All India Aakash Test Series for NEET-2023

TEST - 6 (Code-C)

Test Date : 20/03/2022

ANSWERS

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

HINTS & SOLUTIONS

[PHYSICS]

SECTION - A

1. Answer (4)

Hint and Sol.:

- Heat flow automatically takes place from higher temperature towards lower temperature.
- Zeroth law defines temperature and concept of thermal equilibrium.

2. Answer (3)

Hint: $\Delta Q = \Delta U + \Delta W$ and $\Delta Q = 0$

Sol.: Adiabatic expansion of gas is at the cost of decrease in its internal energy, hence temperature falls.

3. Answer (3)

Hint: $\Delta Q = \Delta U + \Delta W$

Sol.: $\Delta V = 0$ $\quad \therefore \Delta W = 0$

$U_i = \frac{3P_0V_0}{2}$, $\quad U_f = \frac{9P_0V_0}{2}$

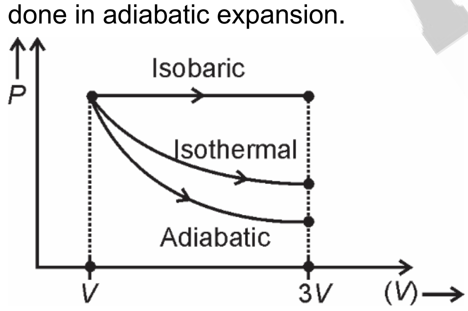
$\Delta Q = \Delta U + \Delta W$

$$\Delta Q = \left(\frac{9P_0V_0}{2} - \frac{3P_0V_0}{2}\right) + 0 = 3P_0V_0$$

4. Answer (2)

Hint: Work done is equal to area under PV diagram.

Sol.: When PV diagram is drawn, maximum area is under isobaric expansion and minimum under adiabatic expansion. Therefore minimum work is done in adiabatic expansion.



5. Answer (3)

Hint: For constant pressure

$\Delta W = P\Delta V = nR\Delta T$

$\Delta U = nC_v\Delta T$ and $\Delta Q = nC_p\,\Delta T$

Sol.: $\Delta U : \Delta W : \Delta Q$

$nC_v\Delta T : nR\Delta T : nC_p\Delta T$

$$\frac{C_v}{C_p} : \frac{R}{C_p} : 1 = \frac{1}{\gamma} : \frac{\gamma - 1}{\gamma} : 1$$

$\left(\text{given } \gamma = \frac{7}{5}\right)$

$$= \frac{5}{7} : \frac{\frac{7}{5} - 1}{\frac{7}{5}} : 1$$

$\Rightarrow$ 5 : 2 : 7

6. Answer (3)

Hint: PV^γ = constant for adiabatic process, PV = constant for isothermal process

Sol.: For isothermal process

$PV = P' \times 3V$

$P' = \frac{P}{3}$ ...(1)

Now for adiabatic process

$P' \times (3V)^\gamma = P'' \times (V)^\gamma$

$$P'' = \left(\frac{P}{3}\right) \times \left(\frac{3V}{V}\right)^\gamma = \frac{P}{3} \times (3)^{\frac{5}{3}} = P \times (3)^{\frac{5}{3} - 1}$$

$$= P \times (3)^{\frac{2}{3}}$$

7. Answer (3)

Hint: Heat loss = Heat gain

Heat required to melt m gram of ice = mL_f

Heat released in converting steam to water at 100ºC = $m \times L_v$

Sol.: Heat required to melt whole ice

= 1000 × 80 = 80,000 cal

Heat required to convert water from 0°C further to 100°C

= 1000 × 1 × 100 = 1,00,000 cal

Total heat required by ice to become 100°C water = 80,000 + 100000 = 1,80,000

Heat given by steam to reach 0°C water

= 200 × 540 + 200 × 1 × 100

= 1,08,000 + 20,000 cal

= 1,28,000 cal

So temperature reached is not 100ºC as steam can not give sufficient heat.

$\therefore$ Let common temperature be T

$1000 \times 80 + 1000 \times 1 \times (T - 0) = 200 \times 540 + 200 \times 1 \times (100 - T)$

$\Rightarrow$ 80,000 + 1000T = 1,08,000 + 20000 – 200T

$\Rightarrow$ 1200T = 48,000

T = 40ºC

8. Answer (2)

Hint: $PV = nRT$ and V = Constant, for closed rigid vessel

Sol.: V = Constant, then by gas equation

$$\frac{P_1}{T_1} = \frac{P_2}{T_2} \quad \text{(where } T \text{ is in kelvin)}$$

$$P_2 = P_1 + \frac{0.4}{100}P_1 = \left(1 + \frac{0.4}{100}\right)P_1$$

ΔT = 1°C $\therefore$ $T_2 = T_1 + 1$

$$\frac{P_1}{T_1} = \frac{\left(1+\frac{0.4}{100}\right)P_1}{(T_1+1)}$$

$$\frac{T_1+1}{T_1} = 1 + \frac{0.4}{100}$$

$$\frac{1}{T_1} = \frac{0.4}{100} \quad \therefore T_1 = \frac{100}{0.4} = 250 \text{ K}$$

9. Answer (3)

Hint: Mean free path length = $\lambda = \dfrac{1}{\sqrt{2}\pi d^2 xn}$

Sol.: $P = nKT \quad \therefore n = \dfrac{P}{KT}$

$$\lambda = \frac{KT}{\sqrt{2}\pi d^2 \times P}$$

$\therefore$ If T is constant, then

$$\lambda \propto \frac{1}{P}$$

$\lambda P = \lambda' \times 5P$

$$\therefore \lambda' = \frac{\lambda}{5}$$

10. Answer (4)

Hint: $V_{mp} = \sqrt{\dfrac{2RT}{M}}, \quad V_{av} = \sqrt{\dfrac{8RT}{\pi M}}$

Sol.: $\dfrac{V_{mp}}{V_{av}} = \sqrt{\dfrac{2RT}{M}} \times \sqrt{\dfrac{\pi M}{8RT}} = \sqrt{\dfrac{\pi}{4}} = \dfrac{\sqrt{\pi}}{2}$

11. Answer (2)

Hint: $\eta = \dfrac{\text{Work done in one cycle}}{\text{heat intake}}$

Sol.: Heat intake = $Q_1 + Q_3$ = 100 + 45 = 145 J

Heat rejected = (80 + 20) = 100 J

Work done in one cycle = heat intake – heat rejected

W = 145 J –100 J = 45 J

$$\eta = \frac{\text{Work}}{\text{heat intake}} = \frac{45}{145} = 0.31$$

$\therefore$ η = 31%

12. Answer (3)

Hint: By Wein's displacement law: $\lambda_m T$= constant

Sol.: $\lambda_{m_1} T_1 = \lambda_{m_2} T_2$

6500 × T_1 = 5200 × T_2

$$\frac{T_1}{T_2} = \frac{5200}{6500} = \frac{4}{5}$$

13. Answer (3)

Hint: $\dfrac{\Delta T}{\Delta t} = -k\left(T_{av} - T_0\right)$ where $T_{av} = \dfrac{T_1 + T_2}{2}$

Sol.: From 70°C to 60°C by Newton's cooling law

$$\frac{70-60}{t} = k[65-30] \quad \text{...(i)}$$

From 60 to 45°C

$$\frac{60-45}{t'} = k[52.5-30] \quad \text{...(ii)}$$

(now dividing Equations (i) and (ii))

$$\frac{t'}{t} \times \frac{10}{15} = \frac{35}{22.5}$$

$$t' = t \times \frac{15}{10} \times \frac{35}{22.5} = 6 \times 2.33 = 14 \text{ min}$$

14. Answer (1)

Hint: $U = nC_V T$; $v_{\text{rms}} = \sqrt{\dfrac{3RT}{M}}$

Sol.: $C_V = \dfrac{5R}{2}$ for diatomic gas

$\therefore$ N_2 and O_2 will have same internal energy since, $M_{O_2} > M_{N_2}$

$\therefore$ $v_{\text{rms}(O_2)} < v_{\text{rms}(N_2)}$

15. Answer (2)

Hint: $PV = nRT$

$$\therefore P = \frac{n}{V}RT = \frac{m}{M(V)}RT = \frac{\rho RT}{M}$$

Sol.: $\dfrac{P}{\rho} =$ slope of graph $= \dfrac{RT}{M}$

$\therefore \frac{P}{\rho} \propto T$ for a gas

$\therefore T_2 > T_1$

16. Answer (3)

Hint:

