All India Aakash Test Series for NEET - 2025

TEST - 4 (Code - A)

Click here for Code-B Sol.

Test Date : 22/12/2024

ANSWERS

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

HINTS & SOLUTIONS

[PHYSICS]

SECTION - A

1. Answer (1)

Hint: Use de-Broglie wavelength associated with matter $\lambda = \frac{h}{p}$.

Sol.: de-Broglie wavelength is given by

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

$\therefore \lambda_d = \lambda_\alpha$

$$\frac{h}{m_d v_d} = \frac{h}{m_\alpha v_\alpha}$$

$$\Rightarrow \frac{v_d}{v_\alpha} = \frac{m_\alpha}{m_d} = \frac{4m_p}{2m_p} = \frac{2}{1}$$

2. Answer (1)

Hint: In the half-deflection method, the galvanometer resistance $G = \frac{RS}{R-S}$.

Sol.: $\frac{1}{G} = \frac{1}{S} - \frac{1}{R}$

$$\Rightarrow \frac{1}{S} = \frac{1}{R} + \frac{1}{G}$$

$$\Rightarrow \frac{1}{S} = \frac{1}{600} + \frac{1}{3} = \frac{201}{600}$$

$$\Rightarrow S = \frac{600}{201}\,\Omega$$

3. Answer (4)

Hint & Sol.: The current under reverse bias is voltage independent upto breakdown voltage (V_{br}). Even a slight increase in bias voltage at $V = V_{br}$, the diode reverse current increases sharply.

4. Answer (4)

Hint: Observation of photoelectric effect experiment.

Energy of incident photon	=	Maximum kinetic energy acquired by electron	+	Work function

Sol.: Due to energy loss inside the metal, photoelectrons emitted from a surface have different speeds.

5. Answer (1)

Hint: Energy of emitted photon when an electron jumps from n_1 orbit to n_2 orbit is

$$E_p = 13.6\left[\frac{1}{n_2^2} - \frac{1}{n_1^2}\right] \text{eV}$$

Sol.: $E_p = 13.6\left[\frac{1}{1} - \frac{1}{9}\right]$ eV

$$E_p = 13.6 \times \frac{8}{9} \text{eV}$$

E_p = 12.08 eV

6. Answer (4)

Hint: Energy of electron in n^{th} orbit

$$E_n = \frac{-13.6z^2}{n^2} \text{eV}$$

Sol.: For electron in fourth orbit of hydrogen atom, z = 1 and n = 4

$$E_4 = -\frac{13.6 \times 1}{16}$$

E_4 = –0.85 eV

$\Rightarrow \therefore$ energy required $E = -E_4$

= 0.85 eV

7. Answer (3)

Hint: Least count = 1 MSD – 1 VSD.

Sol.: 20 divisions of vernier scale = 18 divisions of main scale

$$\Rightarrow 1\,\text{VSD} = \left(\frac{18}{20}\right)\text{MSD}$$

= 0.9 MSD

L.C = 1 MSD –1 VSD

= 1 MSD – 0.9 MSD

= 0.1 MSD

= 0.1 × 0.1 cm

= 0.01 cm $\left[\because 1\ \text{MSD} = \frac{1}{10}\text{cm} = 0.1\,\text{cm}\right]$

8. Answer (2)

Hint & Sol.: Fusion of hydrogen nuclei into helium nuclei is the source of energy of all stars including our sun.

9. Answer (2)

Hint: Speed of electron in n^{th} orbit is equal to $\frac{c}{137}\times\frac{z}{n}$

Sol.: For hydrogen atom, $z = 1$ and for $n = 2$

$$v = \frac{c}{137\times 2}$$

$$v = \frac{c}{274}$$

10. Answer (3)

Hint: α-particle is the nucleus of He atom

Sol.: Given reaction,

$${}_2^4\text{He} + {}_7^{14}\text{N} \longrightarrow {}_8^{17}\text{O} + {}_1^1\text{H}$$

11. Answer (3)

Hint: Radius of shell $(r) = \frac{r_0 n^2}{z}$

Sol.: $$\frac{r_H}{r_{Li^{++}}} = \frac{1^2}{1}\times\frac{3}{3^2}$$

$$= \frac{1}{3}$$

12. Answer (3)

Hint: Refractive index of the prism, $\mu = \frac{\sin\left(\frac{A+\delta_m}{2}\right)}{\sin\left(\frac{A}{2}\right)}$

Sol.: $$\mu = \frac{\sin\left(\frac{60^\circ}{2}+\frac{\delta_m}{2}\right)}{\sin\left(\frac{60^\circ}{2}\right)} = \frac{\sin\left(30^\circ+\frac{\delta_m}{2}\right)}{\frac{1}{2}}$$

$$= 2\sin\left(30^\circ+\frac{\delta_m}{2}\right)$$

13. Answer (4)

Hint: Energy of infrared radiation is less than the visible radiation.

Sol.: In transition $n = 6$ to $n = 4$, radiation energy will be less than the transition from $n = 5$ to $n = 3$.

14. Answer (4)

Hint: Maximum kinetic energy of the photoelectrons is independent of intensity but depends on frequency while saturation current is proportional to photon intensity of source.

Sol.: By Einstein's equation

$(K.E.)_{max} = hf - \phi$

$\therefore$ By quadrupling the frequency, (K.E.) becomes more than 4 times.

15. Answer (2)

Hint: Use de-Broglie wavelength equation, $\lambda = \frac{h}{mv}$

Sol.: $\lambda_p = \lambda_e$

$$\Rightarrow \frac{h}{m_p v_p} = \frac{h}{m_e v_e}$$

$$\Rightarrow m_p v_p = m_e v_e$$

$$v_p = \frac{m_e v_e}{m_p}$$

$$= \frac{9\times10^{-31}\times4\times10^{6}}{9\times10^{-25}}$$

$$= 4 \text{ m s}^{-1}$$

16. Answer (4)

Hint: Use equation: $E = \phi_0 + KE_{max}$

Sol.: $E = \phi_0 + KE_{max} = \phi_0 + eV_s$

$$\frac{hc}{\lambda} = \phi_0 + 3 \text{ eV} \quad \text{...(i)}$$

$$\frac{hc}{2\lambda} = \phi_0 + 1 \text{ eV} \quad \text{...(ii)}$$

$$\frac{1}{2}(\phi_0 + 3 \text{ eV}) = \phi_0 + 1 \text{ eV}$$

$$\Rightarrow \frac{\phi_0}{2} + \frac{3}{2}\text{eV} = \phi_0 + 1 \text{ eV}$$

$$\frac{\phi_0}{2} = \frac{1}{2}\text{eV} \Rightarrow \phi_0 = 1 \text{ eV}$$

17. Answer (4)

Hint: Binding energy of nucleus = $\Delta m(u) \times 930$ MeV

Sol.:

Total binding energy (B.E.) = $\Delta m(u) \times 930$ MeV

= 0.077 × 930 MeV

$\therefore$ Binding energy per nucleon = $\frac{0.077 \times 930}{11}$

$= 7 \times 10^{-3} \times 930$

$= 6510 \times 10^{-3}$

$= 6.51$ MeV

18. Answer (2)

Hint: Use relation between electric field and potential difference $|\Delta V| = E \cdot d$

Sol.: In depletion layer,

$|\Delta V| = E \cdot d$

$\Rightarrow E = \frac{\Delta V}{d}$

$= \frac{0.6}{3 \times 10^{-5}}$

$= 0.2 \times 10^5$

$= 2 \times 10^4$ V/m

19. Answer (3)

Hint: At rotational equilibrium, sum of moments is equal to zero, about the wedge.

Sol.: $F_1 d_1 = F_2 d_2$

$\Rightarrow 60 \times 10 = W \times (80 - 50)$

$\Rightarrow \frac{600}{30} = W$

$\therefore W = 20$ N

20. Answer (2)

Hint: In nuclear reaction, linear momentum is conserved.

Sol.: ${}_{92}U^{238} \longrightarrow {}_{90}Th^{234} + {}_{2}He^{4}$

$p_i = p_f$

$\Rightarrow 0 = m_d v_d + m_\alpha v_\alpha$

$\Rightarrow |v_d| = \frac{4v_0}{234}$

$= \frac{2v_0}{117}$

21. Answer (3)

Hint & Sol.: Nuclear forces are independent of charge and are type of non-central forces.

22. Answer (1)

Hint & Sol.: Heavier nuclides contains more number protons and that's why to provide stability more neutrons are required.

23. Answer (2)

Hint & Sol.: When contact angle is less than 90°, then shape of meniscus is concave upwards.

24. Answer (2)

Hint: $i_{avg} = \frac{\int i dt}{\int dt}$

Sol.: Average value of output in case of half wave rectifier is $\frac{i_0}{\pi}$.

25. Answer (3)

Hint: Potential energy = – 2 × kinetic energy = 2 × Total energy of electron

Sol.: $E = -13.6 \times \frac{Z^2}{n^2}$ eV

Kinetic energy in 1st orbit of H atom = 13.6 eV = K

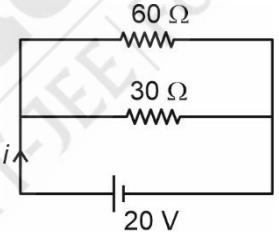
Potential energy in 1st orbit of He^+ atom $= -\frac{13.6 \times 2^2}{1^2} \times 2$ eV

$\therefore$ PE = – (13.6 eV) × 8 = – 8K

26. Answer (1)

Hint: Ideal diode, in forward bias has zero resistance and in reverse bias it has infinite resistance.

Sol.: Equivalent circuit,



$i = \frac{20}{30} + \frac{20}{60} = 1$ A

27. Answer (3)

Hint & Sol.: Zener diode is fabricated by heavy doping on both sides (P and N). It is designed to operate in reverse bias condition and hence offers finite resistance.

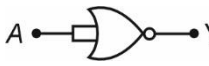
28. Answer (1)

Hint: When pure semiconductor is doped with impurities, it gives P-type and N-type semiconductor.

Sol.: Pentavalent as well as trivalent impurities have neutral atoms. So overall neutrality of crystal does not change due to doping.

29. Answer (4)

Hint:



act as a NOT gate *i.e.*, $Y = \overline{A}$

Sol.:

$Y = \overline{\overline{A} \cdot \overline{B}}$

$= \overline{\overline{A}} + \overline{\overline{B}}$

$= A + B$

30. Answer (3)

Hint & Sol.:

Isotopes → same atomic number

Isobars → same mass number

Isotones → same number of neutrons

Nucleons → sum of number of neutrons and protons

31. Answer (4)

Hint & Sol.: Conductivity of pure silicon can be increased by increasing the temperature and by doping (both acceptor as well as donor impurities)

32. Answer (1)

Hint & Sol.: Kinetic energy (K.E.) = –(Total energy)

K.E. = –(–13.6) = 13.6 eV

33. Answer (3)

Hint: Q-value = $(\text{B.E.})_{\text{product}} - (\text{B.E.})_{\text{reactant}}$

Sol.:

Given reaction is

$${}_1^2\text{H} + {}_1^2\text{H} \longrightarrow {}_2^4\text{He} + Q\text{-value}$$

Q-value = $(\text{B.E.})_{\text{product}} - (\text{B.E.})_{\text{reactant}}$

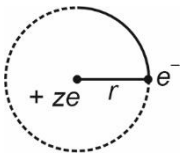
$= 26 - 2 \times 2.5$

$= 26 - 5$

$= 21$ MeV

34. Answer (2)

Hint & Sol.:



$$U = -\frac{K(ze)(e)}{r}$$

$z = 1$ for hydrogen atom

$$= -\frac{Ke^2}{r}$$

35. Answer (3)

Hint & Sol.: β^- particle is emitted when neutron inside a nucleus is transformed into a proton.

SECTION - B

36. Answer (3)

Hint: Use de-Broglie wavelength $\lambda = \frac{h}{p}$ and $p = \sqrt{2mK} = \sqrt{2mqV}$.

Sol.: de-Broglie wavelength

$$\lambda = \frac{h}{\sqrt{2mqV}}$$

$$\lambda \propto \frac{1}{\sqrt{V}}$$

$$\therefore \quad \frac{\lambda_2}{\lambda_1} = \sqrt{\frac{V_1}{V_2}}$$

$$\frac{\lambda_2}{1} = \sqrt{\frac{130}{520}}$$

$$\lambda_2 = \frac{1}{2}$$

$= 0.5$ Å

37. Answer (4)

Hint: de-Broglie wavelength $\lambda = \frac{h}{\sqrt{2mk}}$

Sol.: For same kinetic energy $\lambda \propto \frac{1}{\sqrt{m}}$

$m_d > m_p > m_e$

$\therefore \quad \lambda_e > \lambda_p > \lambda_d$

38. Answer (1)

Hint: Binding energy (B.E.) = Δmc^2

Sol.: $\Delta m = 6M_p + 6M_n - M_0$

B.E. = $(6M_p + 6M_n - M_0)c^2$

39. Answer (2)

Hint: Potential difference across 2 kΩ, $V_{2\,\text{k}\Omega} = iR$

Sol.: $i = \frac{20 - 0.7 - 0.3}{R_{\text{eq}}} = \frac{19}{5}$ mA

$i = 3.8$ mA

$V = 3.8 \times 10^{-3} \times 2 \times 10^3$

$= 7.6$ V

40. Answer (3)

Hint: Number of spectral lines emitted $= \frac{n(n-1)}{2}$

Sol.: 12.75 eV is the energy difference of state $n = 1$ and $n = 4$

$\therefore$ No. of spectral lines $= \frac{4(4-1)}{2}$

$= 6$

41. Answer (3)

Hint: First resonating length $l_1 = \frac{\lambda}{4} + e$ and second resonating length $l_2 = \frac{3\lambda}{4} + e$

Sol.: $l_2 - l_1 = \left(\frac{3\lambda}{4} + e\right) - \left(\frac{\lambda}{4} + e\right)$

$l_2 - l_1 = \frac{\lambda}{2}$

$\Rightarrow \lambda = 2(l_2 - l_1)$

$= 2(47 - 15)$

$= 2 \times 32$

$= 64$ cm

42. Answer (2)

Hint:

Least count =

$$\frac{\text{Pitch}}{\text{Total number of division on circular scale}}$$

Sol.: Pitch = 0.02 cm

Least count $= \frac{0.02}{50}$

$= 4 \times 10^{-4}$ cm

43. Answer (1)

Hint: Use, $\Delta E = \frac{hc}{\lambda}$

Sol.: $\Delta E = 5$ eV

$\Delta E = \frac{12400}{\lambda(\text{Å})}$

$\Rightarrow 5 = \frac{12400}{\lambda_{max}}$

$\Rightarrow \lambda_{max} = \frac{12400}{5}$

$= 2480$ Å

44. Answer (2)

Hint: Use, $\frac{1}{\lambda} = Rz^2\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$

Sol.: For shortest wavelength of Paschen series $n_1 = 3$ and $n_2 = \infty$

$\frac{1}{\lambda_1} = R\left[\frac{1}{9}\right]$ ...(i)

For shortest wavelength of Lyman series

$n_1 = 1$ and $n_2 = \infty$

$\frac{1}{\lambda_2} = R[1]$ ...(ii)

Divide (ii) by (i)

$\frac{\lambda_1}{\lambda_2} = \frac{R \times 9}{R} = \frac{9}{1}$

45. Answer (1)

Hint: Radius of nucleus $(R) = R_0(A)^{1/3}$

Sol.: $\frac{R_X}{R_Y} = \left(\frac{A_X}{A_Y}\right)^{1/3}$

$\Rightarrow \frac{2R_Y}{R_Y} = \left(\frac{A_X}{A_Y}\right)^{1/3}$

$\Rightarrow \frac{A_X}{A_Y} = 8$

46. Answer (2)

Hint: Use, time period $(T) = \frac{2\pi r}{v}$

Sol.: Radius $(r) \propto \frac{n^2}{z}$

and velocity $(v) \propto \frac{z}{n}$

$\therefore T \propto \frac{r}{v} \propto \left(\frac{n^2}{z} \times \frac{n}{z}\right) \propto \frac{n^3}{z^2}$

47. Answer (3)

Hint: Use Einstein's photoelectric equation.

Sol.: By Einstein's photoelectric equation,

$eV_s = hf - \phi_0$, as frequency increases, stopping potential increases

$\rightarrow I_{saturation} \propto$ intensity

$\rightarrow$ Work function of material depends on material of plate.

48. Answer (4)

Hint: Work done = maximum kinetic energy

Sol.: KE_{max} = work done

$KE_{max} = (eE)d \Rightarrow KE_{max} = e \times 3 \times 2 = 6$ eV

49. Answer (2)

Hint: Intensity is equal to energy passing through per unit area per unit time.

Sol.: $I = I_1 + I_2$

$$I_1 = \frac{2n \times hc}{\lambda A}, I_2 = \frac{3n \times hc}{2\lambda A}$$

$$\therefore \ I = \frac{2nhc}{\lambda A} + \frac{3nhc}{2\lambda A} = \frac{7nhc}{2\lambda A}$$

50. Answer (1)

Hint: In the given nuclear reaction, atomic number and atomic mass numbers are conserved.

Sol.: Let particle as ${}_xR^y$

Atomic number conservation

$92 = 56 + 35 + 0 + x$

$x = 1$

And atomic mass number conservation

$236 = 141 + 93 + 1 + y$

$y = 1$

$\therefore \ R \rightarrow {}_1p^1$

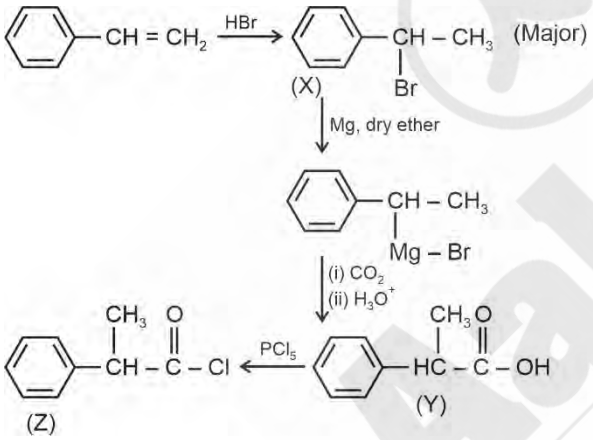
[CHEMISTRY]

SECTION - A

51. Answer (3)

Hint: Magnesium reacts with alkyl halide in the presence of dry ether to form Grignard reagent.

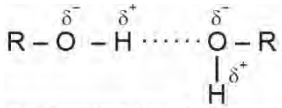
Sol.:



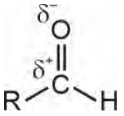
52. Answer (1)

Hint: Alcohols have high boiling point due to intermolecular hydrogen bonding.

Sol.:



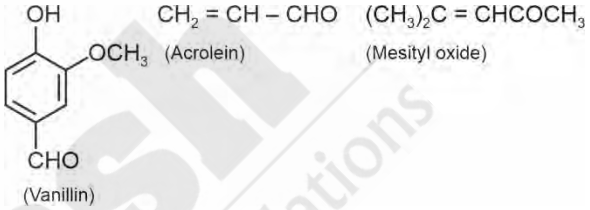
Intermolecular hydrogen bonding



Dipole - dipole interaction because of dipolar nature of aldehydes and ketones.

