# All India Aakash Test Series for NEET-2022

## TEST - 6 (Code-E)

**Test Date : 17/04/2022**

## ANSWERS

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

# HINTS & SOLUTIONS

## [PHYSICS]

### SECTION-A

1. Answer (4)

**Hint:** Time constant $(\tau) = \frac{L}{R}$

**Sol.:** $\tau = \frac{L}{R} = \frac{200 \times 10^{-3}}{2} = 0.1\,\text{s}$

2. Answer (2)

**Hint:** $e = \left|\frac{d\phi}{dt}\right|$

**Sol.:** $e = \frac{d(10t^2 - 50t + 250)}{dt}$

$e = 20t - 50$

at $t = 6$ s, $e = 20 \times 6 - 50 = 70$ V

3. Answer (4)

**Hint and Sol.:** $e = \frac{d\phi}{dt} = \frac{d(\vec{B} \cdot \vec{A})}{dt}$

As magnetic field is uniform and orientation of area vector does not change, so the induced emf will be zero.

4. Answer (3)

**Hint:** $B = \frac{\mu_0 i}{2\pi R}$

**Sol.:** $10 = \frac{\mu_0 (i_1)}{2\pi R} - \frac{\mu_0 (i_2)}{2\pi R}$

and, $30 = \frac{\mu_0 (i_1)}{2\pi R} + \frac{\mu_0 (i_2)}{2\pi R}$

$\Rightarrow \quad \frac{i_1 + i_2}{i_1 - i_2} = 3 \Rightarrow i_1 + i_2 = 3i_1 - 3i_2$

$\Rightarrow \quad 4i_2 = 2i_1$

$\Rightarrow \quad \frac{i_1}{i_2} = \frac{2}{1}$

5. Answer (2)

**Hint and Sol.:** We know

$e = \frac{-d\phi}{dt}$

$\Rightarrow$ $[d\phi] = [edt]$

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

6. Answer (1)

**Hint and Sol.:** Emf can be induced by moving a conductor in magnetic field and this is called motional emf. Changing magnetic field also leads to the change in magnetic flux and thus emf is induced.

7. Answer (4)

**Hint:** $B = \frac{\mu_0 i}{2R}$

**Sol.:** $B = \frac{\mu_0 i}{2R}$

Also, $A = \pi R^2 \Rightarrow R = \sqrt{\frac{A}{\pi}}$

$\Rightarrow \quad B = \frac{\mu_0 i}{2\sqrt{\frac{A}{\pi}}} = \frac{\mu_0 i \sqrt{\pi}}{2\sqrt{A}}$

$\Rightarrow \quad i = \frac{2B\sqrt{A}}{\mu_0 \sqrt{\pi}}$

8. Answer (2)

**Hint:** $\cos\phi = \frac{R}{z}$

**Sol.:** $\cos\phi_1 = \frac{R}{z_1} = \frac{1}{4} \Rightarrow z_1 = 4R$

$\cos\phi_2 = \frac{R}{z_2} = \frac{1}{8} \Rightarrow z_2 = 8R$

Now percentage change in impedance is

$\frac{z_2 - z_1}{z_1} \times 100 = \left(\frac{8R - 4R}{4R}\right) \times 100 = 100\%$

9. Answer (2)

**Hint:** $V_{\text{net}} = \sqrt{V_R^2 + (V_C - V_L)^2}$

$i = \frac{V_{\text{net}}}{z}$

**Sol.:** $V_{\text{net}} = 220 = \sqrt{V_R^2 + (300 - 300)^2} = V_R$

$i = \frac{220}{100} = 2.2$ A

10. Answer (1)

**Hint:** Input power = $V_P I_P$

**Sol.:** $P_O$ = 140 W

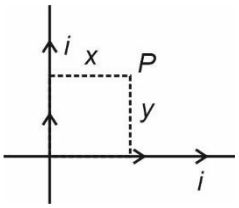
$P_i = V_P I_P = 220 \times 1.5 = 330$ W

Now, Efficiency $= \frac{P_O}{P_i} \times 100 = \frac{140}{330} \times 100 = 42\,\%$

11. Answer (1)

**Hint:** $B = \frac{\mu_0 i}{2\pi r}$

**Sol.:** $B_1 = \frac{\mu_0 i}{2\pi x}$(inwards)




$B_2 = \frac{\mu_0 i}{2\pi y}$(outwards)

Now for $B_{net} = 0$

$\Rightarrow$ $B_1 - B_2 = 0$

$\Rightarrow$ $B_1 = B_2$

$\Rightarrow$ $x = y$

12. Answer (4)

**Hint and Sol.:** The magnetic field causes circular path, while electric field would speed up the particle along it. Thus, the final result is a helical path with increasing pitch.

13. Answer (3)

**Hint and Sol.:** Diamagnetic substances are feebly repelled by magnets.

14. Answer (2)

**Hint:** Due to a bar magnet

$B_{axial} = 2\left(\frac{\mu_0}{4\pi}\right)\frac{M}{r^3}$

**Sol.:** At neutral point, the magnetic field due to the magnet will get cancelled by the earth's horizontal component of magnetic field.

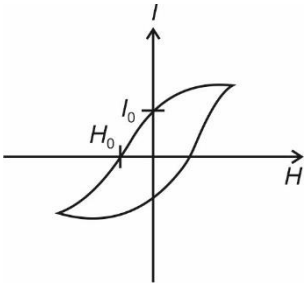
Thus, $2\left(\frac{\mu_0}{4\pi}\right)\frac{M}{r^3} = 0.8 \times 10^{-4}$

$\Rightarrow$ $\frac{2 \times 10^{-7} \times M}{(20 \times 10^{-2})^3} = 0.8 \times 10^{-4}$

= 3.2 A m$^2$

15. Answer (2)

**Hint and Sol.:**




$H_0$ : Coercivity.

16. Answer (3)

**Hint and Sol.:** As we know, resonance angular frequency is equal to $\frac{1}{\sqrt{LC}}$, thus it is independent of resistance.

17. Answer (4)

**Hint and Sol.:** Net displacement current, $I_d = I$, since displacement current is uniformly distributed across the area.

$\therefore$ $i' = i \times \frac{A/4}{2A} = i/8$

18. Answer (4)

**Hint and Sol.:** Electromagnetic waves are transverse in nature and do not require any medium to travel.

The speed of EM waves vary with medium.

$v_{medium} = \frac{c}{\mu}$

Where $c$ is speed of E.M wave in vacuum and $\mu$ is refractive index of medium.

19. Answer (1)

**Hint:** $c = \frac{1}{\sqrt{\mu_0 \varepsilon_0}}$

**Sol.:** $c = 3 \times 10^8 = \frac{1}{\sqrt{\mu_0 \varepsilon_0}}$

$v = 2 \times 10^8 = \frac{1}{\sqrt{\mu\varepsilon}}$

$\Rightarrow$ $\frac{3}{2} = \sqrt{\mu_r \varepsilon_r}$

Given $\mu_r = 1$

$\Rightarrow \varepsilon_r = \frac{9}{4} = 2.25$

20. Answer (4)

**Hint:** $R = \frac{mv}{qB}$

**Sol.:** $R = \frac{mv}{qB} = \frac{\sqrt{2mk}}{qB}$

$\Rightarrow R = \frac{\sqrt{2m\,qV}}{qB}$

$\Rightarrow 2 = \sqrt{\frac{2\times 6.8\times 10^{-27}\times V}{3.2\times 10^{-19}}}\times\frac{1}{2}$

$\Rightarrow V = 3.8 \times 10^8$ V

21. Answer (3)

**Hint:** For circular current

$B = \frac{\mu_0 i}{2R}$

**Sol.:** $B = \frac{\mu_0 i}{2R} = \left(\frac{\mu_0}{2R}\right)\times\left(\frac{Qv}{2\pi R}\right)$

$\Rightarrow B = \left(\frac{\mu_0}{4\pi}\right)\left(\frac{Qv}{R^2}\right) = \frac{10^{-7}\times 1.6\times 10^{-19}\times 9\times 10^6}{(4\times 10^{-10})^2}$

= 0.9 T

22. Answer (2)

**Hint and Sol.:** Induced electric field due to time varying magnetic field, form closed loops and they are non-conservative in nature.

23. Answer (1)

**Hint:** $\phi = \vec{B}\cdot\vec{A}$ and $|e_{induced}| = \left|\frac{d\phi}{dt}\right|$

**Sol.:** $\phi = B(\pi R^2)$

Now, $e = \frac{d\phi}{dt} = \frac{d(B\pi R^2)}{dt}$

$\Rightarrow e = \pi B\frac{dR^2}{dt} = \pi B(2R)\frac{dR}{dt}$

$= (2\pi B)\,[R_0(1 + t^2)] \times [2R_0 t]$

at $t = 4$,

$\Rightarrow e = 2\pi B(R_0)\,(1 + 16)\,(2R_0 \times 4)$

$= 272\pi B R_0^2$

24. Answer (2)

**Hint:** $e = \frac{d\phi}{dt}$ and $i = \frac{e}{R}$

**Sol.:** $\phi = BA \Rightarrow e = A\frac{dB}{dt}$

$\Rightarrow e = 8 \times 2 \times 0.02 = 0.32$ V

Now, current = $\frac{e}{R} = \frac{0.32}{1} = 0.32$ A

25. Answer (2)

**Hint and Sol.:** As the circular loops are moved away, the magnetic flux in each loop would decrease and thus as per Lenz's law, the current in each loop would increase.

26. Answer (1)

**Hint:** In case of rotation

$e = \frac{B\omega r^2}{2}$

**Sol.:** $e = \frac{B\omega}{2}r^2 = \frac{4\times 4\times (0.2)^2}{2} = 0.32$ V

27. Answer (3)

**Hint:** $\vec{F} = q\vec{E} + q\vec{v}\times\vec{B}$

**Sol.:** As the charged particle experiences no force,

$\vec{F} = q\vec{E} + q\vec{v}\times\vec{B} = 0$

or $\vec{E} = -\vec{v}\times\vec{B} = \vec{B}\times\vec{v}$

28. Answer (2)

**Hint:** $B = \frac{\mu_0 i}{2R}$

**Sol.:** $B_1 = \frac{\mu_0(x)}{2a}$

and $B_2 = \frac{\mu_0(y)}{2b}$

Now, $B_1 - B_2 = 0$

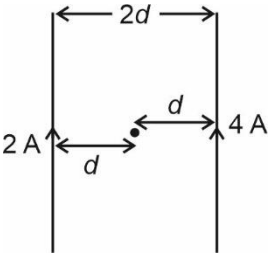
$\Rightarrow \frac{\mu_0 x}{2a} - \frac{\mu_0 y}{2b} = 0$

$\Rightarrow \frac{x}{a} - \frac{y}{b} = 0 \Rightarrow \frac{x}{y} = \frac{a}{b} = \frac{4}{3}$

29. Answer (2)

**Hint:** $B_{(\text{long wire})} = \frac{\mu_0 i}{2\pi R}$

**Sol.:**




$B_1 = \frac{\mu_0(2)}{2\pi(d)}$

$B_2 = \frac{\mu_0(4)}{2\pi d}$

$B_{net} = B_2 - B_1$

$\Rightarrow \quad B_{net} = \frac{\mu_0(2)}{2\pi d}$

$\therefore \quad B_{net} = B_1 = \frac{B_2}{2}$

30. Answer (4)

**Hint:** $|e| = \left|M\frac{di}{dt}\right|$

**Sol.:** $4 = M \times \frac{2}{t} \Rightarrow 4 = 0.45 \times \frac{2}{t}$

$\Rightarrow \quad t = \frac{0.9}{4} = 0.225 \text{ s} = 225 \text{ ms}$

31. Answer (1)

**Hint and Sol.:** Steady current $(i) = \frac{e}{R}$

$= \frac{10}{8}$ A

= 1.25 A

32. Answer (4)

**Hint:** For DC : $i = \frac{V}{R}$

For AC : $i_0 = \frac{V_0}{Z}$

**Sol.:** Case I : DC : $i = \frac{10}{R} = 5$

Case II : AC : $i_{ac} = \frac{10}{Z}$

As minimum value of $Z$ is $R$, thus maximum value of $i_{ac} = \frac{10}{R} = 5$ A. Hence, 6 A is not possible.

33. Answer (4)

**Hint:** Power = $E_{rms}\, I_{rms} \cos\phi$

**Sol.:** $E_{rms} = \frac{E_0}{\sqrt{2}}$

$I_{rms} = \frac{I_0}{\sqrt{2}}$

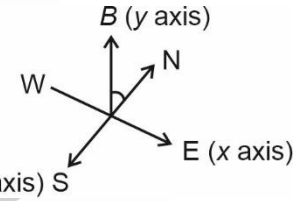
$\phi = \frac{\pi}{2}$

Power = $\left(\frac{E_0}{\sqrt{2}}\right)\left(\frac{I_0}{\sqrt{2}}\right)\cos(\pi/2) = 0$

34. Answer (4)

**Hint:** $\vec{F} = q(\vec{v} \times \vec{B})$

**Sol.:**




$\vec{v} \Rightarrow$ along $\hat{i}$

$\vec{B} \Rightarrow$ along $\hat{j}$

$\therefore \quad \vec{F}$ will be along $\hat{k}$ i.e., southwards.

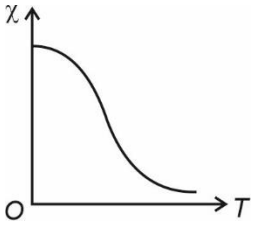
35. Answer (3)

**Hint and Sol.:** For a uniform current carrying long hollow cylinder, magnetic field inside the cylinder (tube) is zero, while outside, it is inversely proportional to the distance from axis of the cylinder.

## SECTION-B

36. Answer (1)

**Hint and Sol.:** For ferromagnetic substances, the susceptibility varies as



37. Answer (1)

**Hint:** Coercivity $(H) = \frac{B}{\mu_0}$

**Sol.:** The bar magnet will be demagnetized if the magnetizing field intensity becomes equal to coercivity in magnitude.

$H = \frac{B}{\mu_0} = ni$

$\Rightarrow$ 4000 = 200 × $i$

$\Rightarrow$ $i$ = 20 A

38. Answer (2)

**Hint and Sol.:** Curie temperature is the temperature above which a ferromagnetic substance becomes paramagnetic.

39. Answer (4)

**Hint:** $\mu_r = 1 + \chi$

**Sol.:** $\mu_r = 1 + \chi$

$\Rightarrow$ $67 = 1 + \chi \Rightarrow \chi = 66$

40. Answer (2)

**Hint:** For DC, $i = \frac{V}{R}$

For AC, $i = \frac{V}{Z}$

**Sol.:** $i_{max} = \sqrt{2}\text{ A} \Rightarrow i_{rms} = i_{ac} = \frac{\sqrt{2}}{\sqrt{2}} = 1\text{ A}$

$i_{dc} = 4\text{ A} = \frac{100}{R} \Rightarrow R = 25\ \Omega$

Now, $i_{ac} = 1\text{ A} = \frac{V}{Z} \Rightarrow Z = 200\ \Omega$

We know, $Z = \sqrt{R^2 + X^2}$

$\Rightarrow$ $X = \sqrt{200^2 - 25^2} = 198.43\ \Omega$

41. Answer (1)

**Hint and Sol.:** $I_E = E_B = I$

$\Rightarrow$ $\frac{I_B}{2} = \frac{I}{2}$

42. Answer (4)

**Hint:** $R = \frac{mv}{qB} = \frac{\sqrt{2mK}}{qB}$

Where $K$ : kinetic energy of charged particle.

**Sol.:** $R_P = \frac{\sqrt{2m(32)}}{eB}$

$R_\alpha = \frac{\sqrt{2(4m)(E)}}{2eB}$

$\Rightarrow$ $R_P = R_\alpha$ (given)

$\Rightarrow$ $E$ = 32 eV

43. Answer (2)

**Hint:** $\vec{F} = i(\vec{l}_{eff} \times \vec{B})$

**Sol.:** For closed loop, effective length is zero.

Thus $F$ = 0

44. Answer (1)

**Hint and Sol.:** $\omega = \frac{qB}{m}$

Thus $\omega$ is independent of speed

$\therefore$ The ratio is 1 : 1

45. Answer (2)

**Hint and Sol.:** At south pole earth's magnetic field lines exit from earth surface. Thus the top end of the pillar will be polarized as north pole.

