All India Aakash Test Series for NEET - 2023

TEST - 4 (Code-A)

Test Date : 11/12/2022

ANSWERS

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

HINTS & SOLUTIONS

[PHYSICS]

SECTION-A

1. Answer (2)

Hint: If $N_D >> n_i$, then $n_e \simeq N_D$

Sol.: $N_D = \dfrac{5\times10^{28}}{10^6} = 5\times10^{22}\ \text{m}^{-3}$

$n_i = 1.5\times10^{16}\ \text{m}^{-3}$

$\because N_D >> n_i$

$\therefore n_e \approx N_D = 5\times10^{22}\ \text{m}^{-3}$

2. Answer (3)

Hint: $V_{CE} = V_{CC} - I_C R_C$

Sol.: In cut off mode $I_B = I_C = 0 \Rightarrow V_{CE} = V_{CC}$

3. Answer (1)

Hint: $\sigma_i = e n_i (\mu_e + \mu_h)$

Sol.: $\sigma_i = 1.6\times10^{-19}\times1.5\times10^{16}(0.145+0.05)$

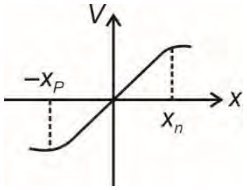
$= 0.468\times10^{-3}\ \text{S m}^{-1} \approx 4.7\times10^{-4}\ \text{S m}^{-1}$

4. Answer (4)

Hint and Sol.: NAND and NOR gates are called universal gates because they can be combined to produce any of the other gate like OR, AND and NOT gates.

5. Answer (4)

Hint and Sol.: The variation of potential across the junction is best represented as



6. Answer (4)

Hint: Oscillator utilizes positive feedback while amplifier utilises negative feedback.

Sol.: For positive feedback $A_{CL} = \dfrac{A_0}{1 - A_0 B}$

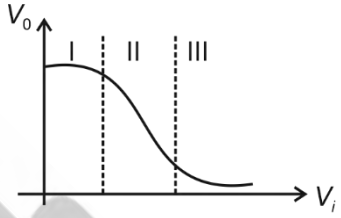
$\because \quad 1 - A_0\beta < 1 \qquad \therefore A_{CL} > A_0$

7. Answer (4)

Hint and Sol.: Zener breakdown occurs in reverse biasing for heavily doped p-n junction, due to field emission of EHP. It is reversible process and Zener diode can be used as a voltage regulator.

8. Answer (1)

Hint and Sol.: From transfer characteristics of CE amplifier.



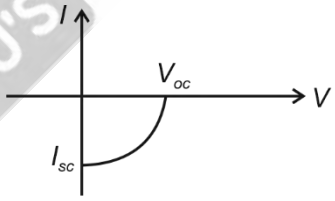
Region I $\rightarrow$ As switch (OFF)

Region II $\rightarrow$ As an amplifier

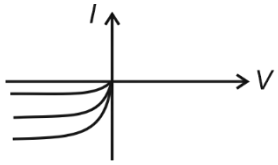
Region III $\rightarrow$ As switch (ON)

9. Answer (4)

Hint and Sol.: I-*V* characteristics of solar cell is



I-V characteristic of photodiode is



10. Answer (2)

Hint and Sol.: If *p* side is at higher potential than *n* side of *p*-*n* junction, then the junction diode is said to be in forward bias.

11. Answer (1)

Hint and Sol.: All types of semiconductor are electrically neutral.

12. Answer (4)

Hint: $A_V = \beta\dfrac{R_o}{R_i}$ and $A_P = A_V \times \beta$

Sol.: $\because g_m = \frac{I_C}{V_{BE}} \text{ or } \frac{I_o}{V_i}$

$\Rightarrow g_m = \frac{I_o}{I_i R_i} = \frac{\beta}{R_i}$

$\Rightarrow \beta = g_m R_i$

Also $A_V = \beta \frac{R_o}{R_i} = g_m R_i \times \frac{R_o}{R_i} = g_m R_o$

$A_P = \beta \cdot A_V = \beta \cdot \beta \frac{R_o}{R_i} = \beta^2 \frac{R_o}{R_i}$

13. Answer (2)

Hint: In reverse biasing for $V_{R_L} \geq V_z$, the Zener diode becomes ON and V_{R_L} becomes equal to V_z.

Sol.: $V_{R_L} = \frac{1}{3} \times 15 = 5 \text{ V}$

$V_{R_L} < V_Z \Rightarrow$ Zener diode remains OFF.

Hence V_L = 5 V.

14. Answer (3)

Hint: $E_g \leq \frac{hc}{\lambda}$

Sol.: $\lambda \leq \frac{hc}{E_g}$

$\Rightarrow \lambda_{max} = \frac{hc}{E_g} \approx \frac{12400}{2} \text{ Å} \approx 6200 \text{ Å}$

15. Answer (2)

Hint: $A = A_1 \cdot A_2 .....$

$A|_{dB} = A_1|_{dB} + A_2|_{dB} + ...$

Sol.: $A|_{dB} = 10 \text{ dB} + 10 \text{ dB} + ...$

$= 100 \text{ dB}$

16. Answer (1)

Hint and Sol.: For CE amplifier, output is out of phase with input (i.e. phase difference is 180°)

Current gain is maximum for common collector amplifier. $(\because \gamma = \beta + 1)$

17. Answer (3)

Hint: When both inputs *A* and *B* are low (0) or either of *A* or *B* is low (0) then current will flow through LED and output *Y* will be high (1). When both *A* and *B* are high (1) then output *Y* will be low (0) because no current will flow through LED.

Sol.: The truth table will be like

A	B	Y
0	0	1
0	1	1
1	0	1
1	1	0

$\Rightarrow$ NAND gate

18. Answer (1)

Hint: $P = \left(\frac{n}{t}\right) h\nu$

Sol.: $P = IA = 10^{-9} \times 6.6 \times 10^{-4} = 6.6 \times 10^{-13} \text{ W}$

$\left(\frac{n}{t}\right) = \frac{P}{h\nu} = \frac{6.6 \times 10^{-13}}{6.6 \times 10^{-34} \times 4 \times 10^{14}}$

$= \frac{10^7}{4} = 2.5 \times 10^6 \text{ photons/s}$

19. Answer (1)

Hint: Use $eV = \frac{hc}{\lambda} - \phi$

Sol.: $\frac{hc}{\lambda} = eV + \phi = (1 + 2.5) \text{ eV}$

$\lambda = \frac{12400}{3.5} \text{ Å} \approx 3543 \text{ Å}$

20. Answer (2)

Hint: $\lambda = \frac{h}{mv} = \frac{h}{\sqrt{2m(\text{KE})}}$

Sol.: $\lambda \propto \frac{1}{\sqrt{m}}$ (As KE is same for both)

$\because m_\propto > m_e$

$\therefore \lambda_\propto < \lambda_e$

21. Answer (4)

Hint: $eV_s = h\nu - \phi$

Sol.: $V_s = \frac{h}{e}\nu - \frac{\phi}{e}$

22. Answer (3)

Hint and Sol.: The light having equal photon flux have same intensity *i.e.* same saturation photo current. *A* and *B* have same stopping potential *i.e.* they have same frequencies.

23. Answer (2)

Hint: $\frac{1}{2}mv^2 = h\nu - \phi$

Sol.: $\frac{1}{2}mv_1^2 = h\nu_1 - \phi$

$\frac{1}{2}mv_2^2 = h\nu_2 - \phi$

$\frac{1}{2}m\left(v_1^2 - v_2^2\right) = h\left(\nu_1 - \nu_2\right)$

$v_1^2 - v_2^2 = \frac{2h}{m}\left(\nu_1 - \nu_2\right)$

24. Answer (4)

Hint: $\lambda_e = \frac{h}{\sqrt{2m(E)}}$ and $\lambda_P = \frac{hc}{E}$

Sol.: $E_e = \frac{h^2}{2m\lambda^2}$ and $E_P = \frac{hc}{\lambda}$

$\frac{E_P}{E_e} = \frac{(hc/\lambda)}{\left(\frac{h^2}{2m\lambda^2}\right)} = \frac{2m\lambda c}{h}$

25. Answer (3)

Hint and Sol.: Photoelectric effect shows the particle nature of light.

26. Answer (4)

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

Sol.: $\lambda = \frac{h}{mv} = \frac{h}{p} = \frac{h}{\sqrt{2m(E)}}$

Hence de Broglie wavelength 'λ' is independent of charge.

27. Answer (3)

Hint and Sol.: Mean nuclear density of nucleus is independent of mass number.

28. Answer (1)

Hint: $E = \Delta mc^2$

Sol.: Given Δm = 10 amu

$E = (10 \text{ amu})c^2 = 10 \times 931.5 \text{ MeV}$

$= 9315 \text{ MeV}$

29. Answer (4)

Hint: $E_n = -\frac{Z^2}{n^2}(13.6 \text{ eV})$

Sol.: $E_2 = -\frac{2^2}{2^2}(13.6 \text{ eV}) = -13.6 \text{ eV}$

$U_2 = 2E_2 = -13.6 \times 2 = -27.2 \text{ eV}$

30. Answer (2)

Hint and Sol.: Angular momentum is $L = \frac{nh}{2\pi}$.

31. Answer (3)

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

Sol.: For Paschen series n_1 = 3 and n_2 = 4, 5, 6… the wavelengths of Paschen series lies in IR region.

32. Answer (1)

Hint: $N = N_0\left(\frac{1}{2}\right)^{t/T_{1/2}}$

Sol.: $\frac{N}{N_0} = \left(\frac{1}{2}\right)^{t/T_{1/2}}$

$\frac{250}{2000} = \left(\frac{1}{2}\right)^{120/T_{1/2}}$

$\frac{1}{8} = \left(\frac{1}{2}\right)^{120/T_{1/2}}$

$\frac{120}{T_{1/2}} = 3 \Rightarrow T_{1/2} = 40 \text{ min}$

33. Answer (3)

Hint and Sol.:

$${}_ZX^A \xrightarrow{\beta^-} {}_{Z+1}Y^A \xrightarrow{\alpha} {}_{Z-1}K^{*A-4} \xrightarrow{\gamma} {}_{Z-1}K^{A-4}$$

34. Answer (3)

Hint: Use $\frac{1}{2}mv^2 = \frac{1}{4\pi\varepsilon_0}\frac{(2e)(ze)}{d}$

Sol.: $d = \frac{4ze^2}{4\pi\varepsilon_0 mv^2}$

$d \propto ze^2$

$d \propto \frac{1}{m}$

$d \propto \frac{1}{v^2}$

35. Answer (2)

Hint: $BE = \Delta mc^2$

Sol.: $BE = \left[ZM_P + (A-Z)M_n - M(A,Z)\right]c^2$

SECTION-B

36. Answer (3)

Hint: $R = R_o e^{-\lambda t}$

Sol.: $\ln R = \ln R_o + \ln\left(e^{-\lambda t}\right)$

$\ln R = \ln R_o - \lambda t$

Similar to, $Y = C - mx$

Slope of line is $-m$ *i.e.* $(-\lambda)$

Now $m = \lambda = \dfrac{8}{200} = \dfrac{1}{25}\ \text{min}^{-1}$

$\lambda = 0.04\ \text{min}^{-1}$

37. Answer (1)

Hint: $\dfrac{N}{N_o} = e^{-\lambda t}$

Sol.: $t = \dfrac{T_{\frac{1}{2}} \ln\left(N_o / N\right)}{\ln 2}$

Now

$$t = \frac{T_{\frac{1}{2}} \ln\left(\frac{N_o}{N}\right)}{\ln 2} = \frac{5\times10^9 \times \ln(1.6)}{\ln 2} \simeq 5\times10^9 \times 0.7$$

$\Rightarrow \quad t = 3.5\times10^9$ years

38. Answer (1)

Hint: Use $I_B = 10 i_b$ and KVL

Sol.: $i_c R_c = 2\,\text{V}$

$$i_c = \frac{2}{2\times10^3} = 1\,\text{mA}$$

$$i_b = \frac{i_c}{\beta} = \frac{1}{100}\,\text{mA}$$

$$I_B = 10 i_b = \frac{10}{100}\text{mA} = 0.1\,\text{mA}$$

Now for dc input loop

$V_{BB} - I_B R_B - V_{BE} = 0$

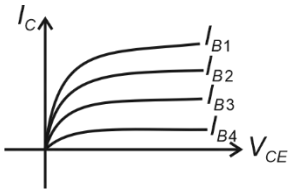
$2 - 0.1\times10^{-3} R_B - 0.6 = 0$

$$R_B = \frac{1.4}{0.1}\times10^3\,\Omega = 14\ \text{k}\Omega$$

39. Answer (2)

Hint: For CE amplifier output voltage is taken across collector and emitter

Sol.: The *I-V* characteristics of CE amplifier is like



40. Answer (2)

Hint:

- Transistor becomes 'ON' in saturation region and OFF in cut off region.
- It is circuit of NOR gate.

Sol.: For both inputs $A = B = 0$, the transistors will be OFF and no current will flow through R and output Y is connected to V_{CC} i.e. Y is 1 (high). For all other combinations one or both transistors will be ON and current will flow through R and output Y will be low (0)

Hence $0 \rightarrow t_1 \Rightarrow A = 1, B = 1 \Rightarrow Y = 0$

$t_1 \rightarrow t_2 \Rightarrow A = 0, B = 1 \Rightarrow Y = 0$

$t_2 \rightarrow t_3 \Rightarrow A = 1, B = 1 \Rightarrow Y = 0$

$t_3 \rightarrow t_4 \Rightarrow A = 0, B = 0 \Rightarrow Y = 1$

41. Answer (1)

Hint: Diodes will be shorted in forward biasing and opened in reverse biasing

Sol.: Only diode D_2 will be ON while diodes D_1 and D_3 will be OFF

Hence $i = \dfrac{10}{100} = 0.1\,\text{A}$

42. Answer (1)

Hint: For p-type semiconductor $n_e < n_h$

Sol.: From the energy band diagram, $E_g = 1.1$ eV

Fermi level is nearer to valence band and $n_h > n_e$ therefore semiconductor is of p-type.

$$E_F - E_V < \frac{E_g}{2}$$

Or $E_F - E_V < 0.55$ eV

In p-type semiconductor trivalent dopants are added.

43. Answer (2)

Hint: $\dfrac{1}{2}mv^2 = h\nu - h\nu_0$

Sol.: $\dfrac{1}{2}mv^2 = h2\nu_0 - h\nu_0 = h\nu_0$

$\dfrac{1}{2}mv'^2 = h\left(4\nu_0\right) - h\nu_0 = 3h\nu_0$

$$\frac{v'^2}{v^2} = \frac{3h\nu_0}{h\nu_0} = 3$$

$$v' = \sqrt{3}\,v$$

44. Answer (3)

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

Sol.: For Lyman series $n_1 = 1$ and $n_2 = 2, 3, 4\ldots$

For Balmer series $n_1 = 2$ and $n_2 = 3, 4, 5\ldots$

For Paschen series $n_1 = 3$ and $n_2 = 4, 5, 6\ldots$

For Brackett series $n_1 = 4$ and $n_2 = 5, 6, 7\ldots$

45. Answer (3)

Hint and Sol.: If energy is absorbed in a process then BE of products decreases and when energy is released in a process then binding energy increases.

