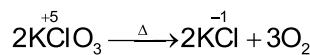
- A reagent that takes away an electron pair from reactive site is called electrophile.
- Electrophiles are electron deficient and hence electron seeking and attack at electron rich site.
- Due to deficiency of electrons electrophiles are Lewis acids.
- $SO_3$  is an electrophile which is used in sulphonation of benzene.

66. Answer (1)

More the number of  $\alpha$ -H atoms, more will be the hyperconjugative structures.



67. Answer (3)



68. Answer (1)

In disproportionation reaction both oxidation and reduction of an element occur simultaneously. In  $ClO_4^-$ , Cl is in its highest oxidation state (+7) so, it cannot increase it further to show oxidation.

69. Answer (3)

Element	$\Delta_i H_1 (\text{kJ/mol})$
Si	786
Ge	761
Sn	708
Pb	715

70. Answer (3)

$Z = 1 \ 0 \ 2$  (Nobelium)

Un nil bium  
(U) (n) (b)

Period  $\rightarrow$  7<sup>th</sup>

Group  $\rightarrow$  3<sup>rd</sup>

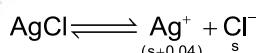
71. Answer (2)

Metallic character increases down a group and decreases along a period as we move from left to right. The correct order is P < Si < Be < Mg

72. Answer (2)

The addition of an inert gas at constant volume does not change the partial pressures or the molar concentration of the substance involved in the reaction so equilibrium remains unchanged.

73. Answer (3)

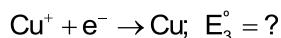
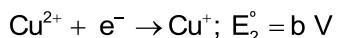
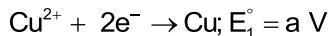


$$K_{sp} = [Ag^+][Cl^-] = (s + 0.04)(s)$$

$$1.6 \times 10^{-10} = (0.04)(s) \text{ [as } s \ll 0.04]$$

$$\begin{aligned} s &= \frac{1.6 \times 10^{-10}}{4 \times 10^{-2}} = \frac{16}{4} \times 10^{-9} \\ &= 4 \times 10^{-9} M \end{aligned}$$

74. Answer (1)



$$\Delta G = -nFE_{cell}^\circ$$

$$-n_3FE_3^\circ = -n_1FE_1^\circ + n_2FE_2^\circ$$

$$-E_3^\circ = -2a + b$$

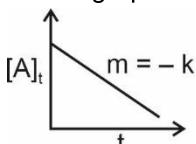
$$E_3^\circ = (2a - b) V$$



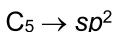
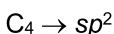
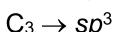
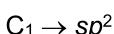
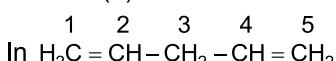
89. Answer (2)

For zero order reaction  $[A]_t = [A]_0 - kt$ 

Hence graph



90. Answer (3)



91. Answer (2)

$$\% \text{ of chlorine} = \frac{35.5 \times \text{wt. of AgCl} \times 100}{143.5 \times \text{wt. of organic compound}}$$

$$= \frac{35.5 \times 0.24 \times 100}{143.5 \times 0.12} = 49.5\%$$

92. Answer (4)

5F electricity is required to convert one mole of  $\text{MnO}_4^-$  to  $\text{Mn}^{2+}$ .Electricity required =  $96500 \times 0.02 \times 5 = 9650 \text{ C}$ 

93. Answer (2)

$$[\text{OH}^-] = 2 \times 10^{-3}$$

$$\text{pOH} = 3 - \log(2)$$

$$\text{pOH} = 3 - 0.3$$

$$\text{pOH} = 2.7$$

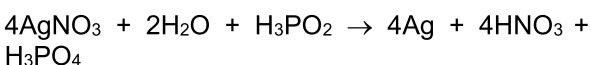
$$\text{pH} = 11.3$$

94. Answer (2)

Total number of nodes =  $n - 1 = 2$ angular nodes =  $\ell = 1 \Rightarrow p\text{-orbital}$ 

3p orbital

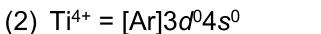
95. Answer (3)

Hypophosphorous acid reduces  $\text{AgNO}_3$  to metallic silver as it contains two P-H bonds.