46. Answer (2)

**Hint:** $B_{end} = \frac{\mu_0 ni}{2}$

**Sol.:** $B_{end} = \frac{\mu_0 ni}{2}$

$= \frac{4\pi \times 10^{-7} \times 300 \times 2}{2} = 0.38\text{ mT}$

47. Answer (2)

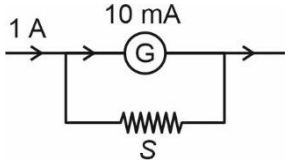
**Hint:** $T = 2\pi\sqrt{\frac{I}{MB}}$

**Sol.:** $T' = 2\pi\sqrt{\frac{I}{4MB}}$

$\frac{T'}{T} = \frac{1}{2} \Rightarrow T' = \frac{T}{2} = 1\text{ s}$

48. Answer (3)

**Hint and Sol.:**




$(10 \times 10^{-3})\ G = (1 - 10 \times 10^{-3})\ S$

$\Rightarrow$ $S = \frac{10 \times 10^{-3} \times 10}{1 - 10 \times 10^{-3}} \approx 0.1\ \Omega$

49. Answer (2)

**Hint:** $|e| = M\left|\frac{di}{dt}\right|$

**Sol.:** $4 = M \times \frac{10}{2} \Rightarrow M = \frac{4}{5} = 0.8\ \text{H}$

50. Answer (4)

**Hint and Sol.:** $V_{source} = \sqrt{V_R^2 + (V_L - V_C)^2}$

$= \sqrt{5^2 + (10-10)^2}$ (Resonance circuit)

= 5 V

# [CHEMISTRY]

## SECTION-A

51. Answer (1)

**Hint:** Dehydrogenation of alcohol takes place

**Sol.:** $R - CH_2 - OH \xrightarrow[\Delta]{Cu} \underset{\text{(Aldehyde)}}{R - CHO} + H_2$

52. Answer (4)

**Hint:** Electron withdrawing group increases the acidic strength of carboxylic acids

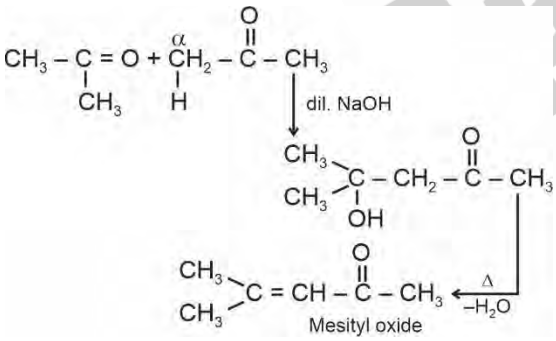
**Sol.:** Order of Acidic strength:

$CCl_3 - COOH > NO_2CH_2 - COOH > C_6H_5 - COOH$

53. Answer (3)

**Hint:** Condensation of two acetone molecules occurs when acetone reacted with dil. NaOH followed by heating

**Sol.:** Aldol condensation reaction

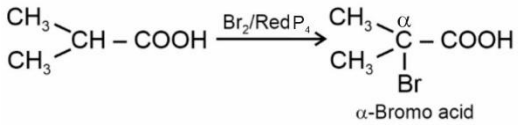



54. Answer (2)

**Hint:** $\alpha$-Halo carboxylic acid is obtained.

**Sol.:** Hell-Volhard-Zelinsky reaction:

$\alpha$-H-atom of acid is replaced by halogen atom during HVZ reaction.




55. Answer (4)

**Hint:** Compounds containing $CH_3 - \overset{O}{\overset{\|}{C}} -$ group on treatment with $I_2$/NaOH gives yellow precipitate of Iodoform.

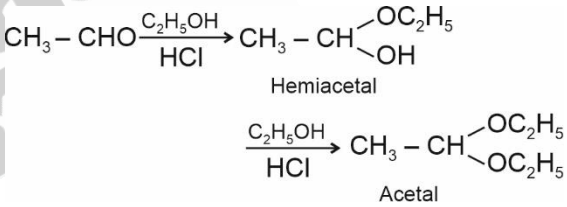
**Sol.:**

| Test Name | $CH_3 - CHO$ | $CH_3COCH_3$ |
|---|---|---|
| Benedict test | Red ppt | × |
| Fehling test | Red ppt | × |
| Tollen's test | Silver mirror | × |
| Iodoform test | Yellow ppt | Yellow ppt |

56. Answer (2)

**Hint:** Gem di-ethers are known as acetal or ketals.

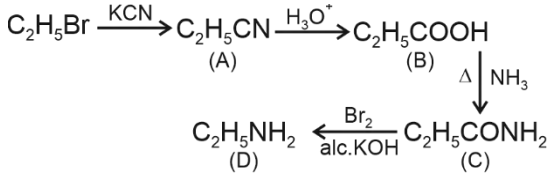
**Sol.:**




57. Answer (3)

**Hint:** Cyanide on hydrolysis gives carboxylic acid which form amide on heating with ammonia

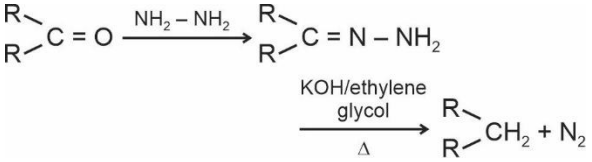
**Sol.:**




58. Answer (4)

**Hint:** Wolff Kishner reduction takes place in basic medium.

**Sol.:** Wolff Kishner reduction.



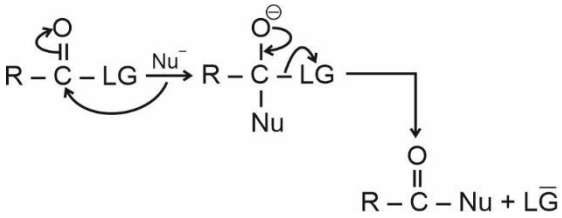
59. Answer (1)

**Hint:** Leaving ability:

$-Cl > -O-\overset{\overset{O}{\|}}{C}-CH_3 > -O-CH_3 > -NH_2$

**Sol.:**

- Hydrolysis of acid derivatives is a $S_N$ reaction.
- More is the leaving ability of leaving group (LG), more will be the rate of reaction.



- Since leaving ability order:

$-Cl > -O-\overset{\overset{O}{\|}}{C}-CH_3 > -O-CH_3 > -NH_2$

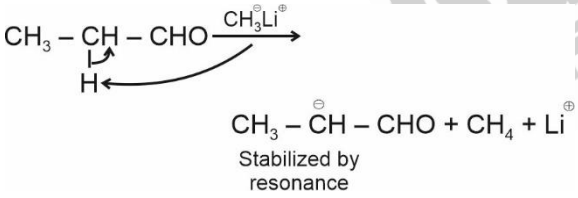
So reactivity order of acid derivatives:

$CH_3COCl > CH_3COOCOCH_3 > CH_3COOCH_3 > CH_3CONH_2$

60. Answer (2)

**Hint:** $\overset{\ominus}{C}H_3\,Li^{\oplus}$ behaves as a base and can abstract an active/acidic H-atom.

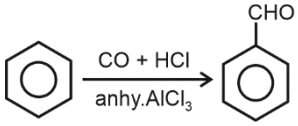
**Sol.:** $\alpha$-H atom(s) of carbonyl compounds is/are acidic in nature so can react with strong base.



61. Answer (3)

**Hint:** In the preparation of benzaldehyde from benzene and (CO + HCl) in presence of anhy. $AlCl_3$, new carbon-carbon bond formation takes place.

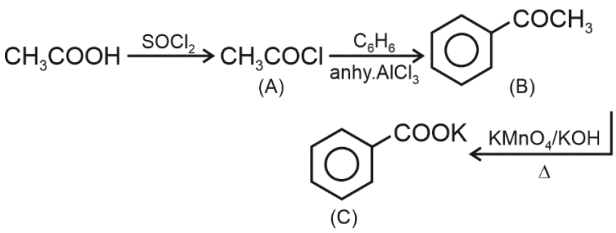
**Sol.:** Gattermann Koch reaction ($S_E$ reaction)



62. Answer (4)

**Hint:** Benzene reacts with acid halides in presence of anhy. $AlCl_3$ to form acetyl benzene.

**Sol.:**



63. Answer (3)

**Hint:** More the electrophilicity of carbonyl carbon, more will be its reactivity towards nucleophile.

**Sol.:**

- Electrophilicity of carbonyl carbon in RCHO and RCOR decreases due to +I effect of R group(s).
- Electrophilicity of carbonyl carbon in benzaldehyde is less as (+)ve charge is delocalized in the benzene ring.
- Hence among given options, HCHO is most reactive towards nucleophile due to maximum electrophilicity of carbonyl carbon.

64. Answer (2)

**Hint:** More the dipole-dipole interactions between the molecules, more will be the boiling point of compound.

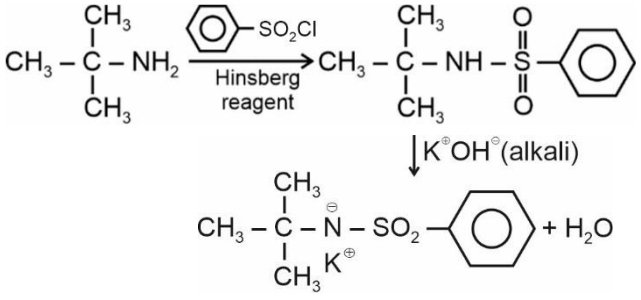
**Sol.:**

| **Compound** | $CH_3CH_2CH_2CH_3$ | $CH_3COCH_3$ | $CH_3CH_2CHO$ | $C_2H_5OCH_3$ |
|---|---|---|---|---|
| **Boiling point(K)** | 273 | 329 | 322 | 281 |

65. Answer (4)

**Hint:** Product of 1°-amine with Hinsberg reagent is alkali soluble.

**Sol.:**



66. Answer (3)

**Hint:** In aqueous solution, the basic nature of an amine

(i) Increases with +I effect of alkyl group.

(ii) Decreases with more size of alkyl group due to less solvation.

**Sol.:** On the basis of I-effect, solvation effect and steric hindrance of ethyl groups in aqueous solution, the basicity order is

$(C_2H_5)_2NH > (C_2H_5)_3N > C_2H_5NH_2$

67. Answer (1)

**Hint:** 1°-amine on reaction with $CHCl_3$ and alc. KOH gives Isocyanide.

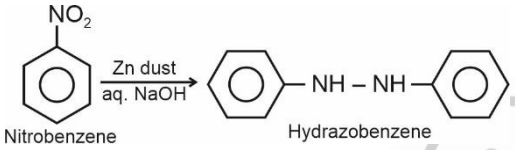
**Sol.:** Carbylamine reaction:

$$CH_3-NH_2 + CHCl_3 + 3KOH \xrightarrow[\text{alc.}]{\Delta} CH_3-NC + 3KCl + 3H_2O$$

68. Answer (2)

**Hint:** Nitrobenzene gives different products in alkaline medium under different conditions.

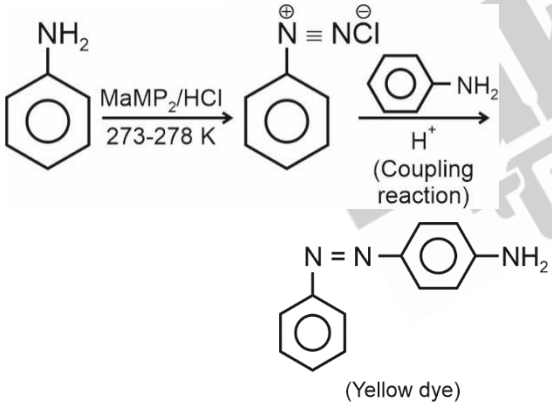
**Sol.:**




69. Answer (2)

**Hint:** Diazonium salts react with aromatic amines to give coloured azo dyes, containing – N = N – group

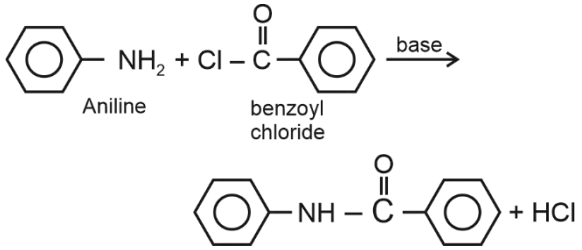
**Sol.:**




70. Answer (2)

**Hint:** Benzoylation of compound having active H-atom.

**Sol.:** Schotten-Baumann reaction:




71. Answer (3)

**Hint:** 1°-amine on reaction with $HNO_2$ gives alcohol.

**Sol.:**

$$\underset{1°-\text{amine}}{CH_3CH_2NH_2} + HNO_2 \rightarrow \underset{\text{alcohol}}{CH_3CH_2OH} + N_2 + H_2O$$

72. Answer (4)

**Hint:** Substituted imines are known as Schiff's base

**Sol.:** $CH_3 - CH = O + \underset{H}{\overset{H}{>}} N - CH_3 \longrightarrow$

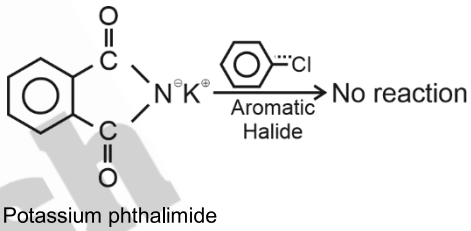
$CH_3 - CH = N - CH_3 + H_2O$

Substituted imine (Schiff's base)

73. Answer (1)

**Hint:** Aromatic-1°-amine can not be prepared by Gabriel phthalimide reaction

**Sol.:**



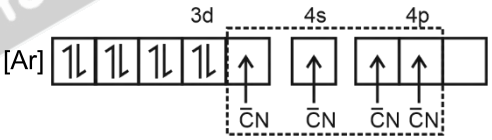

Potassium phthalimide

74. Answer (1)

**Hint:** $CN^-$ is a strong field ligand

**Sol.:** Ni (Z = 28) : [Ar] $3d^8 4s^2$

$[Ni(CN)_4]^{2-} \Rightarrow Ni^{2+}$ :




$\rightarrow dsp^2$ hybridised

$\rightarrow$ Square planar

$\rightarrow$ Diamagnetic

75. Answer (3)

**Hint:** For anionic complex, Fe is named as ferrate.

**Sol.:** $[Fe(CN)_6]^{4-}$ : Hexacyanidoferrate(II) ion

76. Answer (2)

**Hint:** $\Delta_t = \frac{4}{9}\Delta_o$

**Sol.:** $\Delta_t = \frac{4}{9}\Delta_o$

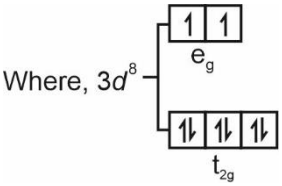
$\therefore \Delta_o = \frac{9}{4}x \text{ cm}^{-1}$

77. Answer (4)

**Hint:** Geometry of given complex is octahedral

**Sol.:** Ni(Z = 28) : [Ar] $3d^8\ 4s^2$

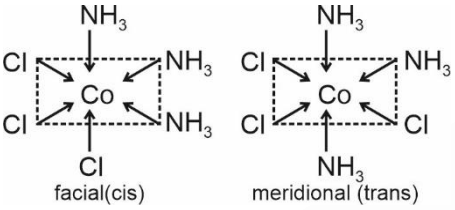
In $[Ni(H_2O)_6]^{2+} \Rightarrow Ni^{2+}$ : [Ar] $3d^8\ 4s^0$




78. Answer (4)

**Hint:** $[Co(NH_3)_3Cl_3]$ is an octahedral complex having a plane of symmetry and has no ambidentate ligand.

**Sol.:** $[Co(NH_3)_3Cl_3]$ show fac-mer isomerism (geometrical isomerism)




79. Answer (4)

**Hint:** CO is $\pi$-acid ligand.

**Sol.:** CO can donate its lone pair to Fe forming $\sigma$ bond and CO can accepts electron from filled *d*-orbital of Fe to its vacant antibonding $\pi^*$ orbital forming $\pi$-bond so $Fe(CO)_5$ is $\sigma$ and $\pi$-bonded complex

80. Answer (2)

**Hint:** $C_2O_4^{2-}$ is a bidentate ligand.

**Sol.:** For $K_3[Co(C_2O_4)_3]$

- Coordination number = 3 × 2 = 6
- Oxidation number of Co = +3

81. Answer (1)

**Hint:** Ligand field strength : $NH_3 > H_2O > Cl^-$

**Sol.:** Complexes having high ligand field strength have more CFSE, so absorb lower wavelength of visible region as $CFSE \propto \frac{1}{\lambda}$

$\therefore$ $[Co(NH_3)_6]^{3+}, [CO(NH_3)_5(H_2O)]^{3+}, [Co(NH_3)_5Cl]^{2+}$

- CFSE decreases
- $\lambda_{absorb}$ increases

82. Answer (3)

**Hint:** Species containing *d*-electrons will show colour.

**Sol.:** $[TiF_6]^{2-} \Rightarrow Ti^{4+}$ : [Ar] $3d^0 4s^0$

No unpaired electron is present, so $[TiF_6]^{2-}$ will be colourless.