$\Delta Q = \Delta U + \Delta W$ and $\Delta W = 0$

$\Delta Q = nC_v \Delta T$

Sol.: $\Delta Q = \Delta U = nC_v \Delta T \quad (\Delta W = 0)$

$$\Delta Q = n \times \frac{R}{(\gamma - 1)} \times \Delta T = \frac{2 \times R}{\left(\frac{5}{3} - 1\right)} \times (380 - 280)$$

$$= \frac{2 \times 100R}{\frac{2}{3}}$$

$\Delta Q = 300R$

17. Answer (4)

Hint: COP = $\frac{\text{heat extracted}}{\text{work performed}}$

Sol.: COP = $\frac{Q_2}{W}$ where $W = Q_1 - Q_2$

$$\therefore \text{COP} = \frac{Q_2}{Q_1 - Q_2} \text{ or } 8 = \frac{300}{Q_1 - 300}$$

$8Q_1 - 2400 = 300$

$\therefore Q_1 = \frac{2700}{8} = 337.5$ J (heat rejected)

18. Answer (1)

Hint: $\vec{F} \propto -\vec{x}$ or $\vec{F} = -k\vec{x}$ (for SHM)

Sol.: For SHM, $\vec{F} \propto -\vec{x}$

$\therefore \vec{F} = -k\vec{x}$

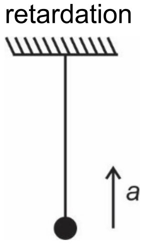
Graph F vs x is straight line with negative slope passing through origin

19. Answer (2)

Hint: Time period of pendulum.

$$T = 2\pi\sqrt{\frac{l_{\text{eff}}}{g_{\text{eff}}}}$$

Sol.: A pendulum in lift is moving down under retardation



$g_{\text{eff}} = g + a$

$$\therefore T = 2\pi\sqrt{\frac{L}{g_{\text{eff}}}} = 2\pi\sqrt{\frac{L}{g + \frac{g}{4}}} = 2\pi\sqrt{\frac{4L}{5g}}$$

$$T = 4\pi\sqrt{\frac{L}{5g}}$$

20. Answer (3)

Hint: If $x = A\sin\omega t + B\cos\omega t$, then its amplitude is $\sqrt{A^2 + B^2}$

Sol.: $x = 3\sin(2\pi t) + 4\cos(2\pi t)$

$$= \sqrt{3^2 + 4^2}\left[\sin(2\pi t) \times \frac{3}{\sqrt{3^2 + 4^2}} + \cos(2\pi t) \times \frac{4}{\sqrt{3^2 + 4^2}}\right]$$

$$x = 5\left[\sin 2\pi t \times \frac{3}{5} + \cos 2\pi t \times \frac{4}{5}\right]$$

$x = 5\sin(2\pi t + \phi)$ (S.H.M)

Where $\phi = \tan^{-1}\left(\frac{4}{3}\right)$

$A = 5$ cm, $T = \frac{2\pi}{\omega} = 1$ s

21. Answer (2)

Hint: For simple pendulum

$$T = 2\pi\sqrt{\frac{L}{g}}$$

Sol.: $T = 2\pi\sqrt{\frac{L}{g}}$

$$\therefore T^2 = \frac{4\pi^2}{g}L \Rightarrow T^2 \propto L$$

$\therefore T^2$ versus L graph will be straight line passing through origin

22. Answer (1)

Hint and Sol.:

$$y = 10\cos\left(2\pi t + \frac{\pi}{4}\right)$$

at $t = 2$ s

$$y = 10\cos\left(2\pi \times (2) + \frac{\pi}{4}\right)$$

$$= 10\cos\left(4\pi + \frac{\pi}{4}\right) = 10\cos\left(\frac{\pi}{4}\right)$$

$$y = 10 \times \frac{1}{\sqrt{2}} = 5\sqrt{2} \text{ m}$$

23. Answer (2)

Hint: $\because$ PE $= \frac{1}{2}Kx^2$, KE $= \frac{1}{2}K\left(A^2 - x^2\right)$

Sol.: Given PE = KE

$$\frac{1}{2}Kx^2 = \frac{1}{2}K\left(A^2 - x^2\right)$$

$x^2 = A^2 - x^2$

$\therefore 2x^2 = A^2$

$$x = \pm\frac{A}{\sqrt{2}}$$

24. Answer (2)

Hint: $T = 2\pi\sqrt{\frac{m}{K}}$ for oscillating spring pendulum

Sol.: $K = 180\ \frac{\text{N}}{\text{m}},\ m = 20$ kg

$$T = 2\pi\sqrt{\frac{m}{K}} = 2\pi\times\sqrt{\frac{20}{180}} = 2\pi\times\sqrt{\frac{1}{9}} = \frac{2\pi}{3}\text{ s}$$

25. Answer (2)

Hint and Sol.: The system in forced oscillations at resonance oscillates with frequency of applied force.

26. Answer (3)

Hint and Sol.: Total mechanical energy remains constant throughout so frequency of oscillations is zero.

27. Answer (1)

Hint: $v = \omega\sqrt{A^2 - x^2}$ and $a = -\omega^2 x$

Sol.: $x = 2\sqrt{2}$ cm, A = 4 cm

given $|a| = |v|$

$$\omega^2 x = \omega\sqrt{A^2 - x^2}$$

$$\omega^2 \times \left(2\sqrt{2}\right) = \omega\times\sqrt{(4)^2 - \left(2\sqrt{2}\right)^2}$$

$$\Rightarrow\ \omega\times 2\sqrt{2} = \sqrt{16 - 8}$$

$$\omega = \frac{2\sqrt{2}}{2\sqrt{2}} = 1\text{ rad s}^{-1}$$

$$T = \frac{2\pi}{\omega} = \frac{2\pi}{1} = 2\pi\text{ s}$$

28. Answer (2)

Hint: PE $= \frac{1}{2}Kx^2$, KE $= \frac{1}{2}K\left(A^2 - x^2\right)$

Sol.: At displacement x

PE $= \frac{1}{2}Kx^2$ [as x increases PE also increases]

KE $= \frac{1}{2}K\left(A^2 - x^2\right)$ [as x increases KE decreases.]

29. Answer (3)

Hint: $n' = n\times\frac{V_{so}}{V_{ss}}$

Sol.: If there is no relative motion between source and detector, then there is no change in frequency.

$$n' = n\times\frac{V_{SO}}{V_{SS}}$$

As $V_{SO} = V_{SS}$

$\therefore n' = n$

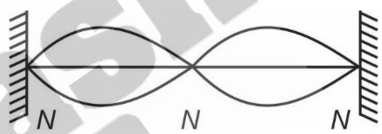
30. Answer (2)

Hint and Sol.: Particle of medium executes SHM with frequency of source. Hence, speed of particle varies from zero to maximum value and depends on amplitude and frequency of source.

31. Answer (3)

Hint: $V = n\lambda,\qquad n = \frac{V}{\lambda}$

Sol.: In second harmonic string vibrates in two loops.



$$\frac{\lambda}{2} + \frac{\lambda}{2} = L\quad \therefore \lambda = L$$

$\therefore \lambda$ = 1.50 m

32. Answer (4)

Hint: For two adjacent segments, particles are out of phase.

Sol.: Separation between two successive nodes and two successive antinodes is $\frac{\lambda}{2}$.

The speed of particle crossing equilibrium position in segments at different location is different due to their different amplitudes. Between any two adjacent segments particles are 180º out of phase.