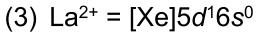
96. Answer (3)



(no unpaired electrons)

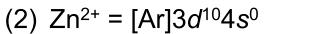


(no unpaired electrons)



∴ 1 unpaired electron

∴ Exhibits colour in aqueous solution



(no unpaired electrons)

97. Answer (2)

$$\Delta H = 100000 \text{ J}$$

$$\Delta S = 200 \text{ JK}^{-1}$$

When  $\Delta G = 0$  (equilibrium)

$$0 = \Delta H - T\Delta S$$

$$\therefore \Delta H = T\Delta S$$

$$\frac{\Delta H}{\Delta S} = T$$

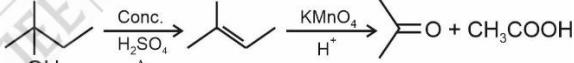
$$\frac{100000}{200} = T$$

$$\therefore T = 500 \text{ K}$$

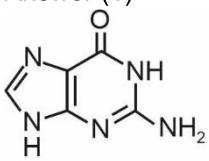
Hence, above this temperature, process will be spontaneous in forward direction.

As  $\Delta G < 0$ , above this temperature.

98. Answer (2)



99. Answer (1)



Guanine (Bicyclic compound)

100. Answer (2)

Secondary alcohol gives blue colouration in Victor Meyer's test.

## BOTANY

### SECTION - A

101. Answer (3)

Pili and fimbriae are surface structures of the bacteria that do not play a role in motility. Flagella helps in motility.

102. Answer (4)

Cytoplasm is the main arena of cellular activities in a cell.

103. Answer (2)

All eukaryotic cells are not identical. Plant and animal cells are different as the former possess cell walls, plastids and a large central vacuoles which are absent in animal cells.

104. Answer (3)

Mitosis usually results in the production of diploid daughter cells with identical genetic complement.

- Meiosis II leads to formation of four haploid daughter cells which are genetically different from each other.
105. Answer (4)  
Karyokinesis refers to the nuclear division.
106. Answer (2)  
Meiosis is a reductional division and leads to formation of haploid daughter cell (meiotic product). Hence number of chromosomes in meiotic product will be 10.
107. Answer (3)  
According to Paul Ehrlich, the species whose removal poses more serious threat to ecosystem are symbolised by rivets on the wings as they are considered as key species that drive major ecosystem functions.
108. Answer (2)  
Species - area relationship was given by Alexander von Humboldt. He observed that within a region species richness increased with increasing explored area but only up to a limit.
109. Answer (4)  
Acetyl CoA is a 2C compound.  
Pyruvic acid, 1, 3-bisphosphoglycerate and phosphoenolpyruvate are 3C compounds.
110. Answer (4)  
Punnett square was developed by a British geneticist, Reginald C. Punnett. It is a graphical representation to calculate the probability of all possible genotype of offspring in a genetic cross.
111. Answer (1)  
Myotonic dystrophy is an autosomal dominant trait. Thalassemia and sickle cell anaemia are autosomal recessive disorders. Haemophilia is X-linked recessive disorder.
112. Answer (4)  
Grasshopper is an example of XO type of sex determination in which the males have only one X chromosome besides the autosomes, whereas females have a pair of X chromosome.
113. Answer (3)  

<b>Carrier female</b>	<b>Normal male</b>
$XX^h$	$XY$
$XX$	$XY$
$XX^h$	$X^hY$
Normal	Carrier
114. Answer (3)  
Phloem parenchyma is absent in most of the monocotyledons.