83. Answer (3)

**Hint:** Due to small size of Be, it shows more covalent character in its compound.

**Sol.:** BeO can react with both acid and base so amphoteric in nature.

- MgO, BaO and SrO are basic oxides.

84. Answer (1)

**Hint:** Li being very small in size, polarises a large $CO_3^{2-}$ ion to more extent.

**Sol.:** Alkali metal carbonates are quite stable towards heat except $Li_2CO_3$.

$$Li_2CO_3 \xrightarrow{\Delta} Li_2O + CO_2$$

85. Answer (2)

**Hint:** Due to smallest size of $Be^{2+}$ ion, it has highest hydration enthalpy among group 2 elements.

**Sol.:** As the hydration energy decreases, solubility also decreases

$\therefore$ Solubility order: $BeSO_4 > MgSO_4 > CaSO_4$ $BaSO_4$

## SECTION-B

86. Answer (2)

**Hint & Sol.:** Hemihydrate of calcium sulphate $\left(CaSO_4 \cdot \frac{1}{2}H_2O\right)$ is known as plaster of Paris.

87. Answer (4)

**Hint :** Species containing $O_2^-$ are superoxides.

**Sol.:**
- $K^+$ ions are the most abundant cations within cell fluids.
- LiCl is deliquescent in nature and crystallises as a hydrate, $LiCl \cdot 2H_2O$
- Solvay's process is used for the preparation of sodium carbonate in which $NaHCO_3$ is obtained as intermediate.

88. Answer (2)

**Hint:** Spin magnetic moment = $\sqrt{n(n+2)}$ BM

Where, n = number of unpaired electrons.

**Sol.:** $Cr^{3+}$ : $[Ar]3d^3 4s^0$

$\therefore$ Magnetic moment $= \sqrt{3(3+2)} = \sqrt{15}$ BM

89. Answer (1)

**Hint & Sol.:**

| **Element** | Cu | Zn | Mn | Ti |
|---|---|---|---|---|
| **$E°(M^{2+}/M)$** | +0.34 V | –0.76 V | –1.18 V | –1.63 V |

90. Answer (3)

**Hint:** Brass is an alloy of Cu and Zn

**Sol.:** Bronze is an alloy of Cu and Sn.

91. Answer (1)

**Hint:** In faintly alkaline or neutral medium, $MnO_4^-$ acts as a better oxidizing agent.

**Sol.:** In faintly alkaline or neutral medium, $MnO_4^-$ oxidises $I^-$ into $IO_3^-$

$$2MnO_4^- + I^- + H_2O \rightarrow 2MnO_2 + 2OH^- + IO_3^-$$

92. Answer (1)

**Hint:** Higher is the atomic number, smaller will be ionic radii

| **Sol. :** | **Element** | La | Eu | Tb | Yb |
|---|---|---|---|---|---|
| | **Z** | 57 | 63 | 65 | 70 |

Among Ln, as the atomic number increases, size of $Ln^{3+}$ decreases.

Size of $Ln^{3+}$ : $La^{3+} > Eu^{3+} > Tb^{3+} > Yb^{3+}$

93. Answer (4)

**Hint:** Weaker the metallic bonding between metal atoms, lower will be the melting point of metal

**Sol.:** Due to half filled stable $d^5$ configuration, Mn atoms do not form strong metallic bonding between atoms so their melting point is exceptionally low.

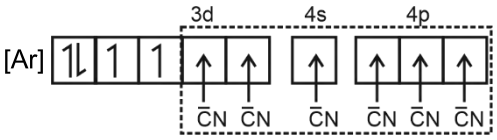
Melting point : Cr > Ti > Ni > Mn

94. Answer (1)

**Hint:** In $[Mn(CN)_6]^{3-}$ pairing of only one electron take place.

**Sol.:** $Mn^{3+}$ : $[Ar]3d^4 4s^0$

In $[Mn(CN)_6]^{3-} \Rightarrow Mn^{3+}$ :




- $d^2sp^3$ hybridised
- Inner orbital complex
- 2 unpaired electrons
- Homoleptic complex

95. Answer (3)

**Hint:** Growth of tumours can be inhibited by some complexes of platinum.

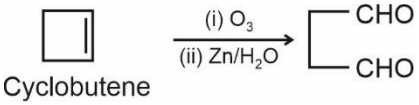
**Sol.:**

- $[(Ph_3P)_3RhCl]$ is used as catalyst for hydrogenation of alkenes (Wilkinson's catalyst)
- Hypo solution dissolves the undecomposed AgBr in photography.
- cis – $[PtCl_2(NH_3)_2]$ is used as anticancer agent
- $Na_2EDTA$ is used to measure the hardness of water.

96. Answer (3)

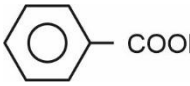
**Hint:** $\underset{R}{\overset{R}{>}}C \equiv CH - R \xrightarrow[(ii)\ Zn/H_2O]{(i)\ O_3} R - \underset{\underset{O}{\|}}{C} - R + R - CHO$ (Ketone, Aldehyde)

**Sol.:** • $\underset{\text{But-1-ene}}{CH_3 - CH_2 - CH = CH_2} \xrightarrow[(ii)\ Zn/H_2O]{(i)\ O_3} CH_3CH_2CHO + HCHO$

-  Cyclobutene $\xrightarrow[(ii)\ Zn/H_2O]{(i)\ O_3}$ 
- $\underset{\text{Isobutylene}}{\overset{CH_3}{\underset{CH_3}{>}}C = CH_2} \xrightarrow[(ii)\ Zn/H_2O]{(i)\ O_3} \underset{\underset{\text{Acetone}}{\underset{\|}{O}}}{CH_3 - C - CH_3} + HCHO$
- $\underset{\text{But-2-ene}}{CH_3 - CH = CH - CH_3} \xrightarrow[(ii)\ Zn/H_2O]{(i)\ O_3} 2CH_3 - CHO$

97. Answer (4)

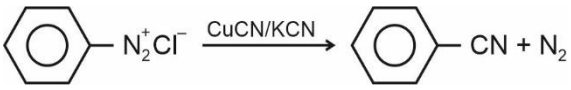
**Hint:** Compounds having more acidic strength than carbonic acid are soluble in aqueous solution of $NaHCO_3$

**Sol.:**  $\xrightarrow{NaHCO_3}$  $+ H_2O + CO_2$

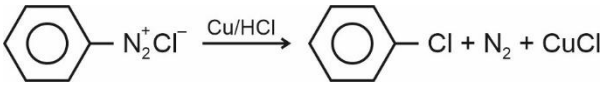
98. Answer (2)

**Hint:** Aryl halides can be prepared by Gattermann reaction.

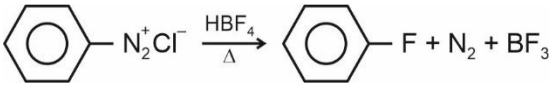
**Sol.:** Sandmeyer reaction :




Gattermann reaction :




Balz Schiemann reaction :




99. Answer (2)

**Hint:** Half filled $t_{2g}^3$ and $d^5$ configurations have extra stability.

**Sol.:**
- Because of large number of unpaired electrons in the atoms of transition elements they have stronger interatomic interaction and hence strong bonding between atoms resulting in higher enthalpies of atomisation.
- $Cr^{2+}$ is reducing as its configuration changes from $d^4$ to $d^3$, the latter having a half filled $t_{2g}$ level. On the other hand, the changes from $Mn^{3+}$ to $Mn^{2+}$ results in the half filled ($d^5$) configuration which has extra stability.

100. Answer (2)

**Hint:** Complex with chelating ligands have extra stability.

**Sol.:** Due to ring formation by $C_2O_4^{2-}$ ligand (didentate) $[Fe(C_2O_4)_3]^{3-}$ is more stable complex.

# [BOTANY]

## SECTION-A

101. Answer (2)

**Sol.:** The numbers of bases is $4.6 \times 10^6$ bp so the total length comes out to be $0.34 \times 10^{-9}$ m $\times$ $4.6 \times 10^6$

= 1.564 mm.

102. Answer (1)

**Hint:** Replication is the process by which a double stranded DNA molecule is copied to produce two identical DNA molecules.

**Sol.:** Unwinding (or opening) of double helical parental DNA is brought about by enzyme helicase, which is ATP dependent.

103. Answer (4)

**Hint:** A polynucleotide chain has N-glycosidic and phosphodiester linkage in it.

**Sol.:**
- Heterochromatin is transcriptionally inactive region in chromatin
- Cytosine pairs with guanine through three hydrogen bonds in a double stranded DNA
- The two strands of DNA run in anti-parallel fashion with 5′ $\rightarrow$ 3′ polarity in one and 3′ $\rightarrow$ 5′ polarity in other.

104. Answer (2)

**Hint:** In DNA replication, the synthesis of primer strand serves as stepping stone to start errorless replication

**Sol.:**
- DNA ligase joins two discontinuously synthesized DNA fragments during DNA replication
- RNA polymerase I synthesizes 28 S rRNA
- DNA dependent DNA polymerase catalyses polymerization only in one direction, i.e., 5′ $\rightarrow$ 3′

105. Answer (3)

**Hint:** UTRs are additional sequences present on mRNA which are not translated.

**Sol.:** UTRs are present at both 5′ end before start codon and 3′-end after stop codon.

106. Answer (4)

**Sol.:** Altmann found nuclein to be acidic in nature and named it nucleic acid.

107. Answer (1)

**Hint:** The codon is read on mRNA without any punctuation.

**Sol.:** The codon is read in mRNA on a contiguous fashion. It reflects commaless nature of genetic code.

108. Answer (4)

**Hint:** Streptokinase is modified by genetic engineering and used as 'clot buster'

**Sol.:**
- Protease helps in clarifying fruit juices.
- Statins have been commercialised as blood cholesterol lowering agent.
- Amylase degrades starch.

109. Answer (3)

**Hint:** Mycorrhiza is the symbiotic association of fungi with roots of higher plants.

**Sol.:** Plants with mycorrhizal association show resistance to root borne pathogens, tolerance to salinity and drought. In return, fungi gets shelter and food from this association.

110. Answer (1)

**Hint:** In endomycorrhiza, fungi usually belong to zygomycetes.

**Sol.:** In ectomycorrhiza, fungi usually belong to basidiomycetes

111. Answer (1)

**Hint:** hnRNA is precursor of mRNA.

**Sol.:** The nascent RNA synthesized by RNA polymerase II is called hnRNA or primary transcript.

112. Answer (3)

**Hint:** Central Dogma of Molecular biology explains one way or unidirectional flow of information from master copy DNA to working copy RNA and from RNA to building molecule or trait expressing molecule polypeptide.

**Sol.:** During replication both the strands act as template DNA

Reverse transcription, translation and transcription do not require two strands of DNA.

113. Answer (1)

**Hint:** The strand with polarity $5' \rightarrow 3'$ (Coding strand) in DNA has the sequence same as RNA, except thymine at the place of uracil.

**Sol.:**

5′ T T G A C C T T A 3′ Coding strand

3′ A A C T G G A A T 5′ Template strand

↓Transcription

5′ U U G A C C U U A 3′ mRNA

114. Answer (2)

**Hint:** NPV have species-specific, narrow spectrum insecticidal application.

**Sol.:** NPV have no negative impacts on plants, mammals, birds, fishes or even on non-target insects.

115. Answer (4)

**Hint:** Cytidine is a RNA nucleoside

**Sol.:** Cytidine contains cytosine and ribose sugar, which is linked with bases through N-glycosidic linkage.

116. Answer (2)

**Sol.:** The science of Bioinformatics was developed during the period of HGP.

117. Answer (1)

**Hint:** The size of VNTR varies from 0.1 to 20 kb.

**Sol.:** VNTRs are minisatellite.

118. Answer (4)

**Hint:** In RNA, uracil replaces thymine.

**Sol.:** According to given question;

C T A T G DNA sequence

G A U A C RNA sequence

119. Answer (2)

**Hint:** Number of phosphodiester bond for a single stranded linear DNA = N–1 [N = numbers of nucleotides]

**Sol.:** Here N – 1 = 1000 – 1 = 999

120. Answer (3)

**Sol.:** In human genome, the average gene consists of 3000 bases.

121. Answer (4)

**Hint:** According to Chargaff's rule; in a double stranded DNA; A = T and G = C

**Sol.:** A = T $\rightarrow$ 32 + 32 = 64%

Thus, G = C $\rightarrow$ (100 – 64) = 36%

$\therefore$ G = 18%

122. Answer (4)

**Hint:** The information of building a polypeptide present on RNA is read in group of three nucleotides called codon.

**Sol.:** Each set of three bases codes for an amino acid, which is then assembled into a polypeptide chain.

123. Answer (4)

**Hint:** Leading strand is produced on the template DNA with polarity 3′ $\rightarrow$ 5′.

**Sol.:**

- The leading strand of DNA is synthesized continuously in 5′ $\rightarrow$ 3′ direction.
- DNA polymerase is used to synthesize DNA on both leading and lagging strands.
- Lagging strand is synthesized simultaneously with leading strand.

124. Answer (2)

**Hint:** Flocs help to reduce the BOD of sewage during secondary treatment.

Secondary treatment is also called biological treatment.

**Sol.:** Flocs are masses of aerobic heterotrophic bacteria associated with fungal filaments to from mesh like structure.

125. Answer (1)

**Hint:** Primary treatment is a physical process which involves removal of large and small particles from sewage through filtration and sedimentation.

**Sol.:** During physical process of sewage treatment, all solids that settle forms the primary sludge and the supernatant forms the primary effluent.

126. Answer (4)

**Hint:** The ministry of environment and forests has initiated Ganga Action plan (1985) and Yamuna Action Plan to save these major rivers of our country from pollution.

**Sol.:** The technology of biogas production was developed in India mainly due to the efforts of India Agricultural Research Institute (IARI) and Khadi and Village Industries Commission (KVIC).

127. Answer (4)

**Hint:** Methanogens produce mixture of gases termed as biogas.

**Sol.:** When methanogens grow anaerobically on cellulosic material, they produce methane, $CO_2$, $H_2$ and $H_2S$.

128. Answer (1)

**Hint:** Relative contribution of various gases in biogas are:

$CH_4$ $\rightarrow$ 50-70%; $CO_2$ $\rightarrow$ 30-40%; $H_2$ and $H_2S$ $\rightarrow$ 10%

**Sol.:** Major component of biogas is methane.

129. Answer (2)

**Hint:** Single cell protein is protein-rich biomass which is used as food or feed.

**Sol.:** SCP is rich in good quality protein and poor in fats.

130. Answer (3)

**Hint:** Meristem (axillary or apical) is free of virus due to high concentration of auxins and rapid rate of cell division.

**Sol.:** Recovery of the healthy plants from diseased plants is possible by meristem culture.

131. Answer (3)

**Hint:** Somatic hybrid cell is obtained by somatic hybridisation.

**Sol.:** During somatic hybridization, plant cells are first treated with pectinase and cellulase to obtain naked protoplast. These naked protoplasts are fused further to obtain a somatic hybrid cell.