53. Answer (2)

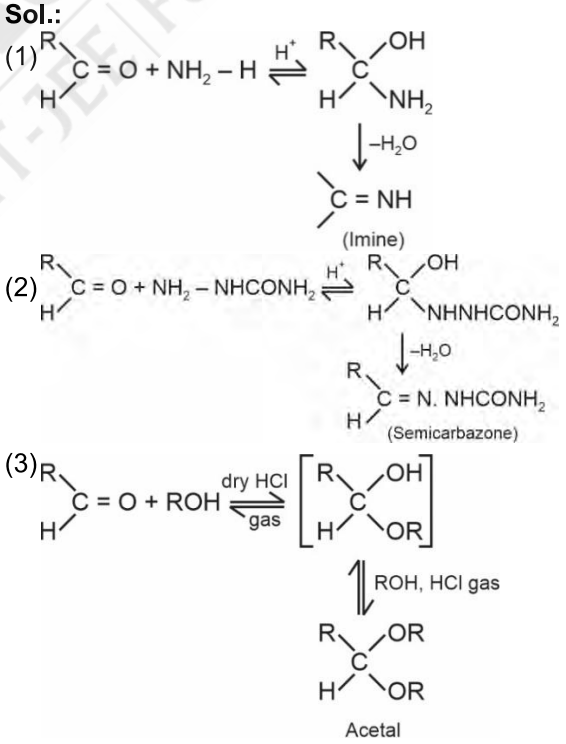
Hint & Sol.:

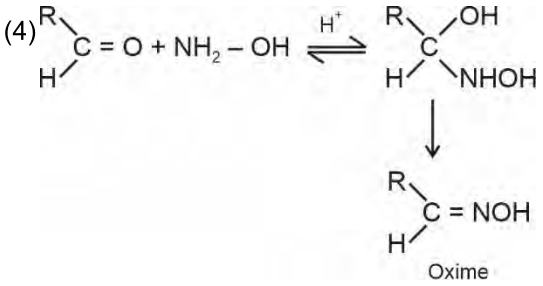


54. Answer (4)

Hint: Ammonia and its derivatives add to carbonyl compounds and form final product after rapid dehydration.

Sol.:



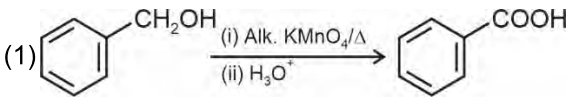
(4) 

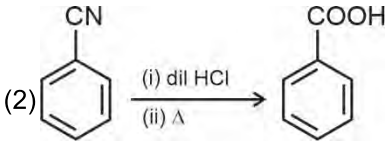
Oxime

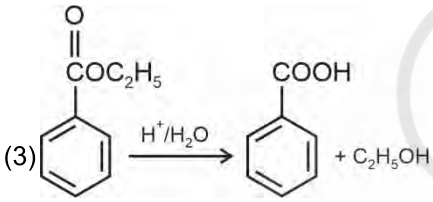
55. Answer (4)

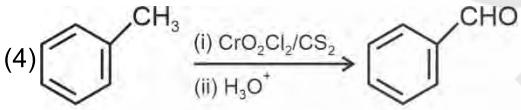
Hint: Only strong oxidising agents can oxidise hydrocarbon into carboxylic acid.

Sol.:

(1) 

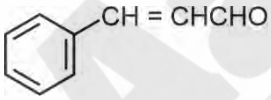
(2) 

(3) 

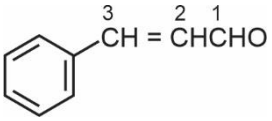
(4) 

(Etard reaction)

56. Answer (3)

Hint: Cinnamaldehyde is 

Sol.:



3-Phenylprop-2-en-1-al

57. Answer (4)

Hint: CH_3CHO reacts with CH_3CH_2CHO in the presence of dil. NaOH followed by heating leads to cross aldol condensation.

Sol.:

(1) $2CH_3CHO \xrightarrow[(ii)\ \Delta]{(i)\ dil.NaOH} \underset{(self\ aldol\ product)}{CH_3CH = CHCHO}$

(2) $2CH_3CH_2CHO \xrightarrow[(ii)\ \Delta]{(i)\ dil.\ NaOH} CH_3 - CH_2CH = \underset{\displaystyle CH_3}{\overset{\displaystyle |}{C}} - CHO$

(Self aldol product)

(3) $CH_3CHO + \underset{\displaystyle CH_3}{\overset{\displaystyle |}{H}}CHCHO \xrightarrow[(ii)\ \Delta]{(i)\ dil.\ NaOH} CH_3CH = \underset{\displaystyle CH_3}{\overset{\displaystyle |}{C}} - CHO$

(Cross-aldol product)

(4) $CH_3 - CH_2CHO + CH_3CHO \xrightarrow[(ii)\ \Delta]{(i)\ dil.\ NaOH} CH_3CH_2CH = CH - CHO$

(Cross aldol product)

58. Answer (2)

Hint: Aldehydes and ketones with $CH_3 - \overset{\displaystyle O}{\overset{\displaystyle ||}{C}} -$ group and alcohols with $CH_3 - \underset{\displaystyle OH}{\overset{\displaystyle |}{CH}}$ group give positive iodoform test.

Sol.:

$CH_3 - \underset{\displaystyle OH}{\overset{\displaystyle H}{\overset{\displaystyle |}{\underset{\displaystyle |}{CH}}}}$ gives positive iodoform test

$H - \overset{\displaystyle O}{\overset{\displaystyle ||}{C}} - H$ does not give iodoform test

$CH_3 - CH_2 - CH_2 - \overset{\displaystyle O}{\overset{\displaystyle ||}{C}} - CH_3$ gives positive iodoform test

$CH_3 - \overset{\displaystyle O}{\overset{\displaystyle ||}{C}} - H$ gives positive iodoform test

$CH_3 - CH_2 - CH_2 - OH$ does not give iodoform test

59. Answer (1)

Hint: Aromatic aldehydes do not respond to Fehling's test.

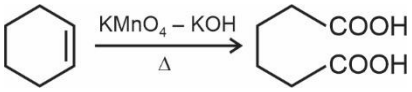
Sol.: Benzaldehyde does not form red brown ppt with Fehling's solution while acetaldehyde reacts as follows:

$$CH_3CHO + 2Cu^{2+} + 5OH^- \rightarrow CH_3COO^- + \underset{\text{Red Brown ppt}}{Cu_2O} + 3H_2O$$

60. Answer (2)

Hint: $KMnO_4 - H_2SO_4$ is a good oxidising agent & oxidises alkene into carboxylic acid.

Sol.:



Hexane –1, 6– dioic acid

61. Answer (4)

Hint & Sol.: Valine, leucine and isoleucine are essential amino acids while glutamine is non-essential amino acid.

62. Answer (2)

Hint: Amylose and amylopectin are two components of starch and starch is main polysaccharide of plants.

Sol.: Amylose is water soluble component which constitutes 15 – 20% of starch while amylopectin is branched chain polysaccharide which is insoluble in water and constitutes 80 – 85% starch.

63. Answer (3)

Hint & Sol.:

Sucrose – α-D-glucose and α-D-fructose

Maltose – α-D-glucose and α-D-glucose

Lactose – β-D-glucose and β-D-galactose

Cellulose – β-D-glucose units.

64. Answer (2)

Hint & Sol.: During denaturation, secondary and tertiary structures get destroyed while primary structure remains intact.

65. Answer (4)

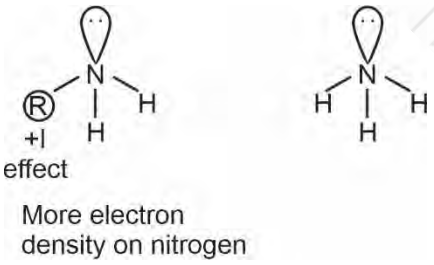
Hint: A unit formed by attachment of a base to 1′ position of sugar is known as nucleoside.

Sol.: When nucleoside is linked to phosphoric acid at 5′ position of sugar moiety, a nucleotide is formed.

66. Answer (1)

Hint: Alkyl group has +I effect and hence increases basic nature of amine.

Sol.:



67. Answer (4)

Hint & Sol.: Hormones are the products of endocrine glands and these act as intercellular messengers.

68. Answer (2)

Hint: In aqueous solution, basicity of 2° amine is more than that of 1° and 3° amines.

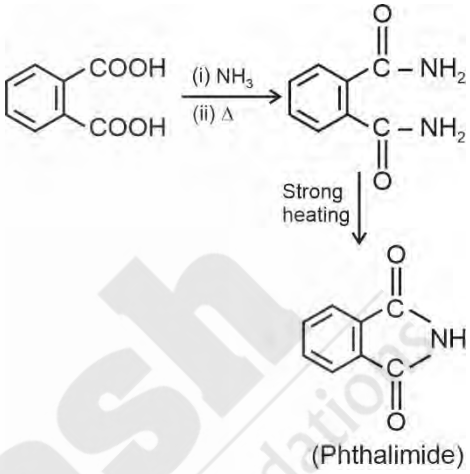
Sol.: There is a subtle interplay of the inductive effect, solvation effect and steric hinderance of the alkyl group is applicable which decides the basic strength of alkyl amines in aqueous solution.

The correct order of basic strength is

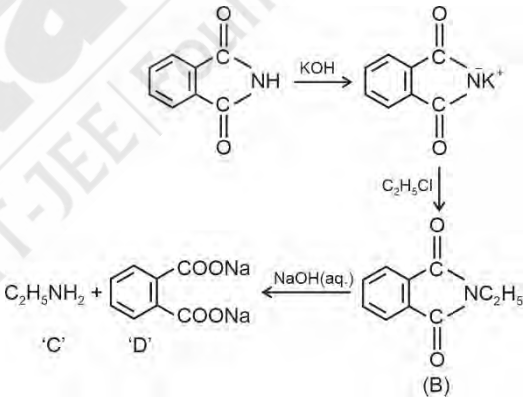
$(C_2H_5)_2NH > (C_2H_5)_3N > C_2H_5NH_2$

69. Answer (2)

Hint:

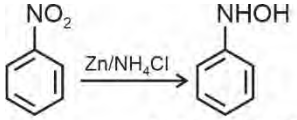


Sol.:



70. Answer (1)

Hint & Sol.:



N-phenylhydroxylamine

71. Answer (4)

Hint: Ceric ammonium nitrate reacts with alcohol to form red coloured complex.

$(NH_4)_2[Ce(NO_3)_6] + 3ROH \rightarrow [Ce(NO_3)_4 (ROH)_3]$

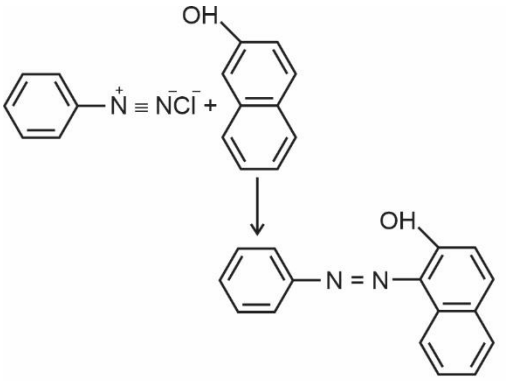
$+ 2NH_4NO_3$

Sol.: Phenols form violet coloured compound with freshly prepared $FeCl_3$ solution.

$6C_6H_5OH + FeCl_3 \rightarrow [Fe(C_6H_5O)_6]^{3-} + 3HCl + 3H^+$

72. Answer (1)

Hint & Sol.:



β– Naphthol azodye
(Scarlet red)

73. Answer (1)

Hint:

$NaNO_3 + H_2SO_4 \rightarrow NaHSO_4 + HNO_3$

$4HNO_3 \xrightarrow{\Delta} 4NO_2 + O_2 + 2H_2O$

Sol.:

On addition of Cu turnings:

$2NaNO_3 + 4H_2SO_4 + 3Cu \rightarrow \underset{\text{(Blue solution)}}{3CuSO_4} + Na_2SO_4 + 4H_2O + 2NO$

$2NO + O_2 \longrightarrow \underset{\text{(Brown fumes)}}{NO_2}$

74. Answer (2)

Hint & Sol.:

Colour of flame observed	Ion
Crimson red	Sr^{2+}
Brick red	Ca^{2+}
Apple green	Ba^{2+}
Green with blue centre	Cu^{2+}

75. Answer (3)

Hint: ($H_2S + NH_4Cl$) is the group reagent for Group IV cations (i.e. Co^{3+}, Ni^{2+}, Mn^{2+}, Zn^{2+})

Sol.: Ba^{2+} is a basic radical of group V and its group reagent is $(NH_4)_2CO_3 + NH_4OH$.

76. Answer (1)

Hint: Pb^{2+} reacts with K_2CrO_4 to form yellow precipitate of lead chromate.

Sol.:

$Pb^{2+} + K_2CrO_4 \rightarrow PbCrO_4 + 2K^+$

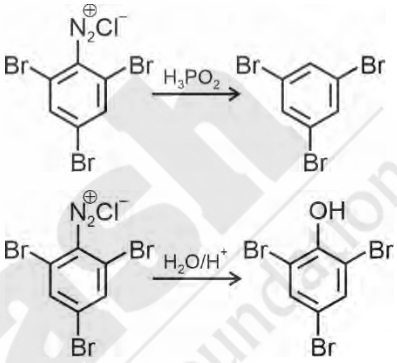
Lead chromate is soluble in hot sodium hydroxide solution.

$PbCrO_4 + 4NaOH \rightleftharpoons Na_2\left[Pb(OH)_4\right] + Na_2CrO_4$

77. Answer (2)

Hint: Diazonium salt reacts with H_2O/H^+ at 283°C to form phenol.

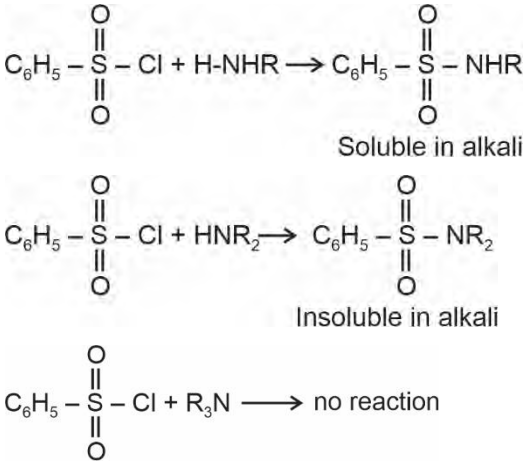
Sol.:



78. Answer (3)

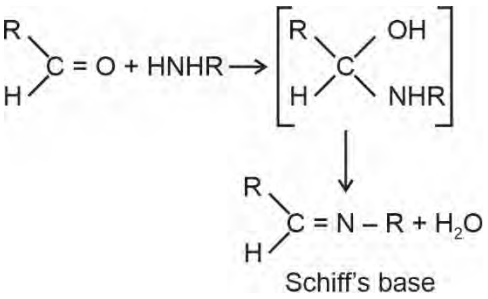
Hint: Hinsberg reagent is $C_6H_5SO_2Cl$.

Sol.: Hinsberg reagent reacts with primary amine to form N-alkylbenzenesulfonylamide which is soluble in NH_4OH while it reacts with secondary amine to form N, N′ – dialkylbenzene sulphonylamine that is insoluble in NH_4OH. 3° amine does not react with Hinsberg reagent.



79. Answer (3)

Hint & Sol.:

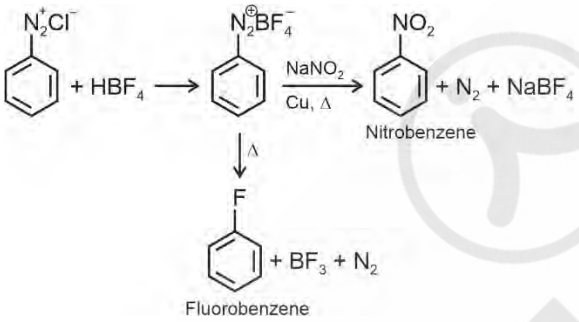


80. Answer (1)

Hint: Diazonium salts give orange coloured dye with phenol in basic medium.

Sol.:

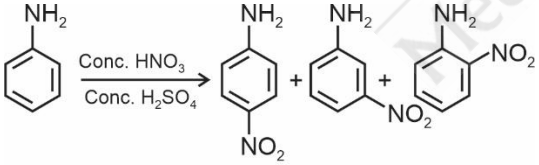
$$R-NH_2 \xrightarrow{NaNO_2+HCl} RN_2^+Cl^- + H_2O \rightarrow ROH + N_2 + HCl$$

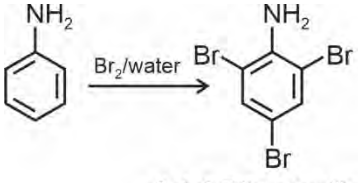


81. Answer (3)

Hint: $-NH_2$ group on benzene ring is highly activating.

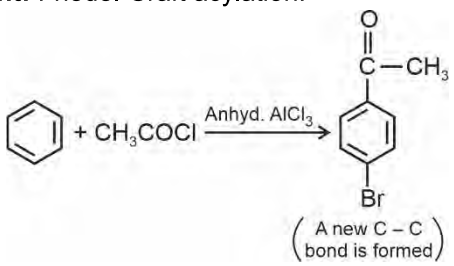
Sol.:

- $R-N\equiv C \xrightarrow{H_2/Ni} R-NH-CH_3$ (2° amine)
- $R-NO_2$ and $R-O-NO$ are functional group isomers.
- 

- 

82. Answer (1)

Hint: Friedel-Craft acylation:

- 

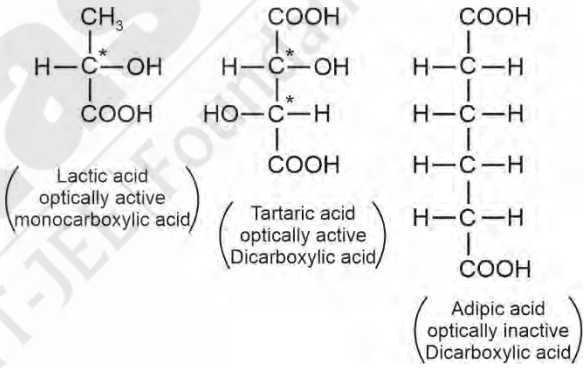
Sol.:

- $2CH_3COOH + 2H_2O \xrightarrow{\text{Electrolysis}} CH_3-CH_3 + 2CO_2 + 2H_2$ (New C – C bond is formed)
- $CH_3COOC_2H_5 \rightleftharpoons CH_3COONa + C_2H_5OH$ (No new C – C Bond is formed)

83. Answer (2)

Hint: Tartaric acid and adipic acid are dicarboxylic acids.

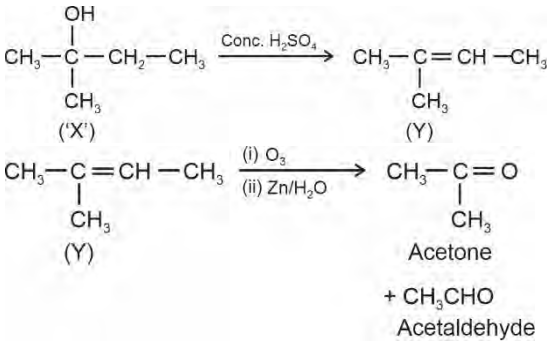
Sol.:



84. Answer (2)

Hint: Both aldehyde and ketone are giving positive haloform reaction, it mean they have α-methyl ketone group $\left(-\overset{O}{\overset{\|}{C}}-CH_3\right)$

Sol.:



85. Answer (3)

Hint & Sol.:

Mohr's salt is $FeSO_4 \cdot (NH_4)_2SO_4 \cdot 6H_2O$

SECTION - B

86. Answer (2)

Hint: Reduction of alkyl cyanide by $SnCl_2/HCl$ followed by hydrolysis to form aldehyde is known as Stephen reaction.

Sol.:

$$CH_3C \equiv N \xrightarrow{SnCl_2/HCl} \underset{\text{Imine}}{CH_3C = NH} \xrightarrow{H_3O^+} \underset{\text{Aldehyde}}{CH_3CHO}$$

87. Answer (2)

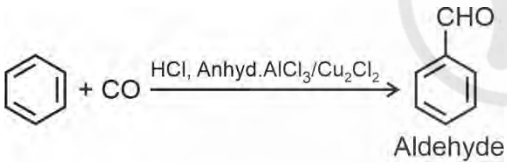
Hint: In Hell-Volhard Zelinsky reaction, carboxylic acid with atleast one α-H atoms react with Cl_2 or Br_2 in the presence of red P to give α-halo carboxylic acid.