115. Answer (3)
  - Anatomy of monocot root is similar to the dicot root in many aspects. It has epidermis, cortex, endodermis, pericycle, vascular bundles and pith.
  - Monocot roots do not undergo any secondary growth because cambium is absent.
  - In dicot root, cambium develops at the time of secondary growth.
  - There are usually more than six (polyarch) xylem bundles in the monocot root and pith is large and well developed.
116. Answer (3)  
The most widely used compound as a source of ethylene is ethephon. Ethephon is an aqueous solution which is readily absorbed and transported within the plant and releases ethylene slowly.
  - Ethepron hastens fruit ripening in tomatoes and apples, and accelerates abscission in flowers and fruits.
117. Answer (2)  
Apple, strawberry and cashew nut are examples of false fruit, and mango is a true fruit.
118. Answer (1)  
Vegetative cell is bigger in size, having abundant food reserve and a large irregularly shaped nucleus.
  - Generative cell is small and floats in the cytoplasm of vegetative cell. It is spindle shaped with dense cytoplasm and a nucleus.
  - Carrot grass came into India as a contaminant with imported wheat.
  - In over 60 percent of angiosperms, pollen grains are shed at 2-celled stage.
119. Answer (4)  
In bryophytes, the dominant phase or the main plant body is a free-living gametophyte and it is haploid.
120. Answer (2)  
*Lycopodium* belongs to Lycopsida.  
*Adiantum* belongs to Pteropsida.  
*Psilotum* belongs to Psilopsida.  
*Equisetum* belongs to Sphenopsida
121. Answer (4)  
Cyanobacteria adds organic matter to the soil and increases its fertility it also reduces alkalinity of soil.
122. Answer (3)  
At high altitude where body does not get enough oxygen due to low atmospheric pressure under these conditions, body increases RBC production, decreases binding capacity of haemoglobin.

123. Answer (3)

Producers are also known as transducers because they convert solar energy into chemical energy.

124. Answer (3)

Binomial nomenclature was given by Linnaeus. Scientific name consists of two words.

125. Answer (2)

Some acellular organisms like viruses and viroids as well as the lichens were not classified in the five-kingdom system of classification.

126. Answer (2)

Domain Archaea includes primitive prokaryotes. The three domain system divides kingdom monera into two domains, leaving the remaining eukaryotic kingdoms in the third domain, eukarya.

127. Answer (3)

In mango and coconut, the fruit is known as a drupe. They develop from monocarpellary superior ovaries and are one seeded. In mango pericarp is well differentiated.

128. Answer (4)

Tendril of pea and tendril of cucumber are the modification of leaf and stem, respectively. These tendrils aid in climbing of plants.

129. Answer (2)

In mustard, china rose and brinjal, the gynoecium occupies the highest position while the other parts of the flower are situated below it.

130. Answer (3)

Label A – DNA

Label B – H1 histone

Label C – Histone octamer

Histone proteins are rich in lysine and arginine

131. Answer (2)

Cytosolic 70S ribosomes are found in prokaryotes. Prokaryotes show non-split gene arrangement, presence of only one type of RNA polymerase and coupled transcription and translation.

132. Answer (3)

Ribozyme (23S rRNA) are used during the process of translation (RNA → protein)

133. Answer (1)

All the codons prior to the deletion remain unaltered, i.e., 30 codons.

134. Answer (1)

*Sorghum* is a C<sub>4</sub> plant thus do not show photorespiration which leads to the formation of phosphoglycolate.

135. Answer (3)

The light saturation for photosynthesis occurs at 10% of the total sunlight available to plants.

## SECTION - B

136. Answer (3)

RNA polymerase III transcribes t-RNA.

137. Answer (1)

DNA polymorphism is the basis of DNA fingerprinting.

138. Answer (1)

Small sized neutral solutes may move across the membrane by the process of simple diffusion along the concentration gradient.

139. Answer (2)

Cells at quiescent stage are metabolically active but no longer proliferate unless called on to do so.

140. Answer (3)

The NADH synthesized in glycolysis is transferred into the mitochondria and undergoes oxidative phosphorylation.

141. Answer (2)

In a polygenic trait the phenotype reflects the contribution of each allele i.e. the effect of each allele is additive.

142. Answer (1)

- Phellogen is a couple of layers thick, made up of narrow, thin-walled and nearly rectangular cells.
- Cork is impervious to water due to suberin deposition in the cell wall.

143. Answer (1)

The exponential growth can be expressed as  $W_1 = W_0 e^{rt}$

144. Answer (1)

*Zostera* is a marine water plant. Female flowers remain submerged in water. Pollen grains are long, ribbon like and they are carried passively inside the water, some of them reach the stigma and achieve pollination. Pollen grains are surrounded by mucilaginous covering.