132. Answer (4)

**Sol.:** Selection and testing of superior recombinants is the crucial step for the success of breeding experiment.

133. Answer (1)

**Hint:** Statins have been commercialised as blood cholesterol lowering agent.

**Sol.:** Cyclosporin A is used as an immunosuppressive agent in organ-transplant patients.

134. Answer (4)

**Hint:** Ladybird and dragonflies are biocontrol agents.

**Sol.:** *Aulosira* and *Anabaena* are important biofertilizers.

135. Answer (1)

**Hint:** *Lactobacillus* grow in milk and convert it into curd.

**Sol.:** Following are the microbes which are employed in production of various products:

*Aspergillus niger* - Citric acid

*Acetobacter aceti* - Acetic acid

*Clostridium butylicum* - Butyric acid

**SECTION-B**

136. Answer (1)

**Hint:** Lactic acid bacteria grow in milk and convert it into curd.

**Sol.:** Curd is more nutritious than milk as it contains a number of vitamins especially $B_{12}$.

137. Answer (1)

**Hint:** Toddy, Roquefort cheese and Camembert cheese are obtained by fermenting activity of fungi.

**Sol.:** Idli is fermented preparation of rice and black gram, prepared by using bacteria.

138. Answer (2)

**Hint:** Bread is prepared from dough which is fermented using baker's yeast.

**Sol.:** Puffed-up appearance of dough during bread making is due to production of $CO_2$ during fermentation.

139. Answer (2)

**Hint:** The concentration of alcohol in beverages that are naturally fermented is less.

**Sol.:**

- Wine and beer are produced without distillation (Low alcohol concentration)
- Whisky, brandy and rum are produced by distillation of fermented broth (high alcohol concentration)

140. Answer (2)

**Hint:** Antibiotics means 'pro life' in context of human beings.

**Sol.:** Antibiotics means 'against life' in context of disease causing organisms.

141. Answer (4)

**Hint:** *Saccharum officinarum* did not grow well in North India.

**Sol.:** *Saccharum officinarum*; a tropical cane grow well in South India.

142. Answer (1)

**Hint:** Germplasm is the building material out of which improved varieties are constructed.

**Sol.:** Germplasm collection refers to collection of genetic variability. It is the backbone or root of any breeding programme.

143. Answer (1)

**Sol.:** Pusa komal is bred by hybridisation and selection for resistance to bacterial blight is a variety of cowpea.

144. Answer (2)

**Sol.:**

- Pusa Gaurav, Pusa Sem 2 and Pusa Sem 3 are resistant to aphids
- Pusa Sawani is resistant to shoot & fruit borer.

145. Answer (2)

**Hint:** Tomato and mustard are vitamin C enriched.

**Sol.:** Carrot, pumpkin, and spinach are vitamin A enriched vegetable crops developed by IARI.

146. Answer (4)

**Hint:** According to Erwin Chargaff, for a double stranded DNA, the ratios between adenine and thymine and guanine and cytosine are constant and equal to one.

**Sol.:** In a double stranded DNA; $\frac{A}{T}=1$ and $\frac{G}{C}=1$

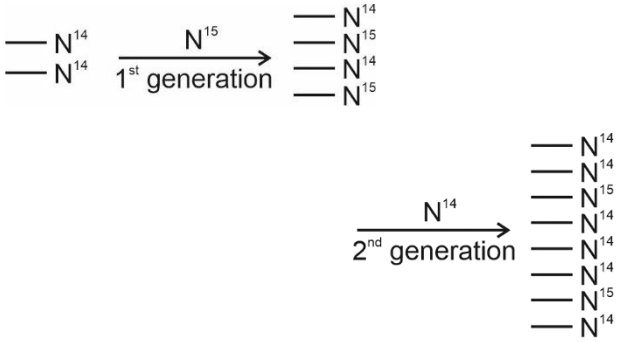
similarly; $\frac{A+C}{T+G}=1, \frac{G+T}{A+C}=1, \frac{A+G}{T+C}=1.$

Hence, $\frac{G+C}{A+T}$ is not equal to unity.

147. Answer (4)

**Hint:** DNA replication is semi-conservative

**Sol.:** According to given question;




In 1st generation;

Hybrid DNA = 100%

In 2nd generation;

Light DNA = 50%, Hybrid DNA = 50%

148. Answer (2)

**Sol.:** Taylor *et. al.* have proved semiconservative mode of chromosome replication in eukaryotes using $^{3}H$– thymidine in roots of *Vicia* faba (Faba beans).

149. Answer (4)

**Hint:** Regulator gene controls the activity of operator gene

**Sol.:**
- Operator gene receives the product of regulator gene.
- Promoter gene provides attachment site for RNA polymerase
- Structural gene transcribes mRNA for polypeptide synthesis

150. Answer (1)

**Hint:** Polycistronic gene codes for more than one polypeptides.

**Sol.:** Prokaryotic structural gene is polycistronic while, eukaryotic structural gene is monocistronic.

# [ZOOLOGY]

## SECTION-A

151. Answer (3)

**Hint:** Phenomenon exhibited by normal cells

**Sol.:** Cancerous cells exhibit metastasis and malignancy. The phenomenon named contact inhibition is exhibited by normal cells of the body in which, the dividing cells when come in contact with other cells, inhibit their uncontrolled growth but cancer cells do not have this property.

152. Answer (2)

**Hint:** Similar to ATS

**Sol.:** Anti-venom is included in artificial passive immunity. Example of natural passive immunity is transfer of IgG to foetus through placenta.

153. Answer (4)

**Hint:** Contains lysozymes

**Sol.:** Macrophages and NK cells are included in cellular barriers of innate immunity, whereas mucus coating of the epithelium lining the respiratory tract is included in physical barriers of innate immunity.

154. Answer (3)

**Hint:** Antibodies which can cross the placenta

**Sol.:** IgA is present in mucus coating and in colostrum. IgG are the smallest antibodies and can cross the placenta thereby confer immunity to the foetus.

155. Answer (2)

**Hint:** Known for their effect on cardiovascular system of the body.

**Sol.:** Cannabinoids are obtained from hemp plant (*Cannabis sativa*) and smack is obtained by chemical acetylation of morphine.

156. Answer (3)

**Hint:** Infective stage of *Plasmodium* for humans

**Sol.:** *Plasmodium* reproduces asexually in liver cells and RBCs of human host. Gametocytes are formed in human RBCs. Fertilisation takes place in lumen of stomach of mosquito. Mature infective stages (sporozoites) escape from gut and migrate to the mosquito's salivary glands.

157. Answer (1)

**Hint:** Rhinovirus affects upper respiratory tract.

**Sol.:** Only macrophages act like HIV factor. In pneumonia, alveoli of the lungs get filled with fluid leading to severe problems in respiration.

158. Answer (4)

**Hint:** Become mature in bone marrow

**Sol.:** B-lymphocytes are associated with humoral immunity whereas, T-lymphocytes are associated with both cell mediated and humoral immunity.

159. Answer (2)

**Hint:** Does not include CNS depressant drugs.

**Sol.:** Marijuana, *Datura* seeds and Atropine show hallucinogenic properties. Benzodiazepines and barbiturates are included in the category of sedatives and tranquilisers.

160. Answer (2)

**Hint:** Diseases of GIT

**Sol.:** Filariasis is a vector-borne disease transmitted to a healthy person through the bite of infected female *Culex* (mosquito). Amoebic dysentery, typhoid, ascariasis spread by contaminated food and water.

161. Answer (4)

**Hint:** Causes paralysis of skeletal muscles

**Sol.:** Polio spreads mainly through intestinal discharges *via* contaminated food and water. The other diseases which are given are examples of vector transmitted diseases.

162. Answer (3)

**Hint:** Combat the allergic reaction

**Sol.:** Allergy is caused by chemicals like histamine and serotonin which are released by mast cells. Eosinophils combat the allergic reactions. The use of antihistamine, adrenaline and steroids quickly reduce the symptoms of allergy.

163. Answer (1)

**Hint:** Reproductive fitness

**Sol.:** In natural selection, the allelic frequency changes from generation to generation. The natural selection may be due to anthropogenic actions.

164. Answer (3)

**Hint:** *Australopithecus* is known as ape-man.

**Sol. :**

| | | |
|---|---|---|
| *Homo habilis* | – | First human like being- the hominid |
| *Homo erectus* | – | First hominid who used fire |
| *Australopithecus* | – | Connecting link between apes and man |
| *Homo sapiens neanderthalensis* | – | Buried their deads |

165. Answer (2)

**Hint:** Tigers in Bengal is an example of it.

**Sol.:** Change in gene frequency by chance in a small scale population is called genetic drift.

Bottle neck effect is included in genetic drift.

166. Answer (1)

**Hint:** Devoid of electrodes

**Sol.:** In Miller's experiment, the control apparatus was devoid of an energy source.

167. Answer (2)

**Hint:** The body attacks self-cells

**Sol.:** In an auto-immune disease, the immune system lost the power of discriminationbetween self and non-self.

168. Answer (1)

**Hint:** Eukaryotic organism

**Sol.:** Hepatitis B vaccine is an example of second generation vaccine. It is produced by recombinant DNA technology using yeast.

169. Answer (3)

**Hint:** Granulocytes are not involved.

**Sol.:** Primary and secondary immune responses are carried out with the help of B-lymphocytes and T-lymphocytes.

170. Answer (2)

**Hint:** 50% of all individuals

**Sol.:** In the question, p is 0.5.

According to Hardy-Weinberg equilibrium, $p + q = 1$

So, q = (1 – 0.5) = 0.5

So, frequency of heterozygotes = 2pq = 2 × 0.5 × 0.5 = 0.5

171. Answer (3)

**Hint:** Opposite to each other

**Sol.:** Variations are small and directional as per Darwin, whereas variations are large and directionless as per Hugo de Vries.

172. Answer (2)

**Hint:** Results into homologous organs

**Sol.:** Australian marsupials represent adaptive radiation or divergent evolution. In the diagram, we can see different species of marsupials which differ from each other in morphology and other features and these differences are due to the adaptations to different environments.

173. Answer (2)

**Hint:** Represents convergent evolution

**Sol.:** Excretory organs in earthworm and cockroach are examples of analogous organs as they are not similar anatomically though they perform similar functions. Rest of the given options are examples of homologous organs.

174. Answer (1)

**Hint:** Non-cellular form of life

**Sol.:**
- In the solar system of the Milky way galaxy, earth was supposed to have been formed about 4.5 billion years back.
- Non-cellular forms of life originated about 3 billion years ago.
- The first cellular forms of life did not possibly originate till about 2000 million years ago.
- Darwin's finches represent the phenomenon of adaptive radiation.
- Industrial melanism is an example of natural selection.

175. Answer (4)

**Hint:** Theory of chemical evolution

**Sol.:** Oparin of Russia and Haldane of England proposed that the first form of life could have come from pre-existing non-living organic molecules (e.g., RNA, protein, etc.) and that formation of life was preceded by chemical evolution.

176. Answer (4)

**Hint:** Dicotyledons evolved from them.

**Sol.:** Seed ferns evolved from Progymnosperms while ferns, ginkgos and conifers have evolved from Psilophyton directly.

177. Answer (3)

**Hint:** Therapsids evolved from Pelycosaurs.

**Sol.:** Early reptiles → Synapsids → Pelycosaurs → Therapsids → Mammals

178. Answer (2)

**Hint:** Ice age

**Sol.:** Modern *Homo sapiens* arose between 75,000-10,000 years ago. Agriculture came around 10,000 years back and human settlement started. Pre-historic cave art developed about 18,000 years ago.

179. Answer (3)

**Hint:** Change in gene pool.

**Sol.:** When migration of a section of population to another place and population occurs, gene frequencies change in the original as well as in the new population.

180. Answer (4)

**Hint:** Process which occurs at the time of gametes formation

**Sol.:** A population remains in genetic equilibrium if mating is random, mutations, natural selection and genetic recombination are absent.

181. Answer (4)

**Hint:** Involves intensive breeding

**Sol.:** Antibiotics resistant bacteria, DDT resistant mosquitoes and herbicide resistant weeds are examples of evolution by natural selection whereas, disease resistance in plants by selective mating is an example of evolution by selective mating (Artificial selection).

182. Answer (3)

**Hint:** Worked in Malay Archipelago

**Sol.:** Alfred Wallace did not give the theory of panspermia or cosmozoa.

183. Answer (2)

**Hint:** Theory of biogenesis

**Sol.:** Our earth originated about 4.5 billion years ago. Louis Pasteur gave the theory of biogenesis. Big bang theory attempts to explain the origin of universe.

184. Answer (1)

**Hint:** Photosynthesis occurs in them

**Sol.:** First organisms that invaded land were plants.

185. Answer (1)

**Hint:** Site of erythropoiesis

**Sol.:** Maturation of B-lymphocytes occurs in bone marrow.

## SECTION-B

186. Answer (4)

**Hint:** Function of thymus

**Sol.:** MALT is an example of secondary lymphoid tissue and it is associated with acquired immunity. Maturation of T-lymphocytes occur in thymus.

187. Answer (3)

**Hint:** Technique which accurately detect pathological and physiological changes in body

**Sol.:** MRI (Magnetic resonance imaging) uses strong magnetic fields and non-ionising radiations to accurately detect pathological and physiological changes in the living tissue.

188. Answer (3)

**Hint:** Included in immunotherapy

**Sol.:** $\alpha$-interferons are included in biological response modifiers which activate the immune system and help in destroying tumor(s) in the cancer patients.

189. Answer (3)

**Hint:** From periods of mesozoic era to periods of paleozoic era.

**Sol.:** Cretaceous $\rightarrow$ Triassic $\rightarrow$ Permian $\rightarrow$ Silurian

190. Answer (2)

**Hint:** Process which requires chlorophyll

**Sol.:** By the process of photosynthesis, oxygen evolved and atmosphere became oxidising.

191. Answer (2)

**Hint:** Process which is non-directional

**Sol.:** The source of a new allele is mutation. Genetic drift causes change in the gene frequency by chance in a small population.

192. Answer (4)

**Hint:** Reproductive fitness

**Sol.:** As per Darwin, fitness refers to reproductive fitness. The organisms which reproduce to produce more progeny and makes a higher contribution to the gene pool are selected by nature.

193. Answer (1)

**Hint:** More close to humans compared to other apes

**Sol.:** The skull of baby chimpanzee is more like an adult human skull than adult chimpanzee skull. It shows that chimpanzee is our close relative.

194. Answer (1)

**Hint:** Period of Paleozoic era

**Sol.:** Arborescent lycopods were dominant during early Paleozoic era, but most of them became extinct in the Permian period of Paleozoic era.

195. Answer (3)

**Hint:** Synonyms

**Sol.:** Convergent evolution resulted in the origin of similar looking members in two different types of mammals (marsupials and placentals). Flying phalanger shows convergent evolution with flying squirrel.

196. Answer (2)

**Hint:** Theory of natural selection

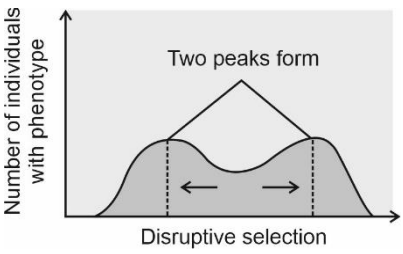
**Sol.:** Branching descent and natural selection are the two key concepts of theory of 'Natural selection' which was given by Darwin.

- Lamarckism is often called the "Theory of inheritance of acquired characters".
- Hugo de Vries proposed the mutation theory.

197. Answer (3)

**Hint:** Decline in individuals with mean character value

**Sol.:**



198. Answer (3)

**Hint:** Occurs in retroviruses

**Sol.:** The enzyme reverse transcriptase is responsible for replication of HIV genome in macrophages.

199. Answer (3)

**Hint:** Heaviest antibody

**Sol.:** IgA – 4 paratopes

IgG – 2 paratopes

IgE – 2 paratopes

IgM – 10 paratopes

200. Answer (1)

**Hint:** Spreads by contaminated food and water

**Sol.:** *Entamoeba histolytica* is a parasite of large intestine of human.

It causes amoebic dysentery/amoebiasis. Housefly acts as mechanical carrier and serves to transmit the parasite from faeces of infected person to food and food products, thereby contaminating them.