46. Answer (1)

Hint: Initial activity

$R_o = \lambda N_o$ and $T_{\frac{1}{2}} = \frac{\ln 2}{\lambda}$

Sol.: From the plot $\lambda_B > \lambda_A$ and $N_{o,A} = N_{o,B}$

$R_{o,A} < R_{o,B}$

Half life $T = \frac{\ln 2}{\lambda}$

$\Rightarrow T_A > T_B$

Mean life $\tau = \frac{1}{\lambda}$

$\Rightarrow \tau_A > \tau_B$

47. Answer (3)

Hint: $\lambda = \frac{h}{p}$ and $a = \frac{eE_0}{m_e}$

Sol.: $\vec{a} = +\frac{eE_0}{m_e}\hat{j}$

$$\vec{v} = \vec{v}_0 + \vec{a}\,t = v_0\hat{j} + \left(\frac{eE_0 t}{m_e}\right)\hat{j}$$

$$\vec{v} = v_0\left(1 + \frac{eE_0 t}{m_e v_0}\right)\hat{j}$$

$$\lambda = \frac{h}{m_e v} = \frac{h}{m_e v_0\left(1 + \frac{eE_0 t}{m_e v_0}\right)} = \frac{\lambda_0}{\left(1 + \frac{eE_0 t}{m_e v_0}\right)}$$

48. Answer (2)

Hint: Use $\lambda = \frac{h}{mv}$ and $v_y^2 = u_y^2 + 2gh$

Sol.: $v = \sqrt{v_x^2 + v_y^2}$

$v = \sqrt{400 + 2\times 10\times 60}$

$= 40$ m/s

$\lambda_0 = \frac{h}{m(20)}$ (Given)

$\lambda = \frac{h}{m(40)} = \frac{1}{2}\left[\frac{h}{m(20)}\right] = \frac{\lambda_0}{2}$

49. Answer (2)

Hint and Sol.: Absorption lines are from ground state ($n = 1$) to higher states.

Hence line 1 and 2 will appear in absorption lines.

50. Answer (3)

Hint: $E_n = -\frac{Z^2}{n^2}(13.6\text{ eV})$, $v_n = \frac{Z}{n}v_0$ and $r_n = \frac{n^2}{Z}r_0$

Sol.: $v_n \propto \frac{1}{n}$

$E_n \propto \frac{1}{n^2}$

$r_n \propto n^2$

[CHEMISTRY]

SECTION-A

51. Answer (4)

Hint:

- 40% aq. solution of formaldehyde is called formalin.

Sol.:

- Fehling reagent comprises Fehling A and Fehling B. Fehling B is alkaline sodium potassium tartarate (Rochelle salt).
- Benzaldehyde undergo benzoin condensation reaction in presence of alcoholic KCN.

a. Formaldehyde → Formalin

b. Acetylsalicylic acid → Aspirin

c. Benzaldehyde → Benzoin (PhCH(OH)COPh)

d. Rochelle salt → Fehling reagent (Fehling solution B which is alkaline sodium potassium tartarate)

52. Answer (3)

Hint: On passing alcohol vapours over heavy metal catalyst (like Cu or Ag), secondary alcohols give ketones.

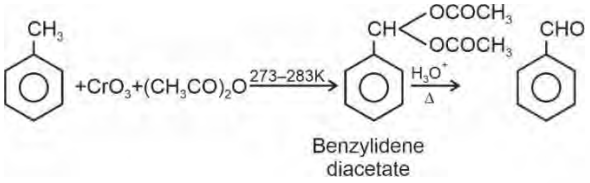
Sol.:

$$(CH_3)_2CH-OH \xrightarrow{\text{Heated Ag}} CH_3-CO-CH_3+H_2$$

53. Answer (3)

Hint: Toluene is converted to benzylidene diacetate on treating with chromic oxide in acetic anhydride.

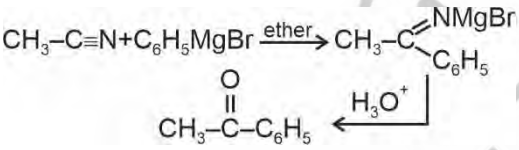
Sol.:



54. Answer (3)

Hint: PhMgBr adds to $-C\equiv N$ forming an addition product.

Sol.:



55. Answer (3)

Hint: Boiling points of aldehydes and ketones are higher than alkanes and lower than those of alcohols of similar molecular masses

Sol.:

Molecule	B.P.
n-Butane	273
Proponal	322
Acetone	329
Propan-1–ol	370

56. Answer (1)

Hint: Electron withdrawing groups increases the acidity of the carboxylic acids.

Sol.: Correct order of acidic strength is as $CF_3COOH > HCOOH > C_6H_5COOH$

57. Answer (4)

Hint: Nitriles are reduced by DIBAL-H followed by hydrolysis to aldehydes.

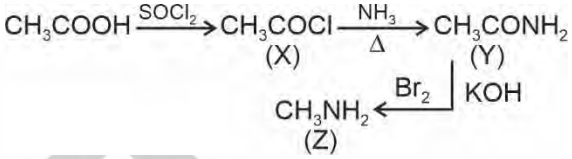
Sol.:

a.	$>C=O \xrightarrow[HCl]{Zn-Hg} >CH_2$	Clemmensen reduction
b.	$>C=O \xrightarrow[(ii)\ KOH,\ \Delta]{(i)\ H_2NNH_2} >CH_2$	Wolff-Kishner reduction
c.	$-C\equiv N \xrightarrow[(ii)\ H_2O]{(i)\ DIBAL-H} -CHO$	Reduction by DIBAL–H
d.	$-COOH \xrightarrow[(ii)\ H_2O]{(i)\ LiAlH_4} -CH_2OH$	Reduction by $LiAlH_4$

58. Answer (2)

Hint: Primary amine is formed by treating an acid amide with bromine in an aqueous solution of KOH.

Sol.:



59. Answer (4)

Hint : Aromatic aldehydes do not give positive Fehling reagent test

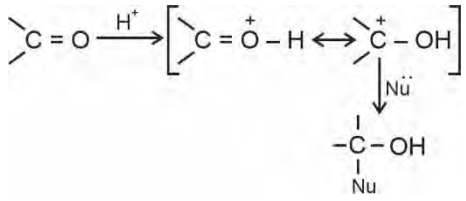
Sol.:

- Aliphatic aldehydes reduce both Tollens′reagent and Fehling's reagent
- Ketones do not reduce Tollens′ reagent or Fehling reagent.

60. Answer (4)

Hint: Nucleophiles, such as ammonia and its derivatives, (H_2N-Z) add to >C=O group of aldehydes and ketones. The reaction is catalysed by acid.

Sol.:



61. Answer (2)

Hint.:

- Terminal alkyne like propyne has an acidic hydrogen atom.
- Alkynes undergo hydrolysis in presence of Hg^{2+} ions

Sol.: $CH_3C{\equiv}CH \xrightarrow[(ii)\ CH_3Br]{(i)\ NaNH_2} CH_3{-}C{\equiv}C{-}CH_3$

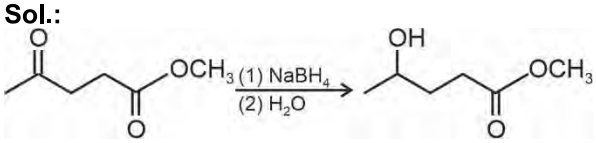
$CH_3{-}C(=O){-}CH_2CH_3 \xleftarrow[H_2SO_4]{HgSO_4,}$

62. Answer (3)

Hint: $NaBH_4$ reduces ketones but not esters.

While $LiAlH_4$ can reduce esters as well as ketones.

Sol.:



63. Answer (1)

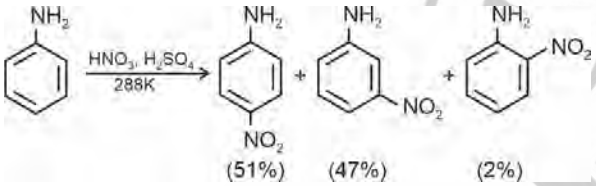
Hint: $LiAlH_4$ reduces amides into primary amines.

Sol.: $R{-}C(=O){-}NH_2 \xrightarrow[(2)\ H_2O]{(1)\ LiAlH_4} R{-}CH_2{-}NH_2$

64. Answer (4)

Hint: NH_2 is ortho/para directing in nature towards electrophilic aromatic substitution reaction.

Sol.:

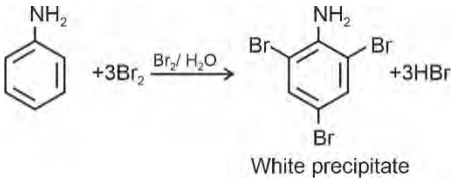


In the strongly acidic medium, aniline is protonated to form $-\overset{+}{N}H_3$ (anilinium ion) which is meta directing, so significant amount of meta derivative is also formed.

65. Answer (3)

Hint: $-NH_2$ group is o, p directing for electrophilic substitution reactions as it exerts strong mesomeric effect (+R) to benzene ring

Sol.:



66. Answer (2)

Hint: The compounds in which lone pair of electron on nitrogen atoms are delocalised are less available for protonation.

Sol.: Lone pair of electron of nitrogen in aniline is delocalised in the benzene ring hence it is less available for protonation. Aniline is least basic in nature.

67. Answer (4)

Hint: Aliphatic and aromatic primary amines on heating with chloroform and alkali form isocyanides which are foul smelling substances.

Sol.:

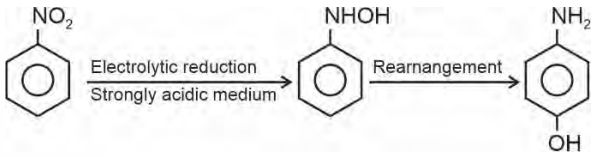
$$R-NH_2 + CHCl_3 \xrightarrow[\Delta]{KOH} \underset{\text{isocyanide}}{R-NC} + KCl + H_2O$$

The reaction is called carbylamine reaction.

68. Answer (3)

Hint: Electrolytic reduction of nitrobenzene in weakly acidic medium produces aniline.

Sol.:



69. Answer (3)

Hint: Primary and secondary amines react with Hinsberg's reagent.

Sol.: $CH_3{-}NH{-}CH_3 + Cl{-}\underset{\underset{O}{\|}}{\overset{\overset{O}{\|}}{S}}{-}Ph \rightarrow Ph{-}\underset{\underset{O}{\|}}{\overset{\overset{O}{\|}}{S}}{-}\underset{\underset{CH_3}{|}}{N}{-}CH_3$

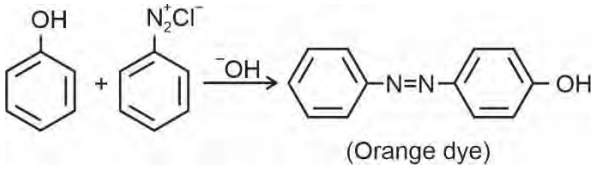
N, N–dimethylbenzene sulphonamide (Insoluble in alkali)

In the reaction of Hinsberg's reagent with secondary amines, N, N–dialkyl benzene–sulphonamide is formed, it does not contain any hydrogen atom attached to nitrogen, so insoluble in alkali.

70. Answer (4)

Hint: In alkaline medium phenol get ionised into phenoxide ion, so benzene ring is highly activated for electrophiles.

Sol.:



pH range should be 9 to 10

71. Answer (3)

Hint and Sol.: The Cl^-, Br^- and CN^- nucleophiles can easily be introduced in the benzene ring in presence of cuprous ion. This reaction is called Sandmeyer reaction.

72. Answer (4)

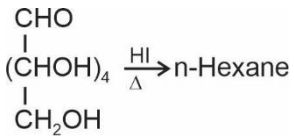
Hint: A carbohydrate that cannot be hydrolyzed further to give simpler unit of polyhydroxy aldehyde or ketone is called a monosaccharide

Sol.: Lactose + $H_2O \rightarrow$ glucose + galactose

73. Answer (4)

Hint: Glucose has an aldehyde group. It is the monomer of cellulose and starch

Sol.:

- 
- Glucose does not form addition product with $NaHSO_3$.

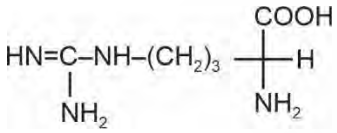
74. Answer (4)

Hint: The amino acids, which cannot be synthesised in the body are known as essential amino acids.

Sol.: Alanine is a non-essential amino acid.

75. Answer (2)

Hint: The amino acid which contains more number of amino than carboxyl groups is basic amino acid.

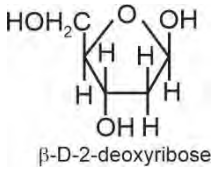
Sol.: 

Arginine has more NH_2 groups so it a basic amino acid.

76. Answer (2)

Hint: Complete hydrolysis of DNA yields a pentose sugar, phosphoric acid and nitrogen containing heterocyclic compounds.

Sol.: Sugar moiety present in DNA molecule is β-D-2-deoxyribose.



β-D-2-deoxyribose

77. Answer (3)

Hint: Vitamin A, D, E and K are fat soluble.

Sol.: B group vitamins and vitamin C are water soluble

78. Answer (3)

Hint: Those isomers which only differ in configuration around C-1 carbon are called anomers.

Sol.: α-and β-forms of glucose only differ at C-1 carbon and are called anomers.

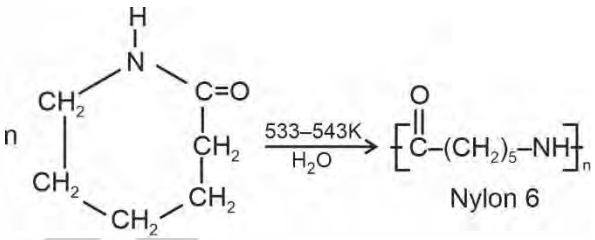
79. Answer (3)

Hint and Sol.: During denaturation secondary and tertiary structures are destroyed but primary structure remains intact.

80. Answer (2)

Hint: Nylon 6 is a condensation polymer.

Sol.:



Nylon 6

81. Answer (4)

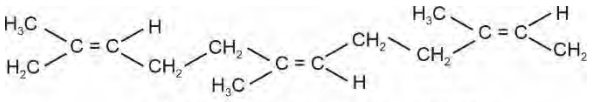
Hint: Some polyesters and polyamides are used as biodegradable polymers.

Sol.: Nylon 2–nylon–6 is a copolymer of glycine and amino caproic acid. It is a biodegradable polymer.

82. Answer (3)

Hint: Natural rubber is a linear polymer of 2-methyl –1, 3–butadiene.

Sol.:



Natural rubber or cis-1, 4-polyisoprene

83. Answer (3)

Hint: Antibiotics which are effective mainly against gram-positive or gram-negative bacteria are narrow spectrum antibiotics.

Sol.: Penicillin-G is a narrow spectrum antibiotic.

84. Answer (1)

Hint: Sucralose is stable at cooking temperature.

Sol.: Aspartame is used in cold food and soft drinks as it is unstable at cooking temperature.

85. Answer (1)

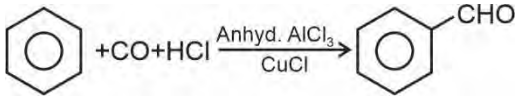
Hint: Antiseptics are applied to the living tissues such as wounds, cuts etc.

Sol.: Bithionol is added to soaps to impart antiseptic properties.

SECTION-B

86. Answer (2)

Hint: Electrophile in this reaction is formyl cation.

Sol.: 

This reaction is called Gatterman-Koch reaction.

87. Answer (4)

Hint: $SnCl_2$ in presence of HCl reduces cyanide.

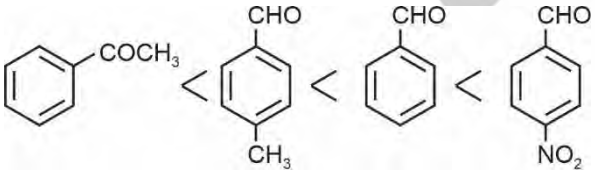
Sol.: $R-CN+SnCl_2+HCl \longrightarrow \underset{\text{imine}}{R-CH=NH} \xrightarrow{H_3O^+} R-CHO+NH_3$

88. Answer (2)

Hint:

- Aldehydes are generally more reactive than ketones in nucleophilic addition reactions due to steric and electronic reasons.
- Presence of an electron withdrawing group at o, p-positions, increases the electrophilicity of carbonyl carbon.