145. Answer (4)

*Pinus* forms mycorrhizal association as its roots lack root hairs. *Cycas* has coralloid roots.

146. Answer (3)

Eurythermal can tolerate and thrive in a wide range of temperatures e.g. most of the mammals. Euryhaline are organisms which tolerate a wide range of salinities.

147. Answer (2)

*Bacillus thuringiensis* (Bt) is a microbial biocontrol agent that can be introduced to control butterfly caterpillars.

148. Answer (2)

Warm and moist environment favour decomposition whereas low temperature inhibits decomposition.

149. Answer (3)

*Aspergillus* is known as weed of laboratory. *Neurospora* is used extensively in biochemical

and genetic work also called Drosophila of plant kingdom.

150. Answer (3)

*Asparagus* and *Gloriosa* belong to Liliaceae family. Family of this plant generally shows perianth condition where tepals are six (3 + 3), often united into tube and show valvate aestivation.

## ZOOLOGY

### SECTION-A

151. Answer (2)

At a chemical synapse, the membranes of pre-synaptic and post-synaptic neurons are separated by a fluid-filled space called synaptic cleft.

152. Answer (1)

The medulla oblongata contains centres which control respiration, cardiovascular reflexes and gastric secretions. Limbic system along with hypothalamus regulates sexual behaviour.

153. Answer (4)

The secretions of paired bulbourethral glands help in lubrication of penis.

154. Answer (2)

Mechanism of muscle contraction is best explained by the sliding filament theory which states that contraction of a muscle fibre takes place by sliding of the thin filaments over the thick filaments.

155. Answer (2)

Primary oocytes start meiotic division and get temporarily arrested in prophase-I.

156. Answer (1)

Respiration involves the following steps:

- (1) Breathing or pulmonary ventilation by which atmospheric air is drawn in and CO<sub>2</sub> rich alveolar air is released out.
- (2) Diffusion of gases across alveolar membrane.
- (3) Transport of gases by the blood.
- (4) Diffusion of gases between blood and tissues.
- (5) Utilisation of O<sub>2</sub> by the cells for catabolic reactions and resultant release of CO<sub>2</sub>.

157. Answer (2)

Air bladder is present in the members of class Osteichthyes and *Trygon* belongs to the class Chondrichthyes.

In *Aptenodytes*, forelimbs are modified into wings.

158. Answer (1)

Alveoli are the primary sites of exchange of gases and it is made up of simple squamous epithelium.

159. Answer (2)

The length of each kidney of an adult human is about 10-12 cm. This numeric value is equal to the length of each fallopian tube present in the human female. The female frog lays 2500-3000 ova at a time. In humans, there are 70-72 cardiac cycles per minute. There are four pairs of gill slits present in bony fishes.

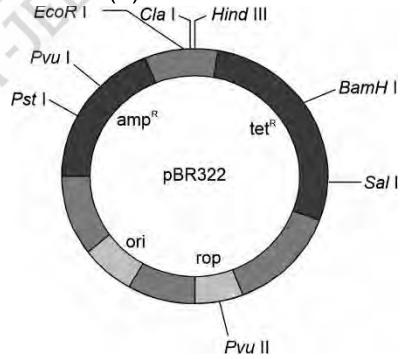
160. Answer (4)

LNG-20 is a hormone releasing IUD, while Lippes loop is a non-medicated IUD. Cu7 is a copper releasing IUD. Diaphragms are barriers made up of rubber.

161. Answer (2)

Steroidal oral contraceptive pills contain progestogens or progestogen-estrogen combinations. They have to be taken daily for a period of 21 days. Mode of action of SOCP and implants is similar. The effective period of implants is much longer than that of OCPs.

162. Answer (3)



Antibiotic resistance genes act as selectable markers.

163. Answer (3)

Fibrous joints do not allow any movement. This type of joint is shown by the flat skull bones which fuse end-to-end with the help of dense fibrous connective tissues in the form of sutures, to form the cranium.