❑ ❑ ❑

# All India Aakash Test Series for NEET-2022

## TEST - 6 (Code-F)

**Test Date : 17/04/2022**

## ANSWERS

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

# HINTS & SOLUTIONS

## [PHYSICS]

### SECTION-A

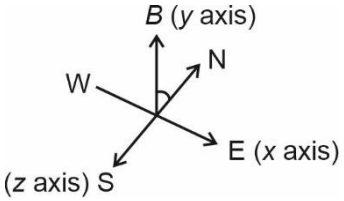
1. Answer (3)

**Hint and Sol.:** For a uniform current carrying long hollow cylinder, magnetic field inside the cylinder (tube) is zero, while outside, it is inversely proportional to the distance from axis of the cylinder.

2. Answer (4)

**Hint:** $\vec{F} = q(\vec{v} \times \vec{B})$

**Sol.:**




$\vec{v} \Rightarrow$ along $\hat{i}$

$\vec{B} \Rightarrow$ along $\hat{j}$

$\therefore$ $\vec{F}$ will be along $\hat{k}$ i.e., southwards.

3. Answer (4)

**Hint:** Power = $E_{rms}\, I_{rms} \cos\phi$

**Sol.:** $E_{rms} = \dfrac{E_0}{\sqrt{2}}$

$I_{rms} = \dfrac{I_0}{\sqrt{2}}$

$\phi = \dfrac{\pi}{2}$

Power = $\left(\dfrac{E_0}{\sqrt{2}}\right)\left(\dfrac{I_0}{\sqrt{2}}\right)\cos(\pi/2) = 0$

4. Answer (4)

**Hint:** For DC : $i = \dfrac{V}{R}$

For AC : $i_0 = \dfrac{V_0}{Z}$

**Sol.:** Case I : DC : $i = \dfrac{10}{R} = 5$

Case II : AC : $i_{ac} = \dfrac{10}{Z}$

As minimum value of $Z$ is $R$, thus maximum value of $i_{ac} = \dfrac{10}{R} = 5$ A. Hence, 6 A is not possible.

5. Answer (1)

**Hint and Sol.:** Steady current $(i) = \dfrac{e}{R}$

$= \dfrac{10}{8}$ A

= 1.25 A

6. Answer (4)

**Hint:** $|e| = \left|M\dfrac{di}{dt}\right|$

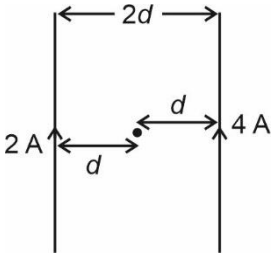
**Sol.:** $4 = M \times \dfrac{2}{t} \Rightarrow 4 = 0.45 \times \dfrac{2}{t}$

$\Rightarrow$ $t = \dfrac{0.9}{4} = 0.225$ s = 225 ms

7. Answer (2)

**Hint:** $B_{(\text{long wire})} = \dfrac{\mu_0 i}{2\pi R}$

**Sol.:**




$B_1 = \dfrac{\mu_0(2)}{2\pi(d)}$

$B_2 = \dfrac{\mu_0(4)}{2\pi d}$

$B_{net} = B_2 - B_1$

$\Rightarrow$ $B_{net} = \dfrac{\mu_0(2)}{2\pi d}$

$\therefore$ $B_{net} = B_1 = \dfrac{B_2}{2}$

8. Answer (2)

**Hint:** $B = \frac{\mu_0 i}{2R}$

**Sol.:** $B_1 = \frac{\mu_0 (x)}{2a}$

and $B_2 = \frac{\mu_0 (y)}{2b}$

Now, $B_1 - B_2 = 0$

$\Rightarrow \quad \frac{\mu_0 x}{2a} - \frac{\mu_0 y}{2b} = 0$

$\Rightarrow \quad \frac{x}{a} - \frac{y}{b} = 0 \Rightarrow \frac{x}{y} = \frac{a}{b} = \frac{4}{3}$

9. Answer (3)

**Hint:** $\vec{F} = q\vec{E} + q\vec{v} \times \vec{B}$

**Sol.:** As the charged particle experiences no force,

$\vec{F} = q\vec{E} + q\vec{v} \times \vec{B} = 0$

or $\vec{E} = -\vec{v} \times \vec{B} = \vec{B} \times \vec{v}$

10. Answer (1)

**Hint:** In case of rotation

$e = \frac{B\omega r^2}{2}$

**Sol.:** $e = \frac{B\omega}{2} r^2 = \frac{4 \times 4 \times (0.2)^2}{2} = 0.32 \text{ V}$

11. Answer (2)

**Hint and Sol.:** As the circular loops are moved away, the magnetic flux in each loop would decrease and thus as per Lenz's law, the current in each loop would increase.

12. Answer (2)

**Hint:** $e = \frac{d\phi}{dt}$ and $i = \frac{e}{R}$

**Sol.:** $\phi = BA \Rightarrow e = A\frac{dB}{dt}$

$\Rightarrow \quad e = 8 \times 2 \times 0.02 = 0.32 \text{ V}$

Now, current = $\frac{e}{R} = \frac{0.32}{1} = 0.32 \text{ A}$

13. Answer (1)

**Hint:** $\phi = \vec{B} \cdot \vec{A}$ and $|e_{\text{induced}}| = \left|\frac{d\phi}{dt}\right|$

**Sol.:** $\phi = B(\pi R^2)$

Now, $e = \frac{d\phi}{dt} = \frac{d(B\pi R^2)}{dt}$

$\Rightarrow \quad e = \pi B \frac{dR^2}{dt} = \pi B(2R)\frac{dR}{dt}$

$= (2\pi B)\,[R_0(1 + t^2)] \times [2R_0 t]$

at $t = 4$,

$\Rightarrow \quad e = 2\pi B(R_0)\,(1 + 16)\,(2R_0 \times 4)$

$= 272\pi B R_0^2$

14. Answer (2)

**Hint and Sol.:** Induced electric field due to time varying magnetic field, form closed loops and they are non-conservative in nature.

15. Answer (3)

**Hint:** For circular current

$B = \frac{\mu_0 i}{2R}$

**Sol.:** $B = \frac{\mu_0 i}{2R} = \left(\frac{\mu_0}{2R}\right) \times \left(\frac{Qv}{2\pi R}\right)$

$\Rightarrow \quad B = \left(\frac{\mu_0}{4\pi}\right)\left(\frac{Qv}{R^2}\right) = \frac{10^{-7} \times 1.6 \times 10^{-19} \times 9 \times 10^6}{(4 \times 10^{-10})^2}$

$= 0.9 \text{ T}$

16. Answer (4)

**Hint:** $R = \frac{mv}{qB}$

**Sol.:** $R = \frac{mv}{qB} = \frac{\sqrt{2mk}}{qB}$

$\Rightarrow \quad R = \frac{\sqrt{2m\,qV}}{qB}$

$\Rightarrow \quad 2 = \sqrt{\frac{2 \times 6.8 \times 10^{-27} \times V}{3.2 \times 10^{-19}}} \times \frac{1}{2}$

$\Rightarrow \quad V = 3.8 \times 10^8 \text{ V}$

17. Answer (1)

**Hint:** $c = \frac{1}{\sqrt{\mu_0 \varepsilon_0}}$

**Sol.:** $c = 3\times10^8 = \frac{1}{\sqrt{\mu_0 \varepsilon_0}}$

$v = 2\times10^8 = \frac{1}{\sqrt{\mu\varepsilon}}$

$\Rightarrow \quad \frac{3}{2} = \sqrt{\mu_r \varepsilon_r}$

Given $\mu_r = 1$

$\Rightarrow \quad \varepsilon_r = \frac{9}{4} = 2.25$

18. Answer (4)

**Hint and Sol.:** Electromagnetic waves are transverse in nature and do not require any medium to travel.

The speed of EM waves vary with medium.

$v_{\text{medium}} = \frac{c}{\mu}$

Where $c$ is speed of E.M wave in vacuum and $\mu$ is refractive index of medium.

19. Answer (4)

**Hint and Sol.:** Net displacement current, $I_d = I$, since displacement current is uniformly distributed across the area.

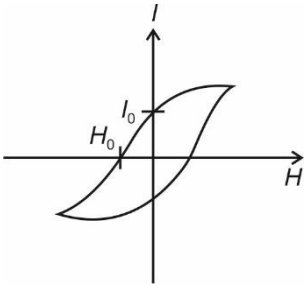
$\therefore \quad i' = i \times \frac{A/4}{2A} = i/8$

20. Answer (3)

**Hint and Sol.:** As we know, resonance angular frequency is equal to $\frac{1}{\sqrt{LC}}$, thus it is independent of resistance.

21. Answer (2)

**Hint and Sol.:**




$H_0$ : Coercivity.

22. Answer (2)

**Hint:** Due to a bar magnet

$B_{axial} = 2\left(\frac{\mu_0}{4\pi}\right)\frac{M}{r^3}$

**Sol.:** At neutral point, the magnetic field due to the magnet will get cancelled by the earth's horizontal component of magnetic field.

Thus, $2\left(\frac{\mu_0}{4\pi}\right)\frac{M}{r^3} = 0.8\times10^{-4}$

$\Rightarrow \quad \frac{2\times10^{-7}\times M}{(20\times10^{-2})^3} = 0.8\times10^{-4}$

$= 3.2 \text{ A m}^2$

23. Answer (3)

**Hint and Sol.:** Diamagnetic substances are feebly repelled by magnets.

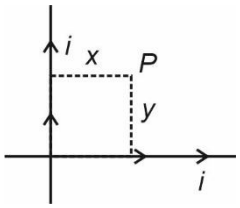
24. Answer (4)

**Hint and Sol.:** The magnetic field causes circular path, while electric field would speed up the particle along it. Thus, the final result is a helical path with increasing pitch.

25. Answer (1)

**Hint:** $B = \frac{\mu_0 i}{2\pi r}$

**Sol.:** $B_1 = \frac{\mu_0 i}{2\pi x}$(inwards)




$B_2 = \frac{\mu_0 i}{2\pi y}$(outwards)

Now for $B_{net} = 0$

$\Rightarrow \quad B_1 - B_2 = 0$

$\Rightarrow \quad B_1 = B_2$

$\Rightarrow \quad x = y$

26. Answer (1)

**Hint:** Input power = $V_P I_P$

**Sol.:** $P_O$ = 140 W

$P_i = V_P I_P = 220 \times 1.5 = 330$ W

Now, Efficiency $= \frac{P_O}{P_i} \times 100 = \frac{140}{330} \times 100 = 42\ \%$

27. Answer (2)

**Hint:** $V_{net} = \sqrt{V_R^2 + (V_C - V_L)^2}$

$i = \frac{V_{net}}{z}$

**Sol.:** $V_{net} = 220 = \sqrt{V_R^2 + (300-300)^2} = V_R$

$i = \frac{220}{100} = 2.2$ A

28. Answer (2)

**Hint:** $\cos\phi = \frac{R}{z}$

**Sol.:** $\cos\phi_1 = \frac{R}{z_1} = \frac{1}{4} \Rightarrow z_1 = 4R$

$\cos\phi_2 = \frac{R}{z_2} = \frac{1}{8} \Rightarrow z_2 = 8R$

Now percentage change in impedance is

$\frac{z_2 - z_1}{z_1} \times 100 = \left(\frac{8R-4R}{4R}\right) \times 100 = 100\%$

29. Answer (4)

**Hint:** $B = \frac{\mu_0 i}{2R}$

**Sol.:** $B = \frac{\mu_0 i}{2R}$

Also, $A = \pi R^2 \Rightarrow R = \sqrt{\frac{A}{\pi}}$

$\Rightarrow B = \frac{\mu_0 i}{2\sqrt{\frac{A}{\pi}}} = \frac{\mu_0 i\sqrt{\pi}}{2\sqrt{A}}$

$\Rightarrow i = \frac{2B\sqrt{A}}{\mu_0\sqrt{\pi}}$

30. Answer (1)

**Hint and Sol.:** Emf can be induced by moving a conductor in magnetic field and this is called motional emf. Changing magnetic field also leads to the change in magnetic flux and thus emf is induced.

31. Answer (2)

**Hint and Sol.:** We know

$e = \frac{-d\phi}{dt}$

$\Rightarrow$ $[d\phi] = [edt]$

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

32. Answer (3)

**Hint:** $B = \frac{\mu_0 i}{2\pi R}$

**Sol.:** $10 = \frac{\mu_0(i_1)}{2\pi R} - \frac{\mu_0(i_2)}{2\pi R}$

and, $30 = \frac{\mu_0(i_1)}{2\pi R} + \frac{\mu_0(i_2)}{2\pi R}$

$\Rightarrow \frac{i_1 + i_2}{i_1 - i_2} = 3 \Rightarrow i_1 + i_2 = 3i_1 - 3i_2$

$\Rightarrow 4i_2 = 2i_1$

$\Rightarrow \frac{i_1}{i_2} = \frac{2}{1}$

33. Answer (4)

**Hint and Sol.:** $e = \frac{d\phi}{dt} = \frac{d(\vec{B}\cdot\vec{A})}{dt}$

As magnetic field is uniform and orientation of area vector does not change, so the induced emf will be zero.

34. Answer (2)

**Hint:** $e = \left|\frac{d\phi}{dt}\right|$

**Sol.:** $e = \frac{d(10t^2 - 50t + 250)}{dt}$

$e = 20t - 50$

at $t$ = 6 s, $e = 20 \times 6 - 50 = 70$ V

35. Answer (4)

**Hint:** Time constant $(\tau) = \frac{L}{R}$

**Sol.:** $\tau = \frac{L}{R} = \frac{200 \times 10^{-3}}{2} = 0.1\,\text{s}$

## SECTION-B

36. Answer (4)

**Hint and Sol.:** $V_{\text{source}} = \sqrt{V_R^2 + (V_L - V_C)^2}$

$= \sqrt{5^2 + (10-10)^2}$ (Resonance circuit)

= 5 V

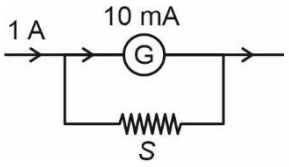
37. Answer (2)

**Hint:** $|e| = M\left|\frac{di}{dt}\right|$

**Sol.:** $4 = M \times \frac{10}{2} \Rightarrow M = \frac{4}{5} = 0.8\,\text{H}$

38. Answer (3)

**Hint and Sol.:**




$(10 \times 10^{-3})\,G = (1 - 10 \times 10^{-3})\,S$

$\Rightarrow \quad S = \frac{10 \times 10^{-3} \times 10}{1 - 10 \times 10^{-3}} \approx 0.1\,\Omega$

39. Answer (2)

**Hint:** $T = 2\pi\sqrt{\frac{I}{MB}}$

**Sol.:** $T' = 2\pi\sqrt{\frac{I}{4MB}}$

$\frac{T'}{T} = \frac{1}{2} \Rightarrow T' = \frac{T}{2} = 1\,\text{s}$

40. Answer (2)

**Hint:** $B_{\text{end}} = \frac{\mu_0 ni}{2}$

**Sol.:** $B_{\text{end}} = \frac{\mu_0 ni}{2}$

$= \frac{4\pi \times 10^{-7} \times 300 \times 2}{2} = 0.38\,\text{mT}$

41. Answer (2)

**Hint and Sol.:** At south pole earth's magnetic field lines exit from earth surface. Thus the top end of the pillar will be polarized as north pole.

42. Answer (1)

**Hint and Sol.:** $\omega = \frac{qB}{m}$

Thus $\omega$ is independent of speed

$\therefore$ The ratio is 1 : 1

43. Answer (2)

**Hint:** $\vec{F} = i(\vec{l}_{\text{eff}} \times \vec{B})$

**Sol.:** For closed loop, effective length is zero.

Thus $F = 0$

44. Answer (4)

**Hint:** $R = \frac{mv}{qB} = \frac{\sqrt{2mK}}{qB}$

Where $K$ : kinetic energy of charged particle.