Sol.: Correct order of nucleophilic addition for the given compounds is



89. Answer (3)

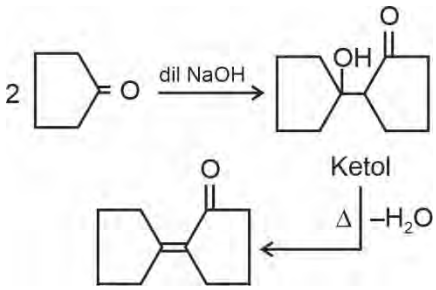
Hint: The carboxylic acids react with weaker bases such as hydrogen carbonates to evolve CO_2 gas.

Sol.: $R-COOH+NaHCO_3 \rightarrow$

$R-COO^- Na+H_2O+CO_2$

90. Answer (3)

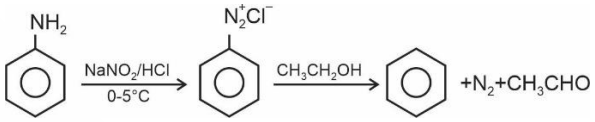
Hint: Final product in aldol condensation is α, β-unsaturated carbonyl compounds.

Sol.: 

91. Answer (3)

Hint: Mild reducing agents like H_3PO_2 or CH_3CH_2OH reduce diazonium salts to arenes.

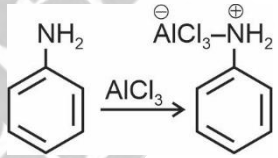
Sol.:



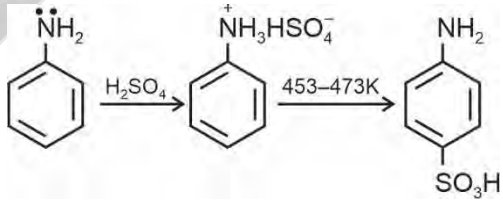
92. Answer (4)

Hint: Acid amides are very weak bases due to delocalisation of lone pair of electrons of Nitrogen.

Sol.:

- 

Deactivated ring due to presence of $-\overset{+}{N}H_2$ group.

- 

Sulphanilic acid

- Acid amides are very weak bases, they are acidic in nature as reacts with bases like NaOH.

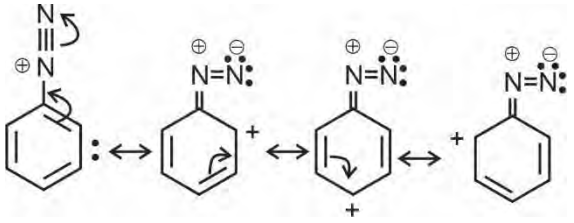
93. Answer (4)

Hint:

- Aliphatic diazonium salts are unstable, it liberate nitrogen gas and form alcohols.

Sol.:

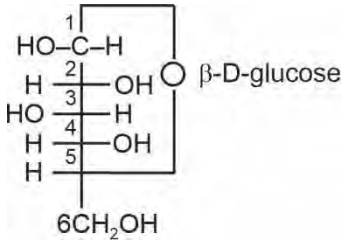
Aromatic amines form stable diazonium salts, as there is partial double bond character between C and N due to its conjugation with the benzene ring.



94. Answer (2)

Hint: Glucose can form a six-membered ring in which –OH at C–5 can add to –CHO group and forms a cyclic hemiacetal structure thus, generates a new stereogenic centre.

Sol.:



β-D-glucose has 5 asymmetric carbon atoms.

95. Answer (1)

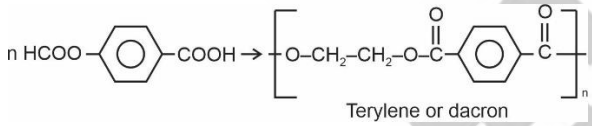
Hint: Xerophthalmia is hardening of cornea of eye

Sol.: Deficiency of vitamin A causes xerophthalmia.

96. Answer (2)

Hint: Dacron is the condensation product of dicarboxylic acids and diols.

Sol.: $nHO–CH_2–CH_2–OH+$



97. Answer (3)

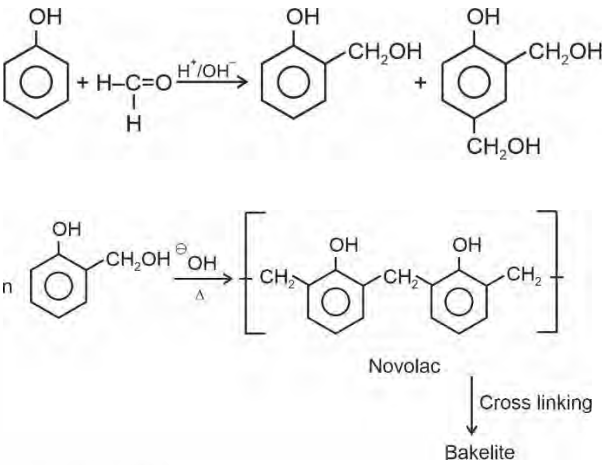
Hint and Sol.: Vulcanisation consists of heating a mixture of raw rubber with sulphur and an appropriate additive at a temperature range between 373 K to 415 K.

Sulphur forms cross links at the reactive sites of double bonds and thus the rubber gets stiffened.

98. Answer (1)

Hint: One of the monomers of Bakelite is phenol.

Sol.:



99. Answer (1)

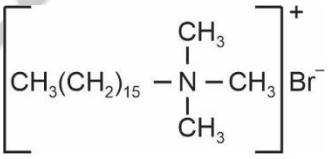
Hint: These are a type of tranquilizers.

Sol.: Derivatives of barbituric acid are hypnotic *i.e.* sleep producing agents.

100. Answer (4)

Hint: Sodium salts of high fatty acids/sulphates are anionic detergents

Sol.: Cationic detergents are quaternary ammonium salts of amines with acetates, chlorides or bromides as anions



Cetyltrimethyl ammonium bromide

[BOTANY]

SECTION-A

101. Answer (1)

Hint: Anthropogenic ecosystem is created and maintained by human beings.

Sol.: Anthropogenic ecosystem does not possess self-regulatory mechanism.

102. Answer (2)

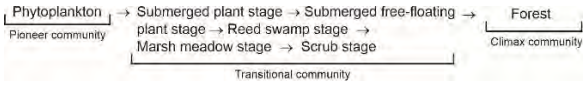
Hint: Pyramid of energy is always upright.

Sol.: Pyramid of number in grassland ecosystem is upright. Pyramid of number in tree ecosystem and pyramid of biomass in aquatic ecosystem are inverted.

103. Answer (2)

Hint: The pioneer community is followed by a specific orderly sequence of series of plant communities known as seral or transitional communities.

Sol.: Sequence of various stages in hydrarch succession is



104. Answer (2)

Hint: The amount of biomass is expressed in terms of kg m^{-2}.

Sol.: According to given question, the biomass of primary producers supports large standing crop of primary consumers. Therefore, the pyramid of biomass is inverted.

105. Answer (3)

Hint: Transfer of energy follows 10 percent law.

Plants capture only 2-10% of PAR or 1-5% of incident solar radiation.

Sol.: T_3 is primary carnivore.

Light energy

100 kcal

↓

Plants (T_1) → T_2 → T_3 → T_4

1000 cal 100 cal 10 cal 1 cal

106. Answer (4)

Hint: Tertiary consumers are also called secondary carnivores.

Sol.: Tertiary consumers are the animals which feed on secondary consumers and constitute the fourth trophic level (T_4).

107. Answer (3)

Hint: Ecological pyramids are graphical representations of various ecological parameters at the successive trophic levels of food chains with producers at the base, top carnivores at the apex and intermediate levels in between.

Sol.: Ecological pyramid does not accommodate a food web.

108. Answer (2)

Hint: Secondary succession starts in area that somehow lost all the living organisms that existed there.

Sol.: Secondary succession occurs in areas such as abandoned farm lands, burned or cut forest.

109. Answer (4)

Hint: During ecological succession, gradual and fairly predictable changes are seen in the species composition of a given area.

Sol.: Humus content of soil increases w.r.t ecological succession.

110. Answer (4)

Hint: Humus is formed during the process of decomposition of detritus.

Sol.: Humus undergoes decomposition at an extremely slow rate.

111. Answer (4)

Hint: Decomposition of detritus is slow if it contains lignin, chitin, tannins (phenolics) and cellulose.

Sol.: Decomposition of detritus is rapid, if detritus possesses more of nitrogenous compounds (like, proteins, nucleic acids) and water-soluble reserve, carbohydrates or sugars.

112. Answer (3)

Hint: Primary productivity is the rate at which biomass or organic matter is produced per unit area over a time period by plants or producers during photosynthesis.

Sol.: The following factors that affect primary productivity of ecosystem are:

(a) Photosynthetic capacity of producers

(b) Available solar radiations

(c) Soil moisture

(d) Availability of nutrients

- Diversity of herbivores does not affect primary productivity of an ecosystem.

113. Answer (3)

Sol.: According to IUCN (2004), the total number of plant and animal species described so far is slightly more than 1.5 million.

114. Answer (4)

Hint: 'X' is fungi

Sol.: Fungi are achlorophyllous and heterotrophic organisms.

115. Answer (4)

Sol.: According to rivet popper hypothesis, an airplane is considered as an ecosystem, rivets as species and rivets on the wings as key species.

116. Answer (3)

Hint: Species richness is the number of species present within a unit area, while species evenness is the proportionate number of individuals of different species.

Sol.: Species diversity is the product of species richness and species evenness.

117. Answer (2)

Hint: Natural or core zone comprises an undisturbed and legally protected ecosystem.

Sol.: The transition zone is the outermost part of biosphere reserve. It is an area of active cooperation between reserve management and the local people. The buffer zone surrounds the core area.

118. Answer (3)

Hint: Western ghat regions are found in Karnataka and Maharashtra

Sol.: Surguja and Chanda are found in Madhya Pradesh

119. Answer (2)

Hint: Food and firewood are narrowly utilitarian services.

Sol.: Pollination and flood control are broadly utilitarian services.

120. Answer (3)

Hint: Erosion control, aesthetic pleasure and oxygen supply are the broadly utilitarian services for conserving biodiversity.

Sol.: Fibre is the narrowly utilitarian service for conserving biodiversity.

121. Answer (4)

Sol.: Kaziranga National Park is important for protection of Rhinoceros.

122. Answer (1)

Hint: Polyblend is a fine powder of recycled modified plastic.

Sol.: Polyblend is an innovative remedy for plastic waste.

123. Answer (4)

Sol.: Integrated organic farming allows maximum utilisation of resources and increases the efficiency of production.

124. Answer (3)

Hint: Green muffler scheme is related to method of reducing noise pollution.

Sol.: Green muffler scheme involves planting trees such as Neem and Ashoka that absorb sound vibrations to a great extent.

125. Answer (2)

Hint: Air pollutants coming directly from the pollution sources are called primary air pollutants.

Sol.: Ozone is a secondary air pollutant.

126. Answer (3)

Hint: The increased accumulation of toxic substances in the food chain at higher trophic level is called biological magnification.

Sol.: The order of decreasing concentration of BHC in the given organisms is

Fish eating bird > Large fish > Small Fish > Zooplanktons > Phytoplanktons

127. Answer (1)

Hint: Ahmed khan was a plastic sack producer in Bangalore.

Sol.: Ahmed khan has managed to find the ideal solution to the ever increasing problem of accumulating plastic waste.

128. Answer (3)

Hint: In a terrestrial ecosystem, a much larger fraction of energy flows through the detritus food chain than through the GFC.

Sol.: In an aquatic ecosystem, GFC is the major conduit for energy flow.

129. Answer (3)

Hint: Intensity of noise is measured in terms of decibel (dB).

Sol.: Thickness of ozone in a column of air from ground to top of atmosphere is measured in terms of Dobson units (DU).

130. Answer (1)

Hint: N_2O contributes least to total global warming.

Sol.: Relative contribution of various greenhouse gases to total global warming is as:

$CO_2 \rightarrow 60\%$, $CH_4 \rightarrow 20\%$,

$CFCs \rightarrow 14\%$, $N_2O \rightarrow 6\%$

131. Answer (4)

Sol.: Composition of waste water is as follows:

- Colloidal material: – Faecal matter, bacteria, cloth, etc.
- Dissolved material:- Nutrients, (nitrate, ammonia, phosphate, sodium, calcium)
- Suspended solids:– Sand, silt and clay.

132. Answer (4)

Hint: Acid rain and its deposition damages foliage.

Sol.: It also damages growing point of plants.

133. Answer (3)

Hint: Montreal protocol became effective in 1989.

Sol.: Montreal protocol was signed at Montreal (Canada) in 1987 (effective in 1989) to control the emission of ozone depleting substances (ODS).

134. Answer (2)

Sol.: Kyoto protocol was committed to mitigate climate change. Bali action plan updated the Kyoto protocol.

135. Answer (1)

Hint: Historic convention of biological diversity was held at Rio de Janeiro, Brazil 1992.

Sol.: It is also known as Earth summit.

SECTION-B

136. Answer (1)

Hint: Primary producers constitute first trophic level (T_1).

Sol.: Primary producers are autotrophic organisms which fix up the solar energy and manufacture their own food from inorganic raw material. So, they form base of food chain.

137. Answer (2)

Hint: Energy flow, decomposition and productivity are functional aspects of ecosystem.

Sol.: Species composition and stratification are structural features of ecosystem.

138. Answer (2)

Sol: Primary productivity is expressed in terms of weight as $(gm^{-2})\ yr^{-1}$ and in terms of energy as $(kcal\ m^{-2})\ yr^{-1}$.

139. Answer (2)

Hint: Auxiliary food chain is also called parasitic food chain

Sol.: Size of organisms finally reduces at higher tropic level in auxiliary food chain

140. Answer (1)

Sol.: Ten percent law of energy transfer was proposed by Lindeman.

141. Answer (2)

Hint: There are more than 40,000 plant species found in Amazonian rain forest.

Sol.: Following are the number of species in Amazonian rain forest:

Birds – 1300, Reptiles – 378, Amphibians – 427, Fishes – 3000.

142. Answer (4)

Hint: On log scale, species – area relationship becomes linear and the equation is expressed as log S = log C + Z log A.

Sol.: $S = CA^Z$ represents species – area relationship in the form of rectangular hyperbolic curve.

143. Answer (2)

Hint: Loss of biodiversity in a region may be due to co-extinction.

Sol.: Co-evolution is an interaction between two species. It does not lead to loss of biodiversity.

144. Answer (3)

Sol.: The Evil Quartet refers to four major causes of biodiversity loss.

145. Answer (4)

Hint: In *ex-situ* conservation strategies, threatened animals and plants are taken out from their natural habitat and placed in special setting where they can be protected and given special care.

Sol.: Seed banks, wildlife safari parks and botanical garden are *ex-situ* conservation strategies of biodiversity.

146. Answer (4)

Hint: Incineration is a method of burning of solid wastes such as hospital wastes.

Sol.: Incineration is controlled aerobic combustion of solid wastes inside chambers of temperature of 850°C – 1000°C.

147. Answer (4)

Hint: e-wastes are irreparable computers, mobiles and other electronic goods.

Sol.: Recycling is the only solution for treatment of e-wastes.

148. Answer (3)

Hint: Photochemical smog is formed in traffic – congested cities where warm conditions and intense solar radiations are present.

Sol.: London smog contains H_2S. Photochemical smog has mainly O_3, PAN and NO_X.

149. Answer (4)

Hint: Domestic sewage includes human faecal matter, animal waste and many dissolved organic compounds.

Sol.: Waste water from industries often contains toxic substances, notably heavy metals.