164. Answer (4)

Seminiferous tubules participate in spermatogenesis. Secretions of epididymis, vas deferens, seminal vesicles and prostate gland help in maturation and motility of sperms.

## 165. Answer (3)

Before industrialisation set in, thick growth of almost white coloured lichen covered the trees - in that background, the white winged moths survived but the dark-coloured moths were picked out by predators.

## 166. Answer (4)

Conventional religious literature tells us about the theory of special creation. This theory has three connotations. One, that all living organisms (species or types) that we see today were created as such. Two, that the diversity was always the same since creation and will be the same in future also. Three, that Earth is about 4000 years old.

## 167. Answer (1)

Louis Pasteur by careful experimentation demonstrated that life comes only from pre-existing life. He showed that in pre-sterilised flasks, life did not come from killed yeast while in another flask open to air, new living organisms arose from 'killed yeast'.

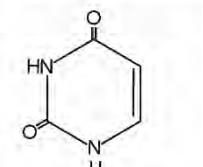
## 168. Answer (2)

RBCs are most abundant of all the cells in blood. A healthy adult man has on an average 5 millions to 5.5 millions of RBC  $\text{mm}^{-3}$  of blood. Blood normally contains 1,500,00 – 3,500,00 platelets  $\text{mm}^{-3}$  and 6000 – 8000  $\text{mm}^{-3}$  WBCs.

## 169. Answer (4)

The fibrins, prothrombin and fibrinogen help in coagulation of blood. Albumin plays an important role in maintaining the osmotic pressure.

## 170. (1)



Nitrogenous bases

## 171. Answer (4)

Some proteins are the assembly of more than one polypeptides or subunits. The manner in which these individual folded polypeptides or subunits are arranged with respect to each other is the architecture of protein and the structure is called quaternary structure.

## 172. Answer (1)

Oxidoreductases/dehydrogenases are enzymes that catalyse oxidoreduction between two substrates like S and S'.

Hydrolases are enzymes catalysing hydrolysis of ester, ether, peptide, glycosidic bonds etc.

## 173. Answer (3)

Thyroid hormone supports RBC production. It also controls water and electrolyte balance. Sleep-wake cycle is maintained by melatonin hormone which is secreted from pineal gland.

## 174. Answer (4)

Columnar epithelium	–	Lining of stomach and intestine
Macrophages	–	Engulf debris and pathogens
Cuboidal epithelium	–	Tubular parts of nephrons in kidney
Cartilage	–	In the tip of nose

## 175. Answer (2)

When a neuron is stimulated, an electrical disturbance is generated which swiftly travels along its plasma membrane.

## 176. Answer (4)

a.	Emphysema	(iv)	$\alpha$ -1-antitrypsin
b.	cry IAb	(v)	Corn borer
c.	Eli Lilly	(i)	Human insulin
d.	RNAi	(iii)	Cellular defence

## 177. Answer (4)

Using conventional methods of diagnosis (serum and urine analysis etc.) early detection of diseases is not possible. RDT, PCR, ELISA are some of the techniques that serve the purpose of early diagnosis.

## 178. Answer (4)

Frogs have muscular heart. It has three chambers, two atria and one ventricle and is covered by a membrane called pericardium.

## 179. Answer (4)

- Heroin is an opioid which binds to opioid receptors. They are also called smack which is chemically diacetylmorphine.
- Cannabinoids affect cardiovascular system of the body.
- *Atropa belladonna* and *Datura* show hallucinogenic properties.

## 180. Answer (1)

*Salmonella typhi* is a pathogenic bacterium which causes typhoid fever in human beings. These pathogens generally enter the small intestine through food and water contaminated with them and migrate to other organs through blood.

## 181. Answer (4)

The stickiness of overhanging stretches produced after restriction enzyme digestion facilitates the action of DNA ligases.

T-DNA transforms normal plant cells into tumor cells.

## 182. Answer (3)

$(2)^n$  number of fragments are obtained after 'n' number of PCR cycles.

1 dsDNA template after 5 PCR cycles gives  $2^5$  i.e., 32 fragments

2 dsDNA templates after 5 PCR cycles will give  $3^2 \times 2$  i.e., 64 fragments

## 183. Answer (4)

Given is the recognition sequence of *EcoRI*.