**Sol.:** $R_P = \frac{\sqrt{2m(32)}}{eB}$

$R_\alpha = \frac{\sqrt{2(4m)(E)}}{2eB}$

$\Rightarrow \quad R_P = R_\alpha$ (given)

$\Rightarrow \quad E = 32$ eV

45. Answer (1)

**Hint and Sol.:** $I_E = E_B = I$

$\Rightarrow \quad \frac{I_B}{2} = \frac{I}{2}$

46. Answer (2)

**Hint:** For DC, $i = \frac{V}{R}$

For AC, $i = \frac{V}{Z}$

**Sol.:** $i_{\max} = \sqrt{2}\,\text{A} \Rightarrow i_{\text{rms}} = i_{ac} = \frac{\sqrt{2}}{\sqrt{2}} = 1\,\text{A}$

$i_{dc} = 4\,\text{A} = \frac{100}{R} \Rightarrow R = 25\,\Omega$

Now, $i_{ac} = 1\,\text{A} = \frac{V}{Z} \Rightarrow Z = 200\,\Omega$

We know, $Z = \sqrt{R^2 + X^2}$

$\Rightarrow \quad X = \sqrt{200^2 - 25^2} = 198.43\ \Omega$

47. Answer (4)

**Hint:** $\mu_r = 1 + \chi$

**Sol.:** $\mu_r = 1 + \chi$

$\Rightarrow \quad 67 = 1 + \chi \Rightarrow \chi = 66$

48. Answer (2)

**Hint and Sol.:** Curie temperature is the temperature above which a ferromagnetic substance becomes paramagnetic.

49. Answer (1)

**Hint:** Coercivity $(H) = \dfrac{B}{\mu_0}$

**Sol.:** The bar magnet will be demagnetized if the magnetizing field intensity becomes equal to coercivity in magnitude.

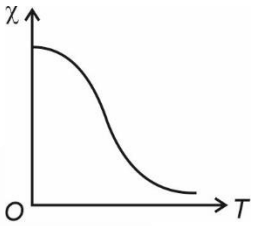
$H = \dfrac{B}{\mu_0} = ni$

$\Rightarrow \quad 4000 = 200 \times i$

$\Rightarrow \quad i = 20$ A

50. Answer (1)

**Hint and Sol.:** For ferromagnetic substances, the susceptibility varies as




# [CHEMISTRY]

## SECTION-A

51. Answer (2)

**Hint:** Due to smallest size of $Be^{2+}$ ion, it has highest hydration enthalpy among group 2 elements.

**Sol.:** As the hydration energy decreases, solubility also decreases

$\therefore$ Solubility order: $BeSO_4 > MgSO_4 > CaSO_4$ $BaSO_4$

52. Answer (1)

**Hint:** Li being very small in size, polarises a large $CO_3^{2-}$ ion to more extent.

**Sol.:** Alkali metal carbonates are quite stable towards heat except $Li_2CO_3$.

$Li_2CO_3 \xrightarrow{\Delta} Li_2O + CO_2$

53. Answer (3)

**Hint:** Due to small size of Be, it shows more covalent character in its compound.

**Sol.:** BeO can react with both acid and base so amphoteric in nature.

- MgO, BaO and SrO are basic oxides.

54. Answer (3)

**Hint:** Species containing *d*-electrons will show colour.

**Sol.:** $[TiF_6]^{2-} \Rightarrow Ti^{4+}$ : [Ar] $3d^0 4s^0$

No unpaired electron is present, so $[TiF_6]^{2-}$ will be colourless.

55. Answer (1)

**Hint:** Ligand field strength : $NH_3 > H_2O > Cl^-$

**Sol.:** Complexes having high ligand field strength have more CFSE, so absorb lower wavelength of visible region as $\text{CFSE} \propto \dfrac{1}{\lambda}$

$\therefore \quad \underset{\longrightarrow}{[Co(NH_3)_6]^{3+}, [CO(NH_3)_5(H_2O)]^{3+}, [Co(NH_3)_5Cl]^{2+}}$

- CFSE decreases
- $\lambda_{absorb}$ increases

56. Answer (2)

**Hint:** $C_2O_4^{2-}$ is a bidentate ligand.

**Sol.:** For $K_3[Co(C_2O_4)_3]$

- Coordination number = 3 × 2 = 6
- Oxidation number of Co = +3

57. Answer (4)

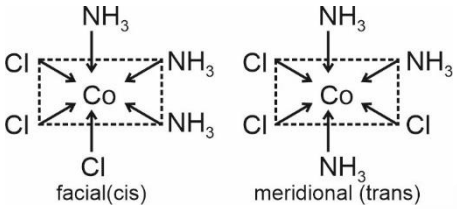
**Hint:** CO is $\pi$-acid ligand.

**Sol.:** CO can donate its lone pair to Fe forming $\sigma$ bond and CO can accepts electron from filled *d*-orbital of Fe to its vacant antibonding $\pi^*$ orbital forming $\pi$-bond so $Fe(CO)_5$ is $\sigma$ and $\pi$-bonded complex

58. Answer (4)

**Hint:** $[Co(NH_3)_3Cl_3]$ is an octahedral complex having a plane of symmetry and has no ambidentate ligand.

**Sol.:** $[Co(NH_3)_3Cl_3]$ show fac-mer isomerism (geometrical isomerism)

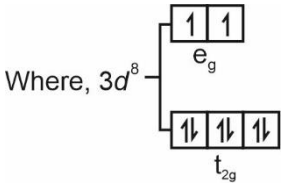



59. Answer (4)

**Hint:** Geometry of given complex is octahedral

**Sol.:** Ni(Z = 28) : [Ar] $3d^8\ 4s^2$

In $[Ni(H_2O)_6]^{2+} \Rightarrow Ni^{2+}$ : [Ar] $3d^8\ 4s^0$




60. Answer (2)

**Hint:** $\Delta_t = \frac{4}{9}\Delta_o$

**Sol.:** $\Delta_t = \frac{4}{9}\Delta_o$

$\therefore \Delta_o = \frac{9}{4}x\ cm^{-1}$

61. Answer (3)

**Hint:** For anionic complex, Fe is named as ferrate.

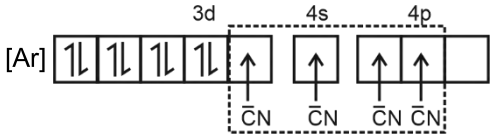
**Sol.:** $[Fe(CN)_6]^{4-}$ : Hexacyanidoferrate(II) ion

62. Answer (1)

**Hint:** $CN^-$ is a strong field ligand

**Sol.:** Ni (Z = 28) : [Ar] $3d^8 4s^2$

$[Ni(CN)_4]^{2-} \Rightarrow Ni^{2+}$ :




$\rightarrow dsp^2$ hybridised

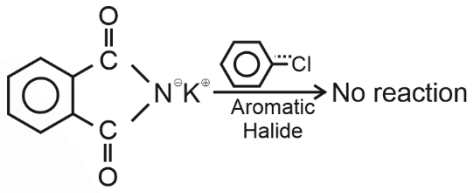
$\rightarrow$ Square planar

$\rightarrow$ Diamagnetic

63. Answer (1)

**Hint:** Aromatic-1°-amine can not be prepared by Gabriel phthalimide reaction

**Sol.:**




Potassium phthalimide

64. Answer (4)

**Hint:** Substituted imines are known as Schiff's base

**Sol.:** $CH_3 - CH = O + \underset{H}{\overset{H}{>}} N - CH_3 \longrightarrow$

$CH_3 - CH = N - CH_3 + H_2O$

Substituted imine (Schiff's base)

65. Answer (3)

**Hint:** 1°-amine on reaction with $HNO_2$ gives alcohol.

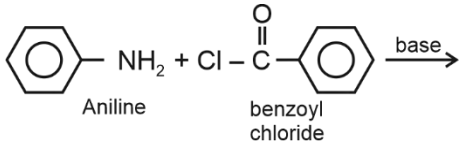
**Sol.:**

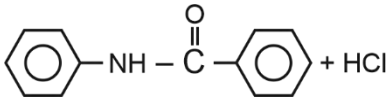
$$\underset{1°-amine}{CH_3CH_2NH_2} + HNO_2 \rightarrow \underset{alcohol}{CH_3CH_2OH} + N_2 + H_2O$$

66. Answer (2)

**Hint:** Benzoylation of compound having active H-atom.

**Sol.:** Schotten-Baumann reaction:

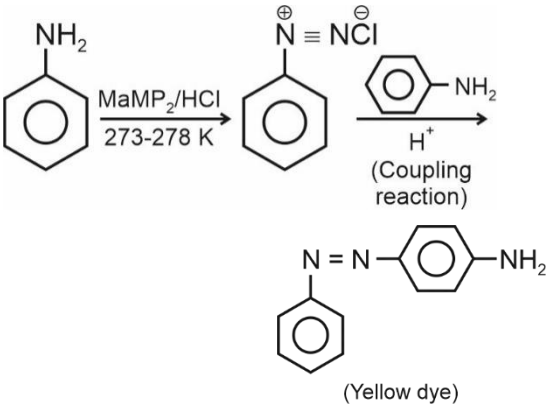


67. Answer (2)

**Hint:** Diazonium salts react with aromatic amines to give coloured azo dyes, containing – N = N – group

**Sol.:**

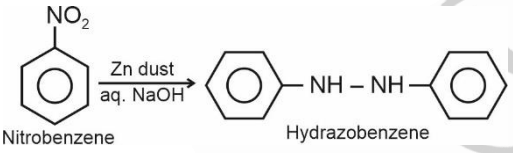



(Yellow dye)

68. Answer (2)

**Hint:** Nitrobenzene gives different products in alkaline medium under different conditions.

**Sol.:**




Nitrobenzene Hydrazobenzene

69. Answer (1)

**Hint:** 1°-amine on reaction with $CHCl_3$ and alc. KOH gives Isocyanide.

**Sol.:** Carbylamine reaction:

$$CH_3-NH_2+CHCl_3+3KOH \xrightarrow[\text{alc.}]{\Delta} CH_3-NC+3KCl+3H_2O$$

70. Answer (3)

**Hint:** In aqueous solution, the basic nature of an amine

(i) Increases with +I effect of alkyl group.

(ii) Decreases with more size of alkyl group due to less solvation.

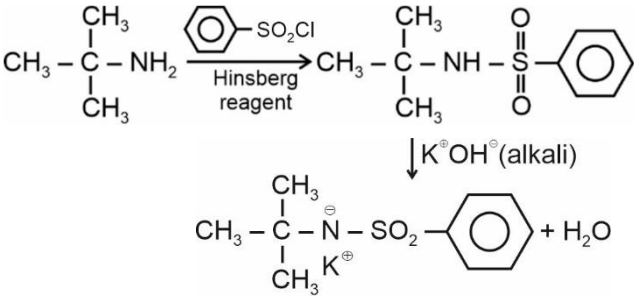
**Sol.:** On the basis of I-effect, solvation effect and steric hindrance of ethyl groups in aqueous solution, the basicity order is

$(C_2H_5)_2NH > (C_2H_5)_3N > C_2H_5NH_2$

71. Answer (4)

**Hint:** Product of 1°-amine with Hinsberg reagent is alkali soluble.

**Sol.:**




72. Answer (2)

**Hint:** More the dipole-dipole interactions between the molecules, more will be the boiling point of compound.

**Sol.:**

| **Compound** | $CH_3CH_2CH_2CH_3$ | $CH_3COCH_3$ | $CH_3CH_2CHO$ | $C_2H_5OCH_3$ |
|---|---|---|---|---|
| **Boiling point(K)** | 273 | 329 | 322 | 281 |

73. Answer (3)

**Hint:** More the electrophilicity of carbonyl carbon, more will be its reactivity towards nucleophile.

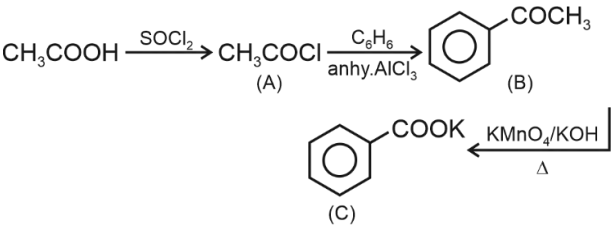
**Sol.:**

- Electrophilicity of carbonyl carbon in RCHO and RCOR decreases due to +I effect of R group(s).
- Electrophilicity of carbonyl carbon in benzaldehyde is less as (+)ve charge is delocalized in the benzene ring.
- Hence among given options, HCHO is most reactive towards nucleophile due to maximum electrophilicity of carbonyl carbon.

74. Answer (4)

**Hint:** Benzene reacts with acid halides in presence of anhy. $AlCl_3$ to form acetyl benzene.

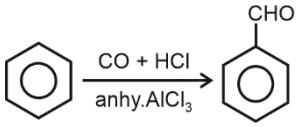
**Sol.:**




75. Answer (3)

**Hint:** In the preparation of benzaldehyde from benzene and (CO + HCl) in presence of anhy. $AlCl_3$, new carbon-carbon bond formation takes place.

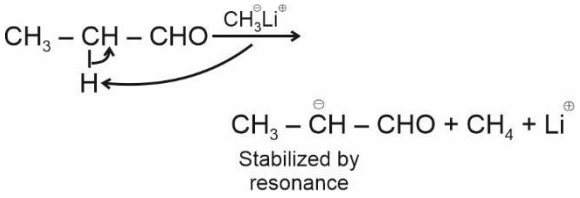
**Sol.:** Gattermann Koch reaction ($S_E$ reaction)




76. Answer (2)

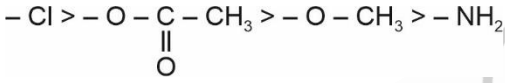
**Hint:** $\overset{\ominus}{C}H_3\,Li^{\oplus}$ behaves as a base and can abstract an active/acidic H-atom.

**Sol.:** $\alpha$-H atom(s) of carbonyl compounds is/are acidic in nature so can react with strong base.



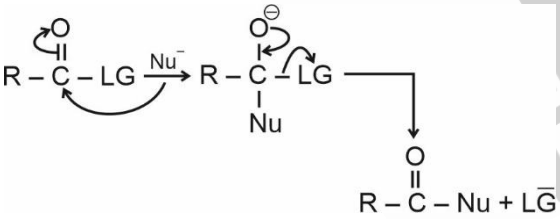

77. Answer (1)

**Hint:** Leaving ability:

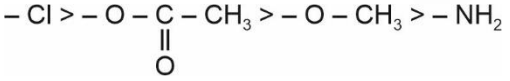



**Sol.:**

- Hydrolysis of acid derivatives is a $S_N$ reaction.
- More is the leaving ability of leaving group (LG), more will be the rate of reaction.




- Since leaving ability order:



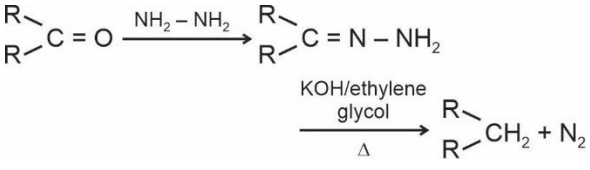

So reactivity order of acid derivatives:

$CH_3COCl > CH_3COOCOCH_3 > CH_3COOCH_3 > CH_3CONH_2$

78. Answer (4)

**Hint:** Wolff Kishner reduction takes place in basic medium.

**Sol.:** Wolff Kishner reduction.




79. Answer (3)

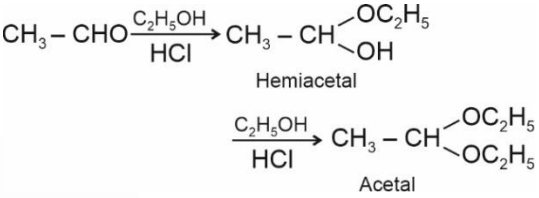
**Hint:** Cyanide on hydrolysis gives carboxylic acid which form amide on heating with ammonia

**Sol.:** $C_2H_5Br \xrightarrow{KCN} \underset{(A)}{C_2H_5CN} \xrightarrow{H_3O^+} \underset{(B)}{C_2H_5COOH} \xrightarrow[\Delta]{NH_3} \underset{(C)}{C_2H_5CONH_2} \xrightarrow[alc.KOH]{Br_2} \underset{(D)}{C_2H_5NH_2}$

80. Answer (2)

**Hint:** Gem di-ethers are known as acetal or ketals.

**Sol.:**




81. Answer (4)

**Hint:** Compounds containing $CH_3 - \overset{O}{\overset{\|}{C}} -$ group on treatment with $I_2$/NaOH gives yellow precipitate of Iodoform.