Sol.:

Clemmensen Reduction:

$$CH_3CHO \xrightarrow[HCl]{Zn-Hg} \underset{\text{(Hydrocarbon)}}{CH_3 - CH_3} + H_2O$$

Gattermann-Koch reaction:



Cannizzaro reaction:

$$HCHO + HCHO \xrightarrow{conc.\ KOH} \underset{\text{Alcohol}}{CH_3OH} + \underset{\text{Salt of carboxylic acid}}{HCOOK}$$

Hell-Volhard Zelinsky reaction:

$$R - CH_2COOH \xrightarrow[(ii)\ H_2O]{(i)\ Red\ P/X_2} \underset{\alpha\text{-halocarboxylic acid}}{R - \underset{X}{\underset{|}{CH}} - COOH}$$

88. Answer (3)

Hint & Sol.:

$$CH_3CH_2 - OH \xrightarrow[573K]{Cu} CH_3 - CHO$$

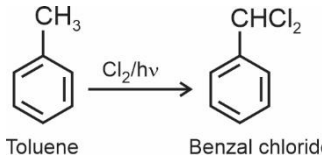
89. Answer (4)

Hint & Sol.:

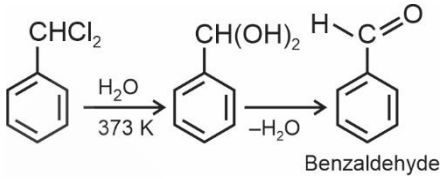
	Species	Colour
(1)	$[Fe(SCN)]^{2+}$	Blood red
(2)	AgI	Yellow
(3)	$Fe_4[Fe(CN)_6]_3 \cdot xH_2O$	Prussian blue
(4)	$[Fe(CN)_5NOS]$	Violet

90. Answer (3)

Hint:



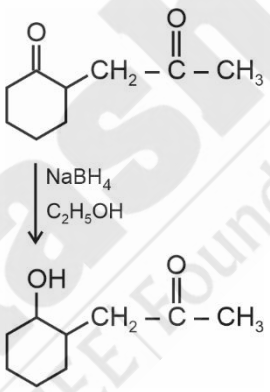
Sol.:



91. Answer (1)

Hint: $NaBH_4$ does not reduce ester group while it can easily reduce carbonyl group to alcoholic group.

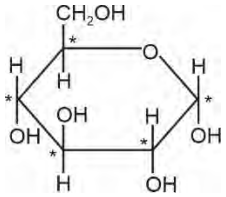
Sol.:



92. Answer (4)

Hint: In the glucopyranose structure, 5 carbon atoms and one oxygen atom are present in the ring.

Sol.:



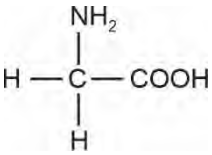
α-D(+) - Glucopyranose

Five carbon atoms marked (*) are chiral

93. Answer (4)

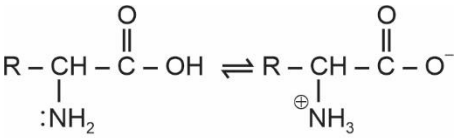
Hint: If an amino acid contains more number of amino groups as compared to carboxylic acid groups then it is considered as basic in nature.

Sol.:



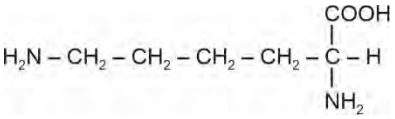
Glycine is an optically inactive, non-essential amino acid.

In aqueous solution, amino acid exists as zwitter ion



Zwitter ion

Lysine is a basic amino acid



94. Answer (2)

Hint & Sol.:

	Vitamin	**Deficiency disease**
(1)	Thiamine (Vitamin B_1)	Beri – beri
(2)	Riboflavin (Vitamin B_2)	Cheilosis
(3)	Pyridoxine (Vitamin B_6)	Convulsions
(4)	Ascorbic acid (Vitamin C)	Scurvy
(5)	Vitamin D	Rickets (in children)
		Osteomalacia (in adults)

95. Answer (4)

Hint: Glycosidic linkage is present in carbohydrates.

Sol.:

(1)	Phosphodiester linkage	Nucleic acids
(2)	Glycosidic linkage	Carbohydrates
(3)	Peptide bond	Protein

96. Answer (3)

Hint: Enthalpy of hydration

Sol.:

Given:

1. $CuSO_4.5H_2O(s) \rightarrow CuSO_4(aq) + 5H_2O(\ell)$

$\Delta H_1 = -11.3 \text{ kJ mol}^{-1}$

2. $CuSO_4(s) \rightarrow CuSO_4(aq)$

$\Delta H_2 = -65.5 \text{ kJ mol}^{-1}$

3. $CuSO_4(s) + 5H_2O(\ell) \rightarrow CuSO_4.5H_2O(s)$

$\Delta H_3 = ?$

On reversing equation (1) and adding equation (2)

$CuSO_4(aq) + 5H_2O(\ell) + CuSO_4(s) \rightarrow CuSO_4(aq) + CuSO_4.5H_2O(s)$

$\Rightarrow CuSO_4(s) + 5H_2O(\ell) \rightarrow CuSO_4.5H_2O(s)$

$\Delta H_3 = -\Delta H_1 + \Delta H_2$

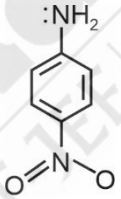
$= +11.3 + (-65.5)$

$= -54.2 \text{ kJ mol}^{-1}$

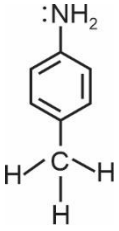
97. Answer (4)

Hint: Nitro group at p-position in aniline shows –R effect while $-CH_3$ group at para position shows hyperconjugation effect.

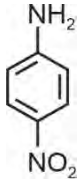
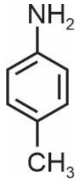
Sol.:



Electron withdrawing $-NO_2$ group decreases the electron density on $-NH_2$ group and hence it is less basic as compared to aniline



$-CH_3$ group at p-position increase electron density at $-NH_2$ and hence increases the basic nature.

So,  is less basic than 

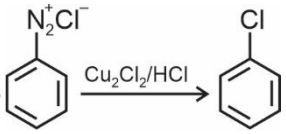
98. Answer (4)

Hint: Ammonolysis of alkyl halide yields a mixture of 1°, 2°, 3° amines and quaternary ammonium salt.

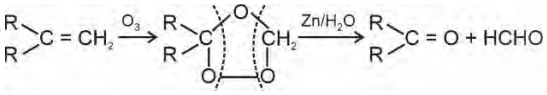
Sol.:

(1) $\ddot{N}H_3 + R\!-\!\ddot{X} \longrightarrow \overset{+}{R}\overset{+}{N}H_3X^- \xrightarrow{NH_3} \underset{(1°)}{RNH_2} + NH_4X$

$\underset{(1°)}{RNH_2} \xrightarrow{RX} \underset{(2°)}{R_2NH} \xrightarrow{R-X} \underset{(3°)}{R_3N} \xrightarrow{R-X} R_4\overset{+}{N}X^-$

(2) 

Sandmeyer Reaction

(3) 

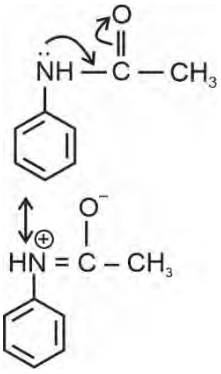
Ozonolysis of alkene leads to the formation of aldehyde/ketone.

(4) $RCONH_2 + Br_2 + 4NaOH \rightarrow RNH_2 + Na_2CO_3 + 2NaBr + 2H_2O$

Hoffmann bromamide degradation leads to the formation of primary aliphatic amine.

99. Answer (2)

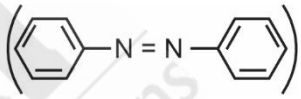
Hint & Sol.: $NHCOCH_3$ group is less activating than amino group.



Lone pair on Nitrogen is in conjugation with carbonyl group in acetylated aniline.

100. Answer (1)

Hint: In Lassaigne test for detection of nitrogen, nitrogen turns to CN^- ion.

Sol.: Azobenzene  and hydriazine does not give Lassaigne test because diazo compound lose their nitrogen as N_2 gas at moderate temperature, and hydrazine does not have carbon atom.

[BOTANY]

SECTION - A

101. Answer (3)

Hint: Interaction of biotic and abiotic components result in the physical structure that is characteristic for each type of ecosystem.

Sol.: Stratification is vertical distribution of different species occupying different levels. It is a structural feature of an ecosystem.

102. Answer (2)

Hint: Key industry animals are primary consumers or first order consumers.

Sol.: Key industry animals are also called herbivores and they convert plant matter into animal matter.

103. Answer (4)

Hint: NPP is the available biomass for the consumption to heterotrophs.

Sol: Primary productivity refers to the rate at which sunlight is captured by producers for the synthesis of energy rich organic compounds through photosynthesis.

104. Answer (3)

Hint: Humus is highly resistant to microbial action.

Sol.: Humus is a dark coloured, amorphous, more or less decomposed organic material rich in cellulose, lignin and tannins. It contains water soluble carbohydrates and nucleic acids.

105. Answer (2)

Hint: Plants capture only 2 - 10% of PAR.

Sol.: 1-5% of incident solar radiation is captured by plants for the synthesis of organic matter.

106. Answer (3)

Hint: Autotrophs are chief producers in aquatic ecosystem.

Sol.: Chief producers in aquatic ecosystem are phytoplanktons.

107. Answer (2)

Hint: Sunlight is not available in deep sea hydrothermal ecosystem.

Sol.: In deep sea hydrothermal ecosystem, the primary producers are chemosynthetic bacteria.

108. Answer (1)

Hint: In the given food chain 'A' is occupied by primary consumers.

Sol.: 'A' in the given food chain is occupied by grasshopper as, it is further eaten by frog.

109. Answer (3)

Hint: A number of generations of phytoplankton is consumed by single generation of zooplanktons.

Sol.: In an aquatic ecosystem, the pyramid of biomass may be inverted. Biomass of zooplanktons is higher than that of phytoplanktons as life span of former is longer and the latter multiply much faster though having shorter life span.

110. Answer (3)

Hint: Mineralisation involves release of CO_2, H_2O and minerals from humus.

Sol.: Mineralisation is the release of inorganic substances from organic matter.

111. Answer (2)

Hint: Process of humification and mineralisation involves living organisms

Sol.: The percolation of water soluble inorganic nutrients down to soil horizon is called leaching. It does not involve living organisms.

112. Answer (3)

Hint: Top carnivores occupy fourth trophic level, second trophic level comprises of herbivores and secondary consumers occupy third trophic level.

Sol.: Top carnivores - Lion

Second trophic level - Grasshopper

Secondary consumers – Wolf

First trophic level - Trees

113. Answer (2)

Hint: According to the first law of thermodynamics energy is neither created nor destroyed.

Fungi are also involved in catabolism.

Sol.: In ecosystem, according to the second law of thermodynamics, no transfer of energy occurs until it is accompanied by degradation of energy from concentrated to dispersed form.

During catabolism, bacterial and fungal enzymes degrade detritus into simpler inorganic substance.

114. Answer (4)

Hint: Detritivores are reducers.

Sol.: Detritivores feed on detritus. They are heterotrophic organisms.

115. Answer (2)

Hint: Transfer of energy across trophic level follows 10% law.

Sol.:

Grasses	→	Grasshopper	→	Birds	→	Hawk.
T_1		T_2		T_3		T_4
40,000 J		4000 J		400 J		40 J
40 kJ		4 kJ		0.4 kJ		0.04 kJ

116. Answer (3)

Hint: Pyramid of biomass in terrestrial ecosystem is triangle shaped.

Sol.: Pyramid of biomass in terrestrial ecosystem is usually upright.

117. Answer (4)

Hint: Biomass is calculated with unit gram, kilogram, milligram. Unit of energy is calorie.

Sol.:

From the given data, spindle-shaped pyramid of biomass is obtained.

118. Answer (2)

Hint: Genetic diversity helps in formation of ecotype.

Sol.: Genetic diversity play a key role in the process of speciation. Maximum taxonomic diversity occurs where species of taxonomically different groups occur in almost equal abundance.

119. Answer (4)

Hint: The Species-Area relationship equation is

$\log S = \log C + Z \log A$

Sol.: In Alexander von Humboldt equation, Z represents regression coefficient.

C represents Y-intercept and S represents species richness

120. Answer (3)

Hint: Highest species diversity is found in the tropical regions.

Sol.: Amazonian rain forest in South America exhibits highest species diversity across globe.

121. Answer (3)

Hint: The zonation of terrestrial biosphere reserve is as follows.

A represents transition zone

B represents buffer zone

C represents core zone

Sol.: Buffer zone manage to accommodate a greater research and educational activities. Human interference is allowed in buffer zone.

122. Answer (4)

Sol.: Khasi and Jaintia hills are situated in Meghalaya. Chanda and Bastar are not situated in Maharashtra.

123. Answer (3)

Hint: Musk deer is also known as hangul.

Sol.: Dachigam National Park is home to musk deer or hangul.

124. Answer (2)

Hint: Stellar's sea cow got recently extinct from Russia.

Sol.: Dodo got extinct from Mauritius, Thylacine from Australia and Quagga got extinct from Africa.

125. Answer (3)

Hint: Carrot grass (*Parthenium*) is a weed which came into India as a contaminant with imported wheat.

Sol.: The Nile perch introduced into Lake Victoria in east Africa led eventually to the extinction of an ecologically unique assemblage of more than 200 species of cichlid fish in the lake.

126. Answer (2)

Hint: Loss of biodiversity may lead to decline in plant production.

Sol.: Loss of biodiversity may lead to reduced resistance to environmental perturbation like drought.

It may also lead to increased variability of ecosystem processes such as plant productivity, pest and disease cycles.

127. Answer (3)

Hint: David Tilman performed long term outdoor experiments and found that plots with more species showed less year-to-year variations in total biomass.

Sol.: David Tilman also showed by his experiments that increased diversity contributed to higher productivity.

128. Answer (2)

Hint &Sol.: 23 percent of all mammal species are facing threat of extinction in the world.

129. Answer (3)

Hint: Broadly utilitarian services are not direct benefits from the ecosystem to the humans.

Sol.: Oxygen, pollination, flood and erosion control are the broadly utilitarian services of the ecosystem.

130. Answer (3)

Hint: Regions which are located near tropics have maximum bird species.

Sol.: The number of birds species in.

$$\underset{\begin{pmatrix}\text{about}\\1400\end{pmatrix}}{\text{Colombia}} > \underset{\begin{pmatrix}\text{more than}\\1200\end{pmatrix}}{\text{India}} > \underset{(105)}{\text{New York}} > \underset{(56)}{\text{Greenland}}$$

131. Answer (3)

Hint: Giant panda and the blue whale are large body size animals.

Sol.: Giant panda and blue whale are more susceptible to extinction as they have small population size and low reproductive rate.

132. Answer (1)

Hint: Keystone species helps to define an entire ecosystem.

Sol.: Endemic species are confined to a particular region and are not found anywhere else.

133. Answer (2)

Hint: Initially 25 biodiversity hotspots were identified.

Sol.: The total number of biodiversity hotspots in the world is 34.

134. Answer (2)

Hint: The accelerated rates of species extinction that the world is facing now are largely due to human activities.

Sol.: Habitat loss and fragmentation is the most important cause driving animals and plants to extinction.

135. Answer (4)

Hint: Biopiracy is the practice of commercial exploitation of biomedical or genetic material which occur naturally.

Sol.: Exploration of molecular, genetic and species level diversity for novel products of economic importance is known as bioprospecting.

SECTION - B

136. Answer (3)

Hint: Anthropogenic ecosystem is a man-made ecosystem and it does not possess self-regulatory mechanism.

Sol.: Anthropogenic ecosystems have little diversity, simple food chain and high productivity.

137. Answer (1)

Hint: The bottom layer of the forest is occupied by grasses and herbs.

Sol.: In a vertical subdivision of a forest, the top layer is occupied by trees.

138. Answer (4)

Hint: It protects the nutrients from being washed out and lost from ecosystem.

Sol.: The phenomenon of incorporation of nutrients in living microbes is called nutrient immobilisation.

139. Answer (2)

Hint: Saprophytes are not given any place in ecological pyramids.

Sol.: Standing crop is the amount of living material present in different trophic levels at a given time.

140. Answer (2)

Hint: Low temperature and anaerobiosis inhibit decomposition.

Sol.: If detritus possesses proteins, nucleic acid and water soluble carbohydrates then the rate of decomposition is faster.

Rate of decomposition is slow if it contains lignin, chitin and cellulose.

141. Answer (2)

Hint: Primary production is defined as the amount of biomass or organic matter produced per unit area over a time period by plants during photosynthesis.

Sol.: Gross primary productivity is the rate of production of organic matter by producers during photosynthesis per unit time and area. NPP is the rate of organic matter built up or stored by producers in excess of respiratory utilization per unit time and area.

142. Answer (3)

Hint: Transducers are also known as converters or producers.

Sol.: Transducers are autotrophic organisms. They convert solar energy into chemical energy. They occupy basal trophic level in the food chain.

143. Answer (2)

Hint: Frugivorous birds are fruit eating birds.

Sol.: Frugivorous birds are found in large number in tropical forest mainly because of availability of fruits throughout the year.

144. Answer (2)

Hint: The historical Convention on Biological Diversity “The Earth Summit" was held in Rio de Janeiro in 1992.

Sol.: “The Earth Summit” called upon all the nation to take appropriate measures for conservation of biodiversity and sustainable utilisation of its benefits.

145. Answer (2)

Hint: The IUCN Red list is a catalogue of extinct and threatened plants and animals facing risk of extinction.

Sol.: The IUCN Red list (2004) documents the extinction of 784 species in last 500 years.

146. Answer (4)

Hint: *In situ* conservation strategy emphasizes protection of whole system.

In *Ex-situ* conservation strategy, threatened plants and animals are conserved away from their natural habitat.

Sol.: *Ex-situ* conservation strategy - Wildlife safari park, Zoological park.

In situ conservation strategy - National park, Biosphere reserve.

147. Answer (3)

Hint: Some extreme estimates of global species diversity range from 20 to 50 million.

Sol.: A more conservative and scientifically sound estimate made by Robert May places the global species diversity at about 7 million.

148. Answer (1)

Hint: The term biodiversity is used to describe the combined diversity at all the levels of biological organization.

Sol.: The term biodiversity was popularized by Edward Wilson.

149. Answer (1)

Hint: India is one of the most diverse countries in the world.

Sol.: India has only 2.4% of the world's land area, its share of the global species diversity is an impressive 8.1%.

150. Answer (2)

Hint: Amazon rain forest is home to 1,300 species of birds and 1,25,000 species of invertebrates.

Sol.: Ascending order of organism, w.r.t. the estimated number of species in Amazon rain forest.

$$\underset{378}{\text{Reptiles}} < \underset{427}{\text{Ambhibians}} < \underset{1300}{\text{Birds}} < \underset{3000}{\text{Fishes}} < \underset{\text{more than } 125000}{\text{Invertebrates}}$$

[ZOOLOGY]

SECTION - A

151. Answer (3)

Hint: Genetic engineering is one of its core techniques.

Sol.: Biotechnology deals with the techniques of using live organisms or enzymes from organisms to produce products and processes useful to humans.

In tissue culture, whole plant could be regenerated from explants.

Evolutionary biology is the study of life forms on Earth. Palaeontology is the study of fossils.