## 184. Answer (2)

Sea fan → *Gorgonia*

Sea urchin → *Echinus*

Pearl oyster → *Pinctada*

Sea hare → *Aplysia*

Brittle star → *Ophiura*

## 185. Answer (2)

*Physalia* and *Pennatula* are diploblastic acoelomates.

*Psittacula* (Bird), *Pteropus* (Mammal) and *Pheretima* (Annelid) are coelomates.

**SECTION-B**

## 186. Answer (3)

The correct sequence of reproductive events in humans is

Gametogenesis → Insemination → Fertilisation → Implantation → Gestation → Parturition.

## 187. Answer (1)

Brain controls both voluntary and involuntary movements of the body and it is a site for processing of vision.

## 188. Answer (1)

Juxta glomerular apparatus is a special sensitive region formed by cellular modifications in the distal convoluted tubule and the afferent arteriole at the location of their contact.

## 189. Answer (1)

In humans, the receptors associated with aortic arch and carotid artery primarily recognise changes in concentration of  $\text{CO}_2$  and  $\text{H}^+$  in blood arterial.

## 190. Answer (3)

Surgical methods also called sterilisation, block gamete transport and thereby prevent conception. In male, it is called vasectomy and that in female, tubectomy. In vasectomy, a small part of vas deferens is removed or tied up through a small incision on the scrotum whereas in tubectomy, a small part of fallopian tube is removed or tied up through a small incision in the abdomen or through vagina. These techniques are highly effective but their reversibility is very poor.

## 191. Answer (3)

Cervical vertebrae = 7 bones

Tarsals in one limb = 7 bones

Floating ribs and pectoral girdle = Each have 4 bones

Metacarpals in one limb and metatarsals in one limb = 5 bones

## 192. Answer (2)

Different aged rock sediments contain fossils of different life-forms who probably died during the formation of the particular sediment.

## 193. Answer (3)

Lymph is a colourless fluid containing specialised lymphocytes. It is also an important carrier for nutrients, hormones, etc. Fats are absorbed through lymph in the lacteals present in the intestinal villi.

## 194. Answer (3)

PTH increases the  $\text{Ca}^{2+}$  levels in the blood. PTH acts on bones and stimulates the process of bone resorption (dissolution/demineralisation). PTH also stimulates reabsorption of  $\text{Ca}^{2+}$  by the renal tubules and increases  $\text{Ca}^{2+}$  absorption from the digested food.

## 195. Answer (1)

In a polypeptide or a protein, amino acids are linked by a peptide bond which is formed when the carboxyl ( $-\text{COOH}$ ) group of one amino acid reacts with the amino ( $-\text{NH}_2$ ) group of the next amino acid with the elimination of water.

In a polysaccharide, the individual monosaccharides are linked by glycosidic bond.

## 196. Answer (2)

In 1990, a 4-year old girl was treated with gene therapy and the targeted enzyme was adenosine deaminase.

## 197. Answer (1)

- Frogs have webbed digits that help in swimming.
- Body of a frog is divisible into head and trunk. A neck and tail are absent.
- On either side of eyes, a membranous tympanum (ear) receives sound signals.

## 198. Answer (2)

For diseases such as malaria and filariasis that are transmitted through insect vectors, the most important measure is to control or eliminate the vectors and their breeding places.

Such precautions have become more important especially in the light of recent widespread incidences of the vector-borne (*Aedes* mosquitoes) diseases like dengue and chikungunya in many parts of India.

## 199. Answer (3)

A bioreactor has an agitator system, an oxygen delivery system and a foam control system, a temperature control system, pH control system and sampling port so that small volumes of culture can be withdrawn periodically.

## 200. Answer (3)

Saheli is a non-steroidal preparation with high contraceptive value. Saheli blocks estrogen receptors in the uterus and prevents implantation. Vault is a barrier made of rubber. Progestasert is a hormone releasing IUD. Tubectomy is a surgical method in which a small part of fallopian tube is removed or tied up through a small incision in the abdomen or through vagina.