**Sol.:**

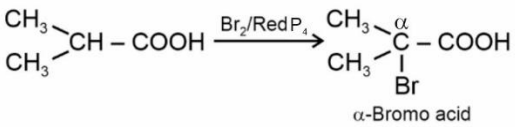
| Test Name | $CH_3 – CHO$ | $CH_3COCH_3$ |
|---|---|---|
| Benedict test | Red ppt | × |
| Fehling test | Red ppt | × |
| Tollen's test | Silver mirror | × |
| Iodoform test | Yellow ppt | Yellow ppt |

82. Answer (2)

**Hint:** $\alpha$-Halo carboxylic acid is obtained.

**Sol.:** Hell-Volhard-Zelinsky reaction:

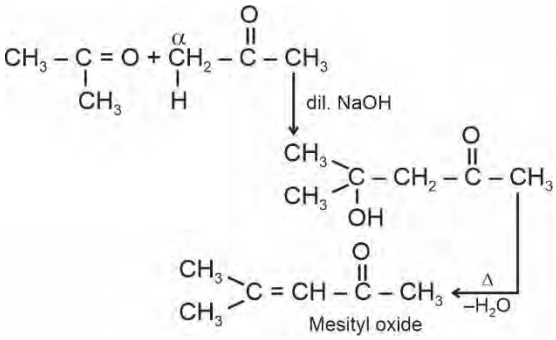
$\alpha$-H-atom of acid is replaced by halogen atom during HVZ reaction.




83. Answer (3)

**Hint:** Condensation of two acetone molecules occurs when acetone reacted with dil. NaOH followed by heating

**Sol.:** Aldol condensation reaction




84. Answer (4)

**Hint:** Electron withdrawing group increases the acidic strength of carboxylic acids

**Sol.:** Order of Acidic strength:

$CCl_3 - COOH > NO_2CH_2 - COOH > C_6H_5 - COOH$

85. Answer (1)

**Hint:** Dehydrogenation of alcohol takes place

**Sol.:** $R-CH_2-OH \xrightarrow[\Delta]{Cu} \underset{\text{(Aldehyde)}}{R-CHO} + H_2$

## SECTION-B

86. Answer (2)

**Hint:** Complex with chelating ligands have extra stability.

**Sol.:** Due to ring formation by $C_2O_4^{2-}$ ligand (didentate) $[Fe(C_2O_4)_3]^{3-}$ is more stable complex.

87. Answer (2)

**Hint:** Half filled $t_{2g}^3$ and $d^5$ configurations have extra stability.

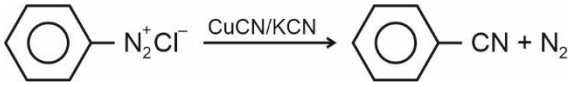
**Sol.:**

- Because of large number of unpaired electrons in the atoms of transition elements they have stronger interatomic interaction and hence strong bonding between atoms resulting in higher enthalpies of atomisation.
- $Cr^{2+}$ is reducing as its configuration changes from $d^4$ to $d^3$, the latter having a half filled $t_{2g}$ level. On the other hand, the changes from $Mn^{3+}$ to $Mn^{2+}$ results in the half filled ($d^5$) configuration which has extra stability.

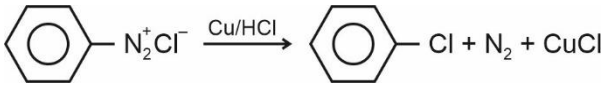
88. Answer (2)

**Hint:** Aryl halides can be prepared by Gattermann reaction.

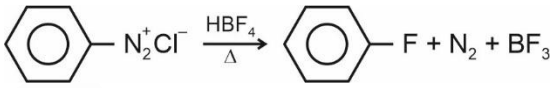
**Sol.:** Sandmeyer reaction :




Gattermann reaction :



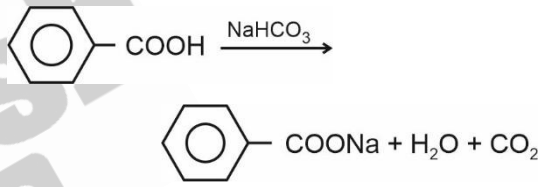

Balz Schiemann reaction :




89. Answer (4)

**Hint:** Compounds having more acidic strength than carbonic acid are soluble in aqueous solution of $NaHCO_3$

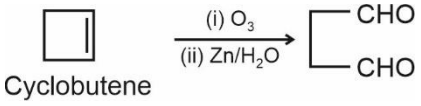
**Sol.:**




90. Answer (3)

**Hint:** $\begin{matrix}R\\R\end{matrix}\!>\!C\equiv CH-R \xrightarrow[(ii)\ Zn/H_2O]{(i)\ O_3} \underset{\text{Ketone}}{R-\overset{\overset{O}{\|}}{C}-R} + \underset{\text{Aldehyde}}{R-CHO}$

**Sol.:**

- $\underset{\text{But-1-ene}}{CH_3-CH_2-CH=CH_2} \xrightarrow[(ii)\ Zn/H_2O]{(i)\ O_3} CH_3CH_2CHO + HCHO$
- 

- $\begin{matrix}CH_3\\CH_3\end{matrix}\!>\!C=CH_2 \xrightarrow[(ii)\ Zn/H_2O]{(i)\ O_3} CH_3-\overset{\overset{O}{\|}}{C}-CH_3 + HCHO$ (Isobutylene; Acetone)
- $\underset{\text{But-2-ene}}{CH_3-CH=CH-CH_3} \xrightarrow[(ii)\ Zn/H_2O]{(i)\ O_3} 2CH_3-CHO$

91. Answer (3)

**Hint:** Growth of tumours can be inhibited by some complexes of platinum.

**Sol.:**

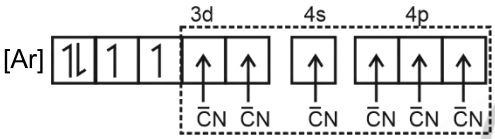
- $[(Ph_3P)_3RhCl]$ is used as catalyst for hydrogenation of alkenes (Wilkinson's catalyst)
- Hypo solution dissolves the undecomposed AgBr in photography.
- cis – $[PtCl_2(NH_3)_2]$ is used as anticancer agent
- $Na_2EDTA$ is used to measure the hardness of water.

92. Answer (1)

**Hint:** In $[Mn(CN)_6]^{3-}$ pairing of only one electron take place.

**Sol.:** $Mn^{3+}$ : $[Ar]3d^4 4s^0$

In $[Mn(CN)_6]^{3-} \Rightarrow Mn^{3+}$ :




- $d^2sp^3$ hybridised
- Inner orbital complex
- 2 unpaired electrons
- Homoleptic complex

93. Answer (4)

**Hint:** Weaker the metallic bonding between metal atoms, lower will be the melting point of metal

**Sol.:** Due to half filled stable $d^5$ configuration, Mn atoms do not form strong metallic bonding between atoms so their melting point is exceptionally low.

Melting point : Cr > Ti > Ni > Mn

94. Answer (1)

**Hint:** Higher is the atomic number, smaller will be ionic radii

| **Sol. :** | **Element** | La | Eu | Tb | Yb |
|---|---|---|---|---|---|
| | **Z** | 57 | 63 | 65 | 70 |

Among Ln, as the atomic number increases, size of $Ln^{3+}$ decreases.

Size of $Ln^{3+}$ : $La^{3+} > Eu^{3+} > Tb^{3+} > Yb^{3+}$

95. Answer (1)

**Hint:** In faintly alkaline or neutral medium, $MnO_4^-$ acts as a better oxidizing agent.

**Sol.:** In faintly alkaline or neutral medium, $MnO_4^-$ oxidises $I^-$ into $IO_3^-$

$$2MnO_4^- + I^- + H_2O \rightarrow 2MnO_2 + 2OH^- + IO_3^-$$

96. Answer (3)

**Hint:** Brass is an alloy of Cu and Zn

**Sol.:** Bronze is an alloy of Cu and Sn.

97. Answer (1)

**Hint & Sol.:**

| **Element** | Cu | Zn | Mn | Ti |
|---|---|---|---|---|
| **$E°(M^{2+}/M)$** | +0.34 V | –0.76 V | –1.18 V | –1.63 V |

98. Answer (2)

**Hint:** Spin magnetic moment = $\sqrt{n(n+2)}$ BM

Where, n = number of unpaired electrons.

**Sol.:** $Cr^{3+}$ : $[Ar]3d^3 4s^0$

$\therefore$ Magnetic moment $= \sqrt{3(3+2)} = \sqrt{15}$ BM

99. Answer (4)

**Hint :** Species containing $O_2^-$ are superoxides.

**Sol.:**
- $K^+$ ions are the most abundant cations within cell fluids.
- LiCl is deliquescent in nature and crystallises as a hydrate, $LiCl \cdot 2H_2O$
- Solvay's process is used for the preparation of sodium carbonate in which $NaHCO_3$ is obtained as intermediate.

100. Answer (2)

**Hint & Sol.:** Hemihydrate of calcium sulphate $\left(CaSO_4 \cdot \frac{1}{2}H_2O\right)$ is known as plaster of Paris.

# [BOTANY]

## SECTION-A

101. Answer (1)

**Hint:** *Lactobacillus* grow in milk and convert it into curd.

**Sol.:** Following are the microbes which are employed in production of various products:

*Aspergillus niger* - Citric acid

*Acetobacter aceti* - Acetic acid

*Clostridium butylicum* - Butyric acid

102. Answer (4)

**Hint:** Ladybird and dragonflies are biocontrol agents.

**Sol.:** *Aulosira* and *Anabaena* are important biofertilizers.

103. Answer (1)

**Hint:** Statins have been commercialised as blood cholesterol lowering agent.

**Sol.:** Cyclosporin A is used as an immunosuppressive agent in organ-transplant patients.

104. Answer (4)

**Sol.:** Selection and testing of superior recombinants is the crucial step for the success of breeding experiment.

105. Answer (3)

**Hint:** Somatic hybrid cell is obtained by somatic hybridisation.

**Sol.:** During somatic hybridization, plant cells are first treated with pectinase and cellulase to obtain naked protoplast. These naked protoplasts are fused further to obtain a somatic hybrid cell.

106. Answer (3)

**Hint:** Meristem (axillary or apical) is free of virus due to high concentration of auxins and rapid rate of cell division.

**Sol.:** Recovery of the healthy plants from diseased plants is possible by meristem culture.

107. Answer (2)

**Hint:** Single cell protein is protein-rich biomass which is used as food or feed.

**Sol.:** SCP is rich in good quality protein and poor in fats.

108. Answer (1)

**Hint:** Relative contribution of various gases in biogas are:

$CH_4 \rightarrow$ 50-70%; $CO_2 \rightarrow$ 30-40%; $H_2$ and $H_2S \rightarrow$ 10%

**Sol.:** Major component of biogas is methane.

109. Answer (4)

**Hint:** Methanogens produce mixture of gases termed as biogas.

**Sol.:** When methanogens grow anaerobically on cellulosic material, they produce methane, $CO_2$, $H_2$ and $H_2S$.

110. Answer (4)

**Hint:** The ministry of environment and forests has initiated Ganga Action plan (1985) and Yamuna Action Plan to save these major rivers of our country from pollution.

**Sol.:** The technology of biogas production was developed in India mainly due to the efforts of India Agricultural Research Institute (IARI) and Khadi and Village Industries Commission (KVIC).

111. Answer (1)

**Hint:** Primary treatment is a physical process which involves removal of large and small particles from sewage through filtration and sedimentation.

**Sol.:** During physical process of sewage treatment, all solids that settle forms the primary sludge and the supernatant forms the primary effluent.

112. Answer (2)

**Hint:** Flocs help to reduce the BOD of sewage during secondary treatment.

Secondary treatment is also called biological treatment.

**Sol.:** Flocs are masses of aerobic heterotrophic bacteria associated with fungal filaments to from mesh like structure.

113. Answer (4)

**Hint:** Leading strand is produced on the template DNA with polarity $3' \rightarrow 5'$.

**Sol.:**

- The leading strand of DNA is synthesized continuously in $5' \rightarrow 3'$ direction.
- DNA polymerase is used to synthesize DNA on both leading and lagging strands.
- Lagging strand is synthesized simultaneously with leading strand.

114. Answer (4)

**Hint:** The information of building a polypeptide present on RNA is read in group of three nucleotides called codon.

**Sol.:** Each set of three bases codes for an amino acid, which is then assembled into a polypeptide chain.

115. Answer (4)

**Hint:** According to Chargaff's rule; in a double stranded DNA; A = T and G = C

**Sol.:** $A = T \rightarrow 32 + 32 = 64\%$

Thus, $G = C \rightarrow (100 - 64) = 36\%$

$\therefore$ G = 18%

116. Answer (3)

**Sol.:** In human genome, the average gene consists of 3000 bases.

117. Answer (2)

**Hint:** Number of phosphodiester bond for a single stranded linear DNA = N–1 [N = numbers of nucleotides]

**Sol.:** Here $N - 1 = 1000 - 1 = 999$

118. Answer (4)

**Hint:** In RNA, uracil replaces thymine.

**Sol.:** According to given question;

C T A T G DNA sequence

G A U A C RNA sequence

119. Answer (1)

**Hint:** The size of VNTR varies from 0.1 to 20 kb.

**Sol.:** VNTRs are minisatellite.

120. Answer (2)

**Sol.:** The science of Bioinformatics was developed during the period of HGP.

121. Answer (4)

**Hint:** Cytidine is a RNA nucleoside

**Sol.:** Cytidine contains cytosine and ribose sugar, which is linked with bases through N-glycosidic linkage.

122. Answer (2)

**Hint:** NPV have species-specific, narrow spectrum insecticidal application.

**Sol.:** NPV have no negative impacts on plants, mammals, birds, fishes or even on non-target insects.

123. Answer (1)

**Hint:** The strand with polarity $5' \rightarrow 3'$ (Coding strand) in DNA has the sequence same as RNA, except thymine at the place of uracil.

**Sol.:**

5′ T T G A C C T T A 3′ Coding strand

3′ A A C T G G A A T 5′ Template strand

↓Transcription

5′ U U G A C C U U A 3′ mRNA

124. Answer (3)

**Hint:** Central Dogma of Molecular biology explains one way or unidirectional flow of information from master copy DNA to working copy RNA and from RNA to building molecule or trait expressing molecule polypeptide.

**Sol.:** During replication both the strands act as template DNA

Reverse transcription, translation and transcription do not require two strands of DNA.

125. Answer (1)

**Hint:** hnRNA is precursor of mRNA.

**Sol.:** The nascent RNA synthesized by RNA polymerase II is called hnRNA or primary transcript.

126. Answer (1)

**Hint:** In endomycorrhiza, fungi usually belong to zygomycetes.

**Sol.:** In ectomycorrhiza, fungi usually belong to basidiomycetes

127. Answer (3)

**Hint:** Mycorrhiza is the symbiotic association of fungi with roots of higher plants.

**Sol.:** Plants with mycorrhizal association show resistance to root borne pathogens, tolerance to salinity and drought. In return, fungi gets shelter and food from this association.

128. Answer (4)

**Hint:** Streptokinase is modified by genetic engineering and used as 'clot buster'

**Sol.:**
- Protease helps in clarifying fruit juices.
- Statins have been commercialised as blood cholesterol lowering agent.
- Amylase degrades starch.

129. Answer (1)

**Hint:** The codon is read on mRNA without any punctuation.

**Sol.:** The codon is read in mRNA on a contiguous fashion. It reflects commaless nature of genetic code.

130. Answer (4)

**Sol.:** Altmann found nuclein to be acidic in nature and named it nucleic acid.

131. Answer (3)

**Hint:** UTRs are additional sequences present on mRNA which are not translated.

**Sol.:** UTRs are present at both 5′ end before start codon and 3′-end after stop codon.

132. Answer (2)

**Hint:** In DNA replication, the synthesis of primer strand serves as stepping stone to start errorless replication

**Sol.:**
- DNA ligase joins two discontinuously synthesized DNA fragments during DNA replication
- RNA polymerase I synthesizes 28 S rRNA
- DNA dependent DNA polymerase catalyses polymerization only in one direction, i.e., $5' \rightarrow 3'$

133. Answer (4)

**Hint:** A polynucleotide chain has N-glycosidic and phosphodiester linkage in it.

**Sol.:**
- Heterochromatin is transcriptionally inactive region in chromatin
- Cytosine pairs with guanine through three hydrogen bonds in a double stranded DNA
- The two strands of DNA run in anti-parallel fashion with $5' \rightarrow 3'$ polarity in one and $3' \rightarrow 5'$ polarity in other.