152. Answer (4)

Hint: Non-profit federation of biotechnology

Sol.: The European Federation of Biotechnology has given the definition of biotechnology that encompasses both traditional view and modern molecular biotechnology.

GEAC - Genetic Engineering Approval Committee

WHO - World Health Organisation

CDRI - Central Drug Research Institute

153. Answer (2)

Hint: Part of tissue culture

Sol.: The techniques of genetic engineering which include creation of recombinant DNA, use of gene cloning and gene transfer, overcome the limitations of traditional hybridisation procedures and allow us to isolate and introduce only one or a set of desirable genes into the host.

The method of producing thousands of plants through tissue culture is called micropropagation.

154. Answer (2)

Hint: Controls the copy number

Sol.: Origin of replication is the sequence from where replication starts and any piece of DNA when linked to this sequence can be made to replicate within host cells.

A restriction site is a specific nucleotide sequence on a DNA molecule that is recognized and cut by a restriction enzyme.

Genes encoding resistance to antibiotics are considered as useful selectable markers.

Repressor of primer codes for the proteins involved in the replication of the plasmid.

155. Answer (2)

Hint: Order of two-winged insects

Sol.: Some strains of *Bacillus thuringiensis* produce proteins that kill certain insects such as lepidopterans (tobacco budworm, armyworm), coleopterans (beetles) and dipterans (flies, mosquitoes).

Insecta is the largest class of the phylum Arthropoda.

Flies and mosquitoes belong to the order Diptera and class Insecta. Crustaceans are aquatic arthropods.

156. Answer (1)

Hint: Multiple of 10

Sol.: At present, about 30 recombinant therapeutics have been approved for human-use, the world over.

In India, 12 of these are presently being marketed.

157. Answer (3)

Hint: Recombinant products are safer

Sol.: The recombinant DNA technological processes have made an immense impact in the area of healthcare by enabling mass production of safe and more effective therapeutic drugs.

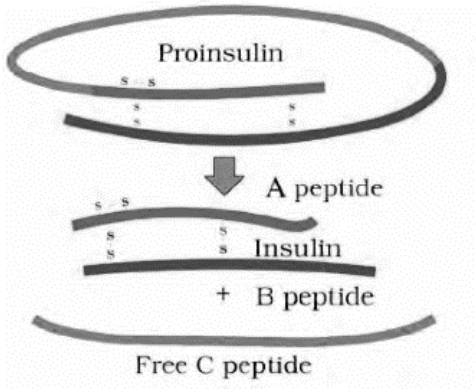
The recombinant therapeutics do not induce unwanted immunological responses and are free from risks of infections as is common in case of similar products isolated from non-human resources.

The production of recombinant therapeutics is expensive.

158. Answer (4)

Hint: Intrachain disulphide bond is present in A-chain.

Sol.:



159. Answer (2)

Hint: Based on antigen antibody interaction

Sol.: Recombinant DNA technology, Polymerase Chain Reaction and Enzyme Linked Immuno-sorbent Assay (ELISA) are some of the techniques that serve the purpose of early diagnosis of diseases.

Serum analysis and urine analysis are the traditional methods of disease diagnosis through which early detection is not possible.

160. Answer (3)

Hint: Identify a nematode.

Sol.: Disarmed retroviruses are used as cloning vectors for animals.

Bacteriophages and plasmids are the cloning vectors. *Meloidogyne incognita* is a nematode that infects the roots of tobacco plants and causes a reduction in the yield.

161. Answer (3)

Hint: Isolation of desired DNA fragment

Sol.: Recombinant DNA technology involves several steps in a specific sequence such as isolation of DNA, fragmentation of DNA by restriction endonucleases, isolation of desired DNA fragment, ligation of the DNA fragment into a vector, transferring the rDNA into the host, culturing the host cells in a medium at a large scale and extraction of the desired product.

Later, the product has to be formulated with suitable preservatives.

162. Answer (3)

Hint: Mice are used for testing safety of vaccines.

Sol.: Transgenic rats, rabbits, pigs, sheep, cows and fishes have been produced, although over 95% of all existing transgenic animals are mice.

Transgenic mice are being used to test the safety of polio vaccine.

163. Answer (4)

Hint: Belongs to class VI of enzymes.

Sol.: Restriction enzymes cut the strands of DNA a little away from the centre of the palindromic sites, but between the same two bases on the opposite strands. This leaves single stranded portion at the ends. The stickiness of ends facilitates the action of enzyme DNA ligase.

Exonucleases remove nucleotides from the ends of DNA.

DNA polymerase (used in PCR) synthesizes a new strand of DNA complementary to an existing DNA template in 5' to 3' direction.

Deoxyribonuclease cleaves the DNA into fragments.

DNA ligases are also called molecular glue.

164. Answer (4)

Hint: Sequence from where replication starts

Sol.: If one wants to recover many copies of the target DNA it should be cloned in a vector whose origin supports high copy number.

rop codes for the proteins involved in the replication of the plasmid.

Selectable marker helps in identifying and eliminating non- transformants.

Presence of more than one recognition site for a single RE within the vector generates multiple fragments, which complicate the process of gene cloning.

165. Answer (1)

Hint: Healthy plants can be recovered from diseased plants *via* tissue culture.

Sol.: Recovery of the healthy plants from the diseased plants is one of the applications of tissue culture. Even if the plant is infected with a virus, the meristem (apical and axillary) is free of virus.

Hence, one can remove the meristem and grow it *in vitro* to obtain virus free plants. Scientists have succeeded in culturing meristems of banana, sugarcane, *etc.*

166. Answer (2)

Hint: Pest resistant crops

Sol.: Plants, bacteria, fungi and animals whose genes have been altered by manipulation are called GMOs. GM plants have been useful in many ways.

Genetic modification has:

(a) Made crops more tolerant to abiotic stresses

(b) Reduced reliance on chemical pesticides

(c) Helped to reduce post-harvest losses

(d) Increased efficiency of mineral usage by plants

(e) Enhanced nutritional value of food

167. Answer (1)

Hint: Belong to largest phylum of kingdom Animalia.

Sol.: Bt toxin is produced by the bacterium *Bacillus thuringiensis* (Bt for short).

Bt gene has been cloned from the bacteria and been expressed in plants to provide resistance against insects without the need of insecticides; in effect created a bio pesticide.

168. Answer (3)

Hint: *crylAc* controls the cotton bollworms.

Sol.: The proteins encoded by the genes *crylAc* and *crylIAb* control the cotton bollworms.

Restriction site for *Pvu*II is present within the *rop* gene in pBR322

Beetles are included in the order Coleoptera.

Transposons are the mobile genetic elements that can move around to different positions in the genome.

169. Answer (3)

Hint: Strain of *Haemophilus influenzae*.

Sol.: *Eco*RI is the first restriction enzyme to be isolated from RY 13 strain of *Escherichia coli*.

*Hin*dII was isolated from strain Rd of *Haemophilus influenzae*.

*Eco*RI recognises the following palindromic nucleotide sequence and cuts in between G and A and produces sticky ends.

5G ↓ AATT C3'

3'C TTAA ↑ G5'

170. Answer (2)

Hint: Polymerisation takes place at 72°C in PCR

Sol.: *Taq* polymerase has been isolated from *Thermus aquaticus* which is a thermophilic bacterium that can survive temperatures upto 95°C.

In primer extension step, the sample is heated to 72°C for some time, during which the DNA polymerase adds nucleotides to the primer, synthesizing a new DNA strand complementary to the template sequences.

The DNA polymerase then adds nucleotides to the 3'-OH end of the growing DNA strand.

171. Answer (2)

Hint: Step in gel electrophoresis

Sol.: Restriction enzymes cleave the DNA fragments.

The separated bands of DNA are cut out from the agarose gel and extracted from the gel piece. This step is known as elution.

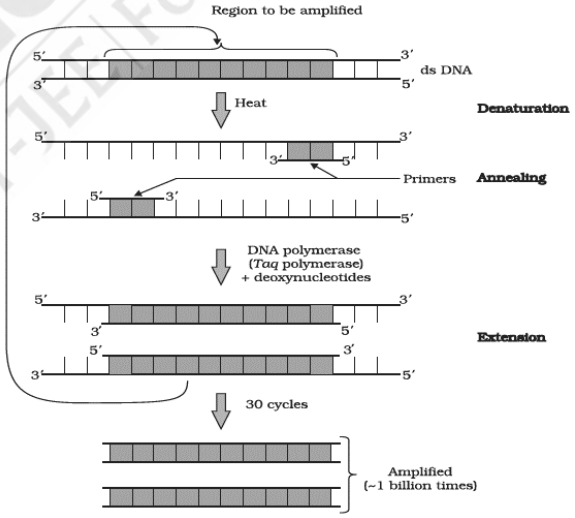
After precipitation using chilled ethanol, the DNA can be seen as a collection of fine threads in the suspension and can be spooled up and twisted around a glass rod. This step is called spooling.

Transformation is the procedure through which a piece of DNA is introduced into a host bacterium.

172. Answer (4)

Hint: 2^n fragments are obtained after 'n' number of PCR cycles.

Sol:



173. Answer (1)

Hint: Bacteriophages are viruses.

Sol.: Bacteriophage is a virus that infects bacteria and is used as a cloning vector.

Retroviruses have the ability to transform normal cells into cancerous cells. Disarmed retroviruses are used as cloning vectors in case of animal host.

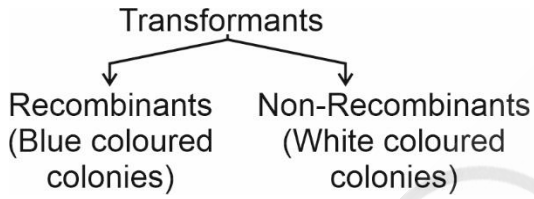
DNA ligases are also called molecular glue and restriction enzymes are also called molecular scissors.

174. Answer (3)

Hint: Lac-Z gene codes for the β-galactosidase.

Sol.: The Lac-Z gene codes for the β-galactosidase. The enzyme utilises its substrate to produce blue coloured product.

In the given case,

- Non-transformants (white coloured colonies)
- 

175. Answer (2)

Hint: Stem cells

Sol.: The method of producing thousands of plants through tissue culture is called micropropagation. Each of these plants are genetically identical to the original plant from which they were grown *i.e.*, they are somaclones.

The capacity to generate a whole plant from any cell/explant is called totipotency.

Isolated protoplasts from two different varieties of plants each having a desirable character can be fused to get hybrid protoplasts, which can be further grown to form a new plant. These hybrids are called somatic hybrids while the process is called somatic hybridisation.

176. Answer (3)

Hint: A and B chains were produced separately.

Sol.: In 1983, Eli Lilly, an American company, prepared two DNA sequences corresponding to A and B chains of human insulin and introduced them in plasmids of *E. coli* to produce insulin chains.

In mammals, the C-peptide is present in the proinsulin and is removed during the maturation.

177. Answer (1)

Hint: Method of cellular defense in eukaryotes.

Sol.: RNAi is a usually occurring mechanism that leads to the silencing of genes.

This method involves silencing of a specific mRNA due to the formation of dsRNA molecule formed by binding of complementary RNA (anti-sense RNA) molecule to original mRNA, thereby preventing translation of the original mRNA.

If genes are exchanged on multiple occasions between two different populations of a species, resulting in homogenous population, it is called gene flow.

Gene cloning is the process of making multiple copies of a particular gene.

178. Answer (1)

Hint: RNase digests the RNA.

Sol.: The genetic material of fungi is DNA. Deoxyribonuclease digests the DNA, therefore cannot be used for isolation of genetic material from a fungal cell.

The RNA can be removed by treatment with ribonuclease whereas proteins can be digested by treatment with proteases.

179. Answer (1)

Hint: Same kinds of sticky ends are required for ligation.

Sol.: When cut by the same restriction enzyme, the resultant DNA fragments have the same kind of sticky ends and can be joined by using DNA ligases.

180. Answer (3)

Hint: Anode is a positively charged electrode.

Sol.: The cutting of DNA by the restriction endonucleases results in the fragments of DNA. These fragments can be separated by a technique known as gel electrophoresis.

The DNA fragments separate according to their size through sieving effect provided by the agarose gel.

Hence, smaller the fragment size, the farther it moves. The comb used to create wells is placed close to the cathode (negatively charged electrode).

181. Answer (4)

Hint: Aerobic conditions

Sol.: A stirred-tank bioreactor is usually cylindrical or with a curved base to facilitate the mixing of the reactor contents.

The stirrer facilitates even mixing and oxygen availability throughout the bioreactor.

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

182. Answer (4)

Hint: Identify an option related with continuous culture system.

Sol.: The cells can be multiplied in continuous culture system wherein the used medium is drained from one side while fresh medium is added from the other to maintain the cells in their physiologically most active log/exponential phase.

After completion of the biosynthetic phase, the product has to be subjected through a series of processes before it is ready for marketing as a finished product.

The processes include separation and purification, which are collectively termed as downstream processing.

The downstream processing and quality control testing vary from product to product.

183. Answer (1)

Hint: Include the gene gun method.

Sol.: Gene gun or biolistic, electroporation and microinjection are the direct methods of gene transfer.

Retroviruses have been disarmed and used to deliver desirable genes into animal cells.

184. Answer (1)

Hint: It is a Governmental organization.

Sol.: The Indian Government has set up organization such as GEAC (Genetic Engineering Approval Committee) which makes decisions regarding the validity of GM research and the safety of introducing GM-organisms for the public services.

PCR stands for Polymerase Chain Reaction.

185. Answer (2)

Hint: Identification of recombinants is a must.

Sol.: The normal *E.coli* cells do not carry resistance against any antibiotics.

The presence of selectable marker helps in identifying and eliminating the non-transformants and selectively permitting the growth of transformants.

The bacteriophages have high copy number. *E.coli* was used as host to produce humulin.

SECTION - B

186. Answer (2)

Hint: Restriction enzyme

Sol.: DNA ligases (6^{th} class) catalyse the linking together of two compounds.

The stickiness of DNA ends facilitates the action of the enzyme DNA ligase.

Restriction enzymes belong to a larger class of enzymes called nucleases, that are hydrolases.

187. Answer (1)

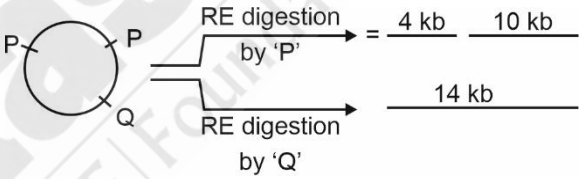
Hint: Eli Lilly did the same experiment.

Sol.: The genetic code is universal. In 1983, Eli Lilly, an American company prepared two DNA sequences corresponding to A and B chains of human insulin and introduced them in plasmids of *E.coli* to produce insulin chains.

188. Answer (1)

Hint: Fragment(s) obtained is/are equal to the number of sites.

Sol.:



In a circular DNA, the number of fragments after RE digestion is equal to the number of restriction sites for the respective enzyme.

If n = number of restriction sites,

then, for the number of fragments obtained after RE digestion for linear DNA is (n + 1) and for circular DNA is n.

189. Answer (2)

Hint: *Pvu*I → amp^R gene

Sol.: In cloning vector pBR322, the restriction site for the *Pvu*I is present in the ampicillin resistance gene. So, if a foreign DNA is ligated at this site then, non-transformants will remain amp^S tet^S, recombinant transformants will be amp^S tet^R and non-recombinant transformants will be amp^R tet^R.

190. Answer (1)

Hint: Methylation

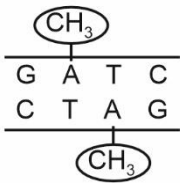
Sol.: In the year 1963, the two enzymes responsible for restricting the growth of

bacteriophage in *E.coli* were isolated. One of these added methyl groups to DNA while the other cut the DNA.

DNA methylation is the modification of DNA bases by addition of a methyl group by DNA methyltransferase.

It is important to consider methylation when planning a restriction digest, as methylated DNA may block or impair the binding of restriction enzymes to DNA.

Pictorial representation



191. Answer (3)

Hint: A needle is used in this technique

Sol.: In the method 'microinjection', recombinant DNA is directly injected into the nucleus of an animal cell. In another method suitable for plants, cells are bombarded with high velocity micro-particles of gold or tungsten coated with DNA in a method known as biolistics or gene gun.

Agrobacterium tumefaciens is the natural genetic engineer of plants.

The tumor inducing (Ti) plasmid of *Agrobacterium* has now been modified into a cloning vector which is no more pathogenic to living plants.

192. Answer (4)

Hint: More than 2

Sol.: Transgenic animals are especially made to serve as models for human diseases so that investigation of new treatments for diseases is made possible.

Today, transgenic models exist for many human diseases such as cancer, cystic fibrosis, rheumatoid arthritis and Alzheimer's disease.

193. Answer (1)

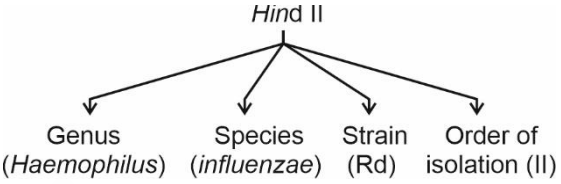
Hint: 1 gm = 1000 mg

Sol.: In 1997, the first transgenic cow, Rosie, produced human protein-enriched milk (2.4 gms/litre). The milk contained the human-alpha-lactalbumin and was nutritionally a more balanced product for human babies than natural cow-milk.

194. Answer (3)

Hint: GTPy/PuAC

Sol.: The first restriction endonuclease - *Hind*II, whose functioning depends on a specific DNA nucleotide sequence was isolated and characterised five years later.



195. Answer (4)

Hint: *Pseudomonas putida* is used to clean oil spills.

Sol.: Bioremediation is the use of microorganism's metabolism to remove pollutants. Biofortification is the method of breeding crops to increase their nutritional value.

At present, about 30 recombinant therapeutics have been approved for human-use, the world over.

Regeneration of whole plant from explant is the part of tissue culture.

196. Answer (2)

Hint: Night blindness

Sol.: Golden rice is the transgenic variety of rice with genes for the synthesis of β-carotene, taken from the temperate garden favourite Daffodil.

Lac-Z gene codes for the β-galactosidase enzyme.

Milk produced by Rosie, was enriched in α- lactalbumin.

197. Answer (2)

Hint: Girl was not a teenager

Sol.: The first clinical gene therapy was given in the year 1990 to a four year old girl with ADA deficiency.

This enzyme is crucial for the immune system to function.

In 1997, the first transgenic cow, 'Rosie' produced human protein-enriched milk.

In 1963, two enzymes responsible for restricting the growth of bacteriophage were isolated.

198. Answer (1)

Hint: DNA polymerase is not heat resistant.

Sol.: In PCR, the starting solution is heated usually to 94°C. The high temperature breaks the hydrogen bonds between the two strands of

original dsDNA, providing the necessary single stranded DNA templates.

The heat shock is given at 42°C in heat shock method of chemical transformation.

199. Answer (2)

Hint: Basic pH favors the activation

Sol.: The Bt toxin proteins exist as inactive protoxin in *Bacillus thuringiensis* but once an insect ingests the inactive toxin it is converted into an active form due to alkaline pH of the gut which solubilises the crystals.

The activated toxin binds to the surface of midgut epithelial cells and create pores that cause cell swelling and lysis and eventually cause death of the insect.

200. Answer (4)

Hint: *Thermus aquaticus* is thermophilic in nature.

Sol.: *Agrobacterium tumefaciens*, a pathogen of several dicot plants is able to deliver a piece of DNA known as 'T-DNA' to transform normal plant cells into a tumor and direct these tumor cells to produce the chemicals required by the pathogen.

The tumor inducing (Ti) plasmid has now been modified into a cloning vector which is no more pathogenic to the plants but is still able to use the mechanisms to deliver gene of interest into plants. Taq polymerase is isolated from *Thermus aquaticus*.