33. Answer (1)

Hint: $a = \frac{g}{2}$ for wave climbing on a freely hanging string

Sol.: Speed of wave at distance x from lower end

$$V = \sqrt{\frac{T}{\mu}} = \sqrt{\frac{\mu g x}{\mu}} = \sqrt{gx}$$

$$\therefore a=\frac{dv}{dt}=\frac{d}{dt}\left(\sqrt{g}\sqrt{x}\right)=\sqrt{g}\cdot\frac{1}{2}\cdot\frac{1}{(x)^{\frac{1}{2}}}\cdot\frac{dx}{dt}$$

$$a=\frac{1}{2}\times\sqrt{g}\times\frac{1}{(x)^{\frac{1}{2}}}\times\sqrt{gx}=\frac{g}{2}$$

$$S=0\times t+\frac{1}{2}at^2$$

$$\therefore T=\sqrt{\frac{2S}{a}}=\sqrt{\frac{2\times L}{\frac{g}{2}}}$$

$$T=\sqrt{\frac{2\times 2\times L}{g}}=\sqrt{\frac{4\times 2.45}{9.8}}=1\text{ s}$$

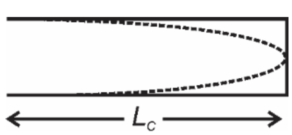
34. Answer (3)

Hint: Only odd harmonics are observed in closed organ pipe.

Sol.: f = 50 Hz, 150 Hz, 250 Hz

These are odd multiples of 50 Hz. Hence, organ pipe is closed at one end, with fundamental frequency of 50 Hz.

$$\frac{\lambda}{4}=L_C \qquad \therefore \lambda=4L_C$$



$$n=\frac{V}{\lambda}\Rightarrow 50=\frac{340}{4\times L_C}$$

$$4L_C=\frac{340}{50} \quad \therefore \quad L_C=\frac{340}{200}=1.7\text{ m}$$

35. Answer (1)

Hint and Sol.: At rigid end, wave is reflected with inverted amplitude.

The phase of wave after reflection from a rigid boundary changes by π radian.

SECTION - B

36. Answer (4)

Hint: $\Delta L=10\log\frac{I_2}{I_1}$ dB (in decibel)

Sol.: ΔL = 30 dB

$$\therefore \Delta L=10\log\frac{I_2}{I_1}$$

$$\frac{30}{10}=\log\left(\frac{I_2}{I_1}\right)$$

$$\therefore \frac{I_2}{I_1}=10^3=1000$$

37. Answer (3)

Hint: Due to slightly different source frequencies, beats are formed.

$n = n_2 - n_1$ where $n=\frac{v}{\lambda}$

Sol.: $n_1=\frac{v}{\lambda_1}$ and $n_2=\frac{v}{\lambda_2}$

And beats per second

$$n=n_1-n_2=\frac{v}{\lambda_1}-\frac{v}{\lambda_2}=\frac{v(\lambda_2-\lambda_1)}{\lambda_1\lambda_2}$$

$$\therefore v=\frac{n\times\lambda_1\lambda_2}{(\lambda_2-\lambda_1)}$$

38. Answer (1)

Hint: By principle of superposition:

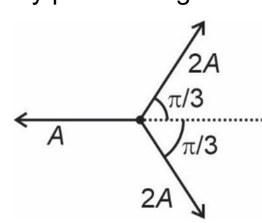
$y = y_1 + y_2 + y_3$: use phasor diagram for resultant amplitude.

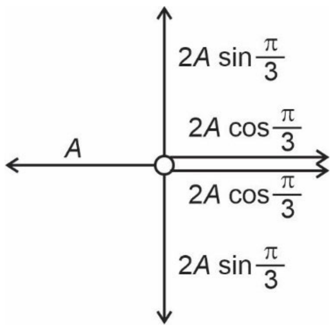
Sol.: $y_1=2A\sin\left(\omega t+\frac{\pi}{3}\right)$

$$y_2=2A\sin\left(\omega t-\frac{\pi}{3}\right)$$

$$y_3=A\sin(\omega t+\pi)$$

By phasor diagram





$\therefore\ R = 2A\cos\frac{\pi}{3} + 2A\cos\frac{\pi}{3} - A$

$= 2A \times \frac{1}{2} + 2A \times \frac{1}{2} - A$

$R = A + A - A = A$

39. Answer (1)

Hint: $n = \frac{1}{2l}\sqrt{\frac{T}{\mu}}$

Sol.: $n_1 = \frac{1}{2l_1} \times \sqrt{\frac{T}{\mu}}, \quad n_2 = \frac{1}{2l_2} \times \sqrt{\frac{T}{\mu}}$

$n_2 - n_1 = 2$ and $\frac{n_1}{n_2} = \frac{l_2}{l_1} = \frac{25}{30} = \frac{5}{6}$

$n_2 - \frac{5}{6}n_2 = 2$

$\frac{1}{6}n_2 = 2 \qquad \therefore n_2 = 12$ Hz

$n_2 - n_1 = 2$

$12 - n_1 = 2$

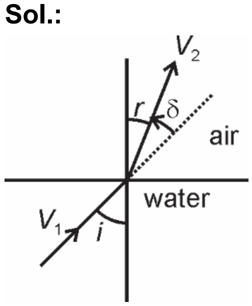
$\therefore\ n_1 = 10$ Hz

40. Answer (1)

Hint:

Velocity of sound in water is more than in air, so when ray travels from rarer (water) to denser (air) medium, it bends towards normal.

Sol.:



$\frac{\sin i}{\sin r} = \frac{V_1}{V_2} > 1$ (law of refraction)

$\therefore$ sin r < sin i

$\Rightarrow \angle r < \angle i$ It bends towards normal.

41. Answer (2)

Hint: There is an end correction because second resonance length is not 3 times the first-length.

Sol.:

$L_1 + e = \frac{\lambda}{4}$ (for 1st resonance)

$L_2 + e = \frac{\lambda}{4} + \frac{\lambda}{2}$ (for 2nd resonance)

$L_3 + e = \frac{\lambda}{4} + \frac{\lambda}{2} + \frac{\lambda}{2}$ (for 3rd resonance)

$\Rightarrow \quad L_2 - L_1 = \frac{\lambda}{2}$

and, $L_3 - L_2 = \frac{\lambda}{2}$

$\Rightarrow L_2 - L_1 = L_3 - L_2$

$53 - 17 = L_3 - 53$

$L_3 = 53 - 17 + 53 = 89$ cm

42. Answer (4)

Hint:

$n_1 : n_2 : n_3 = \frac{1}{l_1} : \frac{1}{l_2} : \frac{1}{l_3}$

Sol.:

$4 : 3 : 2 = \frac{1}{l_1} : \frac{1}{l_2} : \frac{1}{l_3}$

$l_1 : l_2 : l_3 = \frac{1}{4} : \frac{1}{3} : \frac{1}{2}$

$l_1 : l_2 : l_3 = 3 : 4 : 6$

43. Answer (4)

Hint:

$T V^{\gamma-1}$ = const.

Sol.: $T \times \left(\frac{m}{\rho}\right)^{\gamma-1} = \text{constant}$

$T \propto (\rho)^{\gamma-1}$

or $\rho \propto (T)^{\frac{1}{\gamma-1}}$

given $\rho \propto T^3$

$\therefore 3 = \frac{1}{\gamma - 1}$

$\therefore \gamma - 1 = \frac{1}{3}$

$\gamma = \frac{4}{3}$

Since $\gamma = 1 + \frac{2}{f}$

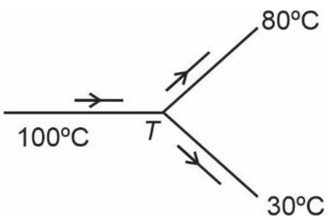
$1 + \frac{2}{f} = \frac{4}{3}$ or $\frac{2}{f} = \frac{1}{3}$ or $f = 6$

44. Answer (3)

Hint: Rate of heat flow = $\frac{\Delta T}{R}$

Where $R = \frac{l}{KA}$ (Thermal resistance)

Sol.:



$\frac{dH_1}{dt} = \frac{dH_2}{dt} + \frac{dH_3}{dt}$ T = junction temperature

$\frac{100-T}{R_1} = \frac{T-80}{R_2} + \frac{T-30}{R_3}$ ($R_1 = R_2 = R_3 = R$)

$100 - T = T - 80 + T - 30$

$100 + 80 + 30 = 3T$

$3T = 210$

$\therefore T = 70ºC$

45. Answer (1)

Hint and Sol.: Laplace corrected Newton's formula on velocity of sound in gases by saying that sound propagation through gases is an adiabatic process, rather than an isothermal process thought by Newton.