150. Answer (3)

Sol.: National Forest policy (1988) of India has recommended 33% forest cover for the plains and 67% for the hills.

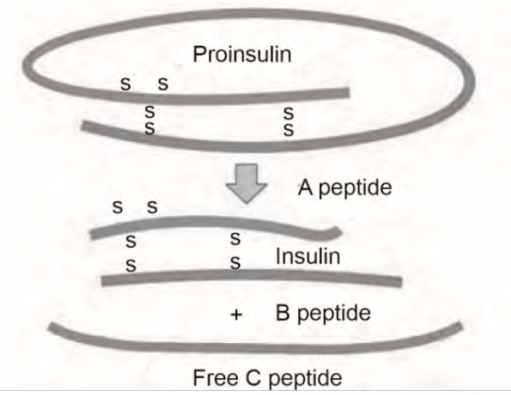
[ZOOLOGY]

SECTION-A

151. Answer (4)

Hint: The number of disulphide bonds are same in proinsulin and insulin.

Sol.:



152. Answer (1)

Hint: Identify the bonds present between nitrogenous bases in DNA.

Sol.: The two polynucleotide strands are held together in their helical structure by hydrogen bonding between nitrogenous bases in opposing strands. Adenine and thymine form two hydrogen bonds. Guanine and cytosine form three hydrogen bonds.

In nucleic acids, phosphate group is attached to the hydroxyl group of sugar through ester bond.

153. Answer (3)

Hint: Present in saliva

Sol.: It is important to break cell open for isolation of genetic material (DNA).

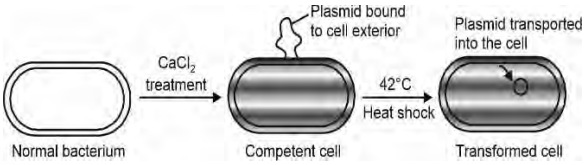
It can be achieved by treating bacterial cells, plant cells and fungus with lysozyme, cellulase and chitinase respectively.

Nuclease belongs to the class hydrolase and cleaves nucleic acids.

154. Answer (3)

Hint: Temperature less than 50°C is used in heat shock method.

Sol.:



In PCR (Denaturation): Starting reaction mixture is heated usually to 94°C.

155. Answer (4)

Hint: Vectorless gene transfer

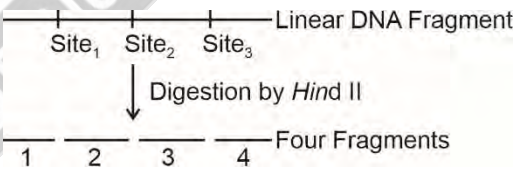
Sol.: Biolistics, electroporation and microinjection are included in direct method of gene transfer.

Retroviruses can be used as a vector to transfer functional ADA cDNA gene into the lymphocytes of a patient for the treatment of SCID.

156. Answer (2)

Hint: More than three

Sol.:



157. Answer (2)

Hint: *cryIIAb* controls cotton bollworm

Sol.: The most Bt toxins are insect group specific.

The proteins encoded by the genes *cryIAc* and *cryIIAb* control the cotton bollworms, that of *cryIAb* controls corn borer.

158. Answer (1)

Hint: Method of cellular defense in all eukaryotic organisms

Sol.: Interference prevents translation of the original mRNA.

Bioprocess engineering includes maintenance of sterile ambience in chemical-engineering process to enable growth of only the desired microbe/eukaryotic cell in large quantities.

159. Answer (2)

Hint: Golden rice is enriched in vitamin A.

Sol.: Genetic modification has

(a) Made crops more tolerant to abiotic stresses

(b) Reduced reliance on chemical pesticides

(c) Helped in reducing post harvest losses

(d) Increased efficiency of mineral usage by plants

(e) Enhanced nutritional value of food

160. Answer (3)

Hint: Starts with formation of rDNA

Sol.: The correct sequence of given steps of RDT is (a) → (d) → (c) → (b)

i.e,

(i) Construction of a recombinant DNA molecule.

(ii) Transfer of rDNA into the host.

(iii) Culturing the host cells in a nutrient medium at a large scale.

(iv) Extraction of the desired product.

161. Answer (4)

Hint: More than one disease are correctly mentioned.

Sol.: Many transgenic animals are designed to increase our understanding of how genes contribute to the development of disease.

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

162. Answer (2)

Hint: Causative agent of typhoid

Sol.: The construction of the first rDNA emerged from the possibility of linking a gene-encoding antibiotic resistance with a native plasmid of *Salmonella typhimurium*.

Eli Lilly, an American company used *E.coli* as host to produce insulin chains.

Agrobacterium tumefaciens is the natural genetic engineer of plants.

The first restriction endonuclease characterized i.e, *Hin*d II was isolated from *Haemophilus influenzae*.

163. Answer (3)

Hint: More than total bones in our body

Sol.: Besides *Hin*d II, today we know more than 900 restriction enzymes that have been isolated from over 230 strains of bacteria each of which recognise different recognition sequences.

164. Answer (3)

Hint: Phosphodiester bonds

Sol.: Restriction endonucleases cleave phosphodiester bonds.

Plasmid is an autonomously replicating circular extra-chromosomal DNA.

A normal *E.coli* do not carry resistance against antibiotics.

Gene encoding resistance to antibiotics is considered as selectable marker.

165. Answer (3)

Hint: Control of aerobic conditions

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

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

166. Answer (2)

Hint: β-galactosidase is not present in recombinant colonies.

Sol.: The presence of chromogenic substrate gives blue coloured colonies if the plasmid in the bacteria does not have an insert.

Presence of insert results in insertional inactivation of the β-galactosidase gene and the colonies do not produce any colour and are called recombinant colonies.

In pBR322, selection of recombinants is a cumbersome procedure because it requires simultaneous plating on two plates having different antibiotics.

167. Answer (2)

Hint: Collection of the product

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

168. Answer (4)

Hint: In world, the number is same as that of bones in each limb of humans.

Sol.: Recombinant therapeutics are therapeutic proteins produced by recombinant DNA technology.

They are safe and more effective drugs and do not induce unwanted immunological responses as is common in case of similar products isolated from non-human sources.

At present, about 30 recombinant therapeutics have been approved globally.

169. Answer (1)

Hint: First cloned mammal

Sol.: Dolly, the sheep was the first animal (mammal) to be successfully cloned from an adult somatic cell.

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

170. Answer (2)

Hint: Chronic disorder of lungs

Sol.: The first transgenic sheep to produce α-1-antitrypsin was Tracy.

Transgenic animals that produce useful biological products can be created by the introduction of the portion of DNA that codes for a particular product such as human protein (α-1-antitrypsin) used to treat emphysema.

171. Answer (3)

Hint: Fed batch culture is commonly used to produce penicillin.

Sol.: Ethidium bromide acts as an intercalating agent that stacks between base pairs of DNA and helps in visualizing them under UV light.

Ampicillin and tetracycline resistance genes are present in pBR322.

Continuous addition of sugars in fed batch fermentation is done to obtain antibiotics.

172. Answer (2)

Hint: Nucleoside

Sol.: Gene therapy is a collection of methods that allows correction of a gene defect that has been diagnosed in a child/embryo.

The first gene therapy was given in 1990 to a 4 year old girl with ADA-deficiency.

173. Answer (2)

Hint: Rhyme with illusion

Sol.: The DNA fragments after the addition of chilled ethanol when precipitated can be removed by spooling.

174. Answer (3)

Hint: 2^n copies are produced after 'n' number of cycles.

Sol.: PCR is a technique that exponentially amplifies DNA segment.

2^n copies of a DNA fragment are produced after 'n' number of PCR cycles.

So, after 10 PCR cycles, 2^{10} copies will produce from a single DNA fragment.

i.e, $2^{10} = 1024$

$\therefore$ From 2 DNA fragments after 10 PCR cycles, the number of copies produced = 1024×2

$= 2048$

175. Answer (3)

Hint: Each restriction endonuclease has specific restriction site.

Sol.: If the *Hin*d II is used to cleave the genome from donor cell then the same restriction enzyme *i.e*, *Hin*d II has to be used to cleave the cloning vector.

Hence, the resultant strands will be complimentary to each other.

Only when the foreign DNA and vector DNA have complementary ends, they can be successfully ligated.

176. Answer (3)

Hint: Modern method of diagnosis

Sol.: Modern method of diagnosis like RDT, PCR and ELISA serve the purpose of early diagnosis.

Serum and urine analysis are traditional methods of diagnosis.

177. Answer (3)

Hint: Genes which make animals more sensitive to toxins are added to their genome.

Sol.: In chemical safety testing, transgenic animals are made that carry genes which make them more sensitive to toxic substances than non-transgenic animals.

Toxicity testing in such animals will allow us to obtain results in less time.

178. Answer (3)

Hint: The act of duplication

Sol.: 'rop' codes for the proteins involved in replication of the plasmid.

Selectable markers help in selection of recombinants and non-recombinants.

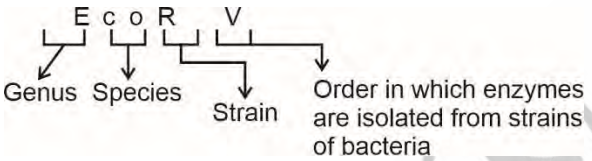
'Ori' is responsible for controlling the copy number of a linked DNA.

179. Answer (2)

Hint: 'R' stands for genetic variant

Sol.: The convention for naming the restriction enzymes is that the first letter comes from the name of genus and the second two letters come from the species of the prokaryotic cell from which they were isolated.

For example,



180. Answer (3)

Hint: Vectorless gene transfer

Sol.: **Micro-injection:** Recombinant DNA is directly injected into the nucleus of an animal cell.

Biolistic: The cells are bombarded with high velocity microparticles of gold or tungsten coated with DNA. This method is suitable for plants.

Agrobacterium is the natural genetic engineer of plants.

181. Answer (4)

Hint: DNA fragments are negatively charged.

Sol.: Agarose gel electrophoresis is employed to check the progression of a restriction enzyme digestion.

Since DNA fragments are negatively charged molecules they can be separated by forcing them to move towards the positive electrode anode under an electric field.

182. Answer (1)

Hint: Exponential phase

Sol.: In continuous culture system, the used medium is drained out from one side while fresh medium is added from other to maintain the cells in their physiologically most active/exponential phase.

183. Answer (4)

Hint: Its metabolism is regulated by PTH in human body.

Sol.: Since DNA is a hydrophilic molecule, it cannot pass through cell membranes.

In order to force bacteria to take up the plasmid, the bacterial cells must first be made competent to take up DNA.

This is done by treating them with a specific concentration of a divalent cation such as calcium, which increases the efficiency with which DNA enters the bacterium through pores in its cell wall.

184. Answer (2)

Hint: Smoking is injurious

Sol.: It is being used to detect mutations in genes in suspected cancer patients too. Emphysema is not a genetic disorder.

185. Answer (2)

Hint: Intercalating agent is used in gel electrophoresis.

Sol.: The separated DNA fragments can be visualised only after staining the DNA with ethidium bromide called intercalating dye followed by exposure to UV rays.

In order to cut the DNA with restriction enzymes, it needs to be in pure form, free from other molecules. Since the DNA is enclosed within the membranes, we have to break the cell open to release DNA and other macromolecules like RNA, proteins and polysaccharides.

SECTION-B

186. Answer (1)

Hint: dsDNA doubles in each cycle.

Sol.: A single PCR reaction involves three temperature dependent steps i.e, denaturation, annealing and primer extension (polymerisation).

Denaturation: The starting reaction mixture is heated, usually at 94°C.

Annealing: The reaction mixture is quickly cooled to somewhere between 50°C and 60°C.

Primer extension : Sample is heated to 72°C.

It is possible to generate '2^n' molecules after 'n' number of cycles.

187. Answer (1)

Hint: Cell membrane is made up of bilipid layer.

Sol.: DNA is hydrophilic in nature.

Golden rice is a transgenic variety of rice with genes for synthesis of β-carotene taken from the temperate garden favourite daffodil (*Narcissus pseudonarcissus*).

188. Answer (4)

Hint: Causes tumor in plants

Sol.: *Agrobacterium tumefaciens* causes crown gall disease in plants.

It is a pathogen of several dicot plants and contains Ti-plasmid that has the ability to transform a normal cell into cancerous cell and hence called natural genetic engineer of plants.

189. Answer (1)

Hint: ELISA is used for early diagnosis of a disease.

Sol.: The first clinical gene therapy was given in 1990 to a 4 year old girl with adenosine deaminase deficiency.

ELISA is based on the principle of antigen-antibody interaction.

Bioreactors are chambers in which microorganisms are cultured in a liquid / solid medium.

Electroporation is a method of transformation.

190. Answer (3)

Hint: *Eco*R I is not present in the region of selectable marker.

Sol.: The restriction site of *Eco*R I is not present in amp^R and tet^R gene, so, the non-recombinants and recombinants both can grow in medium containing the antibiotics *i.e.*, ampicillin and tetracycline.

191. Answer (4)

Hint: Unique restriction site

Sol.: The vector needs to have very few, preferably single recognition sites for the commonly used restriction enzymes.

*Hin*d II is the first discovered restriction endonuclease.

192. Answer (3)

Hint: Replication starts from here

Sol.: Origin of replication is responsible for controlling the copy number of linked DNA.

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

Antibiotic resistance genes act as selectable marker.

193. Answer (1)

Hint: Same type of ends as that produced by *Bam* HI

Sol.: Some restriction enzymes cut the strand 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.

There are overhanging stretches called sticky ends or cohesive ends or staggered ends.

Some restriction enzymes such as *Sma* I cut the strand of DNA in the centre of palindrome. Such ends are called flush or blunt ends.

194. Answer (2)

Hint: Contains restriction sites *Pst* I and *Pvu* I

Sol.: Restriction sites for *Sal* I and *Bam*H I are present in tet^R gene in vector pBR322.

Recognition sequence of *Hin*d II is

5′ GT Py / Pu AC 3′

3′ CA Pu / Py TG 5′

Each restriction enzyme has a unique recognition site.

195. Answer (3)

Hint: Vitamin A

Sol.: In 1997, the first transgenic cow, Rosie, produced human protein enriched milk (2.4 gm/L).

Golden rice is a transgenic variety of rice with genes for synthesis of β-carotene taken from the Daffodil. It was created to combat vitamin-A deficiency.

Bt-toxin produced by *Bacillus thuringiensis* has been cloned in bacteria and been expressed in plants to provide resistance to insects.

196. Answer (3)

Hint: Gene therapy

Sol.: If the gene isolated from marrow cells producing ADA is introduced into cells at early embryonic stages, it could be a permanent cure.

197. Answer (1)

Hint: Related to 'Rosie'

Sol.: Mature insulin lacks 'C' polypeptide chain.

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

In 1997, an American company got patent rights on Basmati rice.

Human insulin is produced using *E. coli*.

198. Answer (3)

Hint: Direct method of transformation

Sol.: Glyphosate is a herbicide which is widely used by farmers and horticulturists.

PEG (polyethylene glycol) mediated gene transfer is a method of introducing DNA into plant protoplasts.

PEG is a compound which helps in protoplast fusion and foreign DNA to enter the host cell.

199. Answer (4)

Hint: It's abnormality in human body is indicative of liver damage.

Sol.: An insert is ligated to the vector in generating rDNA as the vector is prevented from self-ligation by treating it with alkaline phosphatase.

200. Answer (4)

Hint: More than one

Sol.: PCR is of immense value in generating abundant amount of DNA for analysis in the DNA fingerprinting.

In palaeontology: PCR is used to clone the DNA fragments from the mummified remains of humans and animals.