❑ ❑ ❑

All India Aakash Test Series for NEET – 2025

TEST - 4 (Code - B)

Click here for Code-A Sol.

Test Date : 22/12/2024

ANSWERS

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

HINTS & SOLUTIONS

[PHYSICS]

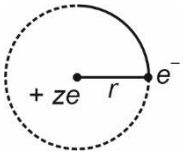
SECTION - A

1. Answer (3)

Hint & Sol.: β^- particle is emitted when neutron inside a nucleus is transformed into a proton

2. Answer (2)

Hint & Sol.:



$$U = -\frac{K(ze)(e)}{r}$$

z = 1 for hydrogen atom

$$= -\frac{Ke^2}{r}$$

3. Answer (3)

Hint: Q-value = $(\text{B.E.})_{\text{product}} - (\text{B.E.})_{\text{reactant}}$

Sol.:

Given reaction is

$${}_1^2\text{H} + {}_1^2\text{H} \longrightarrow {}_2^4\text{He} + Q\text{-value}$$

Q-value = $(\text{B.E.})_{\text{product}} - (\text{B.E.})_{\text{reactant}}$

= 26 – 2 × 2.5

= 26 – 5

= 21 MeV

4. Answer (1)

Hint & Sol.: Kinetic energy (K.E.) = –(Total energy)

K.E. = –(–13.6) = 13.6 eV

5. Answer (4)

Hint & Sol.: Conductivity of pure silicon can be increased by increasing the temperature and by doping (both acceptor as well as donor impurities)

6. Answer (3)

Hint & Sol.:

Isotopes → same atomic number

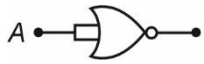
Isobars → same mass number

Isotones → same number of neutrons

Nucleons → sum of number of neutrons and protons

7. Answer (4)

Hint:



act as a NOT gate *i.e.*, $Y = \overline{A}$

Sol.:

$$Y = \overline{\overline{A} \cdot \overline{B}}$$

$$= \overline{\overline{A}} + \overline{\overline{B}}$$

$$= A + B$$

8. Answer (1)

Hint: When pure semiconductor is doped with impurities, it gives *P*-type and *N*-type semiconductor.

Sol.: Pentavalent as well as trivalent impurities have neutral atoms. So overall neutrality of crystal does not change due to doping.

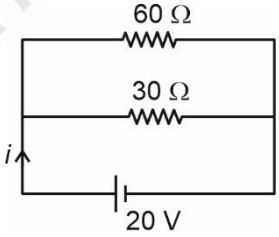
9. Answer (3)

Hint & Sol.: Zener diode is fabricated by heavy doping on both sides (*P* and *N*). It is designed to operate in reverse bias condition and hence offers finite resistance.

10. Answer (1)

Hint: Ideal diode, in forward bias has zero resistance and in reverse bias it has infinite resistance.

Sol.: Equivalent circuit,



$$i = \frac{20}{30} + \frac{20}{60} = 1\,\text{A}$$

11. Answer (3)

Hint: Potential energy = – 2 × kinetic energy = 2 × Total energy of electron

Sol.: $E = -13.6 \times \frac{Z^2}{n^2}$ eV

Kinetic energy in 1st orbit of H atom = 13.6 eV = K

Potential energy in 1st orbit of He^+ atom

$= -\frac{13.6 \times 2^2}{1^2} \times 2$ eV

$\therefore$ PE = – (13.6 eV) × 8 = – 8K

12. Answer (2)

Hint: $i_{avg} = \frac{\int idt}{\int dt}$

Sol.: Average value of output in case of half wave rectifier is $\frac{i_0}{\pi}$.

13. Answer (2)

Hint & Sol.: When contact angle is less than 90°, then shape of meniscus is concave upwards.

14. Answer (1)

Hint & Sol.: Heavier nuclides contains more number protons and that's why to provide stability more neutrons are required.

15. Answer (3)

Hint & Sol.: Nuclear forces are independent of charge and are type of non-central forces.

16. Answer (2)

Hint: In nuclear reaction, linear momentum is conserved.

Sol.: $_{92}U^{238} \longrightarrow {}_{90}Th^{234} + {}_2He^4$

$p_i = p_f$

$\Rightarrow 0 = m_d v_d + m_\alpha v_\alpha$

$\Rightarrow |v_d| = \frac{4v_0}{234}$

$= \frac{2v_0}{117}$

17. Answer (3)

Hint: At rotational equilibrium, sum of moments is equal to zero, about the wedge.

Sol.: $F_1 d_1 = F_2 d_2$

$\Rightarrow 60 \times 10 = W \times (80 - 50)$

$\Rightarrow \frac{600}{30} = W$

$\therefore$ W = 20 N

18. Answer (2)

Hint: Use relation between electric field and potential difference $|\Delta V| = E \cdot d$

Sol.: In depletion layer,

$|\Delta V| = E \cdot d$

$\Rightarrow E = \frac{\Delta V}{d}$

$= \frac{0.6}{3 \times 10^{-5}}$

$= 0.2 \times 10^5$

$= 2 \times 10^4$ V/m

19. Answer (4)

Hint: Binding energy of nucleus = $\Delta m(u) \times 930$ MeV

Sol.:

Total binding energy (B.E.) = $\Delta m(u) \times 930$ MeV

= 0.077 × 930 MeV

$\therefore$ Binding energy per nucleon = $\frac{0.077 \times 930}{11}$

$= 7 \times 10^{-3} \times 930$

$= 6510 \times 10^{-3}$

= 6.51 MeV

20. Answer (4)

Hint: Use equation: $E = \phi_0 + KE_{max}$

Sol.: $E = \phi_0 + KE_{max} = \phi_0 + eV_s$

$\frac{hc}{\lambda} = \phi_0 + 3$ eV ...(i)

$\frac{hc}{2\lambda} = \phi_0 + 1$ eV ...(ii)

$\frac{1}{2}(\phi_0 + 3 \text{ eV}) = \phi_0 + 1$ eV

$\Rightarrow \frac{\phi_0}{2} + \frac{3}{2}$eV = $\phi_0 + 1$ eV

$\frac{\phi_0}{2} = \frac{1}{2}$eV $\Rightarrow \phi_0$ = 1 eV

21. Answer (2)

Hint: Use de-Broglie wavelength equation, $\lambda = \frac{h}{mv}$

Sol.: $\lambda_p = \lambda_e$

$\Rightarrow \frac{h}{m_p v_p} = \frac{h}{m_e v_e}$

$\Rightarrow m_p v_p = m_e v_e$

$v_p = \frac{m_e v_e}{m_p}$

$= \frac{9 \times 10^{-31} \times 4 \times 10^6}{9 \times 10^{-25}}$

$= 4$ m s^{-1}

22. Answer (4)

Hint: Maximum kinetic energy of the photoelectrons is independent of intensity but depends on frequency while saturation current is proportional to photon intensity of source.

Sol.: By Einstein's equation

$(K.E.)_{max} = hf - \phi$

$\therefore$ By quadrupling the frequency, (K.E.) becomes more than 4 times.

23. Answer (4)

Hint: Energy of infrared radiation is less than the visible radiation.

Sol.: In transition $n = 6$ to $n = 4$, radiation energy will be less than the transition from $n = 5$ to $n = 3$.

24. Answer (3)

Hint: Refractive index of the prism, $\mu = \dfrac{\sin\left(\dfrac{A+\delta_m}{2}\right)}{\sin\left(\dfrac{A}{2}\right)}$

Sol.: $\mu = \dfrac{\sin\left(\dfrac{60^\circ}{2}+\dfrac{\delta_m}{2}\right)}{\sin\left(\dfrac{60^\circ}{2}\right)} = \dfrac{\sin\left(30^\circ+\dfrac{\delta_m}{2}\right)}{\dfrac{1}{2}}$

$= 2\sin\left(30^\circ+\dfrac{\delta_m}{2}\right)$

25. Answer (3)

Hint: Radius of shell $(r) = \dfrac{r_0 n^2}{z}$

Sol.: $\dfrac{r_H}{r_{Li^{++}}} = \dfrac{1^2}{1}\times\dfrac{3}{3^2}$

$= \dfrac{1}{3}$

26. Answer (3)

Hint: α-particle is the nucleus of He atom

Sol.: Given reaction,

$${}^4_2He + {}^{14}_7N \longrightarrow {}^{17}_8O + {}^1_1H$$

27. Answer (2)

Hint: Speed of electron in n^{th} orbit is equal to $\dfrac{c}{137}\times\dfrac{z}{n}$

Sol.: For hydrogen atom, $z = 1$ and for $n = 2$

$v = \dfrac{c}{137\times 2}$

$v = \dfrac{c}{274}$

28. Answer (2)

Hint & Sol.: Fusion of hydrogen nuclei into helium nuclei is the source of energy of all stars including our sun.

29. Answer (3)

Hint: Least count = 1 MSD – 1 VSD.

Sol.: 20 divisions of vernier scale = 18 divisions of main scale

$\Rightarrow 1\,VSD = \left(\dfrac{18}{20}\right)MSD$

$= 0.9$ MSD

L.C = 1 MSD –1 VSD

= 1 MSD – 0.9 MSD

= 0.1 MSD

= 0.1 × 0.1 cm

= 0.01 cm $\left[\because 1\ MSD = \dfrac{1}{10}cm = 0.1\,cm\right]$

30. Answer (4)

Hint: Energy of electron in n^{th} orbit $E_n = \dfrac{-13.6z^2}{n^2}eV$

Sol.: For electron in fourth orbit of hydrogen atom, $z = 1$ and $n = 4$

$E_4 = -\dfrac{13.6\times 1}{16}$

$E_4 = -0.85$ eV

$\Rightarrow \therefore$ energy required $E = -E_4$

$= 0.85$ eV

31. Answer (1)

Hint: Energy of emitted photon when an electron jumps from n_1 orbit to n_2 orbit is $E_p = 13.6\left[\dfrac{1}{n_2^2}-\dfrac{1}{n_1^2}\right]eV$

Sol.: $E_p = 13.6\left[\dfrac{1}{1}-\dfrac{1}{9}\right]eV$

$E_p = 13.6\times\dfrac{8}{9}eV$

$E_p = 12.08$ eV

32. Answer (4)

Hint: Observation of photoelectric effect experiment.

Energy of incident photon	=	Maximum kinetic energy acquired by electron	+	Work function

Sol.: Due to energy loss inside the metal, photoelectrons emitted from a surface have different speeds.

33. Answer (4)

Hint & Sol.: The current under reverse bias is voltage independent upto breakdown voltage (V_{br}). Even a slight increase in bias voltage at $V = V_{br}$, the diode reverse current increases sharply.

34. Answer (1)

Hint: In the half-deflection method, the galvanometer resistance $G = \frac{RS}{R-S}$.

Sol.: $\frac{1}{G} = \frac{1}{S} - \frac{1}{R}$

$\Rightarrow \frac{1}{S} = \frac{1}{R} + \frac{1}{G}$

$\Rightarrow \frac{1}{S} = \frac{1}{600} + \frac{1}{3} = \frac{201}{600}$

$\Rightarrow S = \frac{600}{201}\ \Omega$

35. Answer (1)

Hint: Use de-Broglie wavelength associated with matter $\lambda = \frac{h}{p}$.

Sol.: de-Broglie wavelength is given by

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

$\therefore \lambda_d = \lambda_\alpha$

$\frac{h}{m_d v_d} = \frac{h}{m_\alpha v_\alpha}$

$\Rightarrow \frac{v_d}{v_\alpha} = \frac{m_\alpha}{m_d} = \frac{4m_p}{2m_p} = \frac{2}{1}$

SECTION - B

36. Answer (1)

Hint: In the given nuclear reaction, atomic number and atomic mass numbers are conserved.

Sol.: Let particle as ${}_xR^y$

Atomic number conservation

$92 = 56 + 35 + 0 + x$

$x = 1$

And atomic mass number conservation

$236 = 141 + 93 + 1 + y$

$y = 1$

$\therefore R \rightarrow {}_1p^1$

37. Answer (2)

Hint: Intensity is equal to energy passing through per unit area per unit time.

Sol.: $I = I_1 + I_2$

$I_1 = \frac{2n \times hc}{\lambda A}, I_2 = \frac{3n \times hc}{2\lambda A}$

$\therefore I = \frac{2nhc}{\lambda A} + \frac{3nhc}{2\lambda A} = \frac{7nhc}{2\lambda A}$

38. Answer (4)

Hint: Work done = maximum kinetic energy

Sol.: KE_{max} = work done

$KE_{max} = (eE)d \Rightarrow KE_{max} = e \times 3 \times 2 = 6$ eV

39. Answer (3)

Hint: Use Einstein's photoelectric equation.

Sol.: By Einstein's photoelectric equation,

$eV_s = hf - \phi_0$, as frequency increases, stopping potential increases

$\rightarrow I_{saturation} \propto$ intensity

$\rightarrow$ Work function of material depends on material of plate.

40. Answer (2)

Hint: Use, time period $(T) = \frac{2\pi r}{v}$

Sol.: Radius $(r) \propto \frac{n^2}{z}$

and velocity $(v) \propto \frac{z}{n}$

$\therefore T \propto \frac{r}{v} \propto \left(\frac{n^2}{z} \times \frac{n}{z}\right) \propto \frac{n^3}{z^2}$

41. Answer (1)

Hint: Radius of nucleus $(R) = R_0(A)^{1/3}$

Sol.: $\frac{R_X}{R_Y} = \left(\frac{A_X}{A_Y}\right)^{1/3}$

$\Rightarrow \frac{2R_Y}{R_Y} = \left(\frac{A_X}{A_Y}\right)^{1/3}$

$\Rightarrow \frac{A_X}{A_Y} = 8$

42. Answer (2)

Hint: Use, $\frac{1}{\lambda} = Rz^2\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$

Sol.: For shortest wavelength of Paschen series $n_1 = 3$ and $n_2 = \infty$

$$\frac{1}{\lambda_1} = R\left[\frac{1}{9}\right] \quad \ldots(i)$$

For shortest wavelength of Lyman series

$n_1 = 1$ and $n_2 = \infty$

$$\frac{1}{\lambda_2} = R[1] \quad \ldots(ii)$$

Divide (ii) by (i)

$$\frac{\lambda_1}{\lambda_2} = \frac{R \times 9}{R} = \frac{9}{1}$$

43. Answer (1)

Hint: Use, $\Delta E = \frac{hc}{\lambda}$

Sol.: $\Delta E = 5$ eV

$$\Delta E = \frac{12400}{\lambda(\text{Å})}$$

$$\Rightarrow 5 = \frac{12400}{\lambda_{max}}$$

$$\Rightarrow \lambda_{max} = \frac{12400}{5}$$

$= 2480$ Å

44. Answer (2)

Hint:

Least count =

$$\frac{\text{Pitch}}{\text{Total number of division on circular scale}}$$

Sol.: Pitch = 0.02 cm

$$\text{Least count} = \frac{0.02}{50}$$

$= 4 \times 10^{-4}$ cm

45. Answer (3)

Hint: First resonating length $l_1 = \frac{\lambda}{4} + e$ and second resonating length $l_2 = \frac{3\lambda}{4} + e$

Sol.: $l_2 - l_1 = \left(\frac{3\lambda}{4} + e\right) - \left(\frac{\lambda}{4} + e\right)$

$$l_2 - l_1 = \frac{\lambda}{2}$$

$\Rightarrow \lambda = 2(l_2 - l_1)$

$= 2(47 - 15)$

$= 2 \times 32$

$= 64$ cm

46. Answer (3)

Hint: Number of spectral lines emitted $= \frac{n(n-1)}{2}$

Sol.: 12.75 eV is the energy difference of state $n = 1$ and $n = 4$

$\therefore$ No. of spectral lines $= \frac{4(4-1)}{2}$

$= 6$

47. Answer (2)

Hint: Potential difference across 2 kΩ, $V_{2\,k\Omega} = iR$

Sol.: $i = \frac{20 - 0.7 - 0.3}{R_{eq}} = \frac{19}{5}$ mA

$i = 3.8$ mA

$V = 3.8 \times 10^{-3} \times 2 \times 10^3$

$= 7.6$ V

48. Answer (1)

Hint: Binding energy (B.E.) = Δmc^2

Sol.: $\Delta m = 6M_p + 6M_n - M_0$

B.E. = $(6M_p + 6M_n - M_0)c^2$

49. Answer (4)

Hint: de-Broglie wavelength $\lambda = \frac{h}{\sqrt{2mk}}$

Sol.: For same kinetic energy $\lambda \propto \frac{1}{\sqrt{m}}$

$m_d > m_p > m_e$

$\therefore \lambda_e > \lambda_p > \lambda_d$

50. Answer (3)

Hint: Use de-Broglie wavelength $\lambda = \frac{h}{p}$ and $p = \sqrt{2mK} = \sqrt{2mqV}$.

Sol.: de-Broglie wavelength

$$\lambda = \frac{h}{\sqrt{2mqV}}$$

$$\lambda \propto \frac{1}{\sqrt{V}}$$

$$\therefore \quad \frac{\lambda_2}{\lambda_1} = \sqrt{\frac{V_1}{V_2}}$$

$$\frac{\lambda_2}{1} = \sqrt{\frac{130}{520}}$$

$$\lambda_2 = \frac{1}{2} = 0.5 \text{ Å}$$

[CHEMISTRY]

SECTION - A

51. Answer (3)

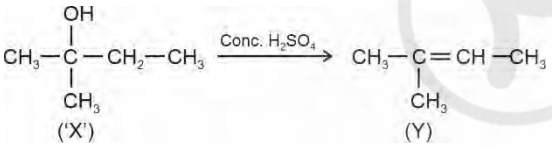
Hint & Sol.:

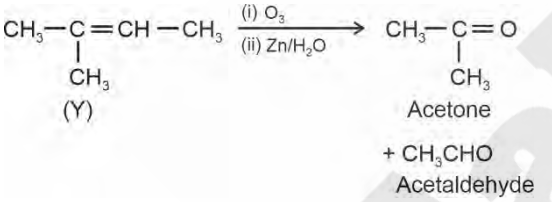
Mohr's salt is $FeSO_4 \cdot (NH_4)_2SO_4 \cdot 6H_2O$

52. Answer (2)

Hint: Both aldehyde and ketone are giving positive haloform reaction, it mean they have α-methyl ketone group $\left(-\overset{O}{\overset{\|}{C}}-CH_3\right)$

Sol.:

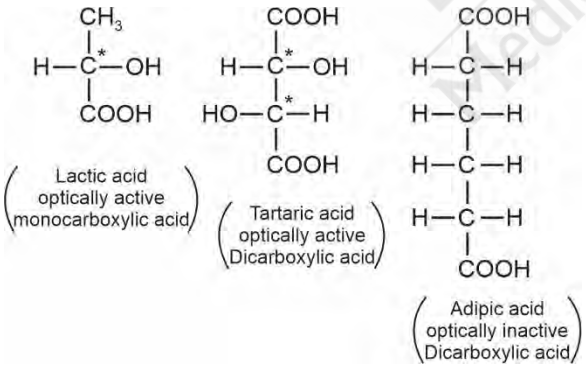




53. Answer (2)

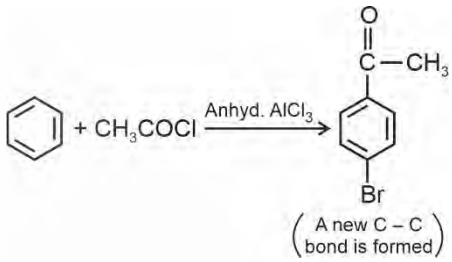
Hint: Tartaric acid and adipic acid are dicarboxylic acids.