46. Answer (3)

Hint: Time period of spring pendulum $T = 2\pi\sqrt{\frac{m}{k}}$

Sol.: In first case $T = 2\pi\sqrt{\frac{m}{k}}$ ...(i)

In second case $T' = 2\pi\sqrt{\frac{m+2}{k}}$ ...(ii)

dividing equations

$\frac{3}{2} = \frac{\sqrt{m+2}}{\sqrt{m}} \Rightarrow \frac{9}{4} = \frac{m+2}{m} \quad \left(\because \frac{T'}{T} = \frac{3}{2}\right)$

$9m = 4m + 8 \Rightarrow 5m = 8$ or $m = 1.6$ kg

47. Answer (3)

Hint: $T = 2\pi\sqrt{\frac{L}{g_{\text{eff}}}}$ and for length comparable to radius of earth $T = 2\pi\sqrt{\frac{1}{g\left(\frac{1}{L}+\frac{1}{R}\right)}}$

Sol.: In a liquid, upthrust acts against gravity, restoring force decreases and period increases.

$T = 2\pi\sqrt{\frac{L}{g\left(1-\frac{d}{d_B}\right)}}$

here d is density of liquid and d_B is density of bob

- In moving lift as it is accelerating upwards

$T = 2\pi\sqrt{\frac{L}{(g+a)}}$, it will decrease.

- For pendulum $L = R_e$

$\therefore T = 2\pi\sqrt{\frac{1}{g\left(\frac{1}{R_e}+\frac{1}{R_e}\right)}} = 2\pi\sqrt{\frac{R_e}{2g}} = 1$ hour

On curved track $T = 2\pi\sqrt{\frac{l}{\sqrt{(g)^2 + \left(\frac{v^2}{r}\right)^2}}}$

it will decrease.

48. Answer (1)

Hint: $v = \frac{\omega}{k}$

Sol.: $y = 1.5\sin(328t - 4.27x)$

$\omega = 328$ rad/s, $k = 4.27$ cm^{-1}

$v = \frac{\omega}{k} = \frac{328}{4.27} = 76.8$ cm s^{-1}

49. Answer (1)

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

Sol.: The distance between particles

$\Delta x = \left(\frac{\lambda}{2} - \frac{\lambda}{8}\right) + \frac{\lambda}{4} = \frac{5\lambda}{8}$

$\Delta\phi = \frac{2\pi}{\lambda}\cdot\Delta x = \frac{2\pi}{\lambda}\cdot\frac{5\lambda}{8} = \frac{10\pi}{8} = \frac{5\pi}{4}$ rad

50. Answer (2)

Hint: $f_C = \frac{v}{4L_C}$ and $f_o = \frac{v}{2L_O}$

Sol.: 2nd overtone of open pipe $= \dfrac{3v}{2L_O}$

2nd overtone of closed pipe $= \dfrac{5v}{4L_C}$

Given two frequencies are unison

$$\frac{3v}{2L_O} = \frac{5v}{4L_C} \quad \therefore \frac{L_C}{L_O} = \frac{10}{12} = \frac{5}{6}$$

[CHEMISTRY]

SECTION - A

51. Answer (3)

Hint and Sol.: Quartz crystals are extensively used as piezoelectric material used to develop accurate clocks.

52. Answer (4)

Hint: Due to poor screening effect of $3d^{10}$ electrons the size of Ga is less than Al.

Sol.: On moving down the group, for each successive member one extra shell of electrons is added therefore atomic radius is expected to increase.

Element	B	Al	Ga	In
Atomic radii (in pm)	88	143	135	167

53. Answer (3)

Hint: Boron cannot expand its octet due to absence of *d*-orbital.

Sol.:

- Six large chloride ions cannot be accommodated around Si^{4+} due to limitation of its size, so $[SiCl_6]^2$ is not known
- BCl_3 being covalent in nature gets hydrolysed in water to form $[B(OH)_4]^-$.

54. Answer (1)

Hint: Due to Inert pair effect stability of lower oxidation state increases down the group.

Sol.: Order of stability of +1 oxidation state

Al < Ga < In < Tl

55. Answer (2)

Hint: Diborane undergoes cleavage reactions with Lewis bases to give borane adducts.

Sol.: B_2H_6 is an electron deficient species. Two bridge bonds are 3-centre-2-electron bonds or banana bonds.

56. Answer (4)

Hint: Reaction of ammonia with diborane gives initially $B_2H_6 \cdot 2NH_3$.

Sol.:

$$3B_2H_6 + 6NH_3 \longrightarrow \underset{(A)}{3\left[BH_2(NH_3)_2\right]^+\left[BH_4\right]^-} \xrightarrow{\Delta} \underset{\text{(Inorganic benzene)}}{2B_3N_3H_6} + 12H_2$$

57. Answer (3)

Hint: Formula of borax is $Na_2[B_4O_5(OH)_4]\cdot 8H_2O$.

Sol.: Borax is a salt of strong base NaOH and weak acid H_3BO_3 therefore on hydrolysis its solution is alkaline in nature.

$Na_2B_4O_7 + 7H_2O \longrightarrow 2NaOH + 4H_3BO_3$

58. Answer (2)

Hint & Sol.:

- CO is stable as carbon can form $p\pi - p\pi$ stable bonds with oxygen.
- SiO only exist at higher temperature.

59. Answer (4)

Hint & Sol.:

Elements	Si	Ge	Sn	Pb
Electronegativity (on Pauling scale)	1.8	1.8	1.8	1.9

60. Answer (2)

Hint: Fullerenes are cage like molecules.

Sol.: Fullerenes are the only pure form of carbon because they have smooth structure without having ‘dangling bonds.

61. Answer (3)

Hint: On small scale pure CO is prepared by dehydration of formic acid with concentrated H_2SO_4 at 373 K.

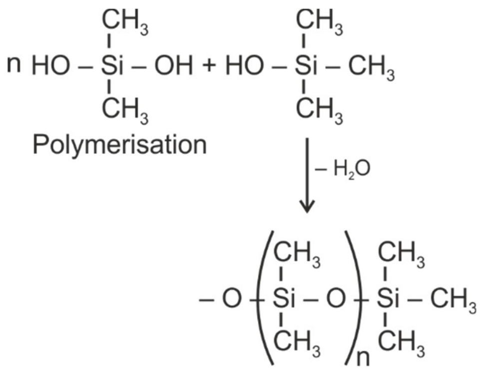
Sol.: On commercial scale CO is prepared by passage of steam over hot coke.

$$C(s) + H_2O(g) \xrightarrow{473-1273\text{ K}} \underbrace{CO(g) + H_2(g)}_{\text{Water gas}}$$

62. Answer (3)

Hint: Monohydroxy silicones are used to control chain length of silicones polymer.

Sol.: The chain length of the silicon polymer can be controlled by adding $(CH_3)_3SiCl$ which on hydrolysis gives $(CH_3)_3SiOH$ that blocks the ends of polymer chain.



Silicone

63. Answer (4)

Hint: Bead of $Co(BO_2)_2$ is formed.

Sol.: When borax is heated in a Bunsen burner flame with CoO on a loop of platinum wire it forms $Co(BO_2)_2$ bead which is of blue colour.

64. Answer (2)

Hint: Mixture of CO + H_2 is water gas.

Sol.: Mixture of CO and N_2 gases is known as producer gas.

65. Answer (4)

Hint: Heat of formations of coke, coal and diamond are non-zero.

Sol.: Graphite is thermodynamically most stable allotrope of carbon and its $\Delta_f H°$ is taken as zero.

66. Answer (4)

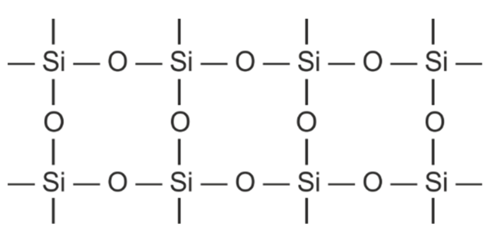
Hint: Lesser is the electron density of boron, stronger is its Lewis acid strength.

Sol.: Extent of back bonding decreases from BF_3 to BI_3 therefore the Lewis acidic character increases from BF_3 to BI_3.

67. Answer (3)

Hint: In SiO_2, each Si atom is covalently bonded in a tetrahedral manner to four oxygen atoms.