❑ ❑ ❑

All India Aakash Test Series for NEET - 2023

TEST - 4 (Code-B)

Test Date : 11/12/2022

ANSWERS

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

HINTS & SOLUTIONS

[PHYSICS]

SECTION-A

1. Answer (2)

Hint: $BE = \Delta mc^2$

Sol.: $BE = \left[ZM_P + (A-Z)M_n - M(A,Z)\right]c^2$

2. Answer (3)

Hint: Use $\frac{1}{2}mv^2 = \frac{1}{4\pi\varepsilon_0}\frac{(2e)(ze)}{d}$

Sol.: $d = \frac{4ze^2}{4\pi\varepsilon_0 mv^2}$

$d \propto ze^2$

$d \propto \frac{1}{m}$

$d \propto \frac{1}{v^2}$

3. Answer (3)

Hint and Sol.:

$${}_Z X^A \xrightarrow{\beta^-} {}_{Z+1}Y^A \xrightarrow{\alpha} {}_{Z-1}K^{*A-4} \xrightarrow{\gamma} {}_{Z-1}K^{A-4}$$

4. Answer (1)

Hint: $N = N_0\left(\frac{1}{2}\right)^{t/T_{1/2}}$

Sol.: $\frac{N}{N_0} = \left(\frac{1}{2}\right)^{t/T_{1/2}}$

$\frac{250}{2000} = \left(\frac{1}{2}\right)^{120/T_{1/2}}$

$\frac{1}{8} = \left(\frac{1}{2}\right)^{120/T_{1/2}}$

$\frac{120}{T_{1/2}} = 3 \Rightarrow T_{1/2} = 40 \text{ min}$

5. Answer (3)

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

Sol.: For Paschen series $n_1 = 3$ and $n_2 = 4, 5, 6\ldots$ the wavelengths of Paschen series lies in IR region.

6. Answer (2)

Hint and Sol.: Angular momentum is $L = \frac{nh}{2\pi}$.

7. Answer (4)

Hint: $E_n = -\frac{Z^2}{n^2}(13.6 \text{ eV})$

Sol.: $E_2 = -\frac{2^2}{2^2}(13.6 \text{ eV}) = -13.6 \text{ eV}$

$U_2 = 2E_2 = -13.6 \times 2 = -27.2 \text{ eV}$

8. Answer (1)

Hint: $E = \Delta mc^2$

Sol.: Given Δm = 10 amu

$E = (10 \text{ amu})c^2 = 10 \times 931.5 \text{ MeV}$

$= 9315 \text{ MeV}$

9. Answer (3)

Hint and Sol.: Mean nuclear density of nucleus is independent of mass number.

10. Answer (4)

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

Sol.: $\lambda = \frac{h}{mv} = \frac{h}{p} = \frac{h}{\sqrt{2m(E)}}$

Hence de Broglie wavelength 'λ' is independent of charge.

11. Answer (3)

Hint and Sol.: Photoelectric effect shows the particle nature of light.

12. Answer (4)

Hint: $\lambda_e = \frac{h}{\sqrt{2m(E)}}$ and $\lambda_P = \frac{hc}{E}$

Sol.: $E_e = \frac{h^2}{2m\lambda^2}$ and $E_P = \frac{hc}{\lambda}$

$\frac{E_P}{E_e} = \frac{(hc/\lambda)}{\left(\frac{h^2}{2m\lambda^2}\right)} = \frac{2m\lambda c}{h}$

13. Answer (2)

Hint: $\frac{1}{2}mv^2 = h\nu - \phi$

Sol.: $\frac{1}{2}mv_1^2 = h\nu_1 - \phi$

$\frac{1}{2}mv_2^2 = h\nu_2 - \phi$

$\frac{1}{2}m\left(v_1^2 - v_2^2\right) = h\left(\nu_1 - \nu_2\right)$

$v_1^2 - v_2^2 = \frac{2h}{m}\left(\nu_1 - \nu_2\right)$

14. Answer (3)

Hint and Sol.: The light having equal photon flux have same intensity *i.e.* same saturation photo current. *A* and *B* have same stopping potential *i.e.* they have same frequencies.

15. Answer (4)

Hint: $eV_s = h\nu - \phi$

Sol.: $V_s = \frac{h}{e}\nu - \frac{\phi}{e}$

16. Answer (2)

Hint: $\lambda = \frac{h}{mv} = \frac{h}{\sqrt{2m(\text{KE})}}$

Sol.: $\lambda \propto \frac{1}{\sqrt{m}}$ (As KE is same for both)

$\because m_\alpha > m_e$

$\therefore \lambda_\alpha < \lambda_e$

17. Answer (1)

Hint: Use $eV = \frac{hc}{\lambda} - \phi$

Sol.: $\frac{hc}{\lambda} = eV + \phi = (1 + 2.5)\text{ eV}$

$\lambda = \frac{12400}{3.5}\text{ Å} \approx 3543\text{ Å}$

18. Answer (1)

Hint: $P = \left(\frac{n}{t}\right)h\nu$

Sol.: $P = IA = 10^{-9} \times 6.6 \times 10^{-4} = 6.6 \times 10^{-13}\text{ W}$

$\left(\frac{n}{t}\right) = \frac{P}{h\nu} = \frac{6.6 \times 10^{-13}}{6.6 \times 10^{-34} \times 4 \times 10^{14}}$

$= \frac{10^7}{4} = 2.5 \times 10^6$ photons/s

19. Answer (3)

Hint: When both inputs *A* and *B* are low (0) or either of *A* or *B* is low (0) then current will flow through LED and output *Y* will be high (1). When both *A* and *B* are high (1) then output *Y* will be low (0) because no current will flow through LED.

Sol.: The truth table will be like

A	*B*	*Y*
0	0	1
0	1	1
1	0	1
1	1	0

$\Rightarrow$ NAND gate

20. Answer (1)

Hint and Sol.: For CE amplifier, output is out of phase with input (i.e. phase difference is 180°)

Current gain is maximum for common collector amplifier. $(\because \gamma = \beta + 1)$

21. Answer (2)

Hint: $A = A_1 \cdot A_2 .....$

$A|_{\text{dB}} = A_1|_{\text{dB}} + A_2|_{\text{dB}} + ...$

Sol.: $A|_{\text{dB}} = 10\text{ dB} + 10\text{ dB} + ...$

$= 100\text{ dB}$

22. Answer (3)

Hint: $E_g \le \frac{hc}{\lambda}$

Sol.: $\lambda \le \frac{hc}{E_g}$

$\Rightarrow \lambda_{\max} = \frac{hc}{E_g} \approx \frac{12400}{2}\text{ Å} \approx 6200\text{ Å}$

23. Answer (2)

Hint: In reverse biasing for $V_{R_L} \ge V_z$, the Zener diode becomes ON and V_{R_L} becomes equal to V_z.

Sol.: $V_{R_L} = \frac{1}{3} \times 15 = 5\text{ V}$

$V_{R_L} < V_Z \Rightarrow$ Zener diode remains OFF.

Hence V_L = 5 V.

24. Answer (4)

Hint: $A_V = \beta\frac{R_o}{R_i}$ and $A_P = A_V \times \beta$

Sol.: $\because g_m = \frac{I_C}{V_{BE}} \text{ or } \frac{I_o}{V_i}$

$\Rightarrow g_m = \frac{I_o}{I_i R_i} = \frac{\beta}{R_i}$

$\Rightarrow \beta = g_m R_i$

Also $A_V = \beta \frac{R_o}{R_i} = g_m R_i \times \frac{R_o}{R_i} = g_m R_o$

$A_P = \beta \cdot A_V = \beta \cdot \beta \frac{R_o}{R_i} = \beta^2 \frac{R_o}{R_i}$

25. Answer (1)

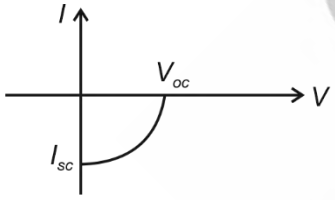
Hint and Sol.: All types of semiconductor are electrically neutral.

26. Answer (2)

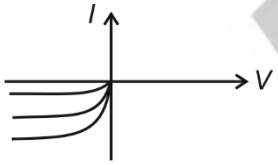
Hint and Sol.: If *p* side is at higher potential than *n* side of *p*-*n* junction, then the junction diode is said to be in forward bias.

27. Answer (4)

Hint and Sol.: I-*V* characteristics of solar cell is

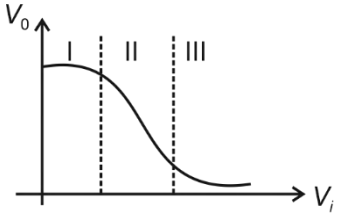


I-V characteristic of photodiode is



28. Answer (1)

Hint and Sol.: From transfer characteristics of CE amplifier.



Region I $\rightarrow$ As switch (OFF)

Region II $\rightarrow$ As an amplifier

Region III $\rightarrow$ As switch (ON)

29. Answer (4)

Hint and Sol.: Zener breakdown occurs in reverse biasing for heavily doped p-n junction, due to field emission of EHP. It is reversible process and Zener diode can be used as a voltage regulator.

30. Answer (4)

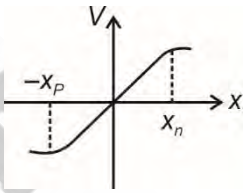
Hint: Oscillator utilizes positive feedback while amplifier utilises negative feedback.

Sol.: For positive feedback $A_{CL} = \frac{A_0}{1 - A_0 B}$

$\because \quad 1 - A_0\beta < 1 \qquad \therefore A_{CL} > A_0$

31. Answer (4)

Hint and Sol.: The variation of potential across the junction is best represented as



32. Answer (4)

Hint and Sol.: NAND and NOR gates are called universal gates because they can be combined to produce any of the other gate like OR, AND and NOT gates.

33. Answer (1)

Hint: $\sigma_i = e n_i (\mu_e + \mu_h)$

Sol.: $\sigma_i = 1.6 \times 10^{-19} \times 1.5 \times 10^{16} (0.145 + 0.05)$

$= 0.468 \times 10^{-3} \text{ S m}^{-1} \approx 4.7 \times 10^{-4} \text{ S m}^{-1}$

34. Answer (3)

Hint: $V_{CE} = V_{CC} - I_C R_C$

Sol.: In cut off mode $I_B = I_C = 0 \Rightarrow V_{CE} = V_{CC}$

35. Answer (2)

Hint: If $N_D >> n_i$, then $n_e \simeq N_D$

Sol.: $N_D = \frac{5 \times 10^{28}}{10^6} = 5 \times 10^{22} \text{ m}^{-3}$

$n_i = 1.5 \times 10^{16} \text{ m}^{-3}$

$\because N_D >> n_i$

$\therefore n_e \approx N_D = 5 \times 10^{22} \text{ m}^{-3}$

SECTION-B

36. Answer (3)

Hint: $E_n = -\frac{Z^2}{n^2}(13.6\text{ eV})$, $v_n = \frac{Z}{n}v_0$ and $r_n = \frac{n^2}{Z}r_0$

Sol.: $v_n \propto \frac{1}{n}$

$E_n \propto \frac{1}{n^2}$

$r_n \propto n^2$

37. Answer (2)

Hint and Sol.: Absorption lines are from ground state (n = 1) to higher states.

Hence line 1 and 2 will appear in absorption lines.

38. Answer (2)

Hint: Use $\lambda = \frac{h}{mv}$ and $v_y^2 = u_y^2 + 2gh$

Sol.: $v = \sqrt{v_x^2 + v_y^2}$

$v = \sqrt{400 + 2\times 10\times 60}$

$= 40$ m/s

$\lambda_0 = \frac{h}{m(20)}$ (Given)

$\lambda = \frac{h}{m(40)} = \frac{1}{2}\left[\frac{h}{m(20)}\right] = \frac{\lambda_0}{2}$

39. Answer (3)

Hint: $\lambda = \frac{h}{p}$ and $a = \frac{eE_0}{m_e}$

Sol.: $\vec{a} = +\frac{eE_0}{m_e}\hat{j}$

$\vec{v} = \vec{v}_0 + \vec{a}t = v_0\hat{j} + \left(\frac{eE_0 t}{m_e}\right)\hat{j}$

$\vec{v} = v_0\left(1 + \frac{eE_0 t}{m_e v_0}\right)\hat{j}$

$\lambda = \frac{h}{m_e v} = \frac{h}{m_e v_0\left(1 + \frac{eE_0 t}{m_e v_0}\right)} = \frac{\lambda_0}{\left(1 + \frac{eE_0 t}{m_e v_0}\right)}$

40. Answer (1)

Hint: Initial activity

$R_o = \lambda N_o$ and $T_{\frac{1}{2}} = \frac{\ln 2}{\lambda}$

Sol.: From the plot $\lambda_B > \lambda_A$ and $N_{o,A} = N_{o,B}$

$R_{o,A} < R_{o,B}$

Half life $T = \frac{\ln 2}{\lambda}$

$\Rightarrow T_A > T_B$

Mean life $\tau = \frac{1}{\lambda}$

$\Rightarrow \tau_A > \tau_B$

41. Answer (3)

Hint and Sol.: If energy is absorbed in a process then BE of products decreases and when energy is released in a process then binding energy increases.

42. Answer (3)

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

Sol.: For Lyman series n_1 = 1 and n_2 = 2, 3, 4…

For Balmer series n_1 = 2 and n_2 = 3, 4, 5…

For Paschen series n_1 = 3 and n_2 = 4, 5, 6…

For Brackett series n_1 = 4 and n_2 = 5, 6, 7…

43. Answer (2)

Hint: $\frac{1}{2}mv^2 = h\nu - h\nu_0$

Sol.: $\frac{1}{2}mv^2 = h2\nu_0 - h\nu_0 = h\nu_0$

$\frac{1}{2}mv'^2 = h(4\nu_0) - h\nu_0 = 3h\nu_0$

$\frac{v'^2}{v^2} = \frac{3h\nu_0}{h\nu_0} = 3$

$v' = \sqrt{3}\,v$

44. Answer (1)

Hint: For p-type semiconductor $n_e < n_h$

Sol.: From the energy band diagram, E_g = 1.1 eV

Fermi level is nearer to valence band and $n_h > n_e$ therefore semiconductor is of p-type.

$E_F - E_V < \frac{E_g}{2}$

Or $E_F - E_V < 0.55$ eV

In p-type semiconductor trivalent dopants are added.

45. Answer (1)

Hint: Diodes will be shorted in forward biasing and opened in reverse biasing

Sol.: Only diode D_2 will be ON while diodes D_1 and D_3 will be OFF

Hence $i = \frac{10}{100} = 0.1$ A

46. Answer (2)

Hint:

- Transistor becomes 'ON' in saturation region and OFF in cut off region.
- It is circuit of NOR gate.