Sol.:

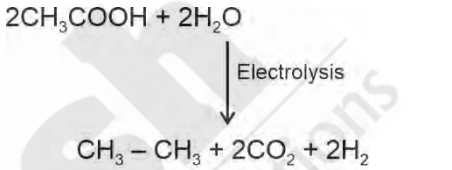


54. Answer (1)

Hint: Friedel-Craft acylation:

- 

Sol.:

- 

- $CH_3COOC_2H_5 \rightleftharpoons CH_3COONa + C_2H_5OH$

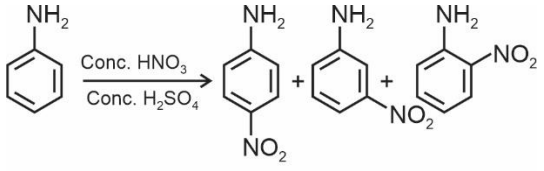
  (No new C – C Bond is formed)

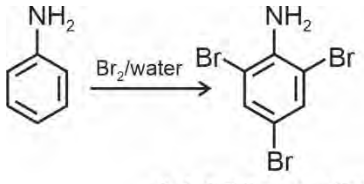
55. Answer (3)

Hint: $-NH_2$ group on benzene ring is highly activating.

Sol.:

- $R - N \equiv C \xrightarrow{H_2/Ni} R - \underset{\displaystyle CH_3}{\underset{|}{NH}}$

  2° amine
- $R - NO_2$ and $R - O - NO$ are functional group isomers.
- 

- 

  2, 4, 6-Tribromoaniline

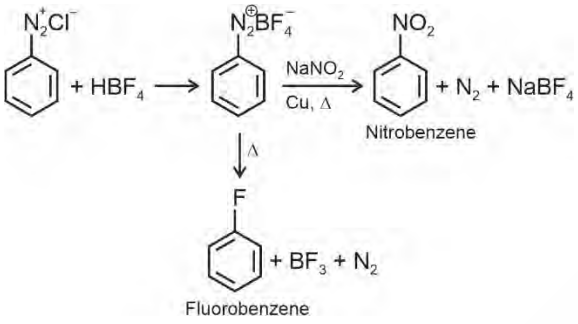
56. Answer (1)

Hint: Diazonium salts give orange coloured dye with phenol in basic medium.

Sol.:

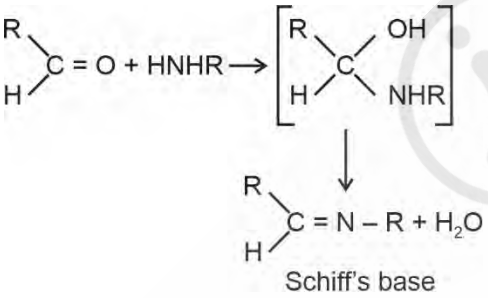
$$R-NH_2 \xrightarrow{NaNO_2+HCl} RN_2^+Cl^-$$

$$+ H_2O \rightarrow ROH + N_2 + HCl$$



57. Answer (3)

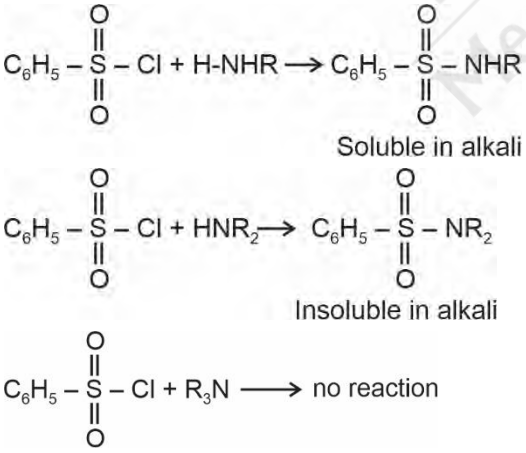
Hint & Sol.:



58. Answer (3)

Hint: Hinsberg reagent is $C_6H_5SO_2Cl$.

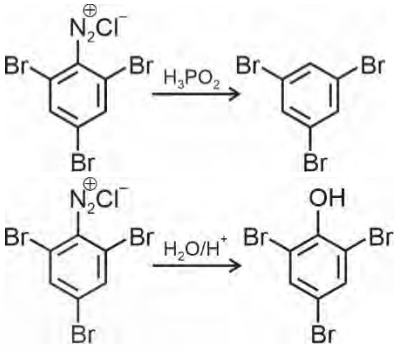
Sol.: Hinsberg reagent reacts with primary amine to form N-alkylbenzenesulfonylamide which is soluble in NH_4OH while it reacts with secondary amine to form N, N′ – dialkylbenzene sulphonylamine that is insoluble in NH_4OH. 3° amine does not react with Hinsberg reagent.



59. Answer (2)

Hint: Diazonium salt reacts with H_2O/H^+ at 283°C to form phenol.

Sol.:



60. Answer (1)

Hint: Pb^{2+} reacts with K_2CrO_4 to form yellow precipitate of lead chromate.

Sol.:

$Pb^{2+} + K_2CrO_4 \rightarrow PbCrO_4 + 2K^+$

Lead chromate is soluble in hot sodium hydroxide solution.

$$PbCrO_4 + 4NaOH \rightleftharpoons Na_2\left[Pb(OH)_4\right] + Na_2CrO_4$$

61. Answer (3)

Hint: ($H_2S + NH_4Cl$) is the group reagent for Group IV cations (i.e. Co^{3+}, Ni^{2+}, Mn^{2+}, Zn^{2+})

Sol.: Ba^{2+} is a basic radical of group V and its group reagent is $(NH_4)_2CO_3 + NH_4OH$.

62. Answer (2)

Hint & Sol.:

Colour of flame observed	Ion
Crimson red	Sr^{2+}
Brick red	Ca^{2+}
Apple green	Ba^{2+}
Green with blue centre	Cu^{2+}

63. Answer (1)

Hint:

$NaNO_3 + H_2SO_4 \rightarrow NaHSO_4 + HNO_3$

$$4HNO_3 \xrightarrow{\Delta} 4NO_2 + O_2 + 2H_2O$$

Sol.:

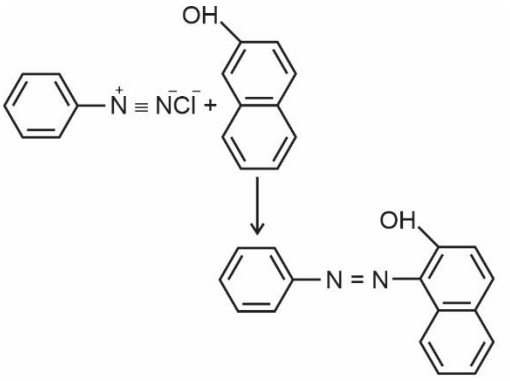
On addition of Cu turnings:

$$2NaNO_3 + 4H_2SO_4 + 3Cu \rightarrow \underset{\text{(Blue solution)}}{3CuSO_4} + Na_2SO_4 + 4H_2O + 2NO$$

$$2NO + O_2 \longrightarrow \underset{\text{(Brown fumes)}}{NO_2}$$

64. Answer (1)

Hint & Sol.:



β– Naphthol azodye
(Scarlet red)

65. Answer (4)

Hint: Ceric ammonium nitrate reacts with alcohol to form red coloured complex.

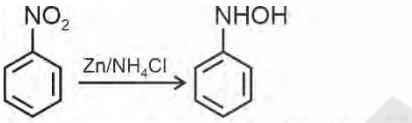
$(NH_4)_2[Ce(NO_3)_6] + 3ROH \rightarrow [Ce(NO_3)_4 (ROH)_3] + 2NH_4NO_3$

Sol.: Phenols form violet coloured compound with freshly prepared $FeCl_3$ solution.

$6C_6H_5OH + FeCl_3 \rightarrow [Fe(C_6H_5O)_6]^{3-} + 3HCl + 3H^+$

66. Answer (1)

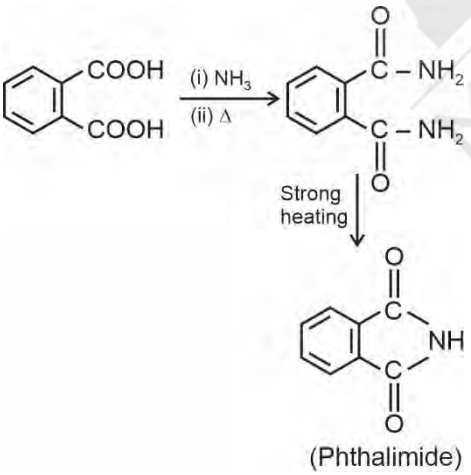
Hint & Sol.:



N-phenylhydroxylamine

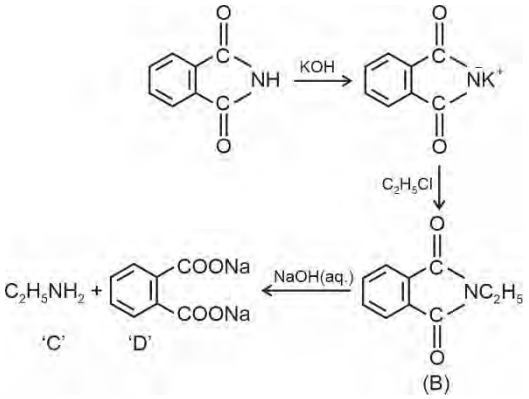
67. Answer (2)

Hint:



(Phthalimide)

Sol.:



68. Answer (2)

Hint: In aqueous solution, basicity of 2° amine is more than that of 1° and 3° amines.

Sol.: There is a subtle interplay of the inductive effect, solvation effect and steric hinderance of the alkyl group is applicable which decides the basic strength of alkyl amines in aqueous solution.

The correct order of basic strength is

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

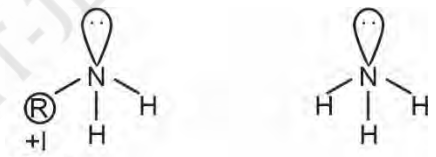
69. Answer (4)

Hint & Sol.: Hormones are the products of endocrine glands and these act as intercellular messengers.

70. Answer (1)

Hint: Alkyl group has +I effect and hence increases basic nature of amine.

Sol.:



More electron
density on nitrogen

71. Answer (4)

Hint: A unit formed by attachment of a base to 1′ position of sugar is known as nucleoside.

Sol.: When nucleoside is linked to phosphoric acid at 5′ position of sugar moiety, a nucleotide is formed.

72. Answer (2)

Hint & Sol.: During denaturation, secondary and tertiary structures get destroyed while primary structure remains intact.

73. Answer (3)

Hint & Sol.:

Sucrose – α-D-glucose and α-D-fructose

Maltose – α-D-glucose and α-D-glucose

Lactose – β-D-glucose and β-D-galactose

Cellulose – β-D-glucose units.

74. Answer (2)

Hint: Amylose and amylopectin are two components of starch and starch is main polysaccharide of plants.

Sol.: Amylose is water soluble component which constitutes 15 – 20% of starch while amylopectin is branched chain polysaccharide which is insoluble in water and constitutes 80 – 85% starch.

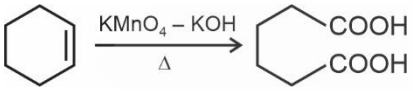
75. Answer (4)

Hint & Sol.: Valine, leucine and isoleucine are essential amino acids while glutamine is non-essential amino acid.

76. Answer (2)

Hint: $KMnO_4 - H_2SO_4$ is a good oxidising agent & oxidises alkene into carboxylic acid.

Sol.:



Hexane –1, 6– dioic acid

77. Answer (1)

Hint: Aromatic aldehydes do not respond to Fehling's test.

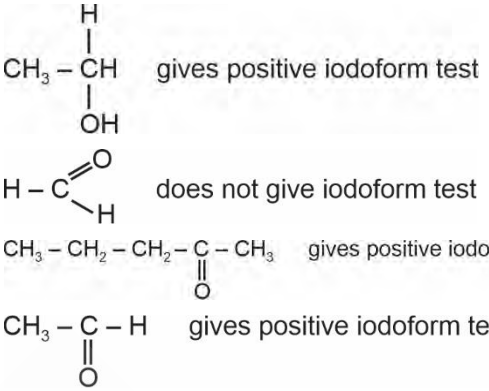
Sol.: Benzaldehyde does not form red brown ppt with Fehling's solution while acetaldehyde reacts as follows:

$$CH_3CHO + 2Cu^{2+} + 5OH^- \rightarrow CH_3COO^- + \underset{\text{Red Brown ppt}}{Cu_2O} + 3H_2O$$

78. Answer (2)

Hint: Aldehydes and ketones with $CH_3-\overset{\overset{O}{\|}}{C}-$ group and alcohols with $CH_3-\underset{\underset{OH}{|}}{CH}$ group give positive iodoform test.

Sol.:

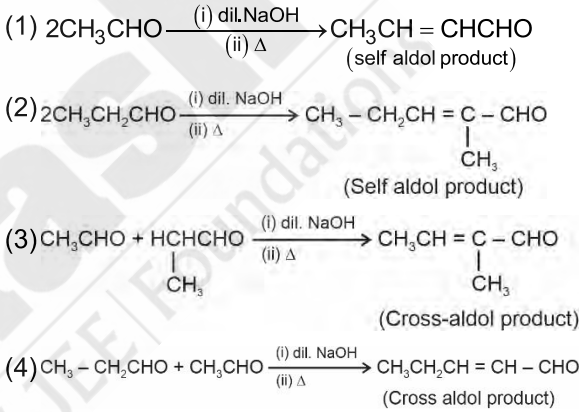


$CH_3 - CH_2 - CH_2 - OH$ does not give iodoform test

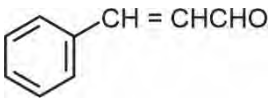
79. Answer (4)

Hint: CH_3CHO reacts with CH_3CH_2CHO in the presence of dil. NaOH followed by heating leads to cross aldol condensation.

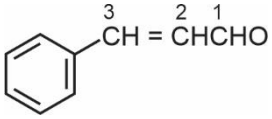
Sol.:



80. Answer (3)

Hint: Cinnamaldehyde is 

Sol.:

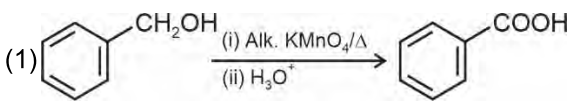


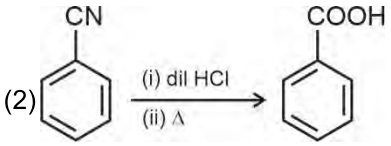
3-Phenylprop-2-en-1-al

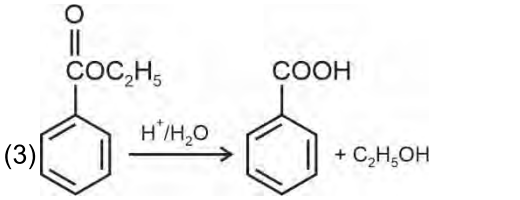
81. Answer (4)

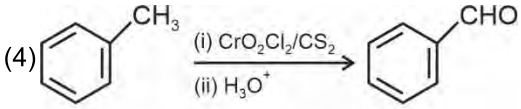
Hint: Only strong oxidising agents can oxidise hydrocarbon into carboxylic acid.

Sol.:



(2) 

(3) 

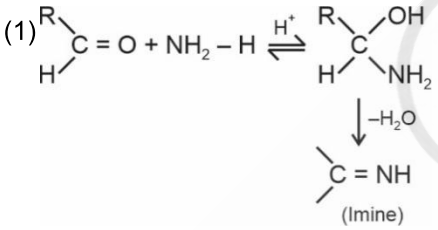
(4) 

(Etard reaction)

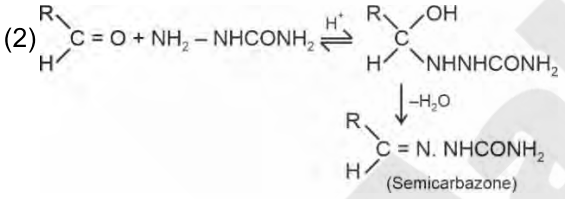
82. Answer (4)

Hint: Ammonia and its derivatives add to carbonyl compounds and form final product after rapid dehydration.

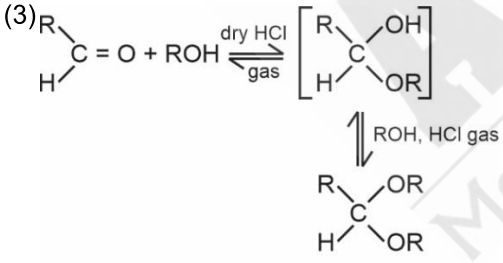
Sol.:

(1) 

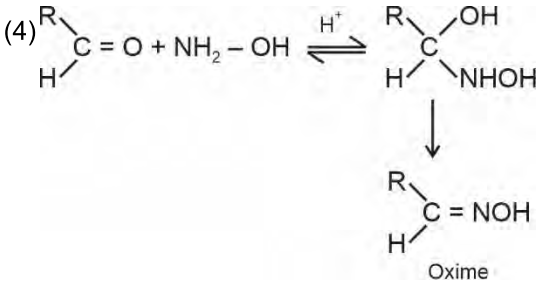
(Imine)

(2) 

(Semicarbazone)

(3) 

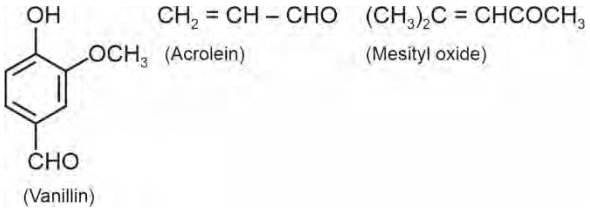
Acetal

(4) 

Oxime

83. Answer (2)

Hint & Sol.:

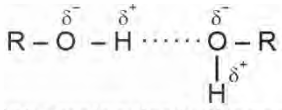


(Vanillin)

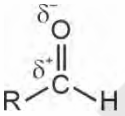
84. Answer (1)

Hint: Alcohols have high boiling point due to intermolecular hydrogen bonding.

Sol.:



Intermolecular hydrogen bonding

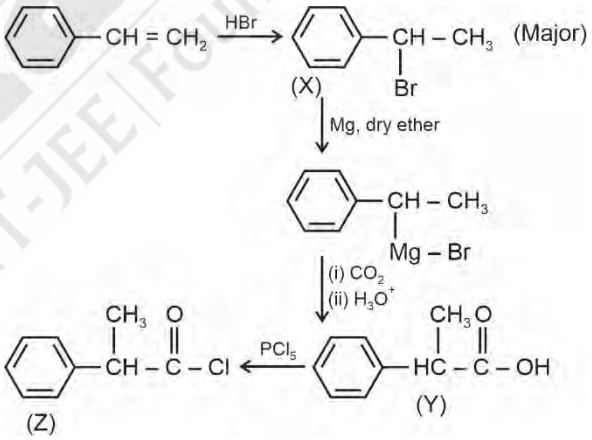


Dipole - dipole interaction because of dipolar nature of aldehydes and ketones.

85. Answer (3)

Hint: Magnesium reacts with alkyl halide in the presence of dry ether to form Grignard reagent.

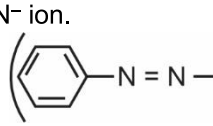
Sol.:



SECTION - B

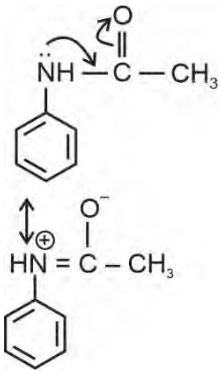
86. Answer (1)

Hint: In Lassaigne test for detection of nitrogen, nitrogen turns to CN^- ion.

Sol.: Azobenzene  and hydriazine does not give Lassaigne test because diazo compound lose their nitrogen as N_2 gas at moderate temperature, and hydrazine does not have carbon atom.

87. Answer (2)

Hint & Sol.: $NHCOCH_3$ group is less activating than amino group.