134. Answer (1)

**Hint:** Replication is the process by which a double stranded DNA molecule is copied to produce two identical DNA molecules.

**Sol.:** Unwinding (or opening) of double helical parental DNA is brought about by enzyme helicase, which is ATP dependent.

135. Answer (2)

**Sol.:** The numbers of bases is $4.6 \times 10^6$ bp so the total length comes out to be $0.34 \times 10^{-9}$ m $\times$ $4.6 \times 10^6$

= 1.564 mm.

## SECTION-B

136. Answer (1)

**Hint:** Polycistronic gene codes for more than one polypeptides.

**Sol.:** Prokaryotic structural gene is polycistronic while, eukaryotic structural gene is monocistronic.

137. Answer (4)

**Hint:** Regulator gene controls the activity of operator gene

**Sol.:**
- Operator gene receives the product of regulator gene.
- Promoter gene provides attachment site for RNA polymerase
- Structural gene transcribes mRNA for polypeptide synthesis

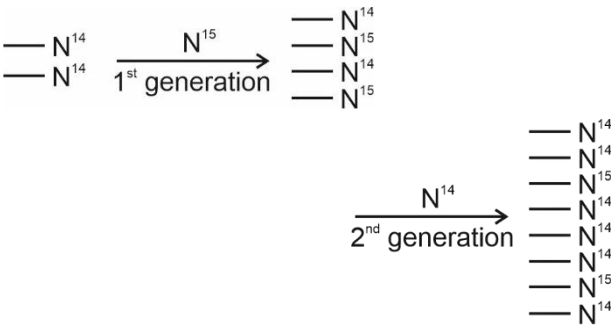
138. Answer (2)

**Sol.:** Taylor *et. al.* have proved semiconservative mode of chromosome replication in eukaryotes using $^3H$– thymidine in roots of *Vicia* faba (Faba beans).

139. Answer (4)

**Hint:** DNA replication is semi-conservative

**Sol.:** According to given question;




In 1st generation;

Hybrid DNA = 100%

In 2nd generation;

Light DNA = 50%, Hybrid DNA = 50%

140. Answer (4)

**Hint:** According to Erwin Chargaff, for a double stranded DNA, the ratios between adenine and thymine and guanine and cytosine are constant and equal to one.

**Sol.:** In a double stranded DNA; $\frac{A}{T}=1$ and $\frac{G}{C}=1$

similarly; $\frac{A+C}{T+G}=1, \frac{G+T}{A+C}=1, \frac{A+G}{T+C}=1.$

Hence, $\frac{G+C}{A+T}$ is not equal to unity.

141. Answer (2)

**Hint:** Tomato and mustard are vitamin C enriched.

**Sol.:** Carrot, pumpkin, and spinach are vitamin A enriched vegetable crops developed by IARI.

142. Answer (2)

**Sol.:**

- Pusa Gaurav, Pusa Sem 2 and Pusa Sem 3 are resistant to aphids
- Pusa Sawani is resistant to shoot & fruit borer.

143. Answer (1)

**Sol.:** Pusa komal is bred by hybridisation and selection for resistance to bacterial blight is a variety of cowpea.

144. Answer (1)

**Hint:** Germplasm is the building material out of which improved varieties are constructed.

**Sol.:** Germplasm collection refers to collection of genetic variability. It is the backbone or root of any breeding programme.

145. Answer (4)

**Hint:** *Saccharum officinarum* did not grow well in North India.

**Sol.:** *Saccharum officinarum*; a tropical cane grow well in South India.

146. Answer (2)

**Hint:** Antibiotics means 'pro life' in context of human beings.

**Sol.:** Antibiotics means 'against life' in context of disease causing organisms.

147. Answer (2)

**Hint:** The concentration of alcohol in beverages that are naturally fermented is less.

**Sol.:**

- Wine and beer are produced without distillation (Low alcohol concentration)
- Whisky, brandy and rum are produced by distillation of fermented broth (high alcohol concentration)

148. Answer (2)

**Hint:** Bread is prepared from dough which is fermented using baker's yeast.

**Sol.:** Puffed-up appearance of dough during bread making is due to production of $CO_2$ during fermentation.

149. Answer (1)

**Hint:** Toddy, Roquefort cheese and Camembert cheese are obtained by fermenting activity of fungi.

**Sol.:** Idli is fermented preparation of rice and black gram, prepared by using bacteria.

150. Answer (1)

**Hint:** Lactic acid bacteria grow in milk and convert it into curd.

**Sol.:** Curd is more nutritious than milk as it contains a number of vitamins especially $B_{12}$.

# [ZOOLOGY]

## SECTION-A

151. Answer (1)

**Hint:** Site of erythropoiesis

**Sol.:** Maturation of B-lymphocytes occurs in bone marrow.

152. Answer (1)

**Hint:** Photosynthesis occurs in them

**Sol.:** First organisms that invaded land were plants.

153. Answer (2)

**Hint:** Theory of biogenesis

**Sol.:** Our earth originated about 4.5 billion years ago. Louis Pasteur gave the theory of biogenesis. Big bang theory attempts to explain the origin of universe.

154. Answer (3)

**Hint:** Worked in Malay Archipelago

**Sol.:** Alfred Wallace did not give the theory of panspermia or cosmozoa.

155. Answer (4)

**Hint:** Involves intensive breeding

**Sol.:** Antibiotics resistant bacteria, DDT resistant mosquitoes and herbicide resistant weeds are examples of evolution by natural selection whereas, disease resistance in plants by selective mating is an example of evolution by selective mating (Artificial selection).

156. Answer (4)

**Hint:** Process which occurs at the time of gametes formation

**Sol.:** A population remains in genetic equilibrium if mating is random, mutations, natural selection and genetic recombination are absent.

157. Answer (3)

**Hint:** Change in gene pool.

**Sol.:** When migration of a section of population to another place and population occurs, gene frequencies change in the original as well as in the new population.

158. Answer (2)

**Hint:** Ice age

**Sol.:** Modern *Homo sapiens* arose between 75,000-10,000 years ago. Agriculture came around 10,000 years back and human settlement started. Pre-historic cave art developed about 18,000 years ago.

159. Answer (3)

**Hint:** Therapsids evolved from Pelycosaurs.

**Sol.:** Early reptiles $\rightarrow$ Synapsids $\rightarrow$ Pelycosaurs $\rightarrow$ Therapsids $\rightarrow$ Mammals

160. Answer (4)

**Hint:** Dicotyledons evolved from them.

**Sol.:** Seed ferns evolved from Progymnosperms while ferns, ginkgos and conifers have evolved from Psilophyton directly.

161. Answer (4)

**Hint:** Theory of chemical evolution

**Sol.:** Oparin of Russia and Haldane of England proposed that the first form of life could have come from pre-existing non-living organic molecules (e.g., RNA, protein, etc.) and that formation of life was preceded by chemical evolution.

162. Answer (1)

**Hint:** Non-cellular form of life

**Sol.:**
- In the solar system of the Milky way galaxy, earth was supposed to have been formed about 4.5 billion years back.
- Non-cellular forms of life originated about 3 billion years ago.
- The first cellular forms of life did not possibly originate till about 2000 million years ago.
- Darwin's finches represent the phenomenon of adaptive radiation.
- Industrial melanism is an example of natural selection.

163. Answer (2)

**Hint:** Represents convergent evolution

**Sol.:** Excretory organs in earthworm and cockroach are examples of analogous organs as they are not similar anatomically though they perform similar functions. Rest of the given options are examples of homologous organs.

164. Answer (2)

**Hint:** Results into homologous organs

**Sol.:** Australian marsupials represent adaptive radiation or divergent evolution. In the diagram, we can see different species of marsupials which differ from each other in morphology and other features and these differences are due to the adaptations to different environments.

165. Answer (3)

**Hint:** Opposite to each other

**Sol.:** Variations are small and directional as per Darwin, whereas variations are large and directionless as per Hugo de Vries.

166. Answer (2)

**Hint:** 50% of all individuals

**Sol.:** In the question, p is 0.5.

According to Hardy-Weinberg equilibrium, $p + q = 1$

So, $q = (1 - 0.5) = 0.5$

So, frequency of heterozygotes $= 2pq = 2 \times 0.5 \times 0.5 = 0.5$

167. Answer (3)

**Hint:** Granulocytes are not involved.

**Sol.:** Primary and secondary immune responses are carried out with the help of B-lymphocytes and T-lymphocytes.

168. Answer (1)

**Hint:** Eukaryotic organism

**Sol.:** Hepatitis B vaccine is an example of second generation vaccine. It is produced by recombinant DNA technology using yeast.

169. Answer (2)

**Hint:** The body attacks self-cells

**Sol.:** In an auto-immune disease, the immune system lost the power of discriminationbetween self and non-self.

170. Answer (1)

**Hint:** Devoid of electrodes

**Sol.:** In Miller's experiment, the control apparatus was devoid of an energy source.

171. Answer (2)

**Hint:** Tigers in Bengal is an example of it.

**Sol.:** Change in gene frequency by chance in a small scale population is called genetic drift.

Bottle neck effect is included in genetic drift.

172. Answer (3)

**Hint:** *Australopithecus* is known as ape-man.

**Sol. :** *Homo habilis* – First human like being-the hominid

*Homo erectus* – First hominid who used fire

*Australopithecus* – Connecting link between apes and man

*Homo sapiens neanderthalensis* – Buried their deads

173. Answer (1)

**Hint:** Reproductive fitness

**Sol.:** In natural selection, the allelic frequency changes from generation to generation. The natural selection may be due to anthropogenic actions.

174. Answer (3)

**Hint:** Combat the allergic reaction

**Sol.:** Allergy is caused by chemicals like histamine and serotonin which are released by mast cells. Eosinophils combat the allergic reactions. The use of antihistamine, adrenaline and steroids quickly reduce the symptoms of allergy.

175. Answer (4)

**Hint:** Causes paralysis of skeletal muscles

**Sol.:** Polio spreads mainly through intestinal discharges *via* contaminated food and water. The other diseases which are given are examples of vector transmitted diseases.

176. Answer (2)

**Hint:** Diseases of GIT

**Sol.:** Filariasis is a vector-borne disease transmitted to a healthy person through the bite of infected female *Culex* (mosquito). Amoebic dysentery, typhoid, ascariasis spread by contaminated food and water.

177. Answer (2)

**Hint:** Does not include CNS depressant drugs.

**Sol.:** Marijuana, *Datura* seeds and Atropine show hallucinogenic properties. Benzodiazepines and barbiturates are included in the category of sedatives and tranquilisers.

178. Answer (4)

**Hint:** Become mature in bone marrow

**Sol.:** B-lymphocytes are associated with humoral immunity whereas, T-lymphocytes are associated with both cell mediated and humoral immunity.

179. Answer (1)

**Hint:** Rhinovirus affects upper respiratory tract.

**Sol.:** Only macrophages act like HIV factor. In pneumonia, alveoli of the lungs get filled with fluid leading to severe problems in respiration.

180. Answer (3)

**Hint:** Infective stage of *Plasmodium* for humans

**Sol.:** *Plasmodium* reproduces asexually in liver cells and RBCs of human host. Gametocytes are formed in human RBCs. Fertilisation takes place in lumen of stomach of mosquito. Mature infective stages (sporozoites) escape from gut and migrate to the mosquito's salivary glands.

181. Answer (2)

**Hint:** Known for their effect on cardiovascular system of the body.

**Sol.:** Cannabinoids are obtained from hemp plant (*Cannabis sativa*) and smack is obtained by chemical acetylation of morphine.

182. Answer (3)

**Hint:** Antibodies which can cross the placenta

**Sol.:** IgA is present in mucus coating and in colostrum. IgG are the smallest antibodies and can cross the placenta thereby confer immunity to the foetus.

183. Answer (4)

**Hint:** Contains lysozymes

**Sol.:** Macrophages and NK cells are included in cellular barriers of innate immunity, whereas mucus coating of the epithelium lining the respiratory tract is included in physical barriers of innate immunity.

184. Answer (2)

**Hint:** Similar to ATS

**Sol.:** Anti-venom is included in artificial passive immunity. Example of natural passive immunity is transfer of IgG to foetus through placenta.

185. Answer (3)

**Hint:** Phenomenon exhibited by normal cells

**Sol.:** Cancerous cells exhibit metastasis and malignancy. The phenomenon named contact inhibition is exhibited by normal cells of the body in which, the dividing cells when come in contact with other cells, inhibit their uncontrolled growth but cancer cells do not have this property.

## SECTION-B

186. Answer (1)

**Hint:** Spreads by contaminated food and water

**Sol.:** *Entamoeba histolytica* is a parasite of large intestine of human.

It causes amoebic dysentery/amoebiasis. Housefly acts as mechanical carrier and serves to transmit the parasite from faeces of infected person to food and food products, thereby contaminating them.

187. Answer (3)

**Hint:** Heaviest antibody

**Sol.:** IgA – 4 paratopes

IgG – 2 paratopes

IgE – 2 paratopes

IgM – 10 paratopes

188. Answer (3)

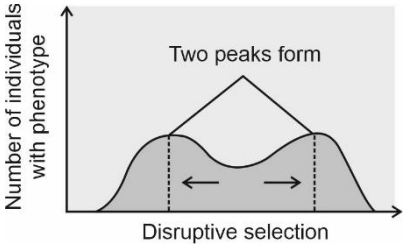
**Hint:** Occurs in retroviruses

**Sol.:** The enzyme reverse transcriptase is responsible for replication of HIV genome in macrophages.

189. Answer (3)

**Hint:** Decline in individuals with mean character value

**Sol.:**




190. Answer (2)

**Hint:** Theory of natural selection

**Sol.:** Branching descent and natural selection are the two key concepts of theory of 'Natural selection' which was given by Darwin.

- Lamarckism is often called the "Theory of inheritance of acquired characters".
- Hugo de Vries proposed the mutation theory.

191. Answer (3)

**Hint:** Synonyms

**Sol.:** Convergent evolution resulted in the origin of similar looking members in two different types of mammals (marsupials and placentals). Flying phalanger shows convergent evolution with flying squirrel.

192. Answer (1)

**Hint:** Period of Paleozoic era

**Sol.:** Arborescent lycopods were dominant during early Paleozoic era, but most of them became extinct in the Permian period of Paleozoic era.

193. Answer (1)

**Hint:** More close to humans compared to other apes

**Sol.:** The skull of baby chimpanzee is more like an adult human skull than adult chimpanzee skull. It shows that chimpanzee is our close relative.

194. Answer (4)

**Hint:** Reproductive fitness

**Sol.:** As per Darwin, fitness refers to reproductive fitness. The organisms which reproduce to produce more progeny and makes a higher contribution to the gene pool are selected by nature.

195. Answer (2)

**Hint:** Process which is non-directional

**Sol.:** The source of a new allele is mutation. Genetic drift causes change in the gene frequency by chance in a small population.

196. Answer (2)

**Hint:** Process which requires chlorophyll

**Sol.:** By the process of photosynthesis, oxygen evolved and atmosphere became oxidising.

197. Answer (3)

**Hint:** From periods of mesozoic era to periods of paleozoic era.

**Sol.:** Cretaceous $\rightarrow$ Triassic $\rightarrow$ Permian $\rightarrow$ Silurian

198. Answer (3)

**Hint:** Included in immunotherapy

**Sol.:** $\alpha$-interferons are included in biological response modifiers which activate the immune system and help in destroying tumor(s) in the cancer patients.

199. Answer (3)

**Hint:** Technique which accurately detect pathological and physiological changes in body

**Sol.:** MRI (Magnetic resonance imaging) uses strong magnetic fields and non-ionising radiations to accurately detect pathological and physiological changes in the living tissue.

200. Answer (4)

**Hint:** Function of thymus

**Sol.:** MALT is an example of secondary lymphoid tissue and it is associated with acquired immunity. Maturation of T-lymphocytes occur in thymus.

❑ ❑ ❑

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