Sol.: For both inputs $A = B = 0$, the transistors will be OFF and no current will flow through R and output Y is connected to V_{CC} i.e. Y is 1 (high). For all other combinations one or both transistors will be ON and current will flow through R and output Y will be low (0)

Hence $0 \rightarrow t_1 \Rightarrow A = 1, B = 1 \Rightarrow Y = 0$

$t_1 \rightarrow t_2 \Rightarrow A = 0, B = 1 \Rightarrow Y = 0$

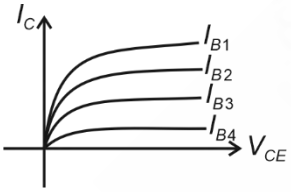
$t_2 \rightarrow t_3 \Rightarrow A = 1, B = 1 \Rightarrow Y = 0$

$t_3 \rightarrow t_4 \Rightarrow A = 0, B = 0 \Rightarrow Y = 1$

47. Answer (2)

Hint: For CE amplifier output voltage is taken across collector and emitter

Sol.: The *I-V* characteristics of CE amplifier is like



48. Answer (1)

Hint: Use $I_B = 10 i_b$ and KVL

Sol.: $i_c R_c = 2\,\text{V}$

$$i_c = \frac{2}{2\times10^3} = 1\,\text{mA}$$

$$i_b = \frac{i_c}{\beta} = \frac{1}{100}\,\text{mA}$$

$$I_B = 10 i_b = \frac{10}{100}\,\text{mA} = 0.1\,\text{mA}$$

Now for dc input loop

$V_{BB} - I_B R_B - V_{BE} = 0$

$2 - 0.1\times10^{-3} R_B - 0.6 = 0$

$$R_B = \frac{1.4}{0.1}\times10^3\,\Omega = 14\ \text{k}\Omega$$

49. Answer (1)

Hint: $\frac{N}{N_o} = e^{-\lambda t}$

Sol.: $t = \frac{T_{\frac{1}{2}}\ln(N_o / N)}{\ln 2}$

Now

$$t = \frac{T_{\frac{1}{2}}\ln\left(\frac{N_o}{N}\right)}{\ln 2} = \frac{5\times10^9\times\ln(1.6)}{\ln 2} \simeq 5\times10^9\times0.7$$

$\Rightarrow \quad t = 3.5\times10^9$ years

50. Answer (3)

Hint: $R = R_o e^{-\lambda t}$

Sol.: $\ln R = \ln R_o + \ln\left(e^{-\lambda t}\right)$

$\ln R = \ln R_o - \lambda t$

Similar to, $Y = C - mx$

Slope of line is $-m$ *i.e.* $(-\lambda)$

Now $m = \lambda = \frac{8}{200} = \frac{1}{25}\,\text{min}^{-1}$

$\lambda = 0.04\ \text{min}^{-1}$

[CHEMISTRY]

SECTION-A

51. Answer (1)

Hint: Antiseptics are applied to the living tissues such as wounds, cuts etc.

Sol.: Bithionol is added to soaps to impart antiseptic properties.

52. Answer (1)

Hint: Sucralose is stable at cooking temperature.

Sol.: Aspartame is used in cold food and soft drinks as it is unstable at cooking temperature.

53. Answer (3)

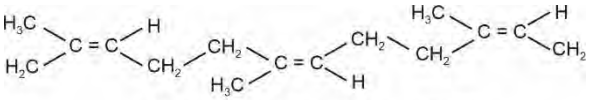
Hint: Antibiotics which are effective mainly against gram-positive or gram-negative bacteria are narrow spectrum antibiotics.

Sol.: Penicillin-G is a narrow spectrum antibiotic.

54. Answer (3)

Hint: Natural rubber is a linear polymer of 2-methyl –1, 3–butadiene.

Sol.:



Natural rubber or cis-1, 4-polyisoprene

55. Answer (4)

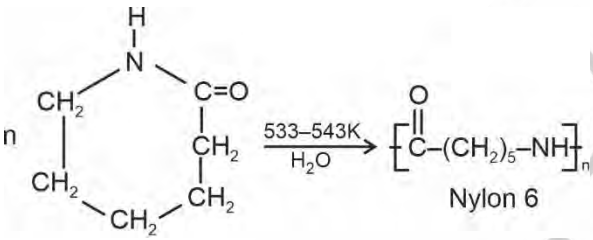
Hint: Some polyesters and polyamides are used as biodegradable polymers.

Sol.: Nylon 2–nylon–6 is a copolymer of glycine and amino caproic acid. It is a biodegradable polymer.

56. Answer (2)

Hint: Nylon 6 is a condensation polymer.

Sol.:



Nylon 6

57. Answer (3)

Hint and Sol.: During denaturation secondary and tertiary structures are destroyed but primary structure remains intact.

58. Answer (3)

Hint: Those isomers which only differ in configuration around C-1 carbon are called anomers.

Sol.: α-and β-forms of glucose only differ at C-1 carbon and are called anomers.

59. Answer (3)

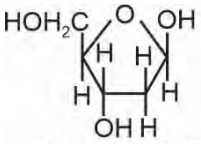
Hint: Vitamin A, D, E and K are fat soluble.

Sol.: B group vitamins and vitamin C are water soluble

60. Answer (2)

Hint: Complete hydrolysis of DNA yields a pentose sugar, phosphoric acid and nitrogen containing heterocyclic compounds.

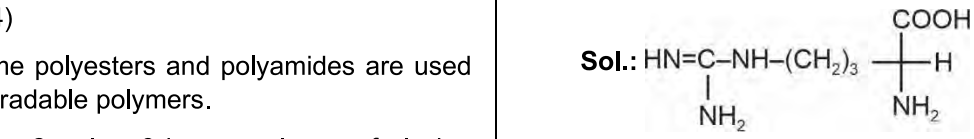
Sol.: Sugar moiety present in DNA molecule is β-D-2-deoxyribose.



β-D-2-deoxyribose

61. Answer (2)

Hint: The amino acid which contains more number of amino than carboxyl groups is basic amino acid.

Sol.: 

Arginine has more NH_2 groups so it a basic amino acid.

62. Answer (4)

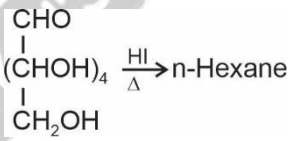
Hint: The amino acids, which cannot be synthesised in the body are known as essential amino acids.

Sol.: Alanine is a non-essential amino acid.

63. Answer (4)

Hint: Glucose has an aldehyde group. It is the monomer of cellulose and starch

Sol.:

- 
- Glucose does not form addition product with $NaHSO_3$.

64. Answer (4)

Hint: A carbohydrate that cannot be hydrolyzed further to give simpler unit of polyhydroxy aldehyde or ketone is called a monosaccharide

Sol.: Lactose + $H_2O \rightarrow$ glucose + galactose

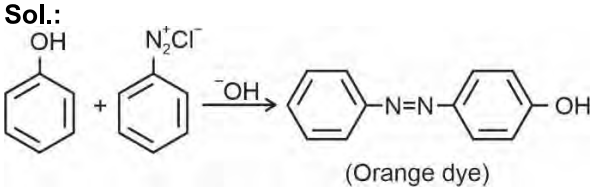
65. Answer (3)

Hint and Sol.: The Cl^-, Br^- and CN^- nucleophiles can easily be introduced in the benzene ring in presence of cuprous ion. This reaction is called Sandmeyer reaction.

66. Answer (4)

Hint: In alkaline medium phenol get ionised into phenoxide ion, so benzene ring is highly activated for electrophiles.

Sol.:



(Orange dye)

pH range should be 9 to 10

67. Answer (3)

Hint: Primary and secondary amines react with Hinsberg's reagent.

Sol.: $CH_3–NH–CH_3 + Cl–\underset{\underset{O}{\|}}{\overset{\overset{O}{\|}}{S}}–Ph \rightarrow Ph–\underset{\underset{O}{\|}}{\overset{\overset{O}{\|}}{S}}–\underset{\underset{CH_3}{|}}{N}–CH_3$

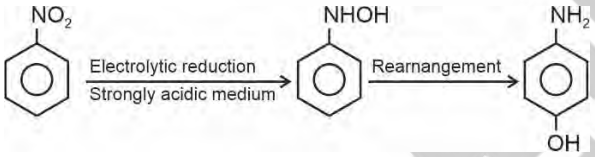
N, N–dimethylbenzene sulphonamide (Insoluble in alkali)

In the reaction of Hinsberg's reagent with secondary amines, N, N–dialkyl benzene–sulphonamide is formed, it does not contain any hydrogen atom attached to nitrogen, so insoluble in alkali.

68. Answer (3)

Hint: Electrolytic reduction of nitrobenzene in weakly acidic medium produces aniline.

Sol.:



69. Answer (4)

Hint: Aliphatic and aromatic primary amines on heating with chloroform and alkali form isocyanides which are foul smelling substances.

Sol.:

$$R-NH_2 + CHCl_3 \xrightarrow[\Delta]{KOH} \underset{\text{isocyanide}}{R-NC} + KCl + H_2O$$

The reaction is called carbylamine reaction.

70. Answer (2)

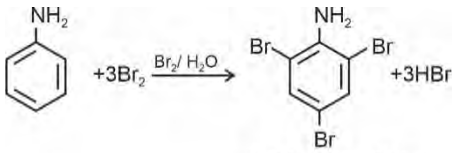
Hint: The compounds in which lone pair of electron on nitrogen atoms are delocalised are less available for protonation.

Sol.: Lone pair of electron of nitrogen in aniline is delocalised in the benzene ring hence it is less available for protonation. Aniline is least basic in nature.

71. Answer (3)

Hint: $–NH_2$ group is o, p directing for electrophilic substitution reactions as it exerts strong mesomeric effect (+R) to benzene ring

Sol.:

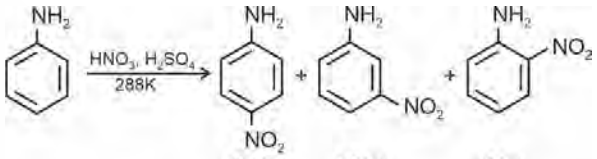


White precipitate

72. Answer (4)

Hint: NH_2 is ortho/para directing in nature towards electrophilic aromatic substitution reaction.

Sol.:



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

In the strongly acidic medium, aniline is protonated to form $–\overset{+}{N}H_3$ (anilinium ion) which is meta directing, so significant amount of meta derivative is also formed.

73. Answer (1)

Hint: $LiAlH_4$ reduces amides into primary amines.

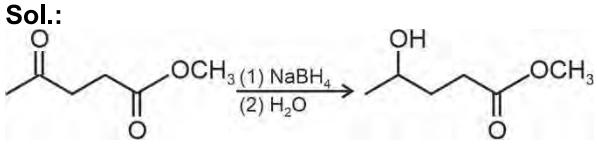
Sol.: $R–\underset{\underset{O}{\|}}{C}–NH_2 \xrightarrow[(2)\ H_2O]{(1)\ LiAlH_4} R–CH_2–NH_2$

74. Answer (3)

Hint: $NaBH_4$ reduces ketones but not esters.

While $LiAlH_4$ can reduce esters as well as ketones.

Sol.:

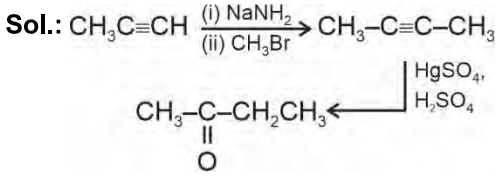


75. Answer (2)

Hint.:

- Terminal alkyne like propyne has an acidic hydrogen atom.
- Alkynes undergo hydrolysis in presence of Hg^{2+} ions

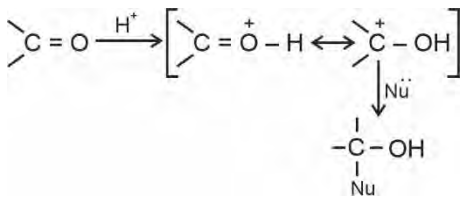
Sol.:



76. Answer (4)

Hint: Nucleophiles, such as ammonia and its derivatives, ($H_2N–Z$) add to >C=O group of aldehydes and ketones. The reaction is catalysed by acid.

Sol.:



77. Answer (4)

Hint : Aromatic aldehydes do not give positive Fehling reagent test

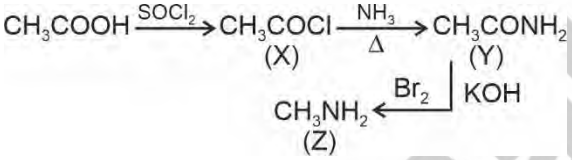
Sol.:

- Aliphatic aldehydes reduce both Tollens′reagent and Fehling's reagent
- Ketones do not reduce Tollens′ reagent or Fehling reagent.

78. Answer (2)

Hint: Primary amine is formed by treating an acid amide with bromine in an aqueous solution of KOH.

Sol.:



79. Answer (4)

Hint: Nitriles are reduced by DIBAL-H followed by hydrolysis to aldehydes.

Sol.:

a.	$>C=O \xrightarrow[HCl]{Zn–Hg} >CH_2$	Clemmensen reduction
b.	$>C=O \xrightarrow[(ii)\ KOH,\ \Delta]{(i)\ H_2NNH_2} >CH_2$	Wolff-Kishner reduction
c.	$-C\equiv N \xrightarrow[(ii)\ H_2O]{(i)\ DIBAL–H} -CHO$	Reduction by DIBAL–H
d.	$-COOH \xrightarrow[(ii)\ H_2O]{(i)\ LiAlH_4} -CH_2OH$	Reduction by $LiAlH_4$

80. Answer (1)

Hint: Electron withdrawing groups increases the acidity of the carboxylic acids.

Sol.: Correct order of acidic strength is as $CF_3COOH > HCOOH > C_6H_5COOH$

81. Answer (3)

Hint: Boiling points of aldehydes and ketones are higher than alkanes and lower than those of alcohols of similar molecular masses

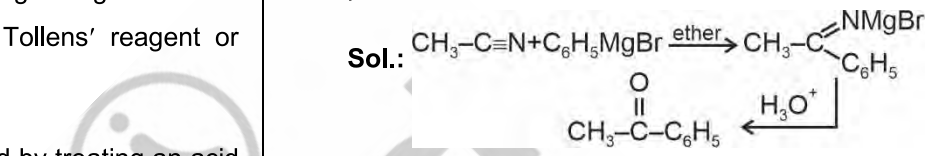
Sol.:

Molecule	B.P.
n-Butane	273
Proponal	322
Acetone	329
Propan-1–ol	370

82. Answer (3)

Hint: PhMgBr adds to $-C\equiv N$ forming an addition product.

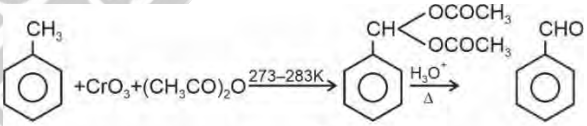
Sol.:



83. Answer (3)

Hint: Toluene is converted to benzylidene diacetate on treating with chromic oxide in acetic anhydride.

Sol.:



Benzylidene diacetate

84. Answer (3)

Hint: On passing alcohol vapours over heavy metal catalyst (like Cu or Ag), secondary alcohols give ketones.

Sol.:

$$(CH_3)_2CH-OH \xrightarrow{\text{Heated Ag}} CH_3-CO-CH_3+H_2$$

85. Answer (4)

Hint:

- 40% aq. solution of formaldehyde is called formalin.

Sol.:

- Fehling reagent comprises Fehling A and Fehling B. Fehling B is alkaline sodium potassium tartarate (Rochelle salt).
- Benzaldehyde undergo benzoin condensation reaction in presence of alcoholic KCN.

a. Formaldehyde → Formalin

b. Acetylsalicylic acid → Aspirin

c. Benzaldehyde → Benzoin (PhCH(OH)COPh)

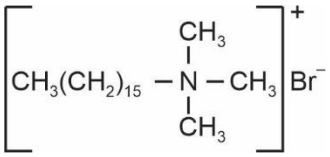
d. Rochelle salt → Fehling reagent (Fehling solution B which is alkaline sodium potassium tartarate)

SECTION-B

86. Answer (4)

Hint: Sodium salts of high fatty acids/sulphates are anionic detergents

Sol.: Cationic detergents are quaternary ammonium salts of amines with acetates, chlorides or bromides as anions



Cetyltrimethyl ammonium bromide

87. Answer (1)

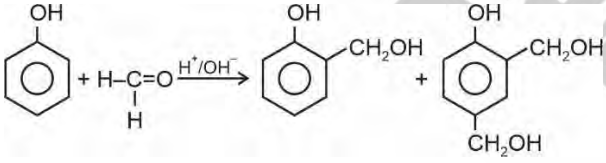
Hint: These are a type of tranquilizers.

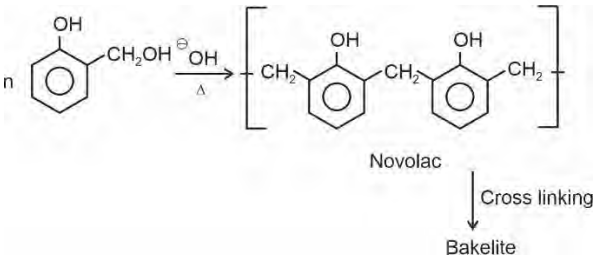
Sol.: Derivatives of barbituric acid are hypnotic *i.e.* sleep producing agents.

88. Answer (1)

Hint: One of the monomers of Bakelite is phenol.

Sol.:





89. Answer (3)

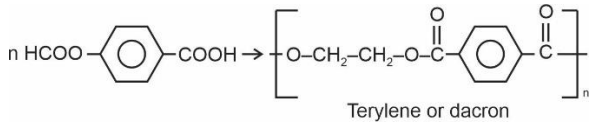
Hint and Sol.: Vulcanisation consists of heating a mixture of raw rubber with sulphur and an appropriate additive at a temperature range between 373 K to 415 K.

Sulphur forms cross links at the reactive sites of double bonds and thus the rubber gets stiffened.

90. Answer (2)

Hint: Dacron is the condensation product of dicarboxylic acids and diols.

Sol.: $nHO–CH_2–CH_2–OH+$



91. Answer (1)

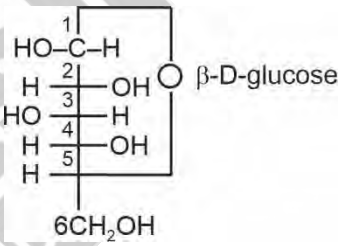
Hint: Xerophthalmia is hardening of cornea of eye

Sol.: Deficiency of vitamin A causes xerophthalmia.

92. Answer (2)

Hint: Glucose can form a six-membered ring in which –OH at C–5 can add to –CHO group and forms a cyclic hemiacetal structure thus, generates a new stereogenic centre.

Sol.:



β-D-glucose has 5 asymmetric carbon atoms.

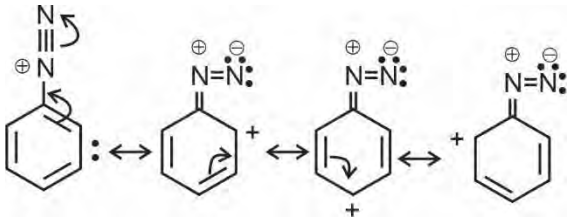
93. Answer (4)

Hint:

- Aliphatic diazonium salts are unstable, it liberate nitrogen gas and form alcohols.

Sol.:

Aromatic amines form stable diazonium salts, as there is partial double bond character between C and N due to its conjugation with the benzene ring.

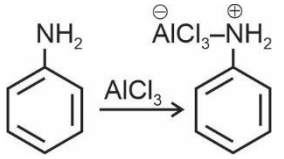


94. Answer (4)

Hint: Acid amides are very weak bases due to delocalisation of lone pair of electrons of Nitrogen.

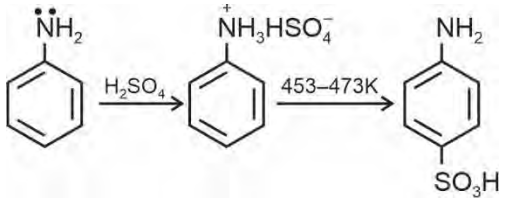
Sol.:

•



Deactivated ring due to presence of $-\overset{+}{N}H_2$ group.

•



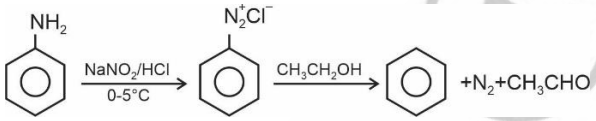
Sulphanilic acid

- Acid amides are very weak bases, they are acidic in nature as reacts with bases like NaOH.

95. Answer (3)

Hint: Mild reducing agents like H_3PO_2 or CH_3CH_2OH reduce diazonium salts to arenes.

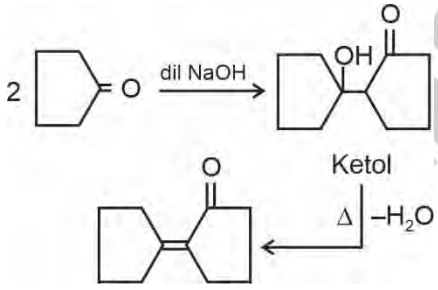
Sol.:



96. Answer (3)

Hint: Final product in aldol condensation is α, β-unsaturated carbonyl compounds.

Sol.:



97. Answer (3)

Hint: The carboxylic acids react with weaker bases such as hydrogen carbonates to evolve CO_2 gas.

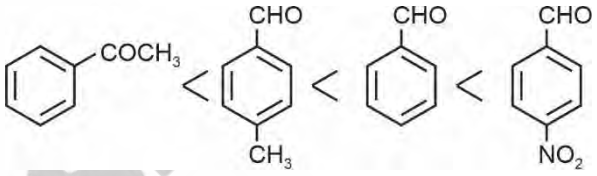
Sol.: $R–COOH+NaHCO_3 \rightarrow R–COO^- Na+H_2O+CO_2$

98. Answer (2)

Hint:

- Aldehydes are generally more reactive than ketones in nucleophilic addition reactions due to steric and electronic reasons.
- Presence of an electron withdrawing group at o, p-positions, increases the electrophilicity of carbonyl carbon.

Sol.: Correct order of nucleophilic addition for the given compounds is



99. Answer (4)

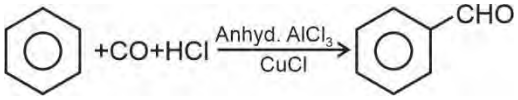
Hint: $SnCl_2$ in presence of HCl reduces cyanide.

Sol.: $R–CN+SnCl_2+HCl \longrightarrow R–CH=NH \xrightarrow[\text{imine}]{H_3O^+} R–CHO+NH_3$

100. Answer (2)

Hint: Electrophile in this reaction is formyl cation.

Sol.:



This reaction is called Gatterman-Koch reaction.

[BOTANY]

SECTION-A

101. Answer (1)

Hint: Historic convention of biological diversity was held at Rio de Janeiro, Brazil 1992.

Sol.: It is also known as Earth summit.

102. Answer (2)

Sol.: Kyoto protocol was committed to mitigate climate change. Bali action plan updated the Kyoto protocol.

103. Answer (3)

Hint: Montreal protocol became effective in 1989.

Sol.: Montreal protocol was signed at Montreal (Canada) in 1987 (effective in 1989) to control the emission of ozone depleting substances (ODS).

104. Answer (4)

Hint: Acid rain and its deposition damages foliage.

Sol.: It also damages growing point of plants.

105. Answer (4)

Sol.: Composition of waste water is as follows:

- Colloidal material: – Faecal matter, bacteria, cloth, etc.
- Dissolved material:- Nutrients, (nitrate, ammonia, phosphate, sodium, calcium)
- Suspended solids:– Sand, silt and clay.

106. Answer (1)

Hint: N_2O contributes least to total global warming.

Sol.: Relative contribution of various greenhouse gases to total global warming is as:

$CO_2 \rightarrow 60\%$, $CH_4 \rightarrow 20\%$,

CFCs $\rightarrow 14\%$, $N_2O \rightarrow 6\%$

107. Answer (3)

Hint: Intensity of noise is measured in terms of decibel (dB).

Sol.: Thickness of ozone in a column of air from ground to top of atmosphere is measured in terms of Dobson units (DU).

108. Answer (3)

Hint: In a terrestrial ecosystem, a much larger fraction of energy flows through the detritus food chain than through the GFC.

Sol.: In an aquatic ecosystem, GFC is the major conduit for energy flow.

109. Answer (1)

Hint: Ahmed khan was a plastic sack producer in Bangalore.

Sol.: Ahmed khan has managed to find the ideal solution to the ever increasing problem of accumulating plastic waste.

110. Answer (3)

Hint: The increased accumulation of toxic substances in the food chain at higher trophic level is called biological magnification.

Sol.: The order of decreasing concentration of BHC in the given organisms is

Fish eating bird > Large fish > Small Fish > Zooplanktons > Phytoplanktons

111. Answer (2)

Hint: Air pollutants coming directly from the pollution sources are called primary air pollutants.

Sol.: Ozone is a secondary air pollutant.

112. Answer (3)

Hint: Green muffler scheme is related to method of reducing noise pollution.

Sol.: Green muffler scheme involves planting trees such as Neem and Ashoka that absorb sound vibrations to a great extent.

113. Answer (4)

Sol.: Integrated organic farming allows maximum utilisation of resources and increases the efficiency of production.

114. Answer (1)

Hint: Polyblend is a fine powder of recycled modified plastic.

Sol.: Polyblend is an innovative remedy for plastic waste.

115. Answer (4)

Sol.: Kaziranga National Park is important for protection of Rhinoceros.

116. Answer (3)

Hint: Erosion control, aesthetic pleasure and oxygen supply are the broadly utilitarian services for conserving biodiversity.

Sol.: Fibre is the narrowly utilitarian service for conserving biodiversity.

117. Answer (2)

Hint: Food and firewood are narrowly utilitarian services.

Sol.: Pollination and flood control are broadly utilitarian services.

118. Answer (3)

Hint: Western ghat regions are found in Karnataka and Maharashtra

Sol.: Surguja and Chanda are found in Madhya Pradesh

119. Answer (2)

Hint: Natural or core zone comprises an undisturbed and legally protected ecosystem.

Sol.: The transition zone is the outermost part of biosphere reserve. It is an area of active cooperation between reserve management and the local people. The buffer zone surrounds the core area.

120. Answer (3)

Hint: Species richness is the number of species present within a unit area, while species evenness is the proportionate number of individuals of different species.

Sol.: Species diversity is the product of species richness and species evenness.

121. Answer (4)

Sol.: According to rivet popper hypothesis, an airplane is considered as an ecosystem, rivets as species and rivets on the wings as key species.

122. Answer (4)

Hint: 'X' is fungi

Sol.: Fungi are achlorophyllous and heterotrophic organisms.

123. Answer (3)

Sol.: According to IUCN (2004), the total number of plant and animal species described so far is slightly more than 1.5 million.

124. Answer (3)

Hint: Primary productivity is the rate at which biomass or organic matter is produced per unit area over a time period by plants or producers during photosynthesis.

Sol.: The following factors that affect primary productivity of ecosystem are:

(a) Photosynthetic capacity of producers
(b) Available solar radiations
(c) Soil moisture
(d) Availability of nutrients

- Diversity of herbivores does not affect primary productivity of an ecosystem.

125. Answer (4)

Hint: Decomposition of detritus is slow if it contains lignin, chitin, tannins (phenolics) and cellulose.

Sol.: Decomposition of detritus is rapid, if detritus possesses more of nitrogenous compounds (like, proteins, nucleic acids) and water-soluble reserve, carbohydrates or sugars.

126. Answer (4)

Hint: Humus is formed during the process of decomposition of detritus.

Sol.: Humus undergoes decomposition at an extremely slow rate.

127. Answer (4)

Hint: During ecological succession, gradual and fairly predictable changes are seen in the species composition of a given area.

Sol.: Humus content of soil increases w.r.t ecological succession.

128. Answer (2)

Hint: Secondary succession starts in area that somehow lost all the living organisms that existed there.

Sol.: Secondary succession occurs in areas such as abandoned farm lands, burned or cut forest.

129. Answer (3)

Hint: Ecological pyramids are graphical representations of various ecological parameters at the successive trophic levels of food chains with producers at the base, top carnivores at the apex and intermediate levels in between.

Sol.: Ecological pyramid does not accommodate a food web.

130. Answer (4)

Hint: Tertiary consumers are also called secondary carnivores.

Sol.: Tertiary consumers are the animals which feed on secondary consumers and constitute the fourth trophic level (T_4).

131. Answer (3)

Hint: Transfer of energy follows 10 percent law.

Plants capture only 2-10% of PAR or 1-5% of incident solar radiation.

Sol.: T_3 is primary carnivore.

Light energy

100 kcal

↓

Plants (T_1) → T_2 → T_3 → T_4

1000 cal 100 cal 10 cal 1 cal

132. Answer (2)

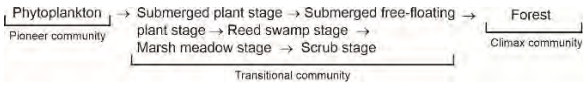
Hint: The amount of biomass is expressed in terms of kg m^{-2}.

Sol.: According to given question, the biomass of primary producers supports large standing crop of primary consumers. Therefore, the pyramid of biomass is inverted.

133. Answer (2)

Hint: The pioneer community is followed by a specific orderly sequence of series of plant communities known as seral or transitional communities.

Sol.: Sequence of various stages in hydrarch succession is



134. Answer (2)

Hint: Pyramid of energy is always upright.

Sol.: Pyramid of number in grassland ecosystem is upright. Pyramid of number in tree ecosystem and pyramid of biomass in aquatic ecosystem are inverted.

135. Answer (1)

Hint: Anthropogenic ecosystem is created and maintained by human beings.

Sol.: Anthropogenic ecosystem does not possess self-regulatory mechanism.

SECTION-B

136. Answer (3)

Sol.: National Forest policy (1988) of India has recommended 33% forest cover for the plains and 67% for the hills.

137. Answer (4)

Hint: Domestic sewage includes human faecal matter, animal waste and many dissolved organic compounds.

Sol.: Waste water from industries often contains toxic substances, notably heavy metals.

138. Answer (3)

Hint: Photochemical smog is formed in traffic – congested cities where warm conditions and intense solar radiations are present.

Sol.: London smog contains H_2S. Photochemical smog has mainly O_3, PAN and NO_X.

139. Answer (4)

Hint: e-wastes are irreparable computers, mobiles and other electronic goods.

Sol.: Recycling is the only solution for treatment of e-wastes.

140. Answer (4)

Hint: Incineration is a method of burning of solid wastes such as hospital wastes.

Sol.: Incineration is controlled aerobic combustion of solid wastes inside chambers of temperature of 850°C – 1000°C.

141. Answer (4)

Hint: In *ex-situ* conservation strategies, threatened animals and plants are taken out from their natural habitat and placed in special setting where they can be protected and given special care.

Sol.: Seed banks, wildlife safari parks and botanical garden are *ex-situ* conservation strategies of biodiversity.

142. Answer (3)

Sol.: The Evil Quartet refers to four major causes of biodiversity loss.

143. Answer (2)

Hint: Loss of biodiversity in a region may be due to co-extinction.

Sol.: Co-evolution is an interaction between two species. It does not lead to loss of biodiversity.

144. Answer (4)

Hint: On log scale, species – area relationship becomes linear and the equation is expressed as log S = log C + Z log A.

Sol.: $S = CA^Z$ represents species – area relationship in the form of rectangular hyperbolic curve.

145. Answer (2)

Hint: There are more than 40,000 plant species found in Amazonian rain forest.

Sol.: Following are the number of species in Amazonian rain forest:

Birds – 1300, Reptiles – 378, Amphibians – 427, Fishes – 3000.

146. Answer (1)

Sol.: Ten percent law of energy transfer was proposed by Lindeman.

147. Answer (2)

Hint: Auxiliary food chain is also called parasitic food chain

Sol.: Size of organisms finally reduces at higher tropic level in auxiliary food chain

148. Answer (2)

Sol: Primary productivity is expressed in terms of weight as (gm^{-2}) yr^{-1} and in terms of energy as (kcal m^{-2}) yr^{-1}.

149. Answer (2)

Hint: Energy flow, decomposition and productivity are functional aspects of ecosystem.

Sol.: Species composition and stratification are structural features of ecosystem.

150. Answer (1)

Hint: Primary producers constitute first trophic level (T_1).

Sol.: Primary producers are autotrophic organisms which fix up the solar energy and manufacture their own food from inorganic raw material. So, they form base of food chain.

[ZOOLOGY]

SECTION-A

151. Answer (2)

Hint: Intercalating agent is used in gel electrophoresis.

Sol.: The separated DNA fragments can be visualised only after staining the DNA with ethidium bromide called intercalating dye followed by exposure to UV rays.

In order to cut the DNA with restriction enzymes, it needs to be in pure form, free from other molecules. Since the DNA is enclosed within the membranes, we have to break the cell open to release DNA and other macromolecules like RNA, proteins and polysaccharides.

152. Answer (2)

Hint: Smoking is injurious

Sol.: It is being used to detect mutations in genes in suspected cancer patients too. Emphysema is not a genetic disorder.

153. Answer (4)

Hint: Its metabolism is regulated by PTH in human body.

Sol.: Since DNA is a hydrophilic molecule, it cannot pass through cell membranes.

In order to force bacteria to take up the plasmid, the bacterial cells must first be made competent to take up DNA.

This is done by treating them with a specific concentration of a divalent cation such as calcium, which increases the efficiency with which DNA enters the bacterium through pores in its cell wall.

154. Answer (1)

Hint: Exponential phase

Sol.: In continuous culture system, the used medium is drained out from one side while fresh medium is added from other to maintain the cells in their physiologically most active/exponential phase.

155. Answer (4)

Hint: DNA fragments are negatively charged.

Sol.: Agarose gel electrophoresis is employed to check the progression of a restriction enzyme digestion.

Since DNA fragments are negatively charged molecules they can be separated by forcing them to move towards the positive electrode anode under an electric field.

156. Answer (3)

Hint: Vectorless gene transfer

Sol.: **Micro-injection:** Recombinant DNA is directly injected into the nucleus of an animal cell.

Biolistic: The cells are bombarded with high velocity microparticles of gold or tungsten coated with DNA. This method is suitable for plants.

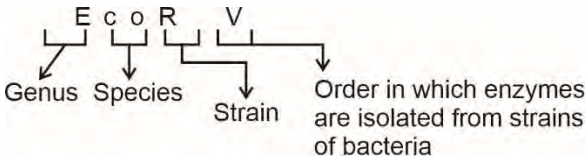
Agrobacterium is the natural genetic engineer of plants.

157. Answer (2)

Hint: 'R' stands for genetic variant

Sol.: The convention for naming the restriction enzymes is that the first letter comes from the name of genus and the second two letters come from the species of the prokaryotic cell from which they were isolated.

For example,



158. Answer (3)

Hint: The act of duplication

Sol.: 'rop' codes for the proteins involved in replication of the plasmid.

Selectable markers help in selection of recombinants and non-recombinants.

'Ori' is responsible for controlling the copy number of a linked DNA.

159. Answer (3)

Hint: Genes which make animals more sensitive to toxins are added to their genome.

Sol.: In chemical safety testing, transgenic animals are made that carry genes which make them more sensitive to toxic substances than non-transgenic animals.

Toxicity testing in such animals will allow us to obtain results in less time.

160. Answer (3)

Hint: Modern method of diagnosis

Sol.: Modern method of diagnosis like RDT, PCR and ELISA serve the purpose of early diagnosis.

Serum and urine analysis are traditional methods of diagnosis.

161. Answer (3)

Hint: Each restriction endonuclease has specific restriction site.

Sol.: If the *Hin*d II is used to cleave the genome from donor cell then the same restriction enzyme *i.e*, *Hin*d II has to be used to cleave the cloning vector.

Hence, the resultant strands will be complimentary to each other.

Only when the foreign DNA and vector DNA have complementary ends, they can be successfully ligated.

162. Answer (3)

Hint: 2^n copies are produced after 'n' number of cycles.

Sol.: PCR is a technique that exponentially amplifies DNA segment.

2^n copies of a DNA fragment are produced after 'n' number of PCR cycles.

So, after 10 PCR cycles, 2^{10} copies will produce from a single DNA fragment.

i.e, $2^{10} = 1024$

$\therefore$ From 2 DNA fragments after 10 PCR cycles, the number of copies produced = 1024×2

$= 2048$

163. Answer (2)

Hint: Rhyme with illusion

Sol.: The DNA fragments after the addition of chilled ethanol when precipitated can be removed by spooling.

164. Answer (2)

Hint: Nucleoside

Sol.: Gene therapy is a collection of methods that allows correction of a gene defect that has been diagnosed in a child/embryo.

The first gene therapy was given in 1990 to a 4 year old girl with ADA-deficiency.

165. Answer (3)

Hint: Fed batch culture is commonly used to produce penicillin.

Sol.: Ethidium bromide acts as an intercalating agent that stacks between base pairs of DNA and helps in visualizing them under UV light.

Ampicillin and tetracycline resistance genes are present in pBR322.

Continuous addition of sugars in fed batch fermentation is done to obtain antibiotics.

166. Answer (2)

Hint: Chronic disorder of lungs

Sol.: The first transgenic sheep to produce α-1-antitrypsin was Tracy.

Transgenic animals that produce useful biological products can be created by the introduction of the portion of DNA that codes for a particular product such as human protein (α-1-antitrypsin) used to treat emphysema.

167. Answer (1)

Hint: First cloned mammal

Sol.: Dolly, the sheep was the first animal (mammal) to be successfully cloned from an adult somatic cell.

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

168. Answer (4)

Hint: In world, the number is same as that of bones in each limb of humans.

Sol.: Recombinant therapeutics are therapeutic proteins produced by recombinant DNA technology.

They are safe and more effective drugs and do not induce unwanted immunological responses as is common in case of similar products isolated from non-human sources.

At present, about 30 recombinant therapeutics have been approved globally.

169. Answer (2)

Hint: Collection of the product

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

170. Answer (2)

Hint: β-galactosidase is not present in recombinant colonies.

Sol.: The presence of chromogenic substrate gives blue coloured colonies if the plasmid in the bacteria does not have an insert.

Presence of insert results in insertional inactivation of the β-galactosidase gene and the colonies do not produce any colour and are called recombinant colonies.

In pBR322, selection of recombinants is a cumbersome procedure because it requires simultaneous plating on two plates having different antibiotics.

171. Answer (3)

Hint: Control of aerobic conditions

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

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

172. Answer (3)

Hint: Phosphodiester bonds

Sol.: Restriction endonucleases cleave phosphodiester bonds.

Plasmid is an autonomously replicating circular extra-chromosomal DNA.

A normal *E.coli* do not carry resistance against antibiotics.

Gene encoding resistance to antibiotics is considered as selectable marker.

173. Answer (3)

Hint: More than total bones in our body

Sol.: Besides *Hin*d II, today we know more than 900 restriction enzymes that have been isolated from over 230 strains of bacteria each of which recognise different recognition sequences.

174. Answer (2)

Hint: Causative agent of typhoid

Sol.: The construction of the first rDNA emerged from the possibility of linking a gene-encoding antibiotic resistance with a native plasmid of *Salmonella typhimurium*.

Eli Lilly, an American company used *E.coli* as host to produce insulin chains.

Agrobacterium tumefaciens is the natural genetic engineer of plants.

The first restriction endonuclease characterized i.e, *Hin*d II was isolated from *Haemophilus influenzae*.

175. Answer (4)

Hint: More than one disease are correctly mentioned.

Sol.: Many transgenic animals are designed to increase our understanding of how genes contribute to the development of disease.

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

176. Answer (3)

Hint: Starts with formation of rDNA

Sol.: The correct sequence of given steps of RDT is (a) → (d) → (c) → (b)

i.e,

(i) Construction of a recombinant DNA molecule.

(ii) Transfer of rDNA into the host.

(iii) Culturing the host cells in a nutrient medium at a large scale.

(iv) Extraction of the desired product.

177. Answer (2)

Hint: Golden rice is enriched in vitamin A.

Sol.: Genetic modification has

(a) Made crops more tolerant to abiotic stresses

(b) Reduced reliance on chemical pesticides

(c) Helped in reducing post harvest losses

(d) Increased efficiency of mineral usage by plants

(e) Enhanced nutritional value of food

178. Answer (1)

Hint: Method of cellular defense in all eukaryotic organisms

Sol.: Interference prevents translation of the original mRNA.

Bioprocess engineering includes maintenance of sterile ambience in chemical-engineering process to enable growth of only the desired microbe/eukaryotic cell in large quantities.

179. Answer (2)

Hint: *cryIIAb* controls cotton bollworm

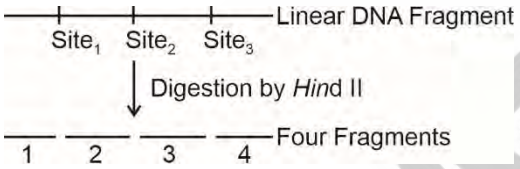
Sol.: The most Bt toxins are insect group specific.

The proteins encoded by the genes *cryIAc* and *cryIIAb* control the cotton bollworms, that of *cryIAb* controls corn borer.

180. Answer (2)

Hint: More than three

Sol.:



181. Answer (4)

Hint: Vectorless gene transfer

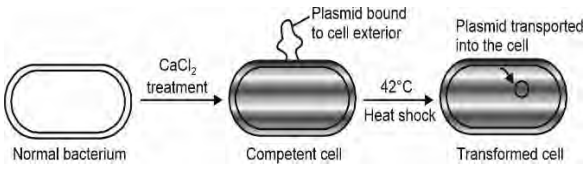
Sol.: Biolistics, electroporation and microinjection are included in direct method of gene transfer.

Retroviruses can be used as a vector to transfer functional ADA cDNA gene into the lymphocytes of a patient for the treatment of SCID.

182. Answer (3)

Hint: Temperature less than 50°C is used in heat shock method.

Sol.:



In PCR (Denaturation): Starting reaction mixture is heated usually to 94°C.

183. Answer (3)

Hint: Present in saliva

Sol.: It is important to break cell open for isolation of genetic material (DNA).

It can be achieved by treating bacterial cells, plant cells and fungus with lysozyme, cellulase and chitinase respectively.

Nuclease belongs to the class hydrolase and cleaves nucleic acids.

184. Answer (1)

Hint: Identify the bonds present between nitrogenous bases in DNA.

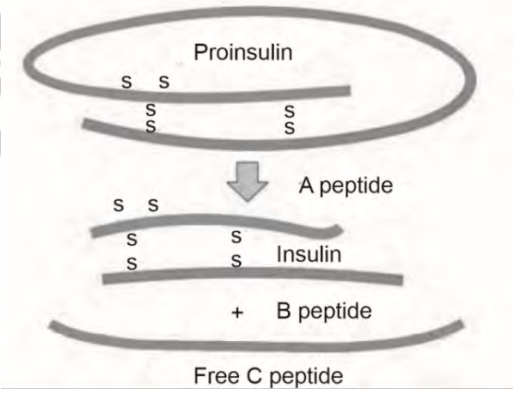
Sol.: The two polynucleotide strands are held together in their helical structure by hydrogen bonding between nitrogenous bases in opposing strands. Adenine and thymine form two hydrogen bonds. Guanine and cytosine form three hydrogen bonds.

In nucleic acids, phosphate group is attached to the hydroxyl group of sugar through ester bond.

185. Answer (4)

Hint: The number of disulphide bonds are same in proinsulin and insulin.

Sol.:



SECTION-B

186. Answer (4)

Hint: More than one

Sol.: PCR is of immense value in generating abundant amount of DNA for analysis in the DNA fingerprinting.

In palaeontology: PCR is used to clone the DNA fragments from the mummified remains of humans and animals.

187. Answer (4)

Hint: It's abnormality in human body is indicative of liver damage.

Sol.: An insert is ligated to the vector in generating rDNA as the vector is prevented from self-ligation by treating it with alkaline phosphatase.

188. Answer (3)

Hint: Direct method of transformation

Sol.: Glyphosate is a herbicide which is widely used by farmers and horticulturists.

PEG (polyethylene glycol) mediated gene transfer is a method of introducing DNA into plant protoplasts.

PEG is a compound which helps in protoplast fusion and foreign DNA to enter the host cell.

189. Answer (1)

Hint: Related to 'Rosie'

Sol.: Mature insulin lacks 'C' polypeptide chain.

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

In 1997, an American company got patent rights on Basmati rice.

Human insulin is produced using *E. coli*.

190. Answer (3)

Hint: Gene therapy

Sol.: If the gene isolated from marrow cells producing ADA is introduced into cells at early embryonic stages, it could be a permanent cure.

191. Answer (3)

Hint: Vitamin A

Sol.: In 1997, the first transgenic cow, Rosie, produced human protein enriched milk (2.4 gm/L).

Golden rice is a transgenic variety of rice with genes for synthesis of β-carotene taken from the Daffodil. It was created to combat vitamin-A deficiency.

Bt-toxin produced by *Bacillus thuringiensis* has been cloned in bacteria and been expressed in plants to provide resistance to insects.

192. Answer (2)

Hint: Contains restriction sites *Pst* I and *Pvu* I

Sol.: Restriction sites for *Sal* I and *Bam*H I are present in tet^R gene in vector pBR322.

Recognition sequence of *Hin*d II is

5′ GT Py / Pu AC 3′

3′ CA Pu / Py TG 5′

Each restriction enzyme has a unique recognition site.

193. Answer (1)

Hint: Same type of ends as that produced by *Bam* HI

Sol.: Some restriction enzymes cut the strand 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.

There are overhanging stretches called sticky ends or cohesive ends or staggered ends.

Some restriction enzymes such as *Sma* I cut the strand of DNA in the centre of palindrome. Such ends are called flush or blunt ends.

194. Answer (3)

Hint: Replication starts from here

Sol.: Origin of replication is responsible for controlling the copy number of linked DNA.

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

Antibiotic resistance genes act as selectable marker.

195. Answer (4)

Hint: Unique restriction site

Sol.: The vector needs to have very few, preferably single recognition sites for the commonly used restriction enzymes.

*Hin*d II is the first discovered restriction endonuclease.

196. Answer (3)

Hint: *Eco*R I is not present in the region of selectable marker.

Sol.: The restriction site of *Eco*R I is not present in amp^R and tet^R gene, so, the non-recombinants and recombinants both can grow in medium containing the antibiotics *i.e.*, ampicillin and tetracycline.

197. Answer (1)

Hint: ELISA is used for early diagnosis of a disease.

Sol.: The first clinical gene therapy was given in 1990 to a 4 year old girl with adenosine deaminase deficiency.

ELISA is based on the principle of antigen-antibody interaction.

Bioreactors are chambers in which microorganisms are cultured in a liquid / solid medium.

Electroporation is a method of transformation.

198. Answer (4)

Hint: Causes tumor in plants

Sol.: *Agrobacterium tumefaciens* causes crown gall disease in plants.

It is a pathogen of several dicot plants and contains Ti-plasmid that has the ability to transform a normal cell into cancerous cell and hence called natural genetic engineer of plants.

199. Answer (1)

Hint: Cell membrane is made up of bilipid layer.

Sol.: DNA is hydrophilic in nature.

Golden rice is a transgenic variety of rice with genes for synthesis of β-carotene taken from the temperate garden favourite daffodil (*Narcissus pseudonarcissus*).

200. Answer (1)

Hint: dsDNA doubles in each cycle.

Sol.: A single PCR reaction involves three temperature dependent steps i.e, denaturation, annealing and primer extension (polymerisation).

Denaturation: The starting reaction mixture is heated, usually at 94°C.

Annealing: The reaction mixture is quickly cooled to somewhere between 50°C and 60°C.

Primer extension : Sample is heated to 72°C.

It is possible to generate '2^n' molecules after 'n' number of cycles.

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