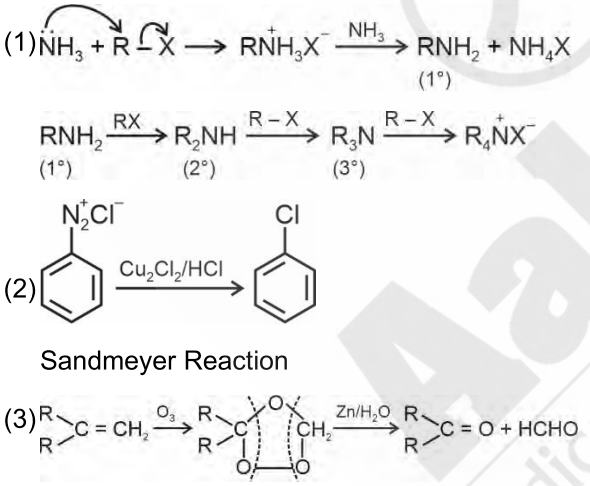


Lone pair on Nitrogen is in conjugation with carbonyl group in acetylated aniline.

88. Answer (4)

Hint: Ammonolysis of alkyl halide yields a mixture of 1°, 2°, 3° amines and quaternary ammonium salt.

Sol.:



Sandmeyer Reaction

Ozonolysis of alkene leads to the formation of aldehyde/ketone.

(4) $RCONH_2 + Br_2 + 4NaOH \rightarrow RNH_2 + Na_2CO_3 + 2NaBr + 2H_2O$

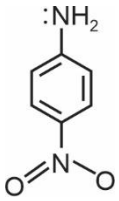
Hoffmann bromamide degradation leads to the formation of primary aliphatic amine.

89. Answer (4)

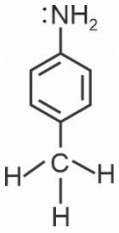
Hint: Nitro group at p-position in aniline shows

–R effect while $–CH_3$ group at para position shows hyperconjugation effect.

Sol.:



Electron withdrawing $–NO_2$ group decreases the electron density on $–NH_2$ group and hence it is less basic as compared to aniline



$–CH_3$ group at p-position increase electron density at $–NH_2$ and hence increases the basic nature.

So,  is less basic than 

90. Answer (3)

Hint: Enthalpy of hydration

Sol.:

Given:

1. $CuSO_4.5H_2O(s) \rightarrow CuSO_4(aq) + 5H_2O(\ell)$

$\Delta H_1 = –11.3 \text{ kJ mol}^{-1}$

2. $CuSO_4(s) \rightarrow CuSO_4(aq)$

$\Delta H_2 = –65.5 \text{ kJ mol}^{-1}$

3. $CuSO_4(s) + 5H_2O(\ell) \rightarrow CuSO_4.5H_2O(s)$

$\Delta H_3 = ?$

On reversing equation (1) and adding equation (2)

$CuSO_4(aq) + 5H_2O(\ell) + CuSO_4(s) \rightarrow CuSO_4(aq) + CuSO_4.5H_2O(s)$

$\Rightarrow CuSO_4(s) + 5H_2O(\ell) \rightarrow CuSO_4.5H_2O(s)$

$\Delta H_3 = –\Delta H_1 + \Delta H_2$

$= +11.3 + (–65.5)$

$= –54.2 \text{ kJ mol}^{-1}$

91. Answer (4)

Hint: Glycosidic linkage is present in carbohydrates.

Sol.:

(1)	Phosphodiester linkage	Nucleic acids
(2)	Glycosidic linkage	Carbohydrates
(3)	Peptide bond	Protein

92. Answer (2)

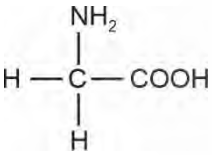
Hint & Sol.:

	Vitamin	**Deficiency disease**
(1)	Thiamine (Vitamin B_1)	Beri – beri
(2)	Riboflavin (Vitamin B_2)	Cheilosis
(3)	Pyridoxine (Vitamin B_6)	Convulsions
(4)	Ascorbic acid (Vitamin C)	Scurvy
(5)	Vitamin D	Rickets (in children)
		Osteomalacia (in adults)

93. Answer (4)

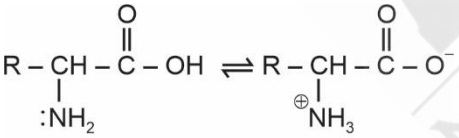
Hint: If an amino acid contains more number of amino groups as compared to carboxylic acid groups then it is considered as basic in nature.

Sol.:



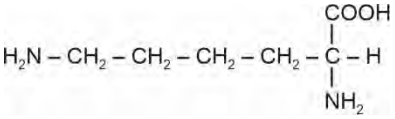
Glycine is an optically inactive, non-essential amino acid.

In aqueous solution, amino acid exists as zwitter ion



Zwitter ion

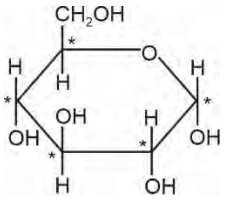
Lysine is a basic amino acid



94. Answer (4)

Hint: In the glucopyranose structure, 5 carbon atoms and one oxygen atom are present in the ring.

Sol.:



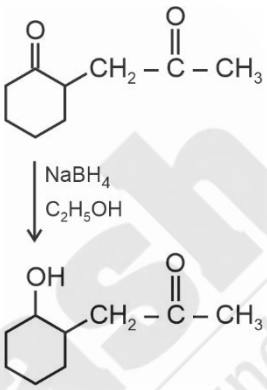
α-D(+) - Glucopyranose

Five carbon atoms marked (*) are chiral

95. Answer (1)

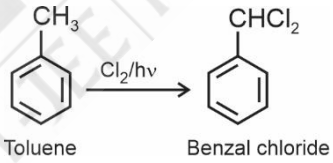
Hint: $NaBH_4$ does not reduce ester group while it can easily reduce carbonyl group to alcoholic group.

Sol.:



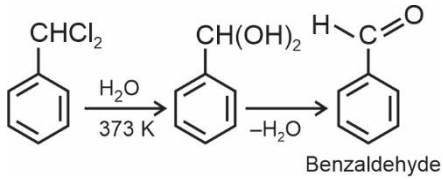
96. Answer (3)

Hint:



Toluene Benzal chloride

Sol.:



Benzaldehyde

97. Answer (4)

Hint & Sol.:

	Species	**Colour**
(1)	$[Fe(SCN)]^{2+}$	Blood red
(2)	AgI	Yellow
(3)	$Fe_4[Fe(CN)_6]_3 \cdot xH_2O$	Prussian blue
(4)	$[Fe(CN)_5NOS]$	Violet

98. Answer (3)

Hint & Sol.:

$$CH_3CH_2 - OH \xrightarrow[573K]{Cu} CH_3 - CHO$$

99. Answer (2)

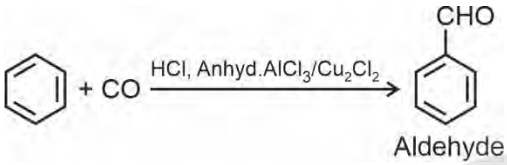
Hint: In Hell-Volhard Zelinsky reaction, carboxylic acid with atleast one α-H atoms react with Cl_2 or Br_2 in the presence of red P to give α-halo carboxylic acid.

Sol.:

Clemmensen Reduction:

$$CH_3CHO \xrightarrow[HCl]{Zn-Hg} \underset{\text{(Hydrocarbon)}}{CH_3 - CH_3} + H_2O$$

Gattermann-Koch reaction:



Cannizzaro reaction:

$$HCHO + HCHO \xrightarrow{conc.KOH} \underset{\text{Alcohol}}{CH_3OH} + \underset{\text{Salt of carboxylic acid}}{HCOOK}$$

Hell-Volhard Zelinsky reaction:

$$R - CH_2COOH \xrightarrow[(ii)\ H_2O]{(i)\ Red\ P/X_2} \underset{\alpha\text{-halocarboxylic acid}}{R - \underset{X}{\underset{|}{CH}} - COOH}$$

100. Answer (2)

Hint: Reduction of alkyl cyanide by $SnCl_2/HCl$ followed by hydrolysis to form aldehyde is known as Stephen reaction.

Sol.:

$$CH_3C \equiv N \xrightarrow{SnCl_2/HCl} \underset{\text{Imine}}{CH_3C = NH} \xrightarrow{H_3O^+} \underset{\text{Aldehyde}}{CH_3CHO}$$

[BOTANY]

SECTION - A

101. Answer (4)

Hint: Biopiracy is the practice of commercial exploitation of biomedical or genetic material which occur naturally.

Sol.: Exploration of molecular, genetic and species level diversity for novel products of economic importance is known as bioprospecting.

102. Answer (2)

Hint: The accelerated rates of species extinction that the world is facing now are largely due to human activities.

Sol.: Habitat loss and fragmentation is the most important cause driving animals and plants to extinction.

103. Answer (2)

Hint: Initially 25 biodiversity hotspots were identified.

Sol.: The total number of biodiversity hotspots in the world is 34.

104. Answer (1)

Hint: Keystone species helps to define an entire ecosystem.

Sol.: Endemic species are confined to a particular region and are not found anywhere else.

105. Answer (3)

Hint: Giant panda and the blue whale are large body size animals.

Sol.: Giant panda and blue whale are more susceptible to extinction as they have small population size and low reproductive rate.

106. Answer (3)

Hint: Regions which are located near tropics have maximum bird species.

Sol.: The number of birds species in.

$$\underset{\begin{pmatrix}\text{about}\\1400\end{pmatrix}}{\text{Colombia}} > \underset{\begin{pmatrix}\text{more than}\\1200\end{pmatrix}}{\text{India}} > \underset{(105)}{\text{New York}} > \underset{(56)}{\text{Greenland}}$$

107. Answer (3)

Hint: Broadly utilitarian services are not direct benefits from the ecosystem to the humans.

Sol.: Oxygen, pollination, flood and erosion control are the broadly utilitarian services of the ecosystem.

108. Answer (2)

Hint &Sol.: 23 percent of all mammal species are facing threat of extinction in the world.

109. Answer (3)

Hint: David Tilman performed long term outdoor experiments and found that plots with more

species showed less year-to-year variations in total biomass.

Sol.: David Tilman also showed by his experiments that increased diversity contributed to higher productivity.

110. Answer (2)

Hint: Loss of biodiversity may lead to decline in plant production.

Sol.: Loss of biodiversity may lead to reduced resistance to environmental perturbation like drought.

It may also lead to increased variability of ecosystem processes such as plant productivity, pest and disease cycles.

111. Answer (3)

Hint: Carrot grass (*Parthenium*) is a weed which came into India as a contaminant with imported wheat.

Sol.: The Nile perch introduced into Lake Victoria in east Africa led eventually to the extinction of an ecologically unique assemblage of more than 200 species of cichlid fish in the lake.

112. Answer (2)

Hint: Stellar's sea cow got recently extinct from Russia.

Sol.: Dodo got extinct from Mauritius, Thylacine from Australia and Quagga got extinct from Africa.

113. Answer (3)

Hint: Musk deer is also known as hangul.

Sol.: Dachigam National Park is home to musk deer or hangul.

114. Answer (4)

Sol.: Khasi and Jaintia hills are situated in Meghalaya. Chanda and Bastar are not situated in Maharashtra.

115. Answer (3)

Hint: The zonation of terrestrial biosphere reserve is as follows.

A represents transition zone

B represents buffer zone

C represents core zone

Sol.: Buffer zone manage to accommodate a greater research and educational activities. Human interference is allowed in buffer zone.

116. Answer (3)

Hint: Highest species diversity is found in the tropical regions.

Sol.: Amazonian rain forest in South America exhibits highest species diversity across globe.

117. Answer (4)

Hint: The Species-Area relationship equation is

$\log S = \log C + Z \log A$

Sol.: In Alexander von Humboldt equation, Z represents regression coefficient.

C represents Y-intercept and S represents species richness

118. Answer (2)

Hint: Genetic diversity helps in formation of ecotype.

Sol.: Genetic diversity play a key role in the process of speciation. Maximum taxonomic diversity occurs where species of taxonomically different groups occur in almost equal abundance.

119. Answer (4)

Hint: Biomass is calculated with unit gram, kilogram, milligram. Unit of energy is calorie.

Sol.:

From the given data, spindle-shaped pyramid of biomass is obtained.

120. Answer (3)

Hint: Pyramid of biomass in terrestrial ecosystem is triangle shaped.

Sol.: Pyramid of biomass in terrestrial ecosystem is usually upright.

121. Answer (2)

Hint: Transfer of energy across trophic level follows 10% law.

Sol.:

Grasses	→	Grasshopper	→	Birds	→	Hawk.
T_1		T_2		T_3		T_4
40,000 J		4000 J		400 J		40 J
40 kJ		4 kJ		0.4 kJ		0.04 kJ

122. Answer (4)

Hint: Detritivores are reducers.

Sol.: Detritivores feed on detritus. They are heterotrophic organisms.

123. Answer (2)

Hint: According to the first law of thermodynamics energy is neither created nor destroyed.

Fungi are also involved in catabolism.

Sol.: In ecosystem, according to the second law of thermodynamics, no transfer of energy occurs until it is accompanied by degradation of energy from concentrated to dispersed form.

During catabolism, bacterial and fungal enzymes degrade detritus into simpler inorganic substance.

124. Answer (3)

Hint: Top carnivores occupy fourth trophic level, second trophic level comprises of herbivores and secondary consumers occupy third trophic level.

Sol.: Top carnivores - Lion

Second trophic level - Grasshopper

Secondary consumers – Wolf

First trophic level - Trees

125. Answer (2)

Hint: Process of humification and mineralisation involves living organisms

Sol.: The percolation of water soluble inorganic nutrients down to soil horizon is called leaching. It does not involve living organisms.

126. Answer (3)

Hint: Mineralisation involves release of CO_2, H_2O and minerals from humus.

Sol.: Mineralisation is the release of inorganic substances from organic matter.

127. Answer (3)

Hint: A number of generations of phytoplankton is consumed by single generation of zooplanktons.

Sol.: In an aquatic ecosystem, the pyramid of biomass may be inverted. Biomass of zooplanktons is higher than that of phytoplanktons as life span of former is longer and the latter multiply much faster though having shorter life span.

128. Answer (1)

Hint: In the given food chain 'A' is occupied by primary consumers.

Sol.: 'A' in the given food chain is occupied by grasshopper as, it is further eaten by frog.

129. Answer (2)

Hint: Sunlight is not available in deep sea hydrothermal ecosystem.

Sol.: In deep sea hydrothermal ecosystem, the primary producers are chemosynthetic bacteria.

130. Answer (3)

Hint: Autotrophs are chief producers in aquatic ecosystem.

Sol.: Chief producers in aquatic ecosystem are phytoplanktons.

131. Answer (2)

Hint: Plants capture only 2 - 10% of PAR.

Sol.: 1-5% of incident solar radiation is captured by plants for the synthesis of organic matter.

132. Answer (3)

Hint: Humus is highly resistant to microbial action.

Sol.: Humus is a dark coloured, amorphous, more or less decomposed organic material rich in cellulose, lignin and tannins. It contains water soluble carbohydrates and nucleic acids.

133. Answer (4)

Hint: NPP is the available biomass for the consumption to heterotrophs.

Sol: Primary productivity refers to the rate at which sunlight is captured by producers for the synthesis of energy rich organic compounds through photosynthesis.

134. Answer (2)

Hint: Key industry animals are primary consumers or first order consumers.

Sol.: Key industry animals are also called herbivores and they convert plant matter into animal matter.

135. Answer (3)

Hint: Interaction of biotic and abiotic components result in the physical structure that is characteristic for each type of ecosystem.

Sol.: Stratification is vertical distribution of different species occupying different levels. It is a structural feature of an ecosystem.

SECTION - B

136. Answer (2)

Hint: Amazon rain forest is home to 1,300 species of birds and 1,25,000 species of invertebrates.

Sol.: Ascending order of organism, w.r.t. the estimated number of species in Amazon rain forest.

$$\underset{378}{\text{Reptiles}} < \underset{427}{\text{Ambhibians}} < \underset{1300}{\text{Birds}} < \underset{3000}{\text{Fishes}} < \underset{\text{more than } 125000}{\text{Invertebrates}}$$

137. Answer (1)

Hint: India is one of the most diverse countries in the world.

Sol.: India has only 2.4% of the world's land area, its share of the global species diversity is an impressive 8.1%.

138. Answer (1)

Hint: The term biodiversity is used to describe the combined diversity at all the levels of biological organization.

Sol.: The term biodiversity was popularized by Edward Wilson.

139. Answer (3)

Hint: Some extreme estimates of global species diversity range from 20 to 50 million.

Sol.: A more conservative and scientifically sound estimate made by Robert May places the global species diversity at about 7 million.

140. Answer (4)

Hint: *In situ* conservation strategy emphasizes protection of whole system.

In *Ex-situ* conservation strategy, threatened plants and animals are conserved away from their natural habitat.

Sol.: *Ex-situ* conservation strategy - Wildlife safari park, Zoological park.

In situ conservation strategy - National park, Biosphere reserve.

141. Answer (2)

Hint: The IUCN Red list is a catalogue of extinct and threatened plants and animals facing risk of extinction.

Sol.: The IUCN Red list (2004) documents the extinction of 784 species in last 500 years.

142. Answer (2)

Hint: The historical Convention on Biological Diversity “The Earth Summit" was held in Rio de Janeiro in 1992.

Sol.: “The Earth Summit” called upon all the nation to take appropriate measures for conservation of biodiversity and sustainable utilisation of its benefits.

143. Answer (2)

Hint: Frugivorous birds are fruit eating birds.

Sol.: Frugivorous birds are found in large number in tropical forest mainly because of availability of fruits throughout the year.

144. Answer (3)

Hint: Transducers are also known as converters or producers.

Sol.: Transducers are autotrophic organisms. They convert solar energy into chemical energy. They occupy basal trophic level in the food chain.

145. Answer (2)

Hint: Primary production is defined as the amount of biomass or organic matter produced per unit area over a time period by plants during photosynthesis.

Sol.: Gross primary productivity is the rate of production of organic matter by producers during photosynthesis per unit time and area. NPP is the rate of organic matter built up or stored by producers in excess of respiratory utilization per unit time and area.

146. Answer (2)

Hint: Low temperature and anaerobiosis inhibit decomposition.

Sol.: If detritus possesses proteins, nucleic acid and water soluble carbohydrates then the rate of decomposition is faster.

Rate of decomposition is slow if it contains lignin, chitin and cellulose.

147. Answer (2)

Hint: Saprophytes are not given any place in ecological pyramids.

Sol.: Standing crop is the amount of living material present in different trophic levels at a given time.

148. Answer (4)

Hint: It protects the nutrients from being washed out and lost from ecosystem.

Sol.: The phenomenon of incorporation of nutrients in living microbes is called nutrient immobilisation.

149. Answer (1)

Hint: The bottom layer of the forest is occupied by grasses and herbs.

Sol.: In a vertical subdivision of a forest, the top layer is occupied by trees.

150. Answer (3)

Hint: Anthropogenic ecosystem is a man-made ecosystem and it does not possess self-regulatory mechanism.

Sol.: Anthropogenic ecosystems have little diversity, simple food chain and high productivity.

[ZOOLOGY]

SECTION - A

151. Answer (3)

Hint: Genetic engineering is one of its core techniques.

Sol.: Biotechnology deals with the techniques of using live organisms or enzymes from organisms to produce products and processes useful to humans.

In tissue culture, whole plant could be regenerated from explants.

Evolutionary biology is the study of life forms on Earth. Palaeontology is the study of fossils.

152. Answer (4)

Hint: Non-profit federation of biotechnology

Sol.: The European Federation of Biotechnology has given the definition of biotechnology that encompasses both traditional view and modern molecular biotechnology.