Sol.: Structure of SiO_2



$\therefore$ Three dimensional structure of SiO_2 has eight membered rings.

68. Answer (3)

Hint: C, Si and Ge are not affected by water.

Sol.: Tin decomposes steam to form dioxide and dihydrogen gas.

$$Sn + 2H_2O \xrightarrow{\Delta} SnO_2 + 2H_2$$

69. Answer (4)

Hint: Water vapour causes greenhouse effect.

Sol.: N_2O and CO_2 cause greenhouse effect while CO does not cause any greenhouse effect.

70. Answer (4)

Hint: Classical smog is a mixture of smoke, fog and sulphur dioxide.

Sol.: Photochemical smog contains nitrogen oxides.

71. Answer (2)

Hint and Sol.: Bloom infested water inhibits the growth of other living organisms in the water body. This process in which nutrient enriched water bodies support a dense plant population, which kills animal life by depriving it of oxygen and results in subsequent loss of biodiversity is known as eutrophication.

72. Answer (3)

Hint: Methemoglobinemia is 'blue baby' syndrome.

Sol.: Excess nitrate in drinking water can cause methemoglobinemia.

73. Answer (3)

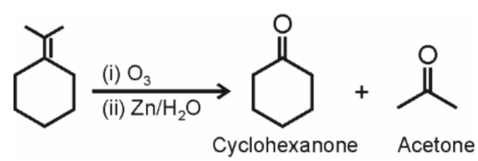
Hint: Chlorine gas was used earlier for bleaching paper.

Sol.: Nowadays, hydrogen peroxide (H_2O_2) with suitable catalyst (which promotes the bleaching action of hydrogen peroxide) is used.

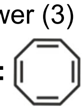
74. Answer (2)

Hint: Double bond are cleaved and carbonyl compounds are obtained during ozonolysis.

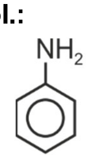
Sol.:



75. Answer (3)

Hint:  has tub shaped like structure.

Sol.:

• 

→ Planar
→ Homocyclic
→ Aromatic

-  → Non planar → Homocyclic → Non aromatic
-  → Planar → Heterocyclic → Aromatic
-  → Planar → Homocyclic → Antiaromatic

76. Answer (1)

Hint: Al_2O_3 is amphoteric in nature.

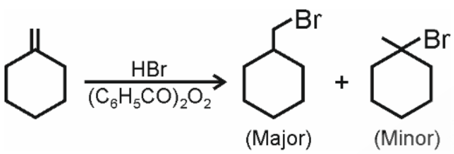
Sol.:

- B_2O_3 is acidic in nature
- In_2O_3 and Tl_2O_3 are basic in nature.

77. Answer (1)

Hint: HBr in presence of benzoyl peroxide with unsymmetrical alkenes gives anti Markovnikov addition product

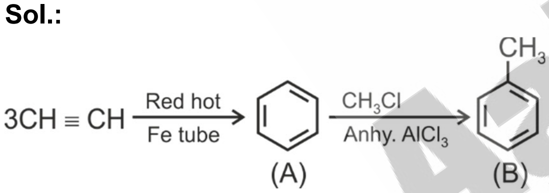
Sol.:

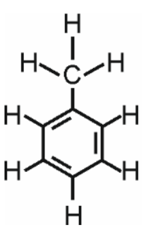


78. Answer (3)

Hint: Acetylene gives benzene on passing through red hot iron tube.

Sol.:

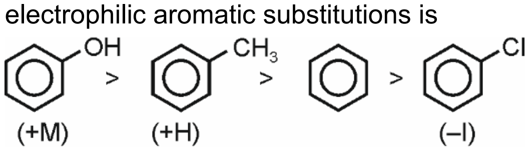


 contains 15 σ bonds.

79. Answer (4)

Hint: Greater is the electron density on the ring, greater is its reactivity towards electrophilic aromatic substitution.

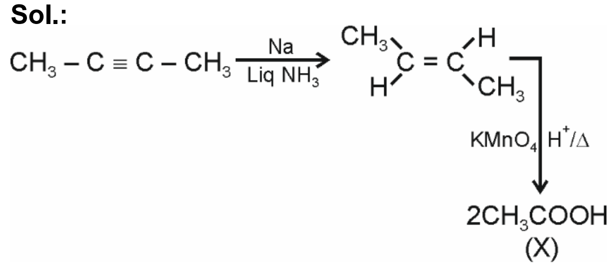
Sol.: Correct order of reactivity towards electrophilic aromatic substitutions is



80. Answer (4)

Hint: Partial hydrogenation of alkynes takes place with Na in liquid NH_3.

Sol.:



81. Answer (3)

Hint: *sp* hybridised carbon forms two sigma and two pi bonds.

Sol.: $\underset{1}{CH_3} - \overset{sp^2}{\underset{2}{CH}} = \underset{3}{CH} - \underset{4}{CH} = \overset{sp}{\underset{5}{C}} = \underset{6}{CH_2}$

- C-2 sp^2 hybridised.
- C-5 is *sp* hybridised.

82. Answer (4)

Hint: – $NHCOCH_3$ group is activating group.

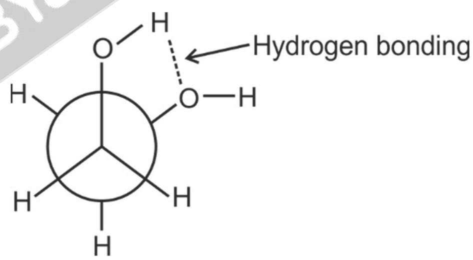
Sol.:

- $-NHCOCH_3$, –OH, $-NH_2$ are electron donating groups therefore these are ring activating groups.
- $-NO_2$ is an electron withdrawing group therefore it is ring deactivating group.

83. Answer (2)

Hint: Hydrogen bonding stabilizes gauche form of Ethane-1, 2-diol.

Sol.:



Gauche form of Ethane-1, 2-diol is most stable due to hydrogen bonding.

84. Answer (3)

Hint: Negative charge is more stable on *sp* hybridised carbon than sp^2 or sp^3 hybridised carbon.

Sol.: Acidic strength order.

$CH \equiv CH > CH_3 - C \equiv CH > CH_2 = CH_2 > CH_3 - CH_3$

85. Answer (4)

Hint: $2CH_4 + O_2 \xrightarrow{Cu/523K/100\ atm} \underset{\text{Methanol}}{2CH_3OH}$

Sol.:

- $CH_4 + O_2 \xrightarrow[\Delta]{Mo_2O_3} \underset{\text{Methanal}}{HCHO} + H_2O$
- $2CH_3CH_3 + 3O_2 \xrightarrow[\Delta]{(CH_3COO)_2Mn} \underset{\text{Ethanoic acid}}{2CH_3COOH} + 2H_2O$
- $CH_4 + H_2O \xrightarrow[\Delta]{Ni} CO + 3H_2$

SECTION - B

86. Answer (2)

Hint: Formation of triozonide indicates the three double bonds in benzene.

Sol.: Formation of only one monosubstituted derivative which indicates that all six carbon and six hydrogen atoms of benzene are identical.

87. Answer (3)

Hint: Dipole moment is a vector quantity.

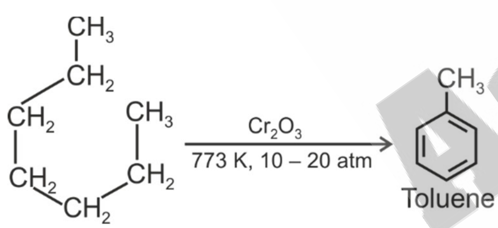
Sol.: Order of dipole moment:

cis-Pent-2-ene > cis-But-2-ene > trans-Pent-2-ene > trans-But-2-ene.

88. Answer (2)

Hint: Cr_2O_3 at 773 K and 10-20 atm causes aromatization.

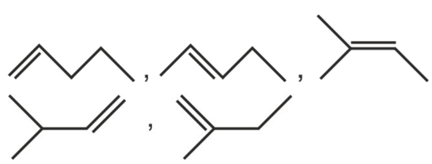
Sol.:



89. Answer (3)

Hint: C_5H_{10} has one degree of unsaturation.

Sol.: Possible structures



90. Answer (1)

Hint: Sodium or potassium salt of carboxylic acid on electrolysis gives alkane.

Sol.:

$$2CH_3CH_2CO\bar{O}\overset{+}{N}a \rightleftharpoons 2CH_3CH_2-\overset{O}{\overset{\|}{C}}-\bar{O} + 2Na^+$$

At anode:

$$2CH_3-CH_2-\overset{O}{\overset{\|}{C}}-\bar{O} \xrightarrow{2e^-} 2CH_3-CH_2-\overset{O}{\overset{\|}{C}}-\dot{O}: \longrightarrow 2CH_3\dot{C}H_2 + 2CO_2\uparrow$$

$$CH_3\dot{C}H_2 + \dot{C}H_2CH_3 \longrightarrow CH_3-CH_2-CH_2-CH_3$$

At cathode:

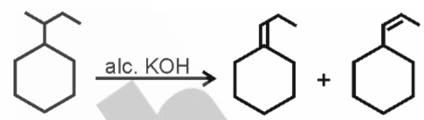
$$H_2O + \bar{e} \longrightarrow O\bar{H} + \dot{H}$$

$$2\dot{H} \longrightarrow H_2\uparrow$$

91. Answer (2)

Hint: alc. KOH performs dehydrohalogenation reaction.

Sol.:

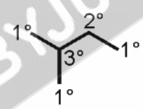


Major (Saytzeff product) Minor

92. Answer (1)

Hint: Carbon joined with two other carbon is considered as 2° carbon.

Sol.:



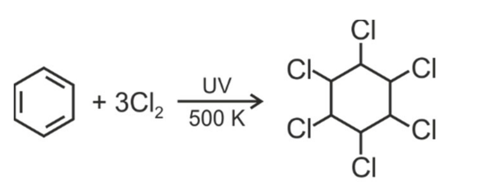
(Isopentane)

Isopentane contains 1 two degree (2°) carbon and 2 hydrogens are attached to that carbon.

93. Answer (3)

Hint: Free radical addition reaction take place

Sol.:



Benzene hexachloride (BHC)

94. Answer (3)

Hint: Alkynes on hydration gives carbonyl compounds.

Sol.:

$$CH_3-C\equiv CH + H-OH \xrightarrow[333\text{ K}]{Hg^{2+}/H^+} CH_3-\underset{\underset{OH}{|}}{C}=CH_2$$

$$\xrightarrow{\text{Isomerisation}} CH_3-\underset{\underset{O}{\|}}{C}-CH_3$$

Propanone

95. Answer (2)

Hint: Alkenes undergo addition reaction with Br_2 in CCl_4.

Sol.:

$$CH_3-CH=CH_2 \xrightarrow[CCl_4]{Br_2} \underset{(A)}{CH_3-\underset{\underset{Br}{|}}{CH}-\underset{\underset{Br}{|}}{CH_2}} \xrightarrow{\text{alc. KOH}} \underset{(B)}{CH_3-\underset{\underset{Br}{|}}{C}=CH_2} \xrightarrow{NaNH_2} \underset{(C)}{CH_3-C\equiv CH}$$

96. Answer (2)

Hint: Greater is the molecular mass and lesser is the number of branch, greater is the boiling point of alkane.

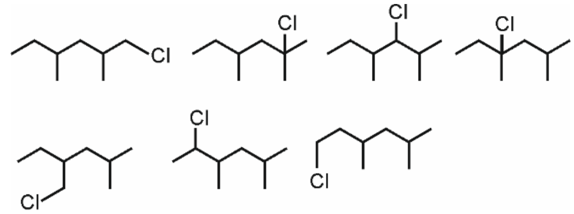
Sol.:

Compound	n-butane	isobutane	isopentane	neopentane
Boiling Point	272.4 K	261 K	301 K	282.5 K

97. Answer (3)

Hint: 2,4-dimethyl hexane has seven distinct hydrogens.

Sol.: Possible structures



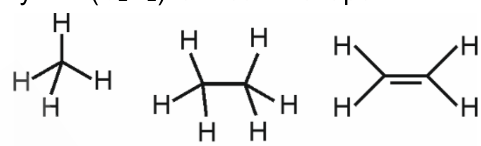
98. Answer (4)

Hint: *sp* hybridised carbon molecule is linear in shape.

Sol.:

- $H-\overset{180°}{C}\equiv\overset{180°}{C}-H$

Acetylene (C_2H_2) is linear in shape

- 

(CH_4) (C_2H_6) (C_2H_4)

Non linear

99. Answer (4)

Hint: Pent-1-ene and Pent-2-ene are position isomers.

Sol.: Pent-1-ene and 3-Methylbut-1-ene are chain isomers of each other.

100. Answer (2)

Hint: Sodium carboxylate undergoes decarboxylation on heating with soda lime mixture.

Sol.:

$$CH_3COONa \xrightarrow[CaO/\Delta]{NaOH} \underset{(A)}{CH_4} \xrightarrow[h\nu]{Cl_2\text{ (1 equivalent)}} \underset{(B)}{CH_3Cl} \xrightarrow[\text{Dry ether}]{Na} \underset{(C)}{C_2H_6}$$

[BOTANY]

SECTION - A

101. Answer (4)

Hint: Redifferentiation of cork cambium leads to the formation of secondary cortex and cork.

Sol.: Primary medullary rays are group of parenchymatous cells present between the vascular bundles. It is made up of differentiated cells.

102. Answer (1)

Hint: Ethylene is a ripening agent.

Sol.: Ripening of fruits can be delayed by gibberellin.

103. Answer (1)

Hint: 2, 4-D kills the dicotyledonous weeds

Sol.: 2, 4-D is weedicide also used by gardeners to prepare weed-free lawns.

104. Answer (2)

Hint: Auxin plays an important role in geotropism.

Sol.: Auxin is responsible for geotropism.

Ethylene shows apogeotropism.

105. Answer (3)

Hint: Ethylene increases the number of fruits.

Sol.: Application of ethylene in cucumber increases the number of female flowers thereby increasing the yield.

106. Answer (4)

Sol.: Sugarbeet is biennial as well as long day plant.

107. Answer (3)

Hint: Complete oxidation of one pyruvate gives 15 ATP

Sol.: 1 pyruvate gives 3 ATP from Link reaction and 12 ATP from Krebs' cycle

Total = 3 + 12 = 15

So, 15 × 6 = 90

108. Answer (4)

Hint: RQ of proteins and fats is less than 1.

Sol.: RQ for proteins is 0.9 and for fats it is 0.7.

109. Answer (3)

Hint: Tripalmitin = $C_{51}H_{98}O_6$

Sol.: $2(C_{51}H_{98}O_6) + 145O_2 \rightarrow 102CO_2 + 98\ H_2O$ + energy

110. Answer (2)

Hint: Krebs cycle takes place in mitochondria.

Sol.: It is also called citric acid cycle, starts with OAA and acetyl CoA.

111. Answer (4)

Hint: There is conversion of pyruvate into acetyl CoA in Link reaction.

Sol.: Pyruvate is 3C compound whereas acetyl CoA is 2C compound. Hence one CO_2 molecule is released in Link reaction.

112. Answer (4)

Hint: NADH + H^+ is oxidised through ETC in aerobic respiration.

Sol.: NADH + H^+ is oxidised to NAD^+ slowly in fermentation/anaerobic respiration.

113. Answer (1)

Hint: Kinetin is cytokinin which is not found naturally in plants.

Sol.: IAA is natural Auxin. Dormin induces seed dormancy. GA increases size of the apple.

114. Answer (1)

Sol.: Development is the sequence of changes related to structure and function of organ and organisms.

115. Answer (3)

Hint: Conversion of stage should be permanent and irrerversible.

Sol.: Turgid cells $\underset{\text{Endosmosis}}{\overset{\text{Exosmosis}}{\rightleftarrows}}$ Flaccid cells

116. Answer (1)

Hint: Growth in plant continues throughout the life.

Sol.: Meristems are the cells which are capable of self perpetuation.

117. Answer (3)

Hint: Ethephon hastens fruit ripening

Sol.: It is artificially prepared commercial product.

118. Answer (1)

Hint: The permanent cells are present in zone of differentiation.

Sol.: After differentiation, the mature cells can become meristematic again.

119. Answer (2)

Hint: Absolute growth is total growth per unit time.

Sol.: Absolute growth rate

$$\frac{30-20}{t} = \frac{10}{5} = 2\ \text{cm}^2/\text{day}$$

120. Answer (3)

Hint: Carotenoid derivative is abscisic acid.

Adenine derivative is cytokinin.

Sol.: In juvenile conifer, maturity is reached early by application of GA.

121. Answer (3)

Hint: Exposure to low temperature for flowering is called vernalization.

Sol.: By vernalization, even some winter varieties are harvested around mid-summer, normally these varieties fail to flower in spring.

122. Answer (4)

Hint: ABA induces seed dormancy

Sol.: Endogenous factors-chemical inhibitors like ABA, Phenolic acids, para-ascorbic acid etc cause seed dormancy.

123. Answer (3)

Hint: Apical dominance is caused by auxin.

Sol.: Apical dominance is counteracted by cytokinin.

124. Answer (1)

Hint: GA_3 promotes the seed germination.

Sol.: ABA plays important role in seed development, maturation and dormancy.

125. Answer (2)

Hint: Cytochrome c is mobile electron carrier.

Sol.: Complex IV is Cytochrome *c* oxidase complex containing Cyt. a, Cyt. a_3, and two copper centres.

126. Answer (3)

Hint: Reduced ubiquinone is ubiquinol

Sol.: Ubiquinol is oxidised with the transfer of electrons to Cyt c.

127. Answer (3)

Hint: Assumptions are not really valid in a living system.

Sol.: If NADH undergoes oxidative phosphorylation, creates proton-gradient and ATP is formed then correct assumptions can be made.

128. Answer (1)

Hint: Total 10 molecules of NADH + H^+ and 2 molecules of $FADH_2$ are formed from one glucose molecule through glycolysis and Krebs cycle.

Sol.: In aerobic respiration net ATP formed is as follows

From $NADH_2 = 10 \times 3 = 30$

From $FADH_2 = 2 \times 2 = 4$

Direct = 6

Used = 2

Net gain = 30 + 4 + 6 – 2 = 38

129. Answer (2)

Hint: 1 glucose $\xrightarrow{\text{Zymase}}$ 2 alcohol + $2CO_2$

Sol.: Aerobic respiration

$C_6H_{12}O_6 + 6O_2 \longrightarrow 6CO_2 + 6H_2O$

130. Answer (3)

Sol.: Acetyl CoA is common to respiration mediated break down of carbohydrates, fats and proteins.

131. Answer (2)

Hint: 1 Pyruvic acid forms 1 acetyl CoA.

Sol.: 1 ATP/GTP is formed by substrate level phosphorylation per Acetyl CoA used for oxidation in Krebs cycle.

132. Answer (3)

Hint: Root hairs are epidermal outgrowth present in mature zone/zone of differentiation.

Sol.: Root cap cells are present below the root apical meristem. Epidermis is peripheral outermost layer.

133. Answer (4)

Hint: Appearance of different forms of leaves on the same plant is called heterophylly.

Sol.: China rose does not show heterophylly.

134. Answer (1)

Hint: Maximum growth is observed in sub-terminal part.

Sol.: Bending is due to higher growth in one side as compare to other side due to auxin.

135. Answer (3)

Sol.: Rate of respiration in seeds increases rapidly during germination.

SECTION - B

136. Answer (2)

Hint: Succinate dehydrogenase is involved in the formation of $FADH_2$.

Sol.: NADH dehydrogenase complex is complex I and $FADH_2$-succinate dehydrogenase complex is complex-II.

137. Answer (3)

Hint: Energy currency in the form of ATP is formed in respiration.

Sol.: Biological oxidation of organic molecules results the release of energy of C– C bond in the form of ATP.

138. Answer (2)

Hint: There are many steps in respiratory pathway.

Sol.: Respiration is basically amphibolic and multistep process.

139. Answer (4)

Hint: Each plant part takes care of its own gaseous exchange need.

Sol.: Simple diffusion is the only means of gaseous exchange within the plant body. From outside it mainly occurs through stomata.

140. Answer (4)

Hint: Gaseous exchange from atmosphere occurs in plants.

Sol.: Availability of oxygen is not a problem for plants. Plants require CO_2 and O_2 from atmosphere.

141. Answer (1)

Hint: *Clostridium botulinum* can not survive in presence of O_2.

Sol.: Facultative anaerobe can survive even in the absence of oxygen for some time but obligate anaerobes do not survive when exposed to oxygen.

142. Answer (3)

Hint: In lactic acid fermentation, 2 ATPs are the net gain.

Sol.: $\text{Glucose} \rightarrow \underset{(C_3H_6O_3)}{\text{Lactic acid}} + 2\,\text{ATP}$

143. Answer (2)

Hint: NADH is used in the second step of alcoholic fermentation.

Sol.: First step: Pyruvic acid $\longrightarrow$ Acetaldehyde + CO_2

Second step: Acetaldehyde + NADH + H^+ $\rightarrow$ Ethyl alcohol + NAD^+

144. Answer (1)

Hint: ATP is formed in the last step of glycolysis also.

Sol.:

$$PEP + ADP \xrightarrow[Mg^{2+}]{\text{Pyruvate kinase}} \text{Pyruvic acid + ATP}.$$

145. Answer (1)

Hint: Synthesis of chlorophyll is anabolism where succinyl CoA is used as precursor.

Sol.: The conversion of fatty acid to acetyl CoA involves many steps, collectively called β-oxidation.

146. Answer (2)

Hint: Heterophylly is the example of plasticity.

Sol.: Plasticity means the ability of plants to follow different pathways and to produce different structures in response to environment.

147. Answer (3)

Hint: Cytokinins promote cell division.

Sol.: Cytokinins delay senescence and stimulate lateral shoot growth.

148. Answer (3)

Hint: 1 GTP is generated in Krebs' cycle.

Sol.: One GTP and one $FADH_2$ are formed in each Krebs cycle.

149. Answer (1)

Hint: F_0 is an integral membrane protein.

Sol.: F_1 is a peripheral membrane protein complex. Pure proteins are never used as respiratory substrate.

150. Answer (1)

Hint: Decapitation prevents apical dominance.

Sol.: Removal of apical buds enhances the lateral growth or lateral bud formation.

[ZOOLOGY]

SECTION - A

151. Answer (2)

Hint: The gland secretes thymosin.

Sol.: Thymus is a bilobed gland situated in mediastinum, ventral side to the aorta. It is responsible for the maturation of T-lymphocytes, which provide cell-mediated immunity.

152. Answer (3)

Hint: Between 5 to 10 in numbers

Sol.: 6-8 finger-like structures called hepatic caecae are present at the junction of foregut and midgut. They pour digestive juice into midgut.

153. Answer (2)

Hint: Disease characterised by glycosuria

Sol.: Diabetes mellitus is caused due to hyposecretion of insulin and is characterised by polyuria, polydipsia (excessive thirst), ketonuria, hyperglycemia (presence of excess glucose in blood) and glycosuria (presence of glucose in urine).

154. Answer (4)

Hint: Hypercalciuria

Sol.: Parathormone is a hypercalcemic hormone because it increases the blood calcium level by resorption of bones, reabsorption of Ca^{2+} by renal tubules and Ca^{2+} absorption in intestine.

155. Answer (2)

Hint: Hormone which maintains pregnancy

Sol.: Progesterone maintains endometrium lining during secretory phase of menstrual cycle and during pregnancy, progesterone also increases blood supply to endometrium of the uterus. Insulin promotes uptake of amino acids by muscle cells and stimulate protein synthesis.

Catecholamines stimulate the breakdown of glycogen *i.e.*, glycogenolysis.

156. Answer (3)

Hint: Water soluble hormones

Sol.: Adrenaline, ADH, insulin, calcitonin and parathormone are water soluble hormones and cannot directly pass through the membranes, thus their receptors are present on the cell surface. Cortisol, aldosterone and progesterone are fat soluble hormones and their receptors are intracellular as they can easily pass through plasma membranes of cells and directly enter the cells.

157. Answer (4)

Hint: Androgens are male sex hormones

Sol.: Thyroxine, erythropoietin, cortisol and testosterone stimulates erythropoiesis, in which only testosterone is a male sex hormone.

158. Answer (3)

Hint: Hormone synthesized from parafollicular cells of thyroid gland

Sol.: TCT is also called as thyrocalcitonin which is synthesized from parafollicular cells of thyroid gland. TCT is responsible for regulating blood calcium levels. It is hypocalcemic hormone. T_4 is thyroxine and PTH is parathormone, a hypercalcemic hormone. GnRH is gonadotrophin releasing hormone.

159. Answer (2)

Hint: Synthesized from atria

Sol.: Atrial natriuretic factor (ANF) is a potent vasodilator (dilate the blood vessels) and thereby decreases the blood pressure and GFR. So, this hormone is considered antagonistic to Renin-Angiotensin-Aldosterone system (RAAS).

160. Answer (3)

Hint: These glands are under the control of hypothalamus.

Sol.: GIT, liver, kidneys and heart are called non-organised endocrine organs.

161. Answer (3)

Hint: Stimulates distribution of melanin

Sol.: MSH is synthesized from the pars intermedia of anterior pituitary. It acts on melanocytes (which contain melanin pigment) and regulates the pigmentation of skin. Trophic hormones are hormones that have other glands as their target and pars distalis of adenohypophyses synthesizes 6 trophic hormones.

162. Answer (2)

Hint: Not paired in male cockroach

Sol.: In male, 3 gonapophyses are present, left gonapophyses possess pseudopenis and titillator. A single phallic or conglobate gland is also present in male cockroach. Phallic gland secretes the outer layer of spermatophore.

163. Answer (1)

Hint: Intercellular messengers

Sol.: Hormones are non-nutrient chemicals which act as intercellular messengers that are produced in trace amounts and generally act on distant cells from site of their secretion.

164. Answer (1)

Hint: Function which decreases blood glucose

Sol.: Glycogenesis is not a function of cortisol. Glucagon and adrenaline are responsible for glycogenolysis which stimulates elevation of blood glucose by converting liver glycogen into glucose.

Cortisol stimulates gluconeogenesis, lipolysis and proteolysis.

165. Answer (2)

Hint: Adrenaline causes dilation of pupil

Sol.: Adrenaline and noradrenaline are collectively known as catecholamines which cause pupilary dilation, piloerection (raising of hair), hyperglycemia (increased concentration of blood glucose), sweating, bronchodilation etc.

166. Answer (1)

Hint: Consist of only sterna

Sol.: In female cockroach, the 7th sternum is large, boat-shaped and together with the 8th and 9th sterna forms a brood or genital pouch whose anterior part contains female gonopore and pores of spermatheca and collaterial glands, while its posterior part in which ootheca is formed is called vestibulum.

167. Answer (2)

Hint: The hormone of pituitary

Sol.: The growth hormone is also known as somatotrophin or somatotrophic hormone. It regulates the growth of the body by promoting protein anabolism, conservation of glucose etc.

Calcitonin decreases blood Ca^{2+} level while parathormone increases blood Ca^{2+} level.

Insulin lowers blood glucose level while glucagon raises blood glucose level.

168. Answer (4)

Hint: Hormonal functions are receptor specific

Sol.: Glucagon acts on liver cells due to the presence of its receptors on plasma membrane of hepatocytes. Receptors for ACTH are present on the cells of adrenal cortex but not on liver cells. So, ACTH cannot act on liver cells and thus, cannot perform glycogenolysis.

169. Answer (1)

Hint: The gland is also called epiphysis cerebri

Sol.: The pineal gland is located on the dorsal side of forebrain.

The thyroid gland is composed of two lobes which are located on either side of the trachea.

Thymus is a lobular structure located between lungs behind sternum on the ventral side of aorta.

Pituitary gland is attached to hypothalamus by a stalk.

170. Answer (4)

Hint: Thyroxine is commonly known as intelligence hormone.

Sol.: Hypothyroidism during pregnancy causes defective development and maturation of the growing baby leading to stunted growth (cretinism), mental retardation, low I.Q., abnormal skin and deaf-mutism.

171. Answer (2)

Hint: Plays major role in development of immune system

Sol.: Thymus gland secretes the peptide hormones called thymosins. Thymosins play a major role in the differentiation of T-lymphocytes and promote production of antibodies from lymphocytes to provide humoral immunity. Corticosteroids (cortisol) have immunosuppressive effect. Gonadotropins (FSH and LH) act on gonads.

172. Answer (3)

Hint: Disease characterised by exophthalmos

Sol.: Graves' disease is caused due to hyperthyroidism, characterised by enlargement of thyroid gland, protrusion of eyeballs, increased BMR and weight loss. Diabetes insipidus, dwarfism and Addison's disease, all are caused due to hyposecretion of their respective hormones.

173. Answer (1)

Hint: Largest endocrine gland of the body

Sol.: Thyrocalcitonin and PTH together regulate the blood Ca^{+2} levels. Hypothalamus is the source gland for vasopressin. Pineal gland synthesizes hormone called melatonin which regulates diurnal rhythm of the body.

174. Answer (3)

Hint: Relaxin is a peptide hormone

Sol.: Cortisol, androgens, oestrogens and progesterone are water insoluble hormones and can cross plasma membrane of cells. Their receptors are present within cells. Relaxin is a proteinaceous, water soluble hormone having membrane bound receptors as they cannot directly pass through the membranes.

175. Answer (4)

Hint: Hormone mainly synthesized from corpus luteum.

Sol.: Melatonin is derived from amino acid, tryptophan while adrenaline is derived from amino acid, tyrosine. FSH and LH are hormones of hypophysis. Pepsin is an enzyme but gastrin is a hormone. Progesterone and prolactin both stimulate milk secretion.

176. Answer (3)

Hint: These hormones are called catecholamines

Sol.: Epinephrine and norepinephrine are called catecholamines. They are synthesized from adrenal medulla. They act as neurotransmitters (local hormones) in ANS and as hormones in endocrine system. Melatonin, cortisol, calcitonin and relaxin are hormones which do not act as neurotransmitters.

177. Answer (4)

Hint: Anti-diabetic hormone

Sol.: Growth hormone and adrenaline are hyperglycemic hormones. Insulin acts through GLUT-4 receptors in order to transport glucose in cells and decreases blood glucose level (hypoglycemia). Insulin inhibits metabolic breakdown of stored glycogen in liver and muscle cells.

178. Answer (4)

Hint: Associated with Ca^{+2} metabolism

Sol.: Osteocytes are mature bone cells responsible for maintaining matrix of bone. Glucagon regulates carbohydrate metabolism and mainly acts on liver. It raises blood glucose level by accelerating breakdown of glycogen into glucose.

179. Answer (3)

Hint: Gastric inhibitory peptide

Sol.: Epinephrine and norepinephrine are synergistic pair of hormones. Growth hormone and thyroxine are also synergistic hormones w.r.t protein synthesis and growth. Parathormone and vitamin-D are also synergistic hormones w.r.t blood calcium level. GIP inhibits gastric motility and secretion and thus, acts antagonistic to gastrin hormone.

180. Answer (1)

Hint: Collaterial glands secrete ootheca around fertilised eggs.

Sol.: Collaterial glands and spermatheca are present in reproductive system of only female cockroach. Alary muscles and anal cerci are present in both male and female cockroach.

181. Answer (3)

Hint: Total nine in number

Sol.: In cockroach, three ganglia are present in the thorax region and six ganglia are present in the abdomen region.

182. Answer (3)

Hint: Excluding structure associated with digestive system

Sol.: In cockroach, the hepatic caecae are present in abdominal region which secretes digestive enzymes into midgut. Rest structures are present in the head region of cockroach.

183. Answer (2)

Hint: Used in flying

Sol.: In cockroach, the mesothoracic wings are also called elytra or tegmina, they protect the hind (metathoracic) wings during rest. The hind wings are delicate, transparent and membranous and are used in flight.

184. Answer (3)

Hint: Their size ranges from 0.6-7.6 cm.

Sol.: In cockroach, a pair of segmented antennae are present, which possess sensory receptors that help in monitoring the environment *i.e.,* detecting the presence of food and object in front of it.

185. Answer (2)

Hint: Present in only male cockroach

Sol.: Uricose glands help in excretion only in male cockroach and they are absent in female cockroach.

Malpighian tubules are associated with excretion and osmoregulation. They are present at the junction of midgut and hindgut.