All India Aakash Test Series for NEET - 2026

TEST - 6 (Code-E)

Click here for Code-F Sol.

Test Date : 08/03/2026

ANSWERS

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

HINTS & SOLUTIONS

[PHYSICS]

1. Answer (3)

Hint & Sol.: For a paramagnetic material $\chi_m \propto \frac{1}{T}$.

2. Answer (4)

Hint: Magnetic moment $M = ml$, where l = length of each bar magnet

Sol.: Option (1) $\Rightarrow$ $M_1 = (2m)l = 2M > M$

Option (2) $\Rightarrow$ $M_2 = m(2l) = 2M > M$

Option (3) $\Rightarrow$ $M_3 = \sqrt{(ml)^2 + (ml)^2} = \sqrt{2}ml$

$= \sqrt{2}\, M > M$

3. Answer (3)

Hint: Magnetic field due to arc of a circle carrying current i is $B' = \frac{\mu_0 i}{4\pi r}\theta$, where θ = angle subtended by arc at the centre of the circle.

Sol.: Semi-infinite wire $AX \Rightarrow B_1 = \frac{\mu_0 i}{4\pi(AO)}$

$= \frac{\mu_0 i}{4\pi R}\odot$

Finite wire $AC \Rightarrow B_2$ = zero

Quadrant $CD \Rightarrow B_3 = \frac{\mu_0 i}{4\pi(OC)}.\frac{\pi}{2} = \frac{\mu_0 i}{4R}\otimes$

Semi-infinite wire $DX' \Rightarrow B_4$ = zero

$\therefore$ Net magnetic field $B = B_1 + B_2 + B_3 + B_4$

$= \left(\frac{\mu_0 i}{4R} - \frac{\mu_0 i}{4\pi R}\right)\otimes$

$= \frac{\mu_0 i}{4R}\left(1 - \frac{1}{\pi}\right)\otimes$

4. Answer (2)

Hint: Magnetic force on moving charge, $\vec{F} = q(\vec{v}\times\vec{B})$

Sol.: Acceleration of charge, $\vec{a} = \frac{\vec{F}}{m} \perp \vec{B}$ always

$\therefore\ \vec{a}\cdot\vec{B}$ = zero

5. Answer (4)

Hint: At resonance, $X_L = X_C$

$\Rightarrow\ \omega L = \frac{1}{\omega C} \Rightarrow \omega^2 = \frac{1}{LC}$

Sol.: Quality factor, $Q = \frac{\omega L}{R} = \frac{1}{R\omega C} = \frac{1}{R}\sqrt{\frac{L}{C}}$

6. Answer (3)

Hint: Self-inductance $L = \mu_0 n^2 Al$

Sol.: $\because$ n = constant and A = constant,

$\therefore\ L \propto l$

7. Answer (3)

Hint: Radius, $R = \frac{mv}{qB} = \sqrt{\frac{2m(\text{K.E.})}{qB}}$

Sol.: $R = \sqrt{\frac{2m(\text{K.E.})}{qB}}$

$R_2 = \sqrt{\frac{2\times m\times 3E_0}{q(2B)}} = \frac{\sqrt{3}}{2}R$

8. Answer (2)

Hint: [Induced emf] = [Voltage]

Sol.: [Induced emf] = $\left[\frac{\text{Energy}}{\text{Current}\times\text{time}}\right]$

$= \frac{[ML^2T^{-2}]}{[A]\,[T]} = [ML^2T^{-3}A^{-1}]$

9. Answer (1)

Hint & Sol.: The net magnetic force,

$\vec{F} = \oint\left(i\,d\vec{l}\times\vec{B}\right) = i\oint d\vec{l}\times\vec{B}$ = zero

10. Answer (4)

Hint: Torque acting on loop, $\vec{\tau} = \vec{M}\times\vec{B} = i(\vec{A}\times\vec{B})$

Sol.: The loop is in both x-z and y-z planes.

y-z plane $\Rightarrow$ $\vec{M}_1 = i_0 l^2\hat{i}$ $\Rightarrow$ $\vec{\tau}_1 = i_0 l^2 B_0(\hat{i}\times\hat{i})$ = zero

x-z plane $\Rightarrow$ $\vec{M}_2 = i_0 l^2\hat{j}$

$\Rightarrow\ \vec{\tau}_2 = i_0 l^2 B_0(\hat{j}\times\hat{i}) = -i_0 l^2 B_0\hat{k}$

Therefore, torque on loop = $i_0 l^2 B_0(-k)$

11. Answer (2)

Hint & Sol.: In electromagnetic waves, the electric field $\vec{E}$ and magnetic field $\vec{B}$ are in phase.

12. Answer (4)

Hint & Sol.: X-rays can damage living tissue can alter cell structures and damage DNA. Excessive exposure can lead to mutations that may damage living tissue increase the risk of developing cancer later in life. Thus, it is crucial to minimize over-exposure to X-rays.

13. Answer (1)

Hint: EMF induced across the ends of the rod is given by $\varepsilon = Blv_{\perp}$

Sol.: $v_{\perp} = v\cos60°$ perpendicular to rod

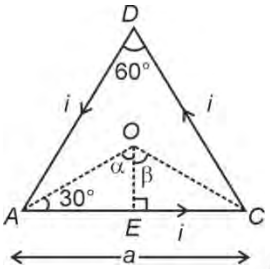
$\therefore\ \varepsilon = Blv\cos60° = 2 \times 2 \times 2 \times \frac{1}{2} = 4$ V

14. Answer (3)

Hint: Due to straight conductor AC, magnetic field at perpendicular distance $d = B$

$$B = \frac{\mu_0 i}{4\pi d}(\sin\alpha + \sin\beta)$$

Sol.: Side $AC = a$ & $\alpha = \beta = 60°$



$$\Rightarrow OE = d = \frac{AE}{\tan\alpha} = \frac{a}{2\sqrt{3}}$$

$$B_{net} = 3B_{AC} = \frac{3 \times \mu_0 i(2\sin60°)}{4\pi\left(\frac{a}{2\sqrt{3}}\right)}$$

$$= \frac{\mu_0 i}{4\pi a} \times 3 \times 4\sqrt{3} \times \frac{\sqrt{3}}{2}$$

$$= 10^{-7}\frac{i}{a} \times 18 = 10^{-7} \times \frac{1}{18 \times 10^{-2}} \times 18$$

$= 10^{-5}$ T

15. Answer (2)

Hint: Use Lenz's law to find direction of induced current.

Sol.: Flux through triangular loop, $\phi = \int \vec{B}.d\vec{s}$ where magnetic field $\vec{B}$ is due to the straight wire, while $d\vec{s}$ is of triangular loop. If i increases, then $|\phi|$ also increases.

$\therefore$ Induced current in loop will be in anti-clockwise direction and would oppose the change in $|\phi|$.

16. Answer (1)

Hint: The resistance R, does not depend upon source frequency.

Sol.: Inductive reactance, $X_L = \omega L = 2\pi fL \propto f$

Capacitive reactance, $X_C = \frac{1}{\omega C} = \frac{1}{2\pi fC} \propto \frac{1}{f}$

17. Answer (1)

Hint: Power factor = $\frac{R}{Z}$

Sol.: For an ideal choke coil, resistance R = zero and hence power factor is also zero.

18. Answer (1)

Hint: For consistency of Ampere circuital law, there must be displacement current between the plates of the capacitor.

Sol.: Modified Ampere circuital law or Ampere-Maxwell law is given by

$\oint \vec{B}.d\vec{l} = \mu_0(i_c + i_d)$, where

i_c = conduction current

i_d = displacement current

19. Answer (3)

Hint: Total average energy density U carried by electromagnetic wave is equally divided between electric field and magnetic field.

Sol.: $U = \frac{1}{2}\varepsilon_0 E_0^2 = \frac{1}{2}\frac{B_0^2}{\mu_0}$

Average energy density of electric field alone = $\frac{U}{2} = \frac{1}{4}\varepsilon_0 E_0^2 = \frac{1}{4}\frac{B_0^2}{\mu_0}$

20. Answer (4)

Hint: A step-down transformer converts a higher a.c. voltage to a lower a.c. voltage

Sol.: In step-down transformer, $V_s < V_p$ or $N_s < N_p$

$\Rightarrow I_s > I_p$

21. Answer (3)

Hint: Emf induced across inductor, $\varepsilon = -L\frac{di}{dt}$

Sol.: Using Lenz's law, $V_C > V_D$

$$V_C - V_D = L\frac{di}{dt} = 1 \times (+4) = +4 \text{ V}$$

22. Answer (2)

Hint: A.C. voltmeter reads rms value of voltage.

Sol.: $i_{rms} = \frac{V_{rms}}{Z} = \frac{12}{3} = 4$ A

$V_2 = i_{rms} \times X_L = 4 \times 4 = 16$ V

23. Answer (3)

Hint: Two parallel conductors carrying current in same direction, attract each other.

Sol.: Wires A and B attract each other. Similarly, wires B and C attract each other. Wires A and C also attract each other.

24. Answer (3)

Hint: The ferromagnetic property depends on temperature.

Sol.: At high enough temperature, a ferromagnet becomes a paramagnet. The disappearance of its magnetisation with temperature is gradual.

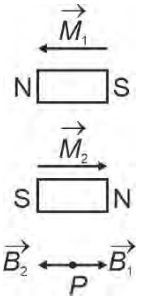
$\therefore$ Both statements A and B are correct

25. Answer (2)

Hint: Magnetic field due to a short bar magnet of magnetic moment $\vec{M}$ at equatorial position P is given by

$$\vec{B} = -\frac{\mu_0}{4\pi}\frac{\vec{M}}{r^3}$$

Sol.:



$$B_1 - B_2 = \frac{\mu_0 M}{4\pi(0.2)^3} - \frac{\mu_0 M}{4\pi(0.1)^3}$$

$$= \frac{\mu_0 M}{4\pi}\left(\frac{1}{\frac{1}{5^3}} - \frac{1}{\frac{1}{10^3}}\right)$$

$= 10^{-7} \times 100 \times (5^3 - 10^3) = -875 \times 10^{-5}$ T

$= -8.75 \times 10^{-3}$ T

$\therefore \vec{B}_{net} = -8.75\hat{i}$ mT

26. Answer (1)

Hint: $I_s = \frac{NBA}{C}, V_s = \frac{NBA}{RC}$

Sol.: Since $I_s = \frac{NBA}{C}$ and $V_s = \frac{NBA}{RC}$

$\therefore R = \frac{I_s}{V_s} = \frac{4}{8} = \frac{1}{2} = 0.5\ \Omega$

27. Answer (3)

Hint: For electric field vector $E_y = E_0 \sin(kx - \omega t)$, the speed of the wave is given by $v = \frac{\omega}{k}$

Sol.: Speed $v = \frac{\omega}{k} = \frac{3\times10^{10}\pi}{300\pi} = 1\times10^8$ m/s

28. Answer (3)

Hint: RMS value of current $i_{rms} = \frac{i_{peak}}{\sqrt{2}}$

Sol.: From the graph, i_{peak} = 6 A

$\therefore i_{rms} = \frac{6}{\sqrt{2}} = 3\sqrt{2}$ A

29. Answer (1)

Hint: Pitch of the helix is the distance moved by the charge along the direction of $\vec{B}$ in one time period.

Sol.: Time period of revolution $(T) = \frac{2\pi m}{qB_0}$

$\therefore$ Pitch = $v_{||}T = \frac{v_0}{2} \times \frac{2\pi m}{qB_0}$

30. Answer (4)

Hint: Time-varying magnetic field (B) induces non-conservative electric field (E).

Sol.: As per Lenz's law induced current will be in anticlockwise direction.

Using Faraday's law, induced emf

$$\varepsilon = \frac{d\phi}{dt} = A\frac{dB}{dt} = \pi r^2\frac{dB}{dt}$$

$\oint \vec{E}.d\vec{l} = \varepsilon \neq 0 \Rightarrow \vec{E}$ is non-conservative

$$\oint \vec{E}.d\vec{l} = \frac{d\phi}{dt}$$

$$\Rightarrow E.2\pi r = \pi r^2\frac{dB}{dt} \Rightarrow E = \frac{r}{2}\frac{dB}{dt}$$

31. Answer (4)

Hint: Magnetic force on moving charge, $\vec{F} = q(\vec{v}\times\vec{B})$

Sol.: $\vec{F} \perp \vec{v}$ and $\vec{F} \perp \vec{B}$

$\Rightarrow$ Its path is circular in a plane perpendicular to the $\vec{B}$

$\Rightarrow$ Its speed (v) and K.E. remain constant

$\Rightarrow$ Frequency of revolution, $f = \frac{qB}{2\pi m}$ is independent of radius of circular path.

$\Rightarrow$ Momentum $\vec{p}$ changes when direction of $\vec{v}$ changes along the path.

32. Answer (2)

Hint: Use Ampere's circuital law

$\oint \vec{B}.d\vec{l} = \mu_0 i_{enclosed}$

Sol.: By sign convention, contribution due to:

i_1 is positive

i_2 is negative

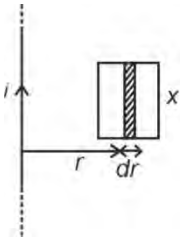
i_3 is positive

$\therefore \oint \vec{B}.d\vec{l} = \mu_0(i_1 - i_2 + i_3)$

33. Answer (2)

Hint: Coefficient of mutual inductance, $M = \frac{\phi}{i}$

Sol.:



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

$d\phi = B\, dA = \frac{\mu_0 i}{2\pi r}(x\, dr)$

$\Rightarrow \int d\phi = \frac{\mu_0 i x}{2\pi}\int_{2x}^{3x}\frac{dr}{r} \Rightarrow \phi = \frac{\mu_0 i x}{2\pi}\ln\left(\frac{3}{2}\right)$

$\therefore\ M = \frac{\phi}{i} = \frac{\mu_0 x}{2\pi}\ln\left(\frac{3}{2}\right)$

34. Answer (2)

Hint & Sol.: Infrared lamp is used in physical therapy i.e., to treat muscular strain.

35. Answer (3)

Hint: Magnetic field at the centre of a long solenoid, $B = \mu_0 ni$

Sol.: n = number of turns per unit length

$= \frac{2\times 700}{0.2} = 7000\ \text{m}^{-1}$

$B = \mu_0 ni \Rightarrow 2.2 \times 10^{-2} = 4\pi \times 10^{-7} \times 7000 \times i$

$\Rightarrow \frac{22}{1000} = 88 \times 10^{-4} \times i$

$\Rightarrow i = \frac{10}{4} = 2.5\ \text{A}$

36. Answer (4)

Hint: Phasor diagram represents phase relationship between voltage & current for an a.c. source.

Sol.: • (a – ii) Voltage and current in same phase

- (b – iv) Voltage leads current by ϕ
  $\Rightarrow R - L$ or RLC circuit
- (c – iii) Current lags behind voltage by $\frac{\pi}{2}$.
  $\Rightarrow$ Pure inductive circuit
- (d – v) Current leads voltage by ϕ.
  $\Rightarrow$ R – C or RLC circuit.

37. Answer (3)

Hint: If $X_C > X_L$, then current leads voltage in LCR series circuit by phase angle ϕ.

Sol.: $\cos\phi = \frac{R}{Z} = \frac{3}{\sqrt{R^2 + (X_C - X_L)^2}}$

$= \frac{3}{\sqrt{3^2 + 4^2}} = \frac{3}{5}$

$\Rightarrow \phi = 53°$

$V_{\text{peak}} = V_0 = \sqrt{2}\, V_{\text{rms}} = 50\sqrt{2} \times \sqrt{2} = 100\ \text{V}$

$i_{\text{peak}} = i_0 = \frac{V_0}{Z} = \frac{100}{5} = 20\ \text{A}$

$\therefore$ Current $i = 20\sin(100\pi t + 53°)$ A

38. Answer (3)

Hint & Sol.: Amongst the given waves, radio waves have highest wavelength while gamma rays have least wavelength.

39. Answer (2)

Hint: Use Ampere's circuital law,

$\oint \vec{B}.d\vec{l} = \mu_0 i_{\text{encl}}$

Sol.: Displacement current $i_d = i_c = 10$ A

$\Rightarrow B_P\, 2\pi r_1 = \frac{\mu_0 i_c}{\pi(10)^2}\pi r_1^2 \Rightarrow B_P \propto r_1$

Also, $B_Q \propto r_2$

$\therefore \frac{B_P}{B_Q} = \frac{r_1}{r_2} = \frac{4}{8} = 1:2$

40. Answer (2)

Hint: Magnetic susceptibility, $\chi_m = \mu_r - 1$

Sol.: Relative permeability $= \mu_r = \frac{\mu}{\mu_0}$

$= \frac{3.2\pi\times 10^{-4}}{4\pi\times 10^{-7}} \Rightarrow \mu_r = 800$

$\therefore\ \chi_m = \mu_r - 1 = 800 - 1 = 799$

41. Answer (1)

Hint: The direction of propagation of EM wave can be determined by $\vec{E}\times\vec{B}$ or by using the argument of sine function.