GEAC - Genetic Engineering Approval Committee

WHO - World Health Organisation

CDRI - Central Drug Research Institute

153. Answer (2)

Hint: Part of tissue culture

Sol.: The techniques of genetic engineering which include creation of recombinant DNA, use of gene cloning and gene transfer, overcome the limitations of traditional hybridisation procedures and allow us to isolate and introduce only one or a set of desirable genes into the host.

The method of producing thousands of plants through tissue culture is called micropropagation.

154. Answer (2)

Hint: Controls the copy number

Sol.: Origin of replication is the sequence from where replication starts and any piece of DNA when linked to this sequence can be made to replicate within host cells.

A restriction site is a specific nucleotide sequence on a DNA molecule that is recognized and cut by a restriction enzyme.

Genes encoding resistance to antibiotics are considered as useful selectable markers.

Repressor of primer codes for the proteins involved in the replication of the plasmid.

155. Answer (2)

Hint: Order of two-winged insects

Sol.: Some strains of *Bacillus thuringiensis* produce proteins that kill certain insects such as lepidopterans (tobacco budworm, armyworm), coleopterans (beetles) and dipterans (flies, mosquitoes).

Insecta is the largest class of the phylum Arthropoda.

Flies and mosquitoes belong to the order Diptera and class Insecta. Crustaceans are aquatic arthropods.

156. Answer (1)

Hint: Multiple of 10

Sol.: At present, about 30 recombinant therapeutics have been approved for human-use, the world over.

In India, 12 of these are presently being marketed.

157. Answer (3)

Hint: Recombinant products are safer

Sol.: The recombinant DNA technological processes have made an immense impact in the area of healthcare by enabling mass production of safe and more effective therapeutic drugs.

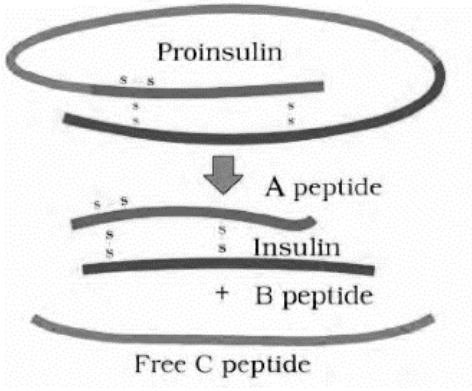
The recombinant therapeutics do not induce unwanted immunological responses and are free from risks of infections as is common in case of similar products isolated from non-human resources.

The production of recombinant therapeutics is expensive.

158. Answer (4)

Hint: Intrachain disulphide bond is present in A-chain.

Sol.:



159. Answer (2)

Hint: Based on antigen antibody interaction

Sol.: Recombinant DNA technology, Polymerase Chain Reaction and Enzyme Linked Immuno-sorbent Assay (ELISA) are some of the techniques that serve the purpose of early diagnosis of diseases.

Serum analysis and urine analysis are the traditional methods of disease diagnosis through which early detection is not possible.

160. Answer (3)

Hint: Identify a nematode.

Sol.: Disarmed retroviruses are used as cloning vectors for animals.

Bacteriophages and plasmids are the cloning vectors. *Meloidogyne incognita* is a nematode that infects the roots of tobacco plants and causes a reduction in the yield.

161. Answer (3)

Hint: Isolation of desired DNA fragment

Sol.: Recombinant DNA technology involves several steps in a specific sequence such as isolation of DNA, fragmentation of DNA by restriction endonucleases, isolation of desired DNA fragment, ligation of the DNA fragment into a vector, transferring the rDNA into the host, culturing the host cells in a medium at a large scale and extraction of the desired product.

Later, the product has to be formulated with suitable preservatives.

162. Answer (3)

Hint: Mice are used for testing safety of vaccines.

Sol.: Transgenic rats, rabbits, pigs, sheep, cows and fishes have been produced, although over 95% of all existing transgenic animals are mice.

Transgenic mice are being used to test the safety of polio vaccine.

163. Answer (4)

Hint: Belongs to class VI of enzymes.

Sol.: Restriction enzymes cut the strands of DNA a little away from the centre of the palindromic sites, but between the same two bases on the opposite strands. This leaves single stranded portion at the ends. The stickiness of ends facilitates the action of enzyme DNA ligase.

Exonucleases remove nucleotides from the ends of DNA.

DNA polymerase (used in PCR) synthesizes a new strand of DNA complementary to an existing DNA template in 5' to 3' direction.

Deoxyribonuclease cleaves the DNA into fragments.

DNA ligases are also called molecular glue.

164. Answer (4)

Hint: Sequence from where replication starts

Sol.: If one wants to recover many copies of the target DNA it should be cloned in a vector whose origin supports high copy number.

rop codes for the proteins involved in the replication of the plasmid.

Selectable marker helps in identifying and eliminating non- transformants.

Presence of more than one recognition site for a single RE within the vector generates multiple fragments, which complicate the process of gene cloning.

165. Answer (1)

Hint: Healthy plants can be recovered from diseased plants *via* tissue culture.

Sol.: Recovery of the healthy plants from the diseased plants is one of the applications of tissue culture. Even if the plant is infected with a virus, the meristem (apical and axillary) is free of virus.

Hence, one can remove the meristem and grow it *in vitro* to obtain virus free plants. Scientists have succeeded in culturing meristems of banana, sugarcane, *etc.*

166. Answer (2)

Hint: Pest resistant crops

Sol.: Plants, bacteria, fungi and animals whose genes have been altered by manipulation are called GMOs. GM plants have been useful in many ways.

Genetic modification has:

(a) Made crops more tolerant to abiotic stresses

(b) Reduced reliance on chemical pesticides

(c) Helped to reduce post-harvest losses

(d) Increased efficiency of mineral usage by plants

(e) Enhanced nutritional value of food

167. Answer (1)

Hint: Belong to largest phylum of kingdom Animalia.

Sol.: Bt toxin is produced by the bacterium *Bacillus thuringiensis* (Bt for short).

Bt gene has been cloned from the bacteria and been expressed in plants to provide resistance against insects without the need of insecticides; in effect created a bio pesticide.

168. Answer (3)

Hint: *cryIAc* controls the cotton bollworms.

Sol.: The proteins encoded by the genes *cryIAc* and *cryIIAb* control the cotton bollworms.

Restriction site for *Pvu*II is present within the *rop* gene in pBR322

Beetles are included in the order Coleoptera.

Transposons are the mobile genetic elements that can move around to different positions in the genome.

169. Answer (3)

Hint: Strain of *Haemophilus influenzae*.

Sol.: *Eco*RI is the first restriction enzyme to be isolated from RY 13 strain of *Escherichia coli*.

*Hin*dII was isolated from strain Rd of *Haemophilus influenzae*.

*Eco*RI recognises the following palindromic nucleotide sequence and cuts in between G and A and produces sticky ends.

5G ↓ AATT C3'

3'C TTAA ↑ G5'

170. Answer (2)

Hint: Polymerisation takes place at 72°C in PCR

Sol.: *Taq* polymerase has been isolated from *Thermus aquaticus* which is a thermophilic bacterium that can survive temperatures upto 95°C.

In primer extension step, the sample is heated to 72°C for some time, during which the DNA polymerase adds nucleotides to the primer, synthesizing a new DNA strand complementary to the template sequences.

The DNA polymerase then adds nucleotides to the 3'-OH end of the growing DNA strand.

171. Answer (2)

Hint: Identification of recombinants is a must.

Sol.: The normal *E.coli* cells do not carry resistance against any antibiotics.

The presence of selectable marker helps in identifying and eliminating the non-transformants and selectively permitting the growth of transformants.

The bacteriophages have high copy number. *E.coli* was used as host to produce humulin.

172. Answer (1)

Hint: It is a Governmental organization.

Sol.: The Indian Government has set up organization such as GEAC (Genetic Engineering Approval Committee) which makes decisions regarding the validity of GM research and the safety of introducing GM-organisms for the public services.

PCR stands for Polymerase Chain Reaction.

173. Answer (1)

Hint: Include the gene gun method.

Sol.: Gene gun or biolistic, electroporation and microinjection are the direct methods of gene transfer.

Retroviruses have been disarmed and used to deliver desirable genes into animal cells.

174. Answer (4)

Hint: Identify an option related with continuous culture system.

Sol.: The cells can be multiplied in continuous culture system wherein the used medium is drained from one side while fresh medium is added from the other to maintain the cells in their physiologically most active log/exponential phase.

After completion of the biosynthetic phase, the product has to be subjected through a series of processes before it is ready for marketing as a finished product.

The processes include separation and purification, which are collectively termed as downstream processing.

The downstream processing and quality control testing vary from product to product.

175. Answer (4)

Hint: Aerobic conditions

Sol.: A stirred-tank bioreactor is usually cylindrical or with a curved base to facilitate the mixing of the reactor contents.

The stirrer facilitates even mixing and oxygen availability throughout the bioreactor.

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

176. Answer (3)

Hint: Anode is a positively charged electrode.

Sol.: The cutting of DNA by the restriction endonucleases results in the fragments of DNA. These fragments can be separated by a technique known as gel electrophoresis.

The DNA fragments separate according to their size through sieving effect provided by the agarose gel.

Hence, smaller the fragment size, the farther it moves. The comb used to create wells is placed close to the cathode (negatively charged electrode).

177. Answer (1)

Hint: Same kinds of sticky ends are required for ligation.

Sol.: When cut by the same restriction enzyme, the resultant DNA fragments have the same kind of sticky ends and can be joined by using DNA ligases.

178. Answer (1)

Hint: RNase digests the RNA.

Sol.: The genetic material of fungi is DNA. Deoxyribonuclease digests the DNA, therefore cannot be used for isolation of genetic material from a fungal cell.

The RNA can be removed by treatment with ribonuclease whereas proteins can be digested by treatment with proteases.

179. Answer (1)

Hint: Method of cellular defense in eukaryotes.

Sol.: RNAi is a usually occurring mechanism that leads to the silencing of genes.

This method involves silencing of a specific mRNA due to the formation of dsRNA molecule formed by binding of complementary RNA (anti-sense RNA) molecule to original mRNA, thereby preventing translation of the original mRNA.

If genes are exchanged on multiple occasions between two different populations of a species, resulting in homogenous population, it is called gene flow.

Gene cloning is the process of making multiple copies of a particular gene.

180. Answer (3)

Hint: A and B chains were produced separately.

Sol.: In 1983, Eli Lilly, an American company, prepared two DNA sequences corresponding to A and B chains of human insulin and introduced them in plasmids of *E. coli* to produce insulin chains.

In mammals, the C-peptide is present in the proinsulin and is removed during the maturation.

181. Answer (2)

Hint: Stem cells

Sol.: The method of producing thousands of plants through tissue culture is called micropropagation. Each of these plants are genetically identical to the original plant from which they were grown *i.e.*, they are somaclones.

The capacity to generate a whole plant from any cell/explant is called totipotency.

Isolated protoplasts from two different varieties of plants each having a desirable character can be fused to get hybrid protoplasts, which can be further grown to form a new plant. These hybrids are called somatic hybrids while the process is called somatic hybridisation.

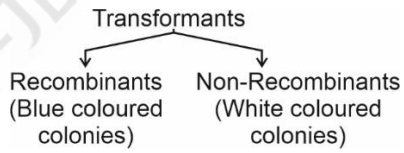
182. Answer (3)

Hint: Lac-Z gene codes for the β-galactosidase.

Sol.: The Lac-Z gene codes for the β-galactosidase. The enzyme utilises its substrate to produce blue coloured product.

In the given case,

- Non-transformants (white coloured colonies)
-



183. Answer (1)

Hint: Bacteriophages are viruses.

Sol.: Bacteriophage is a virus that infects bacteria and is used as a cloning vector.

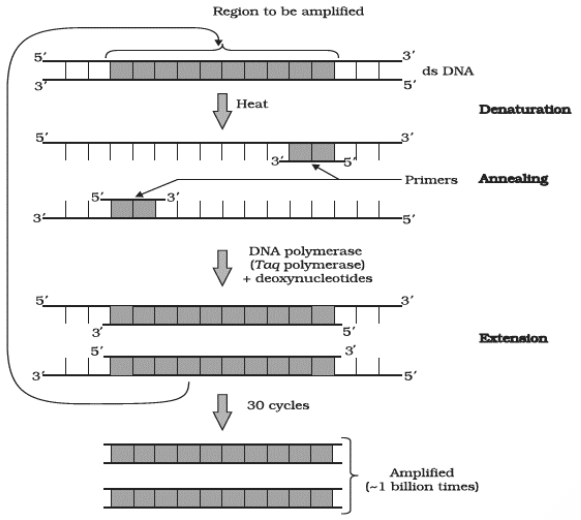
Retroviruses have the ability to transform normal cells into cancerous cells. Disarmed retroviruses are used as cloning vectors in case of animal host.

DNA ligases are also called molecular glue and restriction enzymes are also called molecular scissors.

184. Answer (4)

Hint: 2^n fragments are obtained after 'n' number of PCR cycles.

Sol:



185. Answer (2)

Hint: Step in gel electrophoresis

Sol.: Restriction enzymes cleave the DNA fragments.

The separated bands of DNA are cut out from the agarose gel and extracted from the gel piece. This step is known as elution.

After precipitation using chilled ethanol, the DNA can be seen as a collection of fine threads in the suspension and can be spooled up and twisted around a glass rod. This step is called spooling.

Transformation is the procedure through which a piece of DNA is introduced into a host bacterium.

SECTION - B

186. Answer (4)

Hint: *Thermus aquaticus* is thermophilic in nature.

Sol.: *Agrobacterium tumefaciens*, a pathogen of several dicot plants is able to deliver a piece of DNA known as 'T-DNA' to transform normal plant cells into a tumor and direct these tumor cells to produce the chemicals required by the pathogen.

The tumor inducing (Ti) plasmid has now been modified into a cloning vector which is no more pathogenic to the plants but is still able to use the mechanisms to deliver gene of interest into plants. Taq polymerase is isolated from *Thermus aquaticus*.

187. Answer (2)

Hint: Basic pH favors the activation

Sol.: The Bt toxin proteins exist as inactive protoxin in *Bacillus thuringiensis* but once an insect ingests the inactive toxin it is converted into an active form due to alkaline pH of the gut which solubilises the crystals.

The activated toxin binds to the surface of midgut epithelial cells and create pores that cause cell swelling and lysis and eventually cause death of the insect.

188. Answer (1)

Hint: DNA polymerase is not heat resistant.

Sol.: In PCR, the starting solution is heated usually to 94°C. The high temperature breaks the hydrogen bonds between the two strands of original dsDNA, providing the necessary single stranded DNA templates.

The heat shock is given at 42°C in heat shock method of chemical transformation.

189. Answer (2)

Hint: Girl was not a teenager

Sol.: The first clinical gene therapy was given in the year 1990 to a four year old girl with ADA deficiency.

This enzyme is crucial for the immune system to function.

In 1997, the first transgenic cow, 'Rosie' produced human protein-enriched milk.

In 1963, two enzymes responsible for restricting the growth of bacteriophage were isolated.

190. Answer (2)

Hint: Night blindness

Sol.: Golden rice is the transgenic variety of rice with genes for the synthesis of β-carotene, taken from the temperate garden favourite Daffodil.

Lac-Z gene codes for the β-galactosidase enzyme.

Milk produced by Rosie, was enriched in α- lactalbumin.

191. Answer (4)

Hint: *Pseudomonas putida* is used to clean oil spills.

Sol.: Bioremediation is the use of microorganism's metabolism to remove pollutants. Biofortification is the method of breeding crops to increase their nutritional value.

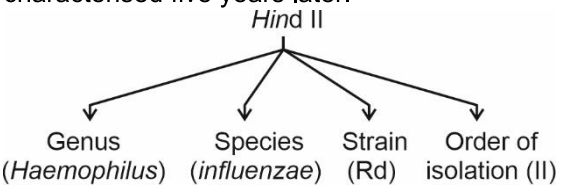
At present, about 30 recombinant therapeutics have been approved for human-use, the world over.

Regeneration of whole plant from explant is the part of tissue culture.

192. Answer (3)

Hint: GTPy/PuAC

Sol.: The first restriction endonuclease - *Hin*dII, whose functioning depends on a specific DNA nucleotide sequence was isolated and characterised five years later.

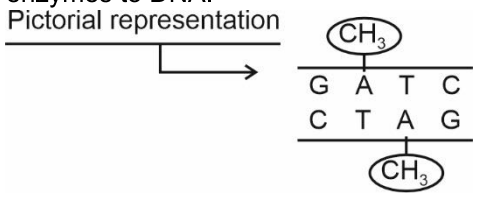


193. Answer (1)
Hint: 1 gm = 1000 mg
Sol.: In 1997, the first transgenic cow, Rosie, produced human protein-enriched milk (2.4 gms/litre). The milk contained the human-alpha-lactalbumin and was nutritionally a more balanced product for human babies than natural cow-milk.

194. Answer (4)
Hint: More than 2
Sol.: Transgenic animals are especially made to serve as models for human diseases so that investigation of new treatments for diseases is made possible.
Today, transgenic models exist for many human diseases such as cancer, cystic fibrosis, rheumatoid arthritis and Alzheimer's disease.

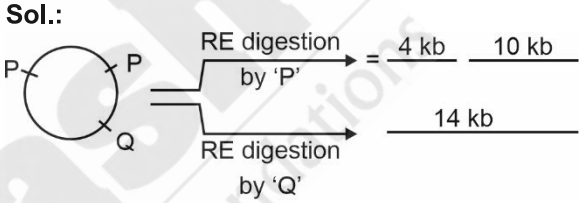
195. Answer (3)
Hint: A needle is used in this technique
Sol.: In the method 'microinjection', recombinant DNA is directly injected into the nucleus of an animal cell. In another method suitable for plants, cells are bombarded with high velocity micro-particles of gold or tungsten coated with DNA in a method known as biolistics or gene gun. *Agrobacterium tumefaciens* is the natural genetic engineer of plants.
The tumor inducing (Ti) plasmid of *Agrobacterium* has now been modified into a cloning vector which is no more pathogenic to living plants.

196. Answer (1)
Hint: Methylation
Sol.: In the year 1963, the two enzymes responsible for restricting the growth of bacteriophage in *E.coli* were isolated. One of these added methyl groups to DNA while the other cut the DNA.
DNA methylation is the modification of DNA bases by addition of a methyl group by DNA methyltransferase.
It is important to consider methylation when planning a restriction digest, as methylated DNA may block or impair the binding of restriction enzymes to DNA.
Pictorial representation



197. Answer (2)
Hint: *Pvu*I → *amp*^{R} gene
Sol.: In cloning vector pBR322, the restriction site for the *Pvu*I is present in the ampicillin resistance gene. So, if a foreign DNA is ligated at this site then, non-transformants will remain *amp*^{S} *tet*^{S}, recombinant transformants will be *amp*^{S} *tet*^{R} and non-recombinant transformants will be *amp*^{R} *tet*^{R}.

198. Answer (1)
Hint: Fragment(s) obtained is/are equal to the number of sites.
Sol.:



In a circular DNA, the number of fragments after RE digestion is equal to the number of restriction sites for the respective enzyme.
If n = number of restriction sites,
then, for the number of fragments obtained after RE digestion for linear DNA is (n + 1) and for circular DNA is n.

199. Answer (1)
Hint: Eli Lilly did the same experiment.
Sol.: The genetic code is universal. In 1983, Eli Lilly, an American company prepared two DNA sequences corresponding to A and B chains of human insulin and introduced them in plasmids of *E.coli* to produce insulin chains.

200. Answer (2)
Hint: Restriction enzyme
Sol.: DNA ligases (6th class) catalyse the linking together of two compounds.
The stickiness of DNA ends facilitates the action of the enzyme DNA ligase.
Restriction enzymes belong to a larger class of enzymes called nucleases, that are hydrolases.

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