Sol.: $B_z = 2\sin\left[3\pi\times 10^8\left(t - \frac{x}{c}\right)\right]$T

The opposite signs of coefficients of x and t implies that wave is travelling along +x-axis.

42. Answer (1)

Hint: Work done by magnetic field to rotate the dipole from initial orientation θ_1 to final orientation θ_2 will be,

$W = U_i - U_f = MB[\cos\theta_f - \cos\theta_i]$

Sol.: $\theta_i = 60°$ and $\theta_f = 0°$

$\therefore\ W = 2\times10^4 \times 2\times10^{-5}\left(1-\frac{1}{2}\right) = 0.2\ \text{J}$

43. Answer (1)

Hint: At resonance in LCR series circuit, $X_C = X_L$

Sol.: At resonance,

Current $i = \frac{V}{Z}$ becomes maximum

Impedance $Z = \sqrt{R^2 + (X_L - X_C)^2} = R$ becomes minimum.

44. Answer (3)

Hint: Radius of circular path traced by charged particle inside transverse magnetic field, $R = \frac{mv_0}{qB}$

Sol.: As width $L > R$

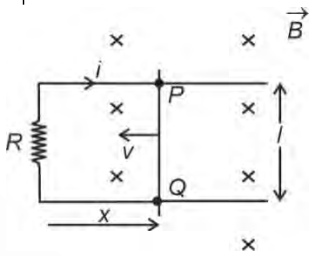
So, charge q will trace a semi-circle and exit the field.

Time spent = $\frac{T}{2} = \frac{2\pi m}{2qB} = \frac{\pi m}{qB}$

45. Answer (1)

Hint: Lenz's law states that the direction of induced emf and hence the direction of induced current in a closed circuit are such that they oppose the cause due to which they were produced.

Sol.: Flux $\phi = BA = Blx$



Induced emf, $\varepsilon = -\frac{d\phi}{dt}$

$\Rightarrow\ \varepsilon = Bl\left(-\frac{dx}{dt}\right) = Blv$

- Statement A is correct as ϕ is decreasing
- Statement B is wrong because $\vec{F} = i(\vec{l}\times\vec{B})$ is towards right

$\Rightarrow F = Bil = B\left(\frac{\varepsilon}{R+r}\right)l = \frac{Bl(Blv)}{R+r} = \frac{B^2l^2v}{R+r}$

- Statement C is wrong because power

$P = Fv = \frac{B^2l^2v^2}{R+r}$

[CHEMISTRY]

46. Answer (2)

Hint: $2Cu^+ \longrightarrow Cu^{2+} + Cu$

Sol.: The stability of $Cu^{2+}(aq)$ rather than $Cu^+(aq)$ is due to much more negative $\Delta_{hyd}H°$ of $Cu^{2+}(aq)$ than Cu^+, which is more than compensates for second ionisation enthalpy of Cu.

47. Answer (3)

Hint: Hf and Zr have almost similar radii

Sol.: Zn has lowest enthalpy of atomisation among 3*d*-series elements due to completely filled 3d orbital.

48. Answer (2)

Hint: Magnetic moment, $\mu = \sqrt{n(n+2)}$, n is number of unpaired electron(s).

Sol.: $Sc^{3+} \longrightarrow n = 0;\ \mu = 0$

$Mn^{2+} \longrightarrow n = 5;\ \mu = \sqrt{35}$ BM

$Cr^{2+} \longrightarrow n = 4;\ \mu = \sqrt{24}$ BM

$Ni^{2+} \longrightarrow n = 2;\ \mu = \sqrt{8}$ BM

49. Answer (1)

Hint: Interstitial compounds are chemically inert.

Sol.: Interstitial compounds retain metallic conductivity.

50. Answer (4)

Hint: Lanthanoids generally show +3 oxidation state.

Sol.: Yb^{2+} oxidises to Yb^{3+} and acts as reductant while Tb^{4+} reduces to Tb^{3+} and acts as oxidant.

51. Answer (2)

Hint: I^- is oxidised to I_2 by $KMnO_4$ in an acidic medium.

Sol.: $10I^- + 2MnO_4^- + 16H^+ \longrightarrow$

$2Mn^{2+} + 8H_2O + 5I_2$

So 10 moles KI require 2 moles of $KMnO_4$

52. Answer (1)

Hint: The ions having d^0 and d^{10} configuration are colourless

Sol.: $Ti^{3+} \longrightarrow [Ar]\ 3d^1$

$V^{3+} \longrightarrow [Ar]\ 3d^2$

$Sc^{3+} \longrightarrow [Ar]\ 3d^0$

$Mn^{2+} \longrightarrow [Ar]\ 3d^5$

$Fe^{3+} \longrightarrow [Ar]\ 3d^5$

$Co^{2+} \longrightarrow [Ar]\ 3d^7$

So, Ti^{3+}, V^{3+}, Mn^{2+}, Fe^{3+} and Co^{2+} are coloured in an aqueous medium.

53. Answer (3)

Hint & Sol.: The correct order of oxidising power is $VO_2^+ < Cr_2O_7^{2-} < MnO_4^-$

54. Answer (2)

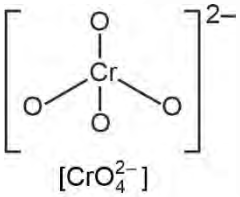
Hint: $d^4 \longrightarrow d^3$ occurs in case of Cr^{2+} to Cr^{3+}

Sol.: $d^6 \longrightarrow d^5$ occurs in case of Fe^{2+} to Fe^{3+}

In an aqueous medium, d^3 electronic configuration is more stable as compared to d^5 electronic configuration.

55. Answer (2)

Hint:



$[CrO_4^{2-}]$

Sol.: • In neutral or faintly alkaline solutions:

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

MnO_4^{2-} (manganate ion) is paramagnetic due to presence of one unpaired electron.

56. Answer (3)

Hint: Th shows predominantly +4 oxidation state

Sol.: Actinoid contraction is greater from element to element than lanthanoid contraction.

57. Answer (3)

Hint: Wilkinson catalyst is $[(Ph_3P)_3RhCl]$.

Sol.: $TiCl_4$ with $Al(CH_3)_3$ is used in manufacture of polyethene.

Fe is used in Haber's process.

$PdCl_2$ is used in Wacker process.

58. Answer (2)

Hint: Due to lanthanoid contraction, the ionic size from La to Lu decreases.

Sol.: The correct order of ionic size of given species is

$Nd^{3+} > Pm^{3+} > Sm^{3+} > Eu^{3+}$

59. Answer (3)

Hint: Curium is an actinoid having 96 atomic number.

Sol.: Electronic configuration of Cm

= [Rn] $5f^7\ 6d^1\ 7s^2$

60. Answer (1)

Hint: As the size of lanthanoid decreases, basic character decreases.

Sol.: The correct order of basic strength of given species is

$La(OH)_3 > Pr(OH)_3 > Gd(OH)_3 > Er(OH)_3$

61. Answer (2)

Hint: Haemoglobin contains Fe.

Sol.: Co is present in vitamin B_{12}

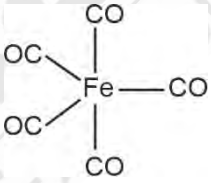
Rh is present in Wilkinson catalyst

Mg is present in chlorophyll.

62. Answer (4)

Hint: Oxidation state of Fe in $Fe(CO)_5$ is zero.

Sol.:



It has trigonal bipyramidal structure.

It has synergic bonding.

63. Answer (1)

Hint: CN^- and NH_3 are strong field ligands.

Sol.:

Coordination entity	Wavelength of light absorbed (nm)
$[Co(CN)_6]^{3-}$	310
$[Co(NH_3)_6]^{3+}$	475
$[Co(NH_3)_5(H_2O)]^{3+}$	500
$[CoCl(NH_3)_5]^{2+}$	535

64. Answer (3)

Hint: The crystal field theory is an electrostatic model which considered the metal-ligand bond to be ionic arising purely from electrostatic interaction between the metal ion and the ligand.

Sol.: The crystal field model does not take into account the covalent character of bonding but it is successful in explaining the formation, structures, colour and magnetic properties.

65. Answer (1)

Hint: When ligands are arranged in their increasing order of field strength, a series is obtained is called spectrochemical series.

Sol.: The correct order of ligand field strength is

$CO > CN^- > en > NH_3$

66. Answer (3)

Hint: Complexes with unsymmetrical distribution of electron in t_{2g} and e_g orbital show Jahn Teller distortion.

Sol.: In $[Cu(H_2O)_6]^{2+}$, Cu^{2+} has $t_{2g}^6 e_g^3$ configuration which is unsymmetrical.

67. Answer (2)

Hint: Crystal field stabilisation energy for octahedral complexes = $-0.4\Delta_0 (t_{2g})e^- + 0.6\ \Delta_0(e_g)$ e^-

Sol.: $[Fe(CN)_6]^{4-} \longrightarrow t_{2g}^6\ e_g^0$

$\rightarrow$ CFSE = $(-0.4 \times 6 + 0.6 \times 0)\ \Delta_0 = -2.4\Delta_0$

$[FeF_6]^{4-} \longrightarrow t_{2g}^4 e_g^2$

$\rightarrow$ CFSE = $(-0.4 \times 4 + 0.6 \times 2)\Delta_0$

$= (-1.6 + 1.2)\ \Delta_0 = -0.4\Delta_0$

68. Answer (3)

Hint: The metal-carbon σ bond in metal carbonyls is formed by donation of lone pair of electrons on the carbonyl carbon into vacant orbital of metal.

Sol.: The metal-carbon π bond in metal carbonyls is formed by donation of a pair of electrons from a filled d orbital of metal into vacant antibonding π^* orbital of carbon monoxide.

69. Answer (1)

Hint: $[NiCl_4]^{2-}$ is paramagnetic because it has two unpaired electrons.

Sol.: $[Ni(NH_3)_6]^{2+}$ is diamagnetic so it is spin paired complex

70. Answer (2)

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

Sol.: $5.9\ BM = \sqrt{n(n+2)}$

n = 5

In $[MnBr_4]^{2-}$, Mn has 5 unpaired electrons and 4 coordination number so it should be tetrahedral in shape rather than square planar.

71. Answer (3)

Hint: Cis-$[PtCl_2(en)_2]^{2+}$ is optically active.

Sol.: $[PtCl_2(en)_2]^{2+}$ has d^6 configuration so all electrons are paired. Hence spin only magnetic moment is zero.

72. Answer (3)

Hint: When a ligand is bound to a metal ion through several donor atoms is known as polydentate ligand.

Sol.: $[EDTA]^{4-}$ is a hexadentate ligand

73. Answer (3)

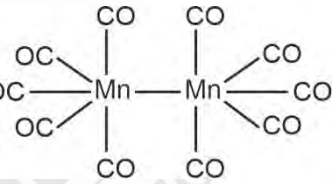
Hint: Higher the negative charge on metal, more is the back donation from metal to carbon and more is the C – O bond length

Sol.: Correct order of C – O bond length $\Rightarrow$

$Fe(CO)_4]^{2-} > [Co(CO)_4]^{\ominus} > [Ni(CO)_4] > [Mn(CO)_6]^+$

74. Answer (1)

Hint & Sol.:



75. Answer (2)

Hint: $[Co(NH_3)_4Cl_2]^+$ is heteroleptic complex.

Sol.: $[Co(NH_3)_4Cl_2]^+$ shows cis-trans isomerism.

76. Answer (3)

Hint: Reaction of amine with benzoyl chloride is known as benzoylation.

Sol.:

$$CH_3NH_2 + C_6H_5-\overset{\overset{O}{\|}}{C}-Cl \longrightarrow CH_3-\overset{\overset{H}{|}}{N}-\overset{\overset{O}{\|}}{C}-C_6H_5$$

(N-Methylbenzamide)

77. Answer (2)

Hint: $CH_3CONH_2 \xrightarrow{LiAlH_4} CH_3CH_2NH_2$

Sol.: $CH_3NC \xrightarrow{LiAlH_4} CH_3NHCH_3$

$CH_3CN \xrightarrow{LiAlH_4} CH_3CH_2NH_2$

$CH_3CONH_2 \xrightarrow{LiAlH_4} CH_3CH_2NH_2$

78. Answer (3)

Hint: Primary amines form three hydrogen bonds

Sol.:

Compound	Boiling point (K)
$n\text{-}C_4H_9NH_2$	350.8
$(C_2H_5)_2NH$	329.3
$C_2H_5N(CH_3)_2$	310.5

79. Answer (1)

Hint: Aliphatic amines are more basic than aromatic amines

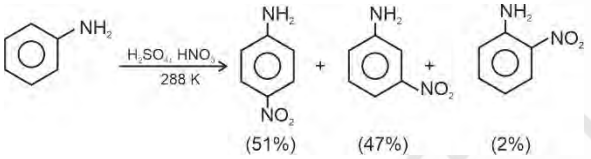
Sol.:

(Amines)	(pK_b value)
Benzenamine	9.38
Phenylmethanamine	4.70
N-Methylaniline	9.30
N, N-Dimethylaniline	8.92

80. Answer (2)

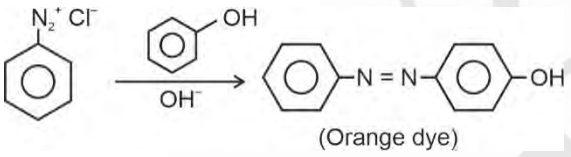
Hint: In strongly acidic medium, aniline is protonated to form anilinium ion which is meta directing.

Sol.:

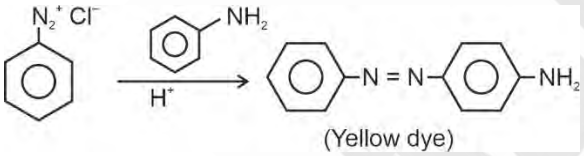


81. Answer (1)

Hint:

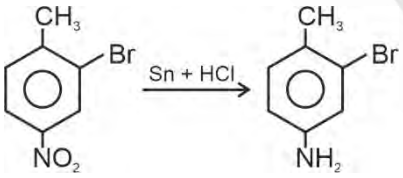


Sol.:

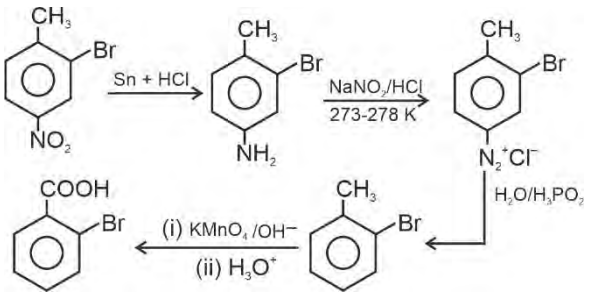


82. Answer (3)

Hint:

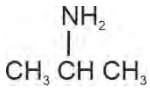


Sol.:



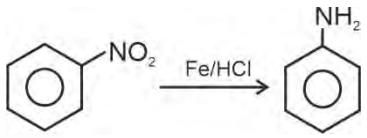
83. Answer (2)

Hint: Primary amines releases N_2 gas on treatment with nitrous acid.

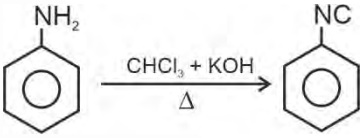
Sol.: $CH_3CH_2CH_2NH_2$ and  are primary amines, those liberate N_2 gas on treatment with nitrous acid.

84. Answer (4)

Hint:



Sol.:



85. Answer (4)

Hint: Aliphatic and aromatic primary amines give carbylamine test.

Sol.: Aliphatic primary amines can be prepared by Gabriel phthalimide synthesis.

86. Answer (1)

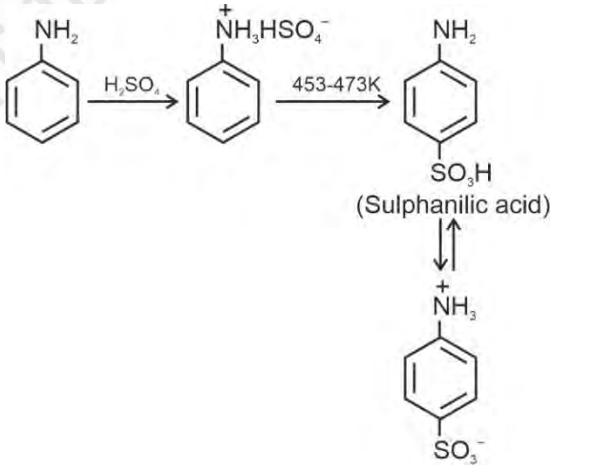
Hint : $C_6H_5SO_2Cl$ is known as Hinsberg's reagent

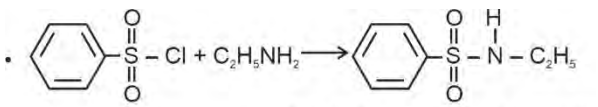
Sol.: Hinsberg's reagent can be used to distinguish 1°, 2° and 3° amines. 3° amines do not react with Hinsberg's reagent.

87. Answer (3)

Hint: p-Aminobenzene sulphonic acid is known as sulphanilic acid

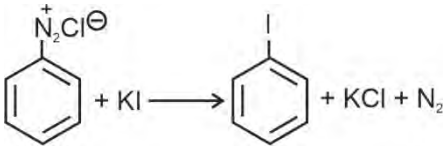
Sol.:





N-Ethylbenzenesulphonamide
(Soluble in alkali)

88. Answer (2)

Hint: 

Sol.: Aniline does not undergo Friedel-Crafts reaction due to salt formation with aluminium chloride, the Lewis acid, which is used as a catalyst.

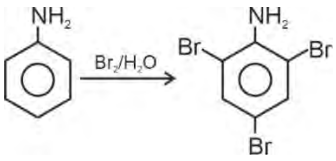
The correct order of basic strength of methyl substituted amines in aqueous phase is

$(CH_3)_2NH > CH_3NH_2 > (CH_3)_3N > NH_3$

89. Answer (4)

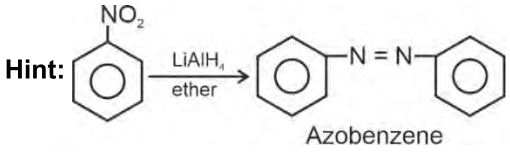
Hint: Aniline is highly reactive towards electrophilic substitution reaction.

Sol.:



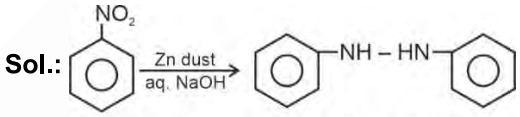
90. Answer (2)

Hint:



Azobenzene

Sol.:



Hydrazobenzene

[BOTANY]

91. Answer (2)

Hint: DNA acts as the genetic material in most of the organisms.

Sol.: RNA also acts as a genetic material in some viruses, but mostly functions as a messenger.

92. Answer (4)

Hint: Base pairing is not present in ssRNA and ssDNA.

Sol.: $\phi \times 174$ bacteriophage has ssDNA and Tobacco mosaic viruses, QB bacteriophage has ssRNA as their genetic material. Thus, these genetic materials lack base pairing and so, hydrogen bonds between bases.

93. Answer (1)

Hint: One of the enzymes used to clear the fruit juice breaks down proteins by hydrolyzing the peptide bonds.

Sol.: Fruit juices are clarified by the use of pectinases and proteases.

94. Answer (2)

Hint: In the first phase itself, amino acids are activated in the presence of ATP and linked to their cognate tRNA – a process commonly called as charging of tRNA.

Sol.: When the small subunit encounters an mRNA, the process of translation of the mRNA to protein begins.

95. Answer (1)

Hint: The pyrimidine Uracil is exclusive to RNA and in RNA, pyrimidines are Cytosine and Uracil.

Sol.: Pyrimidine Cytosine is common to both DNA and RNA.

Number of cytosine in mRNA = 70 – 45 = 25

The number of cytosine in coding strand of DNA would be the same as in mRNA, *i.e.*, 25

96. Answer (4)

Hint: In RNA, every nucleotide residue has an additional –OH group present at 2′ -position in the ribose.

Sol.: The two chains in dsDNA have anti-parallel polarity. The backbone of a polynucleotide chain is formed due to sugar and phosphates.

97. Answer (1)

Hint: Statins are produced by *Monascus purpureus*.

Sol.: Statins produced by the yeast *Monascus purpureus* (a fungus) have been commercialised as blood-cholesterol lowering agents.

98. Answer (3)

Hint: In 1953, James Watson and Francis Crick proposed a very simple Double Helix model for the structure of DNA.

Sol.: James Watson and Francis Crick, based on the X-ray diffraction data produced by Maurice Wilkins and Rosalind Franklin, proposed a very simple but famous Double Helix model for the structure of DNA.

99. Answer (4)

Hint: DNA cannot directly code for the synthesis of proteins.

Sol.: RNA can directly code for the synthesis of proteins, hence can easily express the characters. DNA, however, is dependent on RNA for the synthesis of proteins.

100. Answer (4)

Hint: Phosphodiester linkage between two nucleotides is present in both RNA and DNA.

Sol.: The plane of one base pair in DNA stacks over the other in double helix. This, in addition to H-bonds, confers stability of the helical structure. The packaging makes the DNA more compact and protects it from damage.

101. Answer (2)

Hint: Microbes like bacteria and many fungi can be grown on nutritive media to form colonies.

Sol.: Viruses cannot be grown on nutritive media. They are obligate intracellular parasites and reproduce only inside the living cells.

102. Answer (2)

Hint: The given representation shows reverse central dogma of molecular biology.

Sol.: The process in cells by which an enzyme makes a copy of DNA from RNA is called reverse transcription. A cell infected with viruses that have RNA as genetic material and an enzyme reverse transcriptase would be able to show all four processes.

103. Answer (4)

Hint: Histones are rich in basic amino acid residues lysine and arginine.

Sol.: In eukaryotes, the overall charge on histones is positive because histones are rich in basic amino acid residues lysine and arginine which carry positive charges in their side chains.

104. Answer (3)

Hint: The structure shown in the given diagram represents nucleosomes, that constitute the repeating unit of a structure in nucleus called chromatin.

Sol.: The nucleosomes in chromatin are seen as 'beads-on-string' structure when viewed under electron microscope. The beads-on-string structure in chromatin is packaged to form chromatin fibers that are further coiled and condensed to form chromosomes.

105. Answer (4)

Hint: Methane is formed by the activity of methanogens during biogas production.

Sol.: The common gas that is formed in fermentation of dough, cheese making, production of beverages, and production of biogas is CO_2.

106. Answer (3)

Hint: Capsid of bacteriophages is made up of protein.

Sol.: Proteins have sulphur. When the medium in which *E. coli* is growing has radioactive sulphur, the bacteria will pick up these sulphur compounds as nutrients and these will be further incorporated in the capsid of newly formed phages.

107. Answer (3)

Hint: A molecule that can act as a genetic material should be stable chemically and structurally.

Sol.: Criteria that are fulfilled by a molecule that can act as a genetic material are as follows:

- It should be able to generate its replica (Replication).
- It should be stable chemically and structurally.
- It should provide the scope for slow changes (mutation) that are required for evolution.
- It should be able to express itself in the form of 'Mendelian characters'.

108. Answer (4)

Hint: The pitch of the DNA helix is 3.4 nm and there are roughly 10 bp in each turn.

Sol.: Here, 25000 nucleotides = 12500 bp.

Since, there are 10 bp in 3.4 nm, then 12500 bp would be present in $\frac{12500 \times 3.4}{10} = 4250$ nm

$= 4.25\ \mu m$

109. Answer (2)

Hint: In some viruses, RNA acts as genetic material.

Sol.: RNA can function as adapter, structural, and in some cases, as a catalytic molecule.

110. Answer (3)

Hint: DNA replication is semiconservative.

Sol.: After the completion of replication, each DNA molecule would have one parental and one newly synthesised strand.

111. Answer (1)

Hint: In the first generation, only hybrid DNA is formed.

Sol.: In the third generation there will be two hybrid and six light DNA. Since, there will be no heavy DNA in this generation, number of bands in CsCl will be two, due to two different densities of DNA.

112. Answer (2)

Sol.: Beetle with red and black markings – the Ladybird, and Dragonflies are useful to get rid of aphids and mosquitoes, respectively.

113. Answer (3)

Hint: Primase is an enzyme that synthesizes short RNA sequences in DNA dependent manner, essential for initiating DNA replication.

Sol.: DNA dependent DNA polymerase is the main enzyme for DNA polymerisation. 23S rRNA in bacteria and 28S rRNA in eukaryotes are the enzymes- ribozymes, for the formation of peptide bond.

In addition to acting as substrates, deoxyribonucleoside triphosphates provide energy for polymerization reaction.

114. Answer (3)

Hint: The DNA-dependent DNA polymerases catalyse polymerisation only in one direction, that is, $5' \rightarrow 3'$.

Sol.: The replication occurs within a small opening of the DNA helix, referred to as replication fork. Each origin of replication has two replication forks.

115. Answer (4)

Hint: The Ministry of Environment and Forests has initiated Ganga Action Plan and Yamuna Action Plan to save these major rivers of our country from pollution.

Sol.: Ganga Action Plan and Yamuna Action Plan are proposed to build a large number of sewage treatment plants so that only treated sewage may be discharged in the rivers.

116. Answer (2)

Hint: In humans, chromosome Y has the fewest genes, *i.e.*, 231.

Sol.: In humans, chromosome 1 has the most genes, and Y has the fewest.

117. Answer (2)

Hint: DNA polymorphism refers to variations in DNA sequences between individuals.

Sol.: During DNA fingerprinting, repetitive DNA are separated from bulk genomic DNA as different peaks during density gradient centrifugation. The bulk DNA forms a major peak and the other small peaks are referred to as satellite DNA. The sequences in satellite DNA normally do not code for any proteins, and show high degree of polymorphism.

118. Answer (4)

Hint: In *lac* operon, operator gene interacts with regulator molecule, which prevents RNA polymerase from transcribing the operon.

Sol.: In *lac* operon, both regulator gene and structural genes are transcribed, but promoter gene and operator gene do not.

119. Answer (3)

Hint: Three types of RNA polymerases are found in nucleus.

Sol.: RNA polymerases I and III catalyse the synthesis of rRNA and RNA polymerase II catalyses the synthesis of hnRNA.

120. Answer (1)

Hint: A translational unit in mRNA is the sequence of RNA that is flanked by the start codon (AUG) and the stop codon and codes for a polypeptide.

Sol.: The mRNA transcribed from the given mutated DNA segment is as follows:

121. Answer (4)

Hint: Viroids are also considered as microbes.

Sol.: Microbes are diverse–protozoa, bacteria, fungi and microscopic animal and plant viruses, viroids and also prions, that are the proteinacious infectious agents.

122. Answer (4)

Hint: Organic acids, like citric acid, acetic acid, butyric acid and lactic acid are produced on commercial scale by using microbes.

Sol.: *Clostridium butylicum*, *Aspergillus niger* and *Lactobacillus* are used to produce butyric acid, citric acid and lactic acid respectively on commercial scale.

123. Answer (3)

Hint: Blue green algae, such as *Anabaena*, *Nostoc*, *Oscillatoria* etc. add organic matter to the soil and increase its fertility.

Sol.: *Glomus,* a fungus, in symbiotic association enhances the plant tolerance to salinity and drought. *Rhizobium* forms nodules on the roots of leguminous plants. *Bacillus thuringiensis*, a microbial biocontrol agent can be introduced in order to control butterfly caterpillars.

124. Answer (1)

Hint: During the process of DNA fingerprinting, hybridisation using labelled VNTR probe is done after transferring (blotting) of separated DNA fragments to synthetic membranes, such as nitrocellulose or nylon.

Sol.: The final step of the process of DNA fingerprinting is detection of hybridised DNA fragments by autoradiography. It is done after the hybridisation of DNA, using labelled VNTR probe.

125. Answer (1)

Hint: *Penicillium* inhibits the growth of *Staphylococci*.

Sol.: *Penicillium* secretes a chemical called antibiotic that checks the growth of *Staphylococci*.

126. Answer (1)

Hint: When a mixture of heat-killed S strain and live R strain *Streptococcus pneumoniae* bacteria is injected to the mice, the mice died.

Sol.: When the *Streptococcus pneumoniae* in Griffith's experiments was heat killed, the DNA of the bacteria was not denatured.

127. Answer (3)

Hint: The organic farmers work to create a system where the insects are not eradicated, but instead are kept at manageable levels by a complex system of checks and balances.

Sol.: The use of biocontrol measures greatly reduces the dependence on toxic chemicals and pesticides.

128. Answer (1)

Hint: Avery, MacLeod and McCarty purified biochemicals (proteins, DNA, RNA, etc.) from the heat-killed S cells to see which ones could transform live R cells into S cells.

Sol.: Avery, MacLeod and McCarty discovered that DNA alone from S bacteria caused R bacteria to become transformed, and thus they confirmed that it was DNA that functions as transforming principle.

129. Answer (3)

Hint: *Trichoderma* species are very common in the root ecosystems. They are useful in the treatment of plant disease.

Sol.: *Trichoderma* species are free-living fungi in the root ecosystems. They are effective biocontrol agents of several plant pathogens.

130. Answer (2)

Hint: During the first step of sewage treatment, physical removal of large and small particles from the sewage through filtration and sedimentation is done.

Sol.: After physical removal of large and small particles from the sewage in STP, following steps are done:

- Primary effluent is passed into large aeration tanks.
- Constant agitation mechanically and air is pumped.
- Significant reduction in the Biochemical Oxygen Demand of the effluent.
- The effluent from the treatment plant is released into natural water bodies like rivers and streams.

131. Answer (1)

Hint: Both the nucleic acids (DNA and RNA) have the ability to direct their duplications.

Sol.: The other molecules in the living system, such as proteins do not follow the property of base pairing.

132. Answer (3)

Hint: Oxygenic photosynthesis occurs in cyanobacteria.

Sol.: Cyanobacteria, *e.g., Anabaena*, *Nostoc*, *Oscillatoria*, etc. are photoautotrophic microbes which can fix atmospheric nitrogen. During photosynthesis, they evolve oxygen.

133. Answer (3)

Hint: Replication of DNA is not said to be regulation of gene expression.

Sol.: Mostly in prokaryotes, mRNA does not require any processing to become active.

134. Answer (2)

Hint: During curd formation, the LAB produce acids that coagulate and partially digest the milk proteins.

Sol.: Lactic acid bacteria, while converting milk into curd, improves its nutritional quality by increasing vitamin B_{12}.

135. Answer (3)

Hint: The pyrimidines that are not common between DNA and RNA are Thymine and Uracil.

Sol.: Thymine and Uracil are linked to 1′ carbon of pentose sugar. They form two hydrogen bonds with the corresponding base. Thymine is present in DNA and Uracil is present in RNA.

[ZOOLOGY]

136. Answer (4)

Hint: Eliminate the physical barrier of innate immunity.

Sol.: Innate immunity consists of four types of barriers. They are:

(i) Physical barriers: Skin on our body and mucus coating of the epithelium lining the respiratory, gastrointestinal and urogenital tracts help in trapping microbes entering our body.

(ii) Physiological barriers: Acid in the stomach, saliva in the mouth and tears from eyes.

(iii) Cellular barriers: Neutrophils, monocytes and NK cells.

(iv) Cytokine barriers: Interferons secreted by virus-infected cells.

137. Answer (3)

Hint: Exclude the viral disease

Sol.: Plague is caused by *Yersinia pestis*.

Small pox is caused by Variola virus.

Whooping cough is caused by the bacterium, *Bordetella pertussis*.

Tuberculosis is caused by the bacterium, *Mycobacterium tuberculosis*.

138. Answer (4)

Hint: Can be passed on to future generations

Sol.: Balanced diet, personal hygiene and regular exercise are very important to maintain good health.

Genetic disorders are deficiencies with which a child is born and deficiencies/defects which the child inherits from parents from birth.

139. Answer (1)

Hint: Body generates antibodies on its own.

Sol.: Vaccination provides artificial active immunity.

Colostrum contains I_gA antibodies and it provides natural passive immunity to the infant.

ATS (Anti-tetanus serum) provides artificial passive immunity.

Natural infections induce natural active immunity.

140. Answer (4)

Hint: H_2L_2

Sol.: Antibody molecules are glycoproteins; thus, they are heteropolymers.

Antigen-binding site is present towards the variable region of both heavy and light chains.

Antibody molecules are stabilized by strong covalent disulfide bonds.

Antibody molecules are made up of four polypeptide chains.

141. Answer (2)

Hint: Recall the type of response shown by the body when it encounters a pathogen for the first time.

Sol.: When we recover from an infection without taking anti-microbial drugs, it is usually because of the primary response.

Humoral immunity is mediated by B-lymphocytes. Cell-mediated immunity is mediated by T-lymphocytes.

Plasma cells are differentiated B-lymphocytes which are capable of secreting antibodies.

Secondary immune response is mediated by both B and T-lymphocytes

142. Answer (3)

Hint: Air filled sacs are affected.

Sol.: Symptoms of pneumonia and common cold include headache, cough, *etc*.

Both these diseases can spread *via* contaminated objects like utensils, cups, books, *etc*.

Common cold is caused by rhinoviruses.

Pneumonia is caused by *Streptococcus pneumoniae* and *Haemophilus influenzae.*

In common cold, nose and respiratory passage gets infected, not the lungs.

In pneumonia, alveoli of the lungs get affected.

In severe cases of pneumonia, the lips and finger nails may turn grey to bluish in colour which is called cyanosis.

143. Answer (3)

Hint: Include the disease that affects the knee joint

Sol.: Vitiligo, systemic lupus erythematosus, psoriasis and myasthenia gravis are examples of auto-immune disorders.

Tetanus is a bacterial disease.

Ringworm is a fungal disease.

Rheumatoid arthritis is characterized by inflammation in the joints.

Myasthenia gravis affects neuromuscular junction leading to fatigue, weakening and paralysis of skeletal muscle.

144. Answer (4)

Hint: Not all microorganisms are harmful.

Sol.: All immunogens are antigens, but all antigens are not immunogens.

Thymus is quite large at the time of birth but keeps reducing in size with age and by the time puberty is attained it reduces to a very small size.

Antibodies do not directly engulf and kill pathogens, but by binding to antigens, they interfere with pathogen activity or mark pathogens in various ways for inactivation or destruction.

145. Answer (2)

Hint: Eliminate the multiples of 2.

Sol.: *Salmonella typhi* (a bacterium) is the causative agent of typhoid fever. These pathogens generally enter the small intestine through food and water contaminated with them and migrate to other organs through blood. Sustained high fever, weakness, stomach pain, constipation, headache, *etc.*, are the common symptoms of this disease.

146. Answer (2)

Hint: Diphtheria is caused by the same group of pathogens that causes plague.

Sol.: For diphtheria, vaccine is prepared from inactivated toxins.

For polio, vaccine is prepared from harmless viruses

Harvested antibodies refer to the antibodies that have been collected and extracted from a source after they have been produced, typically from a biological source, like an animal or cell culture.

147. Answer (4)

Hint: Choose a depressant.

Sol.: Amphetamine is a stimulant. It has a potent stimulating action on CNS. Cocaine is also a stimulant and ganja is a cannabinoid. They act as hallucinogens at different doses.

Barbiturates are depressants.

148. Answer (3)

Hint: Recall the functions of primary lymphoid organs.

Sol.: Primary lymphoid organs (bone marrow and thymus) are the sites where lymphocytes mature and become immunocompetent without encountering antigens.

Secondary lymphoid organs are the sites where mature lymphocytes are activated upon antigen exposure.

Both bone marrow and thymus provide micro-environments for the development and maturation of T-lymphocytes.

149. Answer (1)

Hint: Infective stage of the malarial pathogen for mosquitoes is gametocytes.

Sol.: Gametocytes are the sexual forms of the parasite formed in the human blood stream.

While they do not cause symptoms (like fever) they are crucial for the transmission of malaria.

When a female *Anopheles* mosquito bites an infected person, it ingests gametocytes along with the blood.

These gametocytes develop into gametes inside the mosquito's gut, beginning the sexual cycle and eventually leading to the formation of sporozoites, which are the infectious stage for humans.

150. Answer (3)

Hint: HIV belongs to the group of retroviruses.

Sol.: Despite the production of antibodies during early stages of infection, HIV continues to replicate and evade immune responses, leading to progressive T_H-cell depletion and eventually immunodeficiency.

HIV's reverse transcriptase lacks proofreading ability, leading to frequent mutations. This antigenic variability enables it to escape neutralization by existing antibodies, rendering humoral responses insufficient.

The genetic material of HIV is ssRNA not DNA.

151. Answer (4)

Hint: A helminthic disease

Sol.: The pathogen of filariasis is *Wuchereria malayi*. The pathogens are transmitted to a healthy person through the bite of an infected female *Culex* mosquito.

Ascariasis spreads *via* faeco-oral route.

Amoebic dysentery is a protozoan disease. Houseflies act as the mechanical carriers of its pathogen. It spreads *via* faeco-oral route.

152. Answer (1)

Hint: More than the number of external nostrils in humans

Sol.: A large number of infectious diseases like polio, diphtheria, pneumonia and tetanus have been controlled to a large extent by the use of vaccine.

153. Answer (4)

Hint: Eliminate the physical carcinogens

Sol.: Ionizing radiations like X-rays and gamma rays and non-ionizing radiations like UV rays cause DNA damage leading to neoplastic transformation.

The chemical carcinogens such as benzene and 1-3 butadiene present in tobacco smoke have been identified as a major cause of cancer.

Cancer causing viruses, called oncogenic viruses, have genes called viral oncogenes.

154. Answer (4)

Hint: Acts as a potent sedative.

Sol.: The given image represents an opium poppy plant.

Heroin is a semi-synthetic product obtained by the acetylation of morphine. It is not obtained naturally.

Morphine is extracted from the latex of poppy plant named *Papaver somniferum*.

The drugs from this plant bind to specific receptors present in our CNS and GIT.

155. Answer (2)

Hint: Metastasis is the most feared property of malignant tumors.

Sol.: Presence of well-differentiated cells, encapsulation and lack of invasion are the classical features of benign tumors. These tumors do not metastasize and usually remain confined to their tissue of origin, distinguishing them from malignant counterparts which show high mitotic index and invasiveness.

Cells sloughed from malignant tumors reach distant sites through blood and wherever they get lodged in the body, they start a new tumor there. This property is called metastasis.

156. Answer (4)

Hint: Number of patella in a hindlimb.

Sol.: The principle of immunization or vaccination is based on the memory of the immune system.

Innate immunity is a non-specific type of defence present at the time of birth.

Acquired immunity is a specific type of immune response.

Exaggerated response of the immune system of our body is called allergy. Allergy is caused by allergens like dust mites, pollen grains, *etc*.

157. Answer (2)

Hint: Telomerase activity increases in tumor cells.

Sol.: HIV is an enveloped virus.

In tumor cells, the activity of the telomerase enzyme is upregulated to maintain the length of the telomeres.

Telomerase allows cancer cells to bypass replicative senescence. The activity of telomerase inhibitor is destroyed in cancer cells due to mutations.

HIV reverse transcripts to integrate with host's DNA for progeny production.

158. Answer (3)

Hint: Reproductive fitness

Sol.: Darwin proposed that individuals within a species show variation in traits and these variations are often heritable. Those individuals whose inherited traits confer a survival or reproductive advantage are more likely to survive and pass on those traits.

Over generations, these advantageous traits become more common in the population, resulting in evolutionary change.

The theory of inheritance of acquired traits was given by Lamarck.

Hugo deVries talked about mutations.

Random mating maintains genetic equilibrium in a population.

159. Answer (1)

Hint: Chemical theory of evolution

Sol.: The Oparin-Haldane hypothesis proposed that life originated in a reducing atmosphere, where organic molecules could be synthesized abiotically from simple inorganic compounds.

Miller (1953) tested this hypothesis by simulating early Earth conditions: a mixture of CH_4, NH_3, H_2, and water vapour, along with electric sparks to simulate lightning.

After sometime, he observed the formation of amino acids (*e.g.*, glycine, alanine), supporting the idea that non-enzymatic abiotic synthesis of life's building blocks was possible.

Miller's setup did not involve oxygen.

For a long time, it was also believed that, life came out of decaying and rotting matter like straw, mud, *etc*. This was the theory of spontaneous generation.

160. Answer (1)

Hint: Less than 5 bya.

Sol.: In the solar system of the Milky way galaxy, Earth was supposed to have been formed about 4.5 billion years back.

161. Answer (4)

Hint: Given by Hugo de Vries.

Sol.: The Big Bang theory attempts to explain to us the origin of Universe.

Alfred Wallace, a naturalist, who worked in Malay Archipelago, had also come to similar conclusions as Darwin around the same time.

Relative dating is the process of determining if one rock or geologic event is older or younger than another, without knowing their specific ages.

Hugo deVries believed that mutation caused speciation and hence called it saltation (single-step large mutation).

162. Answer (1)

Hint: Few plants existed probably around 320 mya.

Sol.: The first non-cellular forms of life could have originated 3 billion years back.

About 2000 mya, the first cellular forms of life appeared on Earth.

Sea weeds and few plants existed probably around 320 mya.

About 65 mya, the dinosaurs suddenly disappeared from the Earth.

163. Answer (3)

Hint: Ramification of genetic drift

Sol.: The founder effect is a form of genetic drift that occurs when a small group of individuals becomes isolated from a larger population.

In the case given in the question, the red coloured trait, originally rare, becomes common in the island population not because of selection, but because the founding individuals happened to carry it.

This effect is random and non-adaptive, meaning that the trait may increase in frequency regardless of whether it provides a survival advantage.

Gene flow requires movement into the island population from the mainland, which contradicts the isolation described.

Mutation could explain a new trait, but the red-coloured trait was already present in the founding individuals.

164. Answer (1)

Hint: His proposal was disapproved.

Sol.: Embryological support for evolution was proposed by Ernst Heckel based upon the observation of certain features during embryonic stage common to all vertebrates that are absent in adult.

Thomas Malthus studied population.

William Harvey disapproved the good humor hypothesis and discovered blood circulation.

Louis Pasteur by careful experimentation demonstrated that life comes only from pre-existing life.

165. Answer (3)

Hint: q^2 is given

Sol.: According to the Hardy-Weinberg principle, allele frequencies are related to genotype frequencies as follows:

- $p^2 + 2pq + q^2 = 1$,

  where, p = frequency of dominant allele (A)

  q = frequency of recessive allele (a)

  q^2 = frequency of homozygous recessive genotype (aa)

From the question:

- $q^2 = 0.09 \rightarrow q = \sqrt{0.09} = 0.3$

  Since $p + q = 1$,

$\rightarrow p = 1 - 0.3 = 0.7$

166. Answer (1)

Hint: Early Earth's atmosphere was devoid of free oxygen.

Sol.: Early Earth's atmosphere lacked oxygen, so the first life forms were anaerobic.

The first organisms on the primitive Earth were non-photosynthetic as free oxygen was absent in the early atmosphere.

These were likely chemoautotrophs that obtained energy by oxidizing inorganic substances (*e.g.,* sulfur or iron compounds).

Green photosynthetic organisms (like cyanobacteria) and aerobic respiration evolved much later.

167. Answer (2)

Hint: Same structure developed along different directions due to adaptations to different needs

Sol.: Vertebrate hearts or brains show homology. Homology indicates common ancestry.

Homologous organs are the result of divergent evolution.

Analogous structures are the result of convergent evolution; different structures evolving for the same function and hence having similarity.

168. Answer (2)

Hint: Starting from a point and radiating to different directions

Sol.: Darwin's finches evolved from a common ancestral seed-eating species that arrived on the Galapagos Islands.

Over time, these birds diverged morphologically, particularly in beak shape and size, due to natural selection acting on varying feeding strategies (*e.g.*, seed-cracking, insect-catching, nectar-feeding).

The process of evolution of different species in a given geographical area starting from a point and literally radiating to other areas of geography (habitats) is called adaptive radiation.

Geographic isolation promotes speciation, not gene flow.

169. Answer (2)

Hint: Biochemical analysis indicates evolutionary relationships.

Sol.: Molecular evolution reveals that genetic differences accumulate over time and the number of differences reflects the evolutionary distance.

Fewer differences suggest a more recent common ancestor, which is the case with humans and chimpanzees.

Parallel evolution occurs when two or more unrelated species develop similar traits independently, but in response to similar environmental pressures or ecological niches.

170. Answer (2)

Hint: Both types of beetles were present

Sol.: In a mixed population, those that can better adapt, survive and increase in population size. No variant got completely wiped out.

Beetles already possessed genetic variations that were beneficial under new environmental conditions, even before those conditions arose.

171. Answer (1)

Hint: Angiosperms also appeared in the same era.

Sol.: Mesozoic era – Birds originated

Proterozoic era -Lower invertebrates formed

Paleozoic era - Fishes and amphibians originated

172. Answer (4)

Hint: Its removal from the body causes no harm to humans

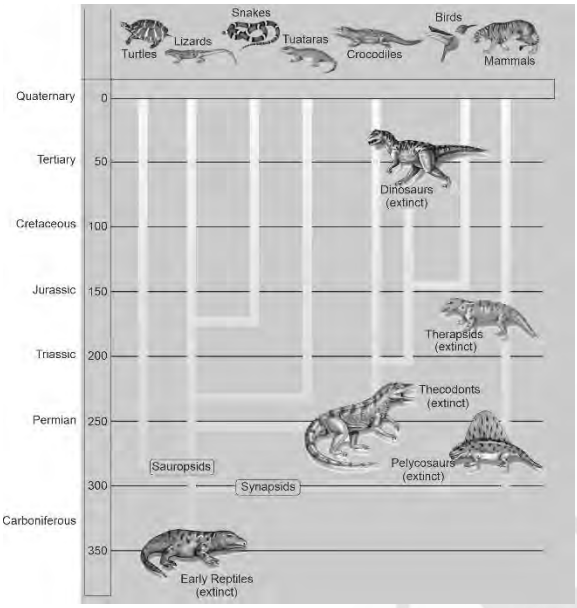
Sol.: Appendix acts as a secondary lymphoid organ but it is a vestigial structure in humans.

Other mentioned structures do act as secondary lymphoid organs, but they are not vestigial.

173. Answer (3)

Hint: Characterized by the presence of mammary glands.

Sol.:



174. Answer (3)

Hint: 2 peaks will be obtained on the distribution curve

Sol.: Disruptive selection occurs when individuals at both phenotypic extremes have higher fitness than those with intermediate traits.

In this case, light and dark shells offer habitat-specific camouflage advantages, while intermediate-coloured snails are more vulnerable to predation in both environments.

Stabilizing selection would favour intermediate colours.

Directional selection would favour only one extreme trait (light or dark colour), not both.

Sexual selection is driven by mating preferences, not predation-based survival.

175. Answer (4)

Hint: *Homo erectus* came into existence later than the *Homo habilis.*

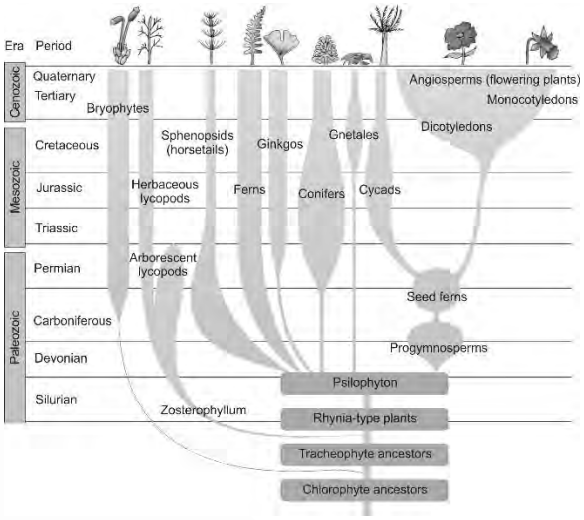
Sol.: *Homo erectus* had a large brain around 900 cc. The brain capacities of *Homo habilis* were between 650-800 cc

Among the stories of evolution of individual species, the story of evolution of modern man is most interesting and appears to parallel evolution of human brain and language.

176. Answer (4)

Hint: Descendants of tracheophyte ancestors

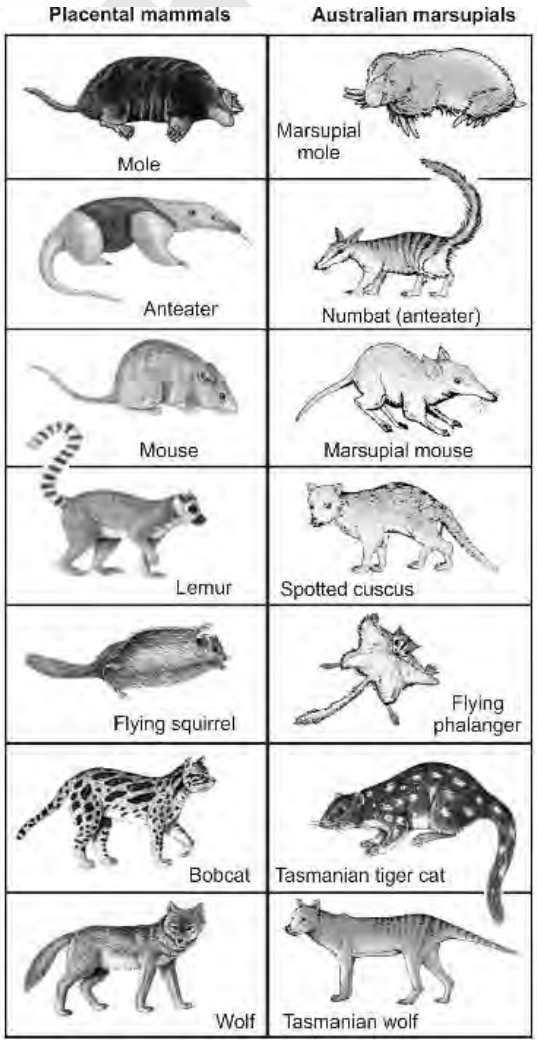
Sol.:



177. Answer (1)

Hint: Eliminate the placental mammals

Sol.:



178. Answer (1)

Hint: Evolution can form new organisms.

Sol: Adaptive ability is inherited. It has a genetic basis. Fitness is the end result of the ability to adapt and get selected by nature.

When we describe the story of this world, we describe evolution as a process. On the other hand, when we describe the story of life on Earth, we treat evolution as a consequence of a process called natural selection.

179. Answer (1)

Hint: Can be divided by 6.

Sol.: Pre-historic cave art developed about 18,000 years ago.

Agriculture came around 10,000 years back and human settlements started.

During ice age, between 75,000-10,000 years ago, modern *Homo sapiens* arose.

180. Answer (4)

Hint: They were herbivores.

Sol.: Two mya, *Australopithecus* probably lived in East African grasslands. Evidence shows that they hunted with stone weapons but essentially ate fruit.

The first human like being, the hominid, was *Homo habilis.*

Australopithecus showed bipedal locomotion and had an erect posture.

❑ ❑ ❑

All India Aakash Test Series for NEET - 2026

TEST - 6 (Code-F)

Click here for Code-E Sol.

Test Date : 08/03/2026

ANSWERS

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

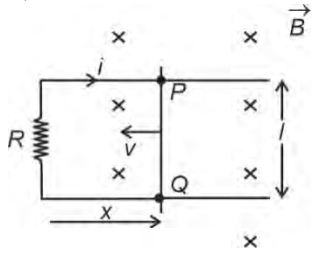
HINTS & SOLUTIONS

[PHYSICS]

1. Answer (1)

Hint: Lenz's law states that the direction of induced emf and hence the direction of induced current in a closed circuit are such that they oppose the cause due to which they were produced.

Sol.: Flux $\phi = BA = Blx$



Induced emf, $\varepsilon = -\frac{d\phi}{dt}$

$\Rightarrow \varepsilon = Bl\left(-\frac{dx}{dt}\right) = Blv$

- Statement A is correct as ϕ is decreasing
- Statement B is wrong because $\vec{F} = i(\vec{l} \times \vec{B})$ is towards right

$\Rightarrow F = Bil = B\left(\frac{\varepsilon}{R+r}\right)l = \frac{Bl(Blv)}{R+r} = \frac{B^2l^2v}{R+r}$

- Statement C is wrong because power

$P = Fv = \frac{B^2l^2v^2}{R+r}$

2. Answer (3)

Hint: Radius of circular path traced by charged particle inside transverse magnetic field, $R = \frac{mv_0}{qB}$

Sol.: As width $L > R$

So, charge q will trace a semi-circle and exit the field.

Time spent = $\frac{T}{2} = \frac{2\pi m}{2qB} = \frac{\pi m}{qB}$

3. Answer (1)

Hint: At resonance in LCR series circuit, $X_C = X_L$

Sol.: At resonance,

Current $i = \frac{V}{Z}$ becomes maximum

Impedance $Z = \sqrt{R^2 + (X_L - X_C)^2} = R$ becomes minimum.

4. Answer (1)

Hint: Work done by magnetic field to rotate the dipole from initial orientation θ_1 to final orientation θ_2 will be,

$W = U_i - U_f = MB[\cos\theta_f - \cos\theta_i]$

Sol.: $\theta_i = 60°$ and $\theta_f = 0°$

$\therefore W = 2\times10^4 \times 2\times10^{-5}\left(1-\frac{1}{2}\right) = 0.2$ J

5. Answer (1)

Hint: The direction of propagation of EM wave can be determined by $\vec{E} \times \vec{B}$ or by using the argument of sine function.

Sol.: $B_z = 2\sin\left[3\pi\times10^8\left(t-\frac{x}{c}\right)\right]$T

The opposite signs of coefficients of x and t implies that wave is travelling along $+x$-axis.

6. Answer (2)

Hint: Magnetic susceptibility, $\chi_m = \mu_r - 1$

Sol.: Relative permeability = $\mu_r = \frac{\mu}{\mu_0}$

$= \frac{3.2\pi\times10^{-4}}{4\pi\times10^{-7}} \Rightarrow \mu_r = 800$

$\therefore \chi_m = \mu_r - 1 = 800 - 1 = 799$

7. Answer (2)

Hint: Use Ampere's circuital law,

$\oint \vec{B}.d\vec{l} = \mu_0 i_{encl}$

Sol.: Displacement current $i_d = i_c = 10$ A

$\Rightarrow B_P\, 2\pi r_1 = \frac{\mu_0 i_c}{\pi(10)^2}\pi r_1^2 \Rightarrow B_P \propto r_1$

Also, $B_Q \propto r_2$

$\therefore \frac{B_P}{B_Q} = \frac{r_1}{r_2} = \frac{4}{8} = 1:2$

8. Answer (3)

Hint & Sol.: Amongst the given waves, radio waves have highest wavelength while gamma rays have least wavelength.

9. Answer (3)

Hint: If $X_C > X_L$, then current leads voltage in LCR series circuit by phase angle ϕ.

Sol.: $\cos\phi = \frac{R}{Z} = \frac{3}{\sqrt{R^2 + (X_C - X_L)^2}}$

$= \frac{3}{\sqrt{3^2 + 4^2}} = \frac{3}{5} \Rightarrow \phi = 53°$

$V_{peak} = V_0 = \sqrt{2}\, V_{rms} = 50\sqrt{2} \times \sqrt{2} = 100$ V

$i_{peak} = i_0 = \frac{V_0}{Z} = \frac{100}{5} = 20$ A

$\therefore$ Current $i = 20 \sin(100\pi t + 53°)$ A

10. Answer (4)

Hint: Phasor diagram represents phase relationship between voltage & current for an a.c. source.

Sol.: • (a – ii) Voltage and current in same phase

- (b – iv) Voltage leads current by ϕ
  $\Rightarrow R - L$ or RLC circuit
- (c – iii) Current lags behind voltage by $\frac{\pi}{2}$.
  $\Rightarrow$ Pure inductive circuit
- (d – v) Current leads voltage by ϕ.
  $\Rightarrow$ R – C or RLC circuit.

11. Answer (3)

Hint: Magnetic field at the centre of a long solenoid, $B = \mu_0 ni$

Sol.: n = number of turns per unit length

$= \frac{2 \times 700}{0.2} = 7000\ m^{-1}$

$B = \mu_0 ni \Rightarrow 2.2 \times 10^{-2} = 4\pi \times 10^{-7} \times 7000 \times i$

$\Rightarrow \frac{22}{1000} = 88 \times 10^{-4} \times i$

$\Rightarrow i = \frac{10}{4} = 2.5$ A

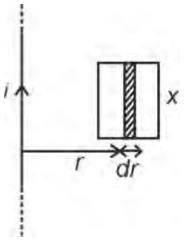
12. Answer (2)

Hint & Sol.: Infrared lamp is used in physical therapy i.e., to treat muscular strain.

13. Answer (2)

Hint: Coefficient of mutual inductance, $M = \frac{\phi}{i}$

Sol.:



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

$d\phi = B\, dA = \frac{\mu_0 i}{2\pi r}(x\, dr)$

$\Rightarrow \int d\phi = \frac{\mu_0 i x}{2\pi} \int_{2x}^{3x} \frac{dr}{r} \Rightarrow \phi = \frac{\mu_0 i x}{2\pi} \ln\left(\frac{3}{2}\right)$

$\therefore M = \frac{\phi}{i} = \frac{\mu_0 x}{2\pi} \ln\left(\frac{3}{2}\right)$

14. Answer (2)

Hint: Use Ampere's circuital law

$\oint \vec{B}.\, d\vec{l} = \mu_0 i_{enclosed}$

Sol.: By sign convention, contribution due to:

i_1 is positive

i_2 is negative

i_3 is positive

$\therefore \oint \vec{B}.\, d\vec{l} = \mu_0 (i_1 - i_2 + i_3)$

15. Answer (4)

Hint: Magnetic force on moving charge, $\vec{F} = q(\vec{v} \times \vec{B})$

Sol.: $\vec{F} \perp \vec{v}$ and $\vec{F} \perp \vec{B}$

$\Rightarrow$ Its path is circular in a plane perpendicular to the $\vec{B}$

$\Rightarrow$ Its speed (v) and K.E. remain constant

$\Rightarrow$ Frequency of revolution, $f = \frac{qB}{2\pi m}$ is independent of radius of circular path.

$\Rightarrow$ Momentum $\vec{p}$ changes when direction of $\vec{v}$ changes along the path.

16. Answer (4)

Hint: Time-varying magnetic field (B) induces non-conservative electric field (E).

Sol.: As per Lenz's law induced current will be in anticlockwise direction.

Using Faraday's law, induced emf $\varepsilon = \frac{d\phi}{dt} = A\frac{dB}{dt} = \pi r^2 \frac{dB}{dt}$

$\oint \vec{E}.\, d\vec{l} = \varepsilon \neq 0 \Rightarrow \vec{E}$ is non-conservative

$\oint \vec{E}.\, d\vec{l} = \frac{d\phi}{dt}$

$\Rightarrow E.2\pi r = \pi r^2 \frac{dB}{dt} \Rightarrow E = \frac{r}{2}\frac{dB}{dt}$

17. Answer (1)

Hint: Pitch of the helix is the distance moved by the charge along the direction of $\vec{B}$ in one time period.

Sol.: Time period of revolution $(T) = \frac{2\pi m}{qB_0}$

$\therefore$ Pitch = $v_{\parallel} T = \frac{v_0}{2} \times \frac{2\pi m}{qB_0}$

18. Answer (3)

Hint: RMS value of current $i_{rms} = \frac{i_{peak}}{\sqrt{2}}$

Sol.: From the graph, i_{peak} = 6 A

$\therefore$ $i_{rms} = \frac{6}{\sqrt{2}} = 3\sqrt{2}$ A

19. Answer (3)

Hint: For electric field vector $E_y = E_0 \sin(kx - \omega t)$, the speed of the wave is given by $v = \frac{\omega}{k}$

Sol.: Speed $v = \frac{\omega}{k} = \frac{3\times10^{10}\pi}{300\pi} = 1\times10^8$ m/s

20. Answer (1)

Hint: $I_s = \frac{NBA}{C}, V_s = \frac{NBA}{RC}$

Sol.: Since $I_s = \frac{NBA}{C}$ and $V_s = \frac{NBA}{RC}$

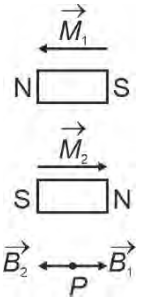
$\therefore$ $R = \frac{I_s}{V_s} = \frac{4}{8} = \frac{1}{2} = 0.5\ \Omega$

21. Answer (2)

Hint: Magnetic field due to a short bar magnet of magnetic moment $\vec{M}$ at equatorial position P is given by

$\vec{B} = -\frac{\mu_0}{4\pi}\frac{\vec{M}}{r^3}$

Sol.:



$B_1 - B_2 = \frac{\mu_0 M}{4\pi(0.2)^3} - \frac{\mu_0 M}{4\pi(0.1)^3}$

$= \frac{\mu_0 M}{4\pi}\left(\frac{1}{\frac{1}{5^3}} - \frac{1}{\frac{1}{10^3}}\right)$

$= 10^{-7} \times 100 \times (5^3 - 10^3) = -875 \times 10^{-5}$ T

$= -8.75 \times 10^{-3}$ T

$\therefore$ $\vec{B}_{net} = -8.75\hat{i}$ mT

22. Answer (3)

Hint: The ferromagnetic property depends on temperature.

Sol.: At high enough temperature, a ferromagnet becomes a paramagnet. The disappearance of its magnetisation with temperature is gradual.

$\therefore$ Both statements A and B are correct

23. Answer (3)

Hint: Two parallel conductors carrying current in same direction, attract each other.

Sol.: Wires *A* and *B* attract each other. Similarly, wires *B* and *C* attract each other. Wires *A* and *C* also attract each other.

24. Answer (2)

Hint: A.C. voltmeter reads rms value of voltage.

Sol.: $i_{rms} = \frac{V_{rms}}{Z} = \frac{12}{3} = 4$ A

$V_2 = i_{rms} \times X_L = 4 \times 4 = 16$ V

25. Answer (3)

Hint: Emf induced across inductor, $\varepsilon = -L\frac{di}{dt}$

Sol.: Using Lenz's law, $V_C > V_D$

$V_C - V_D = L\frac{di}{dt} = 1\times(+4) = +4$ V

26. Answer (4)

Hint: A step-down transformer converts a higher a.c. voltage to a lower a.c. voltage

Sol.: In step-down transformer, $V_s < V_p$ or $N_s < N_p$

$\Rightarrow I_s > I_p$

27. Answer (3)

Hint: Total average energy density *U* carried by electromagnetic wave is equally divided between electric field and magnetic field.

Sol.: $U = \frac{1}{2}\varepsilon_0 E_0^2 = \frac{1}{2}\frac{B_0^2}{\mu_0}$

Average energy density of electric field alone = $\frac{U}{2} = \frac{1}{4}\varepsilon_0 E_0^2 = \frac{1}{4}\frac{B_0^2}{\mu_0}$

28. Answer (1)

Hint: For consistency of Ampere circuital law, there must be displacement current between the plates of the capacitor.

Sol.: Modified Ampere circuital law or Ampere-Maxwell law is given by

$\oint \vec{B}.d\vec{l} = \mu_0(i_c + i_d)$, where

i_c = conduction current

i_d = displacement current

29. Answer (1)

Hint: Power factor = $\frac{R}{Z}$

Sol.: For an ideal choke coil, resistance R = zero and hence power factor is also zero.

30. Answer (1)

Hint: The resistance R, does not depend upon source frequency.

Sol.: Inductive reactance, $X_L = \omega L = 2\pi fL \propto f$

Capacitive reactance, $X_C = \frac{1}{\omega C} = \frac{1}{2\pi fC} \propto \frac{1}{f}$

31. Answer (2)

Hint: Use Lenz's law to find direction of induced current.

Sol.: Flux through triangular loop, $\phi = \int \vec{B}.d\vec{s}$ where magnetic field $\vec{B}$ is due to the straight wire, while $d\vec{s}$ is of triangular loop. If i increases, then $|\phi|$ also increases.

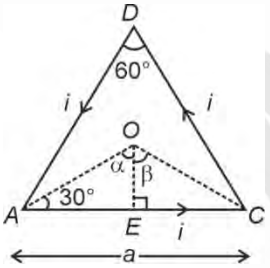
$\therefore$ Induced current in loop will be in anti-clockwise direction and would oppose the change in $|\phi|$.

32. Answer (3)

Hint: Due to straight conductor AC, magnetic field at perpendicular distance $d = B$

$$B = \frac{\mu_0 i}{4\pi d}(\sin\alpha + \sin\beta)$$

Sol.: Side $AC = a$ & $\alpha = \beta = 60°$



$$\Rightarrow OE = d = \frac{AE}{\tan\alpha} = \frac{a}{2\sqrt{3}}$$

$$B_{net} = 3B_{AC} = \frac{3\times\mu_0 i(2\sin 60°)}{4\pi\left(\frac{a}{2\sqrt{3}}\right)}$$

$$= \frac{\mu_0 i}{4\pi a}\times 3\times 4\sqrt{3}\times\frac{\sqrt{3}}{2}$$

$$= 10^{-7}\frac{i}{a}\times 18 = 10^{-7}\times\frac{1}{18\times10^{-2}}\times 18$$

$= 10^{-5}$ T

33. Answer (1)

Hint: EMF induced across the ends of the rod is given by $\varepsilon = Blv_\perp$

Sol.: $v_\perp = v\cos60°$ perpendicular to rod

$\therefore\ \varepsilon = Blv\cos60° = 2\times2\times2\times\frac{1}{2} = 4$ V

34. Answer (4)

Hint & Sol.: X-rays can damage living tissue can alter cell structures and damage DNA. Excessive exposure can lead to mutations that may damage living tissue increase the risk of developing cancer later in life. Thus, it is crucial to minimize over-exposure to X-rays.

35. Answer (2)

Hint & Sol.: In electromagnetic waves, the electric field $\vec{E}$ and magnetic field $\vec{B}$ are in phase.

36. Answer (4)

Hint: Torque acting on loop, $\vec{\tau} = \vec{M}\times\vec{B} = i(\vec{A}\times\vec{B})$

Sol.: The loop is in both x-z and y-z planes.

y-z plane $\Rightarrow \vec{M}_1 = i_0 l^2\hat{i} \Rightarrow \vec{\tau}_1 = i_0 l^2 B_0(\hat{i}\times\hat{i}) =$ zero

x-z plane $\Rightarrow \vec{M}_2 = i_0 l^2\hat{j}$

$$\Rightarrow \vec{\tau}_2 = i_0 l^2 B_0(\hat{j}\times\hat{i}) = -i_0 l^2 B_0\hat{k}$$

Therefore, torque on loop = $i_0 l^2 B_0(-k)$

37. Answer (1)

Hint & Sol.: The net magnetic force,

$\vec{F} = \oint\left(i\,d\vec{l}\times\vec{B}\right) = i\oint d\vec{l}\times\vec{B}$ = zero

38. Answer (2)

Hint: [Induced emf] = [Voltage]

Sol.: [Induced emf] = $\left[\frac{\text{Energy}}{\text{Current}\times\text{time}}\right]$

$$= \frac{[ML^2T^{-2}]}{[A][T]} = [ML^2T^{-3}A^{-1}]$$

39. Answer (3)

Hint: Radius, $R = \frac{mv}{qB} = \sqrt{\frac{2m(\text{K.E.})}{qB}}$

Sol.: $R = \sqrt{\frac{2m(\text{K.E.})}{qB}}$

$$R_2 = \sqrt{\frac{2\times m\times 3E_0}{q(2B)}} = \frac{\sqrt{3}}{2}R$$

40. Answer (3)

Hint: Self-inductance $L = \mu_0 n^2 Al$

Sol.: $\because$ n = constant and A = constant,

$\therefore\ L \propto l$

41. Answer (4)
Hint: At resonance, $X_L = X_C$
$\Rightarrow \omega L = \frac{1}{\omega C} \Rightarrow \omega^2 = \frac{1}{LC}$
Sol.: Quality factor, $Q = \frac{\omega L}{R} = \frac{1}{R\omega C} = \frac{1}{R}\sqrt{\frac{L}{C}}$

42. Answer (2)
Hint: Magnetic force on moving charge, $\vec{F} = q(\vec{v} \times \vec{B})$
Sol.: Acceleration of charge, $\vec{a} = \frac{\vec{F}}{m} \perp \vec{B}$ always
$\therefore \vec{a} \cdot \vec{B} =$ zero

43. Answer (3)
Hint: Magnetic field due to arc of a circle carrying current i is $B' = \frac{\mu_0 i}{4\pi r}\theta$, where θ = angle subtended by arc at the centre of the circle.
Sol.: Semi-infinite wire $AX \Rightarrow B_1 = \frac{\mu_0 i}{4\pi(AO)}$
$= \frac{\mu_0 i}{4\pi R} \odot$
Finite wire $AC \Rightarrow B_2 =$ zero
Quadrant $CD \Rightarrow B_3 = \frac{\mu_0 i}{4\pi(OC)} \cdot \frac{\pi}{2} = \frac{\mu_0 i}{4R} \otimes$
Semi-infinite wire $DX' \Rightarrow B_4 =$ zero
$\therefore$ Net magnetic field $B = B_1 + B_2 + B_3 + B_4$
$= \left(\frac{\mu_0 i}{4R} - \frac{\mu_0 i}{4\pi R}\right) \otimes$
$= \frac{\mu_0 i}{4R}\left(1 - \frac{1}{\pi}\right) \otimes$

44. Answer (4)
Hint: Magnetic moment $M = ml$, where l = length of each bar magnet
Sol.: Option (1) $\Rightarrow M_1 = (2m)l = 2M > M$
Option (2) $\Rightarrow M_2 = m(2l) = 2M > M$
Option (3) $\Rightarrow M_3 = \sqrt{(ml)^2 + (ml)^2} = \sqrt{2}ml$
$= \sqrt{2}\, M > M$

45. Answer (3)
Hint & Sol.: For a paramagnetic material $\chi_m \propto \frac{1}{T}$.

[CHEMISTRY]

46. Answer (2)
Hint: $2Cu^+ \longrightarrow Cu^{2+} + Cu$
Sol.: The stability of $Cu^{2+}(aq)$ rather than $Cu^+(aq)$ is due to much more negative $\Delta_{hyd}H°$ of $Cu^{2+}(aq)$ than Cu^+, which is more than compensates for second ionisation enthalpy of Cu.

47. Answer (3)
Hint: Hf and Zr have almost similar radii
Sol.: Zn has lowest enthalpy of atomisation among 3*d*-series elements due to completely filled 3d orbital.

48. Answer (2)
Hint: Magnetic moment, $\mu = \sqrt{n(n+2)}$, n is number of unpaired electron(s).
Sol.: $Sc^{3+} \longrightarrow n = 0;\ \mu = 0$
$Mn^{2+} \longrightarrow n = 5;\ \mu = \sqrt{35}$ BM
$Cr^{2+} \longrightarrow n = 4;\ \mu = \sqrt{24}$ BM
$Ni^{2+} \longrightarrow n = 2;\ \mu = \sqrt{8}$ BM

49. Answer (1)
Hint: Interstitial compounds are chemically inert.
Sol.: Interstitial compounds retain metallic conductivity.

50. Answer (4)
Hint: Lanthanoids generally show +3 oxidation state.
Sol.: Yb^{2+} oxidises to Yb^{3+} and acts as reductant while Tb^{4+} reduces to Tb^{3+} and acts as oxidant.

51. Answer (2)
Hint: I^- is oxidised to I_2 by $KMnO_4$ in an acidic medium.
Sol.: $10I^- + 2MnO_4^- + 16H^+ \longrightarrow$
$2Mn^{2+} + 8H_2O + 5I_2$
So 10 moles KI require 2 moles of $KMnO_4$

52. Answer (1)
Hint: The ions having d^0 and d^{10} configuration are colourless
Sol.: $Ti^{3+} \longrightarrow [Ar]\ 3d^1$
$V^{3+} \longrightarrow [Ar]\ 3d^2$
$Sc^{3+} \longrightarrow [Ar]\ 3d^0$
$Mn^{2+} \longrightarrow [Ar]\ 3d^5$
$Fe^{3+} \longrightarrow [Ar]\ 3d^5$
$Co^{2+} \longrightarrow [Ar]\ 3d^7$
So, Ti^{3+}, V^{3+}, Mn^{2+}, Fe^{3+} and Co^{2+} are coloured in an aqueous medium.

53. Answer (3)

Hint & Sol.: The correct order of oxidising power is $VO_2^+ < Cr_2O_7^{2-} < MnO_4^-$

54. Answer (2)

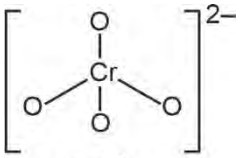
Hint: $d^4 \longrightarrow d^3$ occurs in case of Cr^{2+} to Cr^{3+}

Sol.: $d^6 \longrightarrow d^5$ occurs in case of Fe^{2+} to Fe^{3+}

In an aqueous medium, d^3 electronic configuration is more stable as compared to d^5 electronic configuration.

55. Answer (2)

Hint:



$[CrO_4^{2-}]$

Sol.: • In neutral or faintly alkaline solutions:

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

MnO_4^{2-} (manganate ion) is paramagnetic due to presence of one unpaired electron.

56. Answer (3)

Hint: Th shows predominantly +4 oxidation state

Sol.: Actinoid contraction is greater from element to element than lanthanoid contraction.

57. Answer (3)

Hint: Wilkinson catalyst is $[(Ph_3P)_3RhCl]$.

Sol.: $TiCl_4$ with $Al(CH_3)_3$ is used in manufacture of polyethene.

Fe is used in Haber's process.

$PdCl_2$ is used in Wacker process.

58. Answer (2)

Hint: Due to lanthanoid contraction, the ionic size from La to Lu decreases.

Sol.: The correct order of ionic size of given species is

$Nd^{3+} > Pm^{3+} > Sm^{3+} > Eu^{3+}$

59. Answer (3)

Hint: Curium is an actinoid having 96 atomic number.

Sol.: Electronic configuration of Cm

= [Rn] $5f^7\ 6d^1\ 7s^2$

60. Answer (1)

Hint: As the size of lanthanoid decreases, basic character decreases.

Sol.: The correct order of basic strength of given species is

$La(OH)_3 > Pr(OH)_3 > Gd(OH)_3 > Er(OH)_3$

61. Answer (2)

Hint: Haemoglobin contains Fe.

Sol.: Co is present in vitamin B_{12}

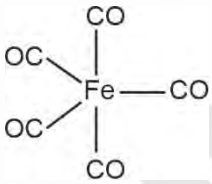
Rh is present in Wilkinson catalyst

Mg is present in chlorophyll.

62. Answer (4)

Hint: Oxidation state of Fe in $Fe(CO)_5$ is zero.

Sol.:



It has trigonal bipyramidal structure.

It has synergic bonding.

63. Answer (1)

Hint: CN^- and NH_3 are strong field ligands.

Sol.:

Coordination entity	Wavelength of light absorbed (nm)
$[Co(CN)_6]^{3-}$	310
$[Co(NH_3)_6]^{3+}$	475
$[Co(NH_3)_5(H_2O)]^{3+}$	500
$[CoCl(NH_3)_5]^{2+}$	535

64. Answer (3)

Hint: The crystal field theory is an electrostatic model which considered the metal-ligand bond to be ionic arising purely from electrostatic interaction between the metal ion and the ligand.

Sol.: The crystal field model does not take into account the covalent character of bonding but it is successful in explaining the formation, structures, colour and magnetic properties.

65. Answer (1)

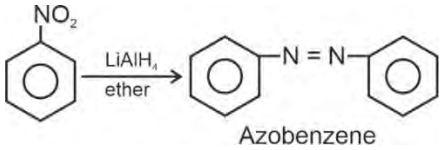
Hint: When ligands are arranged in their increasing order of field strength, a series is obtained is called spectrochemical series.

Sol.: The correct order of ligand field strength is

$CO > CN^- > en > NH_3$

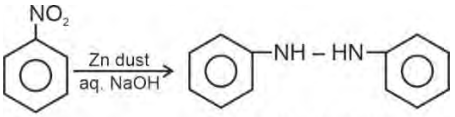
66. Answer (2)

Hint:



Azobenzene

Sol.:

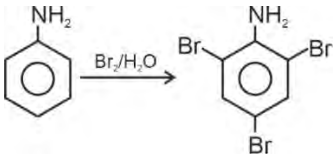


Hydrazobenzene

67. Answer (4)

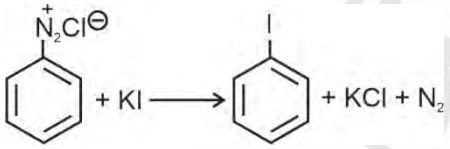
Hint: Aniline is highly reactive towards electrophilic substitution reaction.

Sol.:



68. Answer (2)

Hint:



Sol.: Aniline does not undergo Friedel-Crafts reaction due to salt formation with aluminium chloride, the Lewis acid, which is used as a catalyst.

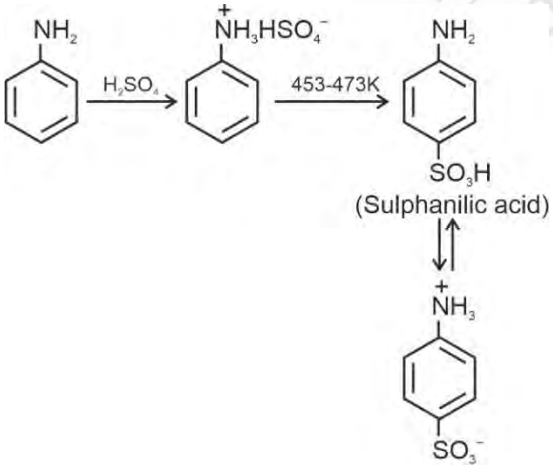
The correct order of basic strength of methyl substituted amines in aqueous phase is

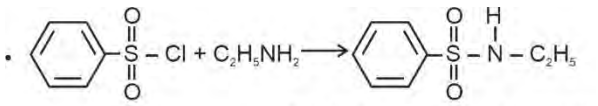
$(CH_3)_2NH > CH_3NH_2 > (CH_3)_3N > NH_3$

69. Answer (3)

Hint: p-Aminobenzene sulphonic acid is known as sulphanilic acid

Sol.:





N-Ethylbenzenesulphonamide
(Soluble in alkali)

70. Answer (1)

Hint : $C_6H_5SO_2Cl$ is known as Hinsberg's reagent

Sol.: Hinsberg's reagent can be used to distinguish 1°, 2° and 3° amines. 3° amines do not react with Hinsberg's reagent.

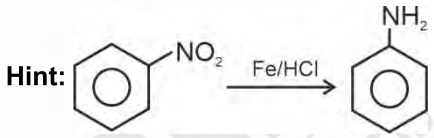
71. Answer (4)

Hint: Aliphatic and aromatic primary amines give carbylamine test.

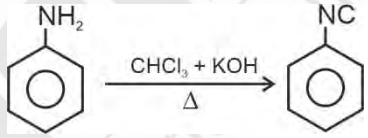
Sol.: Aliphatic primary amines can be prepared by Gabriel phthalimide synthesis.

72. Answer (4)

Hint:

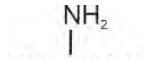


Sol.:



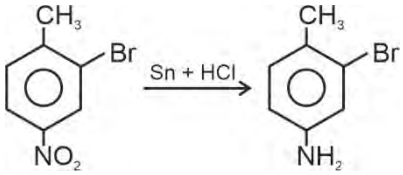
73. Answer (2)

Hint: Primary amines releases N_2 gas on treatment with nitrous acid.

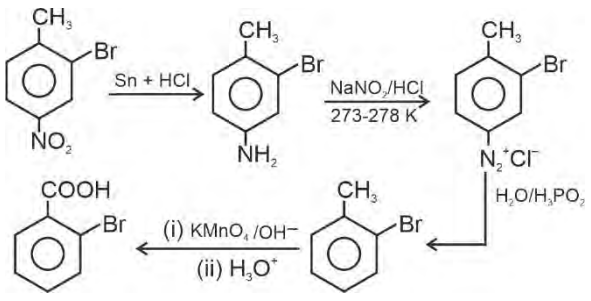
Sol.: $CH_3CH_2CH_2NH_2$ and  are primary amines, those liberate N_2 gas on treatment with nitrous acid.

74. Answer (3)

Hint:

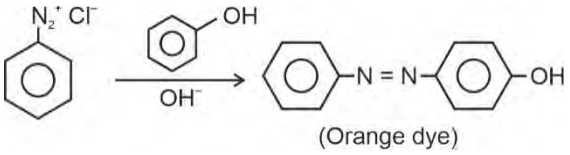


Sol.:



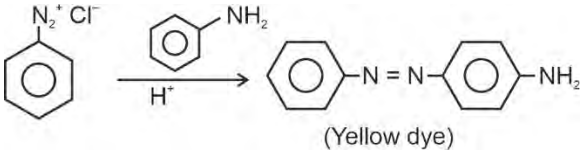
75. Answer (1)

Hint:



(Orange dye)

Sol.:

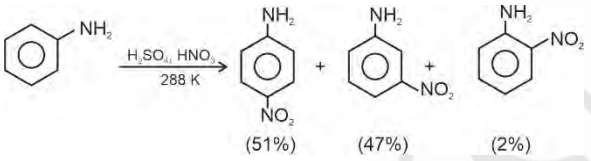


(Yellow dye)

76. Answer (2)

Hint: In strongly acidic medium, aniline is protonated to form anilinium ion which is meta directing.

Sol.:



(51%) (47%) (2%)

77. Answer (1)

Hint: Aliphatic amines are more basic than aromatic amines

Sol.:

(Amines)	(pK_b value)
Benzenamine	9.38
Phenylmethanamine	4.70
N-Methylaniline	9.30
N, N-Dimethylaniline	8.92

78. Answer (3)

Hint: Primary amines form three hydrogen bonds

Sol.:

Compound	Boiling point (K)
$n\text{-}C_4H_9NH_2$	350.8
$(C_2H_5)_2NH$	329.3
$C_2H_5N(CH_3)_2$	310.5

79. Answer (2)

Hint: $CH_3CONH_2 \xrightarrow{LiAlH_4} CH_3CH_2NH_2$

Sol.: $CH_3NC \xrightarrow{LiAlH_4} CH_3NHCH_3$

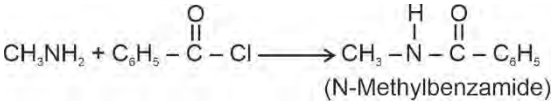
$CH_3CN \xrightarrow{LiAlH_4} CH_3CH_2NH_2$

$CH_3CONH_2 \xrightarrow{LiAlH_4} CH_3CH_2NH_2$

80. Answer (3)

Hint: Reaction of amine with benzoyl chloride is known as benzoylation.

Sol.:



(N-Methylbenzamide)

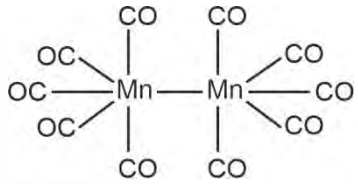
81. Answer (2)

Hint: $[Co(NH_3)_4Cl_2]^+$ is heteroleptic complex.

Sol.: $[Co(NH_3)_4Cl_2]^+$ shows cis-trans isomerism.

82. Answer (1)

Hint & Sol.:



83. Answer (3)

Hint: Higher the negative charge on metal, more is the back donation from metal to carbon and more is the C – O bond length

Sol.: Correct order of C – O bond length $\Rightarrow$

$Fe(CO)_4]^{2-} > [Co(CO)_4]^{\ominus} > [Ni(CO)_4] > [Mn(CO)_6]^+$

84. Answer (3)

Hint: When a ligand is bound to a metal ion through several donor atoms is known as polydentate ligand.

Sol.: $[EDTA]^{4-}$ is a hexadentate ligand

85. Answer (3)

Hint: Cis-$[PtCl_2(en)_2]^{2+}$ is optically active.

Sol.: $[PtCl_2(en)_2]^{2+}$ has d^6 configuration so all electrons are paired. Hence spin only magnetic moment is zero.

86. Answer (2)

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

Sol.: $5.9\ BM = \sqrt{n(n+2)}$

n = 5

In $[MnBr_4]^{2-}$, Mn has 5 unpaired electrons and 4 coordination number so it should be tetrahedral in shape rather than square planar.

87. Answer (1)

Hint: $[NiCl_4]^{2-}$ is paramagnetic because it has two unpaired electrons.

Sol.: $[Ni(NH_3)_6]^{2+}$ is diamagnetic so it is spin paired complex

88. Answer (3)

Hint: The metal-carbon σ bond in metal carbonyls is formed by donation of lone pair of electrons on the carbonyl carbon into vacant orbital of metal.

Sol.: The metal-carbon π bond in metal carbonyls is formed by donation of a pair of electrons from a filled d orbital of metal into vacant antibonding π^* orbital of carbon monoxide.

89. Answer (2)

Hint: Crystal field stabilisation energy for octahedral complexes = $-0.4\Delta_0\ (t_{2g})e^- + 0.6\ \Delta_0(e_g)\ e^-$

Sol.: $[Fe(CN)_6]^{4-} \longrightarrow t_{2g}^6\ e_g^0$

$\rightarrow$ CFSE = $(-0.4 \times 6 + 0.6 \times 0)\ \Delta_0 = -2.4\Delta_0$

$[FeF_6]^{4-} \longrightarrow t_{2g}^4 e_g^2$

$\rightarrow$ CFSE = $(-0.4 \times 4 + 0.6 \times 2)\Delta_0$

$= (-1.6 + 1.2)\ \Delta_0 = -0.4\Delta_0$

90. Answer (3)

Hint: Complexes with unsymmetrical distribution of electron in t_{2g} and e_g orbital show Jahn Teller distortion.

Sol.: In $[Cu(H_2O)_6]^{2+}$, Cu^{2+} has $t_{2g}^6\ e_g^3$ configuration which is unsymmetrical.

[BOTANY]

91. Answer (3)

Hint: The pyrimidines that are not common between DNA and RNA are Thymine and Uracil.

Sol.: Thymine and Uracil are linked to 1′ carbon of pentose sugar. They form two hydrogen bonds with the corresponding base. Thymine is present in DNA and Uracil is present in RNA.

92. Answer (2)

Hint: During curd formation, the LAB produce acids that coagulate and partially digest the milk proteins.

Sol.: Lactic acid bacteria, while converting milk into curd, improves its nutritional quality by increasing vitamin B_{12}.

93. Answer (3)

Hint: Replication of DNA is not said to be regulation of gene expression.

Sol.: Mostly in prokaryotes, mRNA does not require any processing to become active.

94. Answer (3)

Hint: Oxygenic photosynthesis occurs in cyanobacteria.

Sol.: Cyanobacteria, *e.g., Anabaena*, *Nostoc*, *Oscillatoria*, etc. are photoautotrophic microbes which can fix atmospheric nitrogen. During photosynthesis, they evolve oxygen.

95. Answer (1)

Hint: Both the nucleic acids (DNA and RNA) have the ability to direct their duplications.

Sol.: The other molecules in the living system, such as proteins do not follow the property of base pairing.

96. Answer (2)

Hint: During the first step of sewage treatment, physical removal of large and small particles from the sewage through filtration and sedimentation is done.

Sol.: After physical removal of large and small particles from the sewage in STP, following steps are done:

- Primary effluent is passed into large aeration tanks.
- Constant agitation mechanically and air is pumped.
- Significant reduction in the Biochemical Oxygen Demand of the effluent.
- The effluent from the treatment plant is released into natural water bodies like rivers and streams.

97. Answer (3)

Hint: *Trichoderma* species are very common in the root ecosystems. They are useful in the treatment of plant disease.

Sol.: *Trichoderma* species are free-living fungi in the root ecosystems. They are effective biocontrol agents of several plant pathogens.

98. Answer (1)

Hint: Avery, MacLeod and McCarty purified biochemicals (proteins, DNA, RNA, etc.) from the heat-killed S cells to see which ones could transform live R cells into S cells.

Sol.: Avery, MacLeod and McCarty discovered that DNA alone from S bacteria caused R bacteria to become transformed, and thus they confirmed that it was DNA that functions as transforming principle.

99. Answer (3)

Hint: The organic farmers work to create a system where the insects are not eradicated, but instead are kept at manageable levels by a complex system of checks and balances.

Sol.: The use of biocontrol measures greatly reduces the dependence on toxic chemicals and pesticides.

100. Answer (1)

Hint: When a mixture of heat-killed S strain and live R strain *Streptococcus pneumoniae* bacteria is injected to the mice, the mice died.

Sol.: When the *Streptococcus pneumoniae* in Griffith's experiments was heat killed, the DNA of the bacteria was not denatured.

101. Answer (1)

Hint: *Penicillium* inhibits the growth of *Staphylococci*.

Sol.: *Penicillium* secretes a chemical called antibiotic that checks the growth of *Staphylococci*.

102. Answer (1)

Hint: During the process of DNA fingerprinting, hybridisation using labelled VNTR probe is done after transferring (blotting) of separated DNA fragments to synthetic membranes, such as nitrocellulose or nylon.

Sol.: The final step of the process of DNA fingerprinting is detection of hybridised DNA fragments by autoradiography. It is done after the hybridisation of DNA, using labelled VNTR probe.

103. Answer (3)

Hint: Blue green algae, such as *Anabaena*, *Nostoc*, *Oscillatoria* etc. add organic matter to the soil and increase its fertility.

Sol.: *Glomus,* a fungus, in symbiotic association enhances the plant tolerance to salinity and drought. *Rhizobium* forms nodules on the roots of leguminous plants. *Bacillus thuringiensis*, a microbial biocontrol agent can be introduced in order to control butterfly caterpillars.

104. Answer (4)

Hint: Organic acids, like citric acid, acetic acid, butyric acid and lactic acid are produced on commercial scale by using microbes.

Sol.: *Clostridium butylicum*, *Aspergillus niger* and *Lactobacillus* are used to produce butyric acid, citric acid and lactic acid respectively on commercial scale.

105. Answer (4)

Hint: Viroids are also considered as microbes.

Sol.: Microbes are diverse–protozoa, bacteria, fungi and microscopic animal and plant viruses, viroids and also prions, that are the proteinacious infectious agents.

106. Answer (1)

Hint: A translational unit in mRNA is the sequence of RNA that is flanked by the start codon (AUG) and the stop codon and codes for a polypeptide.

Sol.: The mRNA transcribed from the given mutated DNA segment is as follows:

107. Answer (3)

Hint: Three types of RNA polymerases are found in nucleus.

Sol.: RNA polymerases I and III catalyse the synthesis of rRNA and RNA polymerase II catalyses the synthesis of hnRNA.

108. Answer (4)

Hint: In *lac* operon, operator gene interacts with regulator molecule, which prevents RNA polymerase from transcribing the operon.

Sol.: In *lac* operon, both regulator gene and structural genes are transcribed, but promoter gene and operator gene do not.

109. Answer (2)

Hint: DNA polymorphism refers to variations in DNA sequences between individuals.

Sol.: During DNA fingerprinting, repetitive DNA are separated from bulk genomic DNA as different peaks during density gradient centrifugation. The bulk DNA forms a major peak and the other small peaks are referred to as satellite DNA. The sequences in satellite DNA normally do not code for any proteins, and show high degree of polymorphism.

110. Answer (2)

Hint: In humans, chromosome Y has the fewest genes, *i.e.*, 231.

Sol.: In humans, chromosome 1 has the most genes, and Y has the fewest.

111. Answer (4)

Hint: The Ministry of Environment and Forests has initiated Ganga Action Plan and Yamuna Action Plan to save these major rivers of our country from pollution.

Sol.: Ganga Action Plan and Yamuna Action Plan are proposed to build a large number of sewage treatment plants so that only treated sewage may be discharged in the rivers.

112. Answer (3)

Hint: The DNA-dependent DNA polymerases catalyse polymerisation only in one direction, that is, $5' \rightarrow 3'$.

Sol.: The replication occurs within a small opening of the DNA helix, referred to as replication fork. Each origin of replication has two replication forks.

113. Answer (3)

Hint: Primase is an enzyme that synthesizes short RNA sequences in DNA dependent manner, essential for initiating DNA replication.

Sol.: DNA dependent DNA polymerase is the main enzyme for DNA polymerisation. 23S rRNA in bacteria and 28S rRNA in eukaryotes are the enzymes- ribozymes, for the formation of peptide bond.

In addition to acting as substrates, deoxyribonucleoside triphosphates provide energy for polymerization reaction.

114. Answer (2)

Sol.: Beetle with red and black markings – the Ladybird, and Dragonflies are useful to get rid of aphids and mosquitoes, respectively.

115. Answer (1)

Hint: In the first generation, only hybrid DNA is formed.

Sol.: In the third generation there will be two hybrid and six light DNA. Since, there will be no heavy DNA in this generation, number of bands in CsCl will be two, due to two different densities of DNA.

116. Answer (3)

Hint: DNA replication is semiconservative.

Sol.: After the completion of replication, each DNA molecule would have one parental and one newly synthesised strand.

117. Answer (2)

Hint: In some viruses, RNA acts as genetic material.

Sol.: RNA can function as adapter, structural, and in some cases, as a catalytic molecule.

118. Answer (4)

Hint: The pitch of the DNA helix is 3.4 nm and there are roughly 10 bp in each turn.

Sol.: Here, 25000 nucleotides = 12500 bp.

Since, there are 10 bp in 3.4 nm, then 12500 bp would be present in $\frac{12500 \times 3.4}{10} = 4250$ nm

= 4.25 μm

119. Answer (3)

Hint: A molecule that can act as a genetic material should be stable chemically and structurally.

Sol.: Criteria that are fulfilled by a molecule that can act as a genetic material are as follows:

- It should be able to generate its replica (Replication).
- It should be stable chemically and structurally.
- It should provide the scope for slow changes (mutation) that are required for evolution.
- It should be able to express itself in the form of 'Mendelian characters'.

120. Answer (3)

Hint: Capsid of bacteriophages is made up of protein.

Sol.: Proteins have sulphur. When the medium in which *E. coli* is growing has radioactive sulphur, the bacteria will pick up these sulphur compounds as nutrients and these will be further incorporated in the capsid of newly formed phages.

121. Answer (4)

Hint: Methane is formed by the activity of methanogens during biogas production.

Sol.: The common gas that is formed in fermentation of dough, cheese making, production of beverages, and production of biogas is CO_2.

122. Answer (3)

Hint: The structure shown in the given diagram represents nucleosomes, that constitute the repeating unit of a structure in nucleus called chromatin.

Sol.: The nucleosomes in chromatin are seen as 'beads-on-string' structure when viewed under electron microscope. The beads-on-string structure in chromatin is packaged to form chromatin fibers that are further coiled and condensed to form chromosomes.

123. Answer (4)

Hint: Histones are rich in basic amino acid residues lysine and arginine.

Sol.: In eukaryotes, the overall charge on histones is positive because histones are rich in basic amino acid residues lysine and arginine which carry positive charges in their side chains.

124. Answer (2)

Hint: The given representation shows reverse central dogma of molecular biology.

Sol.: The process in cells by which an enzyme makes a copy of DNA from RNA is called reverse transcription. A cell infected with viruses that have RNA as genetic material and an enzyme reverse transcriptase would be able to show all four processes.

125. Answer (2)

Hint: Microbes like bacteria and many fungi can be grown on nutritive media to form colonies.

Sol.: Viruses cannot be grown on nutritive media. They are obligate intracellular parasites and reproduce only inside the living cells.

126. Answer (4)

Hint: Phosphodiester linkage between two nucleotides is present in both RNA and DNA.

Sol.: The plane of one base pair in DNA stacks over the other in double helix. This, in addition to H-bonds, confers stability of the helical structure. The packaging makes the DNA more compact and protects it from damage.

127. Answer (4)

Hint: DNA cannot directly code for the synthesis of proteins.

Sol.: RNA can directly code for the synthesis of proteins, hence can easily express the characters. DNA, however, is dependent on RNA for the synthesis of proteins.

128. Answer (3)

Hint: In 1953, James Watson and Francis Crick proposed a very simple Double Helix model for the structure of DNA.

Sol.: James Watson and Francis Crick, based on the X-ray diffraction data produced by Maurice Wilkins and Rosalind Franklin, proposed a very simple but famous Double Helix model for the structure of DNA.

129. Answer (1)

Hint: Statins are produced by *Monascus purpureus*.

Sol.: Statins produced by the yeast *Monascus purpureus* (a fungus) have been commercialised as blood-cholesterol lowering agents.

130. Answer (4)

Hint: In RNA, every nucleotide residue has an additional –OH group present at 2′ -position in the ribose.

Sol.: The two chains in dsDNA have anti-parallel polarity. The backbone of a polynucleotide chain is formed due to sugar and phosphates.

131. Answer (1)

Hint: The pyrimidine Uracil is exclusive to RNA and in RNA, pyrimidines are Cytosine and Uracil.

Sol.: Pyrimidine Cytosine is common to both DNA and RNA.

Number of cytosine in mRNA = 70 – 45 = 25

The number of cytosine in coding strand of DNA would be the same as in mRNA, *i.e.*, 25

132. Answer (2)

Hint: In the first phase itself, amino acids are activated in the presence of ATP and linked to their cognate tRNA – a process commonly called as charging of tRNA.

Sol.: When the small subunit encounters an mRNA, the process of translation of the mRNA to protein begins.

133. Answer (1)

Hint: One of the enzymes used to clear the fruit juice breaks down proteins by hydrolyzing the peptide bonds.

Sol.: Fruit juices are clarified by the use of pectinases and proteases.

134. Answer (4)

Hint: Base pairing is not present in ssRNA and ssDNA.

Sol.: $\phi \times 174$ bacteriophage has ssDNA and Tobacco mosaic viruses, QB bacteriophage has ssRNA as their genetic material. Thus, these genetic materials lack base pairing and so, hydrogen bonds between bases.

135. Answer (2)

Hint: DNA acts as the genetic material in most of the organisms.

Sol.: RNA also acts as a genetic material in some viruses, but mostly functions as a messenger.

[ZOOLOGY]

136. Answer (4)

Hint: They were herbivores.

Sol.: Two mya, *Australopithecus* probably lived in East African grasslands. Evidence shows that they hunted with stone weapons but essentially ate fruit.

The first human like being, the hominid, was *Homo habilis.*

Australopithecus showed bipedal locomotion and had an erect posture.

137. Answer (1)

Hint: Can be divided by 6.

Sol.: Pre-historic cave art developed about 18,000 years ago.

Agriculture came around 10,000 years back and human settlements started.

During ice age, between 75,000-10,000 years ago, modern *Homo sapiens* arose.

138. Answer (1)

Hint: Evolution can form new organisms.

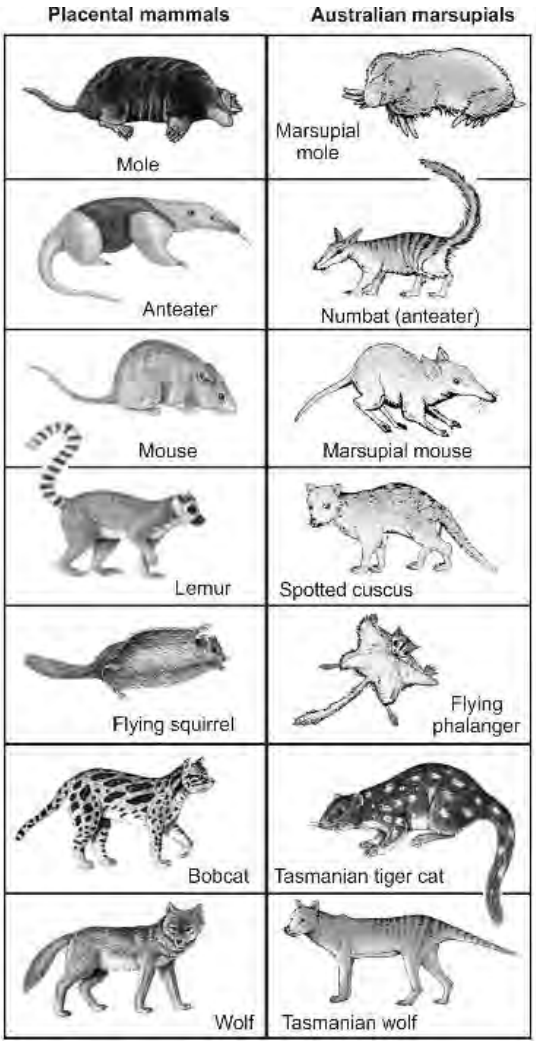
Sol: Adaptive ability is inherited. It has a genetic basis. Fitness is the end result of the ability to adapt and get selected by nature.

When we describe the story of this world, we describe evolution as a process. On the other hand, when we describe the story of life on Earth, we treat evolution as a consequence of a process called natural selection.

139. Answer (1)

Hint: Eliminate the placental mammals

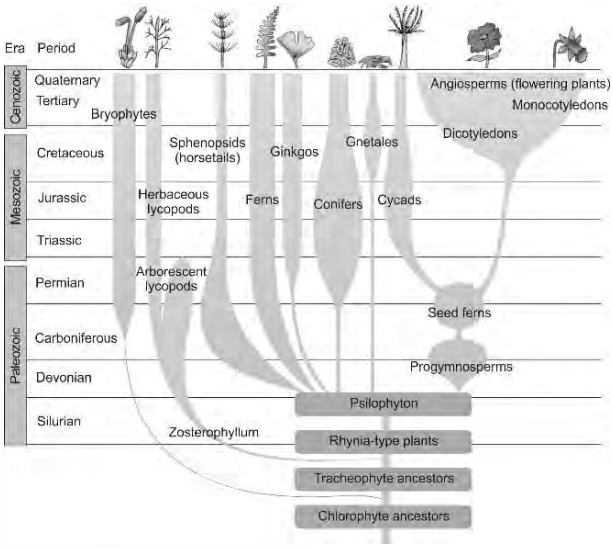
Sol.:



140. Answer (4)

Hint: Descendants of tracheophyte ancestors

Sol.:



141. Answer (4)

Hint: *Homo erectus* came into existence later than the *Homo habilis.*

Sol.: *Homo erectus* had a large brain around 900 cc. The brain capacities of *Homo habilis* were between 650-800 cc

Among the stories of evolution of individual species, the story of evolution of modern man is most interesting and appears to parallel evolution of human brain and language.

142. Answer (3)

Hint: 2 peaks will be obtained on the distribution curve

Sol.: Disruptive selection occurs when individuals at both phenotypic extremes have higher fitness than those with intermediate traits.

In this case, light and dark shells offer habitat-specific camouflage advantages, while intermediate-coloured snails are more vulnerable to predation in both environments.

Stabilizing selection would favour intermediate colours.

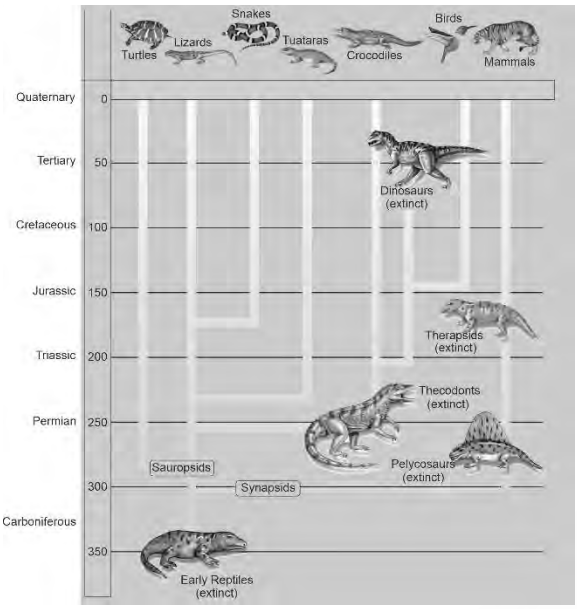
Directional selection would favour only one extreme trait (light or dark colour), not both.

Sexual selection is driven by mating preferences, not predation-based survival.

143. Answer (3)

Hint: Characterized by the presence of mammary glands.

Sol.:



144. Answer (4)

Hint: Its removal from the body causes no harm to humans

Sol.: Appendix acts as a secondary lymphoid organ but it is a vestigial structure in humans.

Other mentioned structures do act as secondary lymphoid organs, but they are not vestigial

145. Answer (1)

Hint: Angiosperms also appeared in the same era.

Sol.: Mesozoic era – Birds originated

Proterozoic era -Lower invertebrates formed

Paleozoic era - Fishes and amphibians originated

146. Answer (2)

Hint: Both types of beetles were present

Sol.: In a mixed population, those that can better adapt, survive and increase in population size. No variant got completely wiped out.

Beetles already possessed genetic variations that were beneficial under new environmental conditions, even before those conditions arose.

147. Answer (2)

Hint: Biochemical analysis indicates evolutionary relationships.

Sol.: Molecular evolution reveals that genetic differences accumulate over time and the number of differences reflects the evolutionary distance.

Fewer differences suggest a more recent common ancestor, which is the case with humans and chimpanzees.

Parallel evolution occurs when two or more unrelated species develop similar traits independently, but in response to similar environmental pressures or ecological niches.

148. Answer (2)

Hint: Starting from a point and radiating to different directions

Sol.: Darwin's finches evolved from a common ancestral seed-eating species that arrived on the Galapagos Islands.

Over time, these birds diverged morphologically, particularly in beak shape and size, due to natural selection acting on varying feeding strategies (*e.g.*, seed-cracking, insect-catching, nectar-feeding).

The process of evolution of different species in a given geographical area starting from a point and literally radiating to other areas of geography (habitats) is called adaptive radiation.

Geographic isolation promotes speciation, not gene flow.

149. Answer (2)

Hint: Same structure developed along different directions due to adaptations to different needs

Sol.: Vertebrate hearts or brains show homology. Homology indicates common ancestry.

Homologous organs are the result of divergent evolution.

Analogous structures are the result of convergent evolution; different structures evolving for the same function and hence having similarity.

150. Answer (1)

Hint: Early Earth's atmosphere was devoid of free oxygen.

Sol.: Early Earth's atmosphere lacked oxygen, so the first life forms were anaerobic.

The first organisms on the primitive Earth were non-photosynthetic as free oxygen was absent in the early atmosphere.

These were likely chemoautotrophs that obtained energy by oxidizing inorganic substances (*e.g.,* sulfur or iron compounds).

Green photosynthetic organisms (like cyanobacteria) and aerobic respiration evolved much later.

151. Answer (3)

Hint: q^2 is given

Sol.: According to the Hardy-Weinberg principle, allele frequencies are related to genotype frequencies as follows:

- $p^2 + 2pq + q^2 = 1$,

  where, p = frequency of dominant allele (A)

  q = frequency of recessive allele (a)

  q^2 = frequency of homozygous recessive genotype (aa)

From the question:

- $q^2 = 0.09 \rightarrow q = \sqrt{0.09} = 0.3$

  Since $p + q = 1$,

$\rightarrow p = 1 - 0.3 = 0.7$

152. Answer (1)

Hint: His proposal was disapproved.

Sol.: Embryological support for evolution was proposed by Ernst Heckel based upon the observation of certain features during embryonic stage common to all vertebrates that are absent in adult.

Thomas Malthus studied population.

William Harvey disapproved the good humor hypothesis and discovered blood circulation.

Louis Pasteur by careful experimentation demonstrated that life comes only from pre-existing life.

153. Answer (3)

Hint: Ramification of genetic drift

Sol.: The founder effect is a form of genetic drift that occurs when a small group of individuals becomes isolated from a larger population.

In the case given in the question, the red coloured trait, originally rare, becomes common in the island population not because of selection, but because the founding individuals happened to carry it.

This effect is random and non-adaptive, meaning that the trait may increase in frequency regardless of whether it provides a survival advantage.

Gene flow requires movement into the island population from the mainland, which contradicts the isolation described.

Mutation could explain a new trait, but the red-coloured trait was already present in the founding individuals.

154. Answer (1)

Hint: Few plants existed probably around 320 mya.

Sol.: The first non-cellular forms of life could have originated 3 billion years back.

About 2000 mya, the first cellular forms of life appeared on Earth.

Sea weeds and few plants existed probably around 320 mya.

About 65 mya, the dinosaurs suddenly disappeared from the Earth.

155. Answer (4)

Hint: Given by Hugo de Vries.

Sol.: The Big Bang theory attempts to explain to us the origin of Universe.

Alfred Wallace, a naturalist, who worked in Malay Archipelago, had also come to similar conclusions as Darwin around the same time.

Relative dating is the process of determining if one rock or geologic event is older or younger than another, without knowing their specific ages.

Hugo deVries believed that mutation caused speciation and hence called it saltation (single-step large mutation).

156. Answer (1)

Hint: Less than 5 bya.

Sol.: In the solar system of the Milky way galaxy, Earth was supposed to have been formed about 4.5 billion years back.

157. Answer (1)

Hint: Chemical theory of evolution

Sol.: The Oparin-Haldane hypothesis proposed that life originated in a reducing atmosphere, where organic molecules could be synthesized abiotically from simple inorganic compounds.

Miller (1953) tested this hypothesis by simulating early Earth conditions: a mixture of CH_4, NH_3, H_2, and water vapour, along with electric sparks to simulate lightning.

After sometime, he observed the formation of amino acids (*e.g.*, glycine, alanine), supporting the idea that non-enzymatic abiotic synthesis of life's building blocks was possible.

Miller's setup did not involve oxygen.

For a long time, it was also believed that, life came out of decaying and rotting matter like straw, mud, *etc*. This was the theory of spontaneous generation.

158. Answer (3)

Hint: Reproductive fitness

Sol.: Darwin proposed that individuals within a species show variation in traits and these variations are often heritable. Those individuals whose inherited traits confer a survival or reproductive advantage are more likely to survive and pass on those traits.

Over generations, these advantageous traits become more common in the population, resulting in evolutionary change.

The theory of inheritance of acquired traits was given by Lamarck.

Hugo deVries talked about mutations.

Random mating maintains genetic equilibrium in a population.

159. Answer (2)

Hint: Telomerase activity increases in tumor cells.

Sol.: HIV is an enveloped virus.

In tumor cells, the activity of the telomerase enzyme is upregulated to maintain the length of the telomeres.

Telomerase allows cancer cells to bypass replicative senescence. The activity of telomerase inhibitor is destroyed in cancer cells due to mutations.

HIV reverse transcripts to integrate with host's DNA for progeny production.

160. Answer (4)

Hint: Number of patella in a hindlimb.

Sol.: The principle of immunization or vaccination is based on the memory of the immune system.

Innate immunity is a non-specific type of defence present at the time of birth.

Acquired immunity is a specific type of immune response.

Exaggerated response of the immune system of our body is called allergy. Allergy is caused by allergens like dust mites, pollen grains, *etc*.

161. Answer (2)

Hint: Metastasis is the most feared property of malignant tumors.

Sol.: Presence of well-differentiated cells, encapsulation and lack of invasion are the classical features of benign tumors. These tumors do not metastasize and usually remain confined to their tissue of origin, distinguishing them from malignant counterparts which show high mitotic index and invasiveness.

Cells sloughed from malignant tumors reach distant sites through blood and wherever they get lodged in the body, they start a new tumor there. This property is called metastasis.

162. Answer (4)

Hint: Acts as a potent sedative.

Sol.: The given image represents an opium poppy plant.

Heroin is a semi-synthetic product obtained by the acetylation of morphine. It is not obtained naturally.

Morphine is extracted from the latex of poppy plant named *Papaver somniferum*.

The drugs from this plant bind to specific receptors present in our CNS and GIT.

163. Answer (4)

Hint: Eliminate the physical carcinogens

Sol.: Ionizing radiations like X-rays and gamma rays and non-ionizing radiations like UV rays cause DNA damage leading to neoplastic transformation.

The chemical carcinogens such as benzene and 1-3 butadiene present in tobacco smoke have been identified as a major cause of cancer.

Cancer causing viruses, called oncogenic viruses, have genes called viral oncogenes.

164. Answer (1)

Hint: More than the number of external nostrils in humans

Sol.: A large number of infectious diseases like polio, diphtheria, pneumonia and tetanus have been controlled to a large extent by the use of vaccine.

165. Answer (4)

Hint: A helminthic disease

Sol.: The pathogen of filariasis is *Wuchereria malayi*. The pathogens are transmitted to a healthy person through the bite of an infected female *Culex* mosquito.

Ascariasis spreads *via* faeco-oral route.

Amoebic dysentery is a protozoan disease. Houseflies act as the mechanical carriers of its pathogen. It spreads *via* faeco-oral route.

166. Answer (3)

Hint: HIV belongs to the group of retroviruses.

Sol.: Despite the production of antibodies during early stages of infection, HIV continues to replicate and evade immune responses, leading to progressive T_H-cell depletion and eventually immunodeficiency.

HIV's reverse transcriptase lacks proofreading ability, leading to frequent mutations. This antigenic variability enables it to escape neutralization by existing antibodies, rendering humoral responses insufficient.

The genetic material of HIV is ssRNA not DNA.

167. Answer (1)

Hint: Infective stage of the malarial pathogen for mosquitoes is gametocytes.

Sol.: Gametocytes are the sexual forms of the parasite formed in the human blood stream.

While they do not cause symptoms (like fever) they are crucial for the transmission of malaria.

When a female *Anopheles* mosquito bites an infected person, it ingests gametocytes along with the blood.

These gametocytes develop into gametes inside the mosquito's gut, beginning the sexual cycle and eventually leading to the formation of sporozoites, which are the infectious stage for humans.

168. Answer (3)

Hint: Recall the functions of primary lymphoid organs.

Sol.: Primary lymphoid organs (bone marrow and thymus) are the sites where lymphocytes mature and become immunocompetent without encountering antigens.

Secondary lymphoid organs are the sites where mature lymphocytes are activated upon antigen exposure.

Both bone marrow and thymus provide micro-environments for the development and maturation of T-lymphocytes.

169. Answer (4)

Hint: Choose a depressant.

Sol.: Amphetamine is a stimulant. It has a potent stimulating action on CNS. Cocaine is also a stimulant and ganja is a cannabinoid. They act as hallucinogens at different doses.

Barbiturates are depressants.

170. Answer (2)

Hint: Diphtheria is caused by the same group of pathogens that causes plague.

Sol.: For diphtheria, vaccine is prepared from inactivated toxins.

For polio, vaccine is prepared from harmless viruses

Harvested antibodies refer to the antibodies that have been collected and extracted from a source after they have been produced, typically from a biological source, like an animal or cell culture.

171. Answer (2)

Hint: Eliminate the multiples of 2.

Sol.: *Salmonella typhi* (a bacterium) is the causative agent of typhoid fever. These pathogens generally enter the small intestine through food and water contaminated with them and migrate to other organs through blood. Sustained high fever, weakness, stomach pain, constipation, headache, *etc.*, are the common symptoms of this disease.

172. Answer (4)

Hint: Not all microorganisms are harmful.

Sol.: All immunogens are antigens, but all antigens are not immunogens.

Thymus is quite large at the time of birth but keeps reducing in size with age and by the time puberty is attained it reduces to a very small size.

Antibodies do not directly engulf and kill pathogens, but by binding to antigens, they interfere with pathogen activity or mark pathogens in various ways for inactivation or destruction.

173. Answer (3)

Hint: Include the disease that affects the knee joint

Sol.: Vitiligo, systemic lupus erythematosus, psoriasis and myasthenia gravis are examples of auto-immune disorders.

Tetanus is a bacterial disease.

Ringworm is a fungal disease.

Rheumatoid arthritis is characterized by inflammation in the joints.

Myasthenia gravis affects neuromuscular junction leading to fatigue, weakening and paralysis of skeletal muscle.

174. Answer (3)

Hint: Air filled sacs are affected.

Sol.: Symptoms of pneumonia and common cold include headache, cough, *etc*.

Both these diseases can spread *via* contaminated objects like utensils, cups, books, *etc*.

Common cold is caused by rhinoviruses.

Pneumonia is caused by *Streptococcus pneumoniae* and *Haemophilus influenzae.*

In common cold, nose and respiratory passage gets infected, not the lungs.

In pneumonia, alveoli of the lungs get affected.

In severe cases of pneumonia, the lips and finger nails may turn grey to bluish in colour which is called cyanosis.

175. Answer (2)

Hint: Recall the type of response shown by the body when it encounters a pathogen for the first time.

Sol.: When we recover from an infection without taking anti-microbial drugs, it is usually because of the primary response.

Humoral immunity is mediated by B-lymphocytes. Cell-mediated immunity is mediated by T-lymphocytes.

Plasma cells are differentiated B-lymphocytes which are capable of secreting antibodies.

Secondary immune response is mediated by both B and T-lymphocytes

176. Answer (4)

Hint: H_2L_2

Sol.: Antibody molecules are glycoproteins; thus, they are heteropolymers.

Antigen-binding site is present towards the variable region of both heavy and light chains.

Antibody molecules are stabilized by strong covalent disulfide bonds.

Antibody molecules are made up of four polypeptide chains.

177. Answer (1)

Hint: Body generates antibodies on its own.

Sol.: Vaccination provides artificial active immunity.

Colostrum contains I_gA antibodies and it provides natural passive immunity to the infant.

ATS (Anti-tetanus serum) provides artificial passive immunity.

Natural infections induce natural active immunity.

178. Answer (4)

Hint: Can be passed on to future generations

Sol.: Balanced diet, personal hygiene and regular exercise are very important to maintain good health.

Genetic disorders are deficiencies with which a child is born and deficiencies/defects which the child inherits from parents from birth.

179. Answer (3)

Hint: Exclude the viral disease

Sol.: Plague is caused by *Yersinia pestis*.

Small pox is caused by Variola virus.

Whooping cough is caused by the bacterium, *Bordetella pertussis*.

Tuberculosis is caused by the bacterium, *Mycobacterium tuberculosis*.

180. Answer (4)

Hint: Eliminate the physical barrier of innate immunity.

Sol.: Innate immunity consists of four types of barriers. They are:

(i) Physical barriers: Skin on our body and mucus coating of the epithelium lining the respiratory, gastrointestinal and urogenital tracts help in trapping microbes entering our body.

(ii) Physiological barriers: Acid in the stomach, saliva in the mouth and tears from eyes.

(iii) Cellular barriers: Neutrophils, monocytes and NK cells.

(iv) Cytokine barriers: Interferons secreted by virus-infected cells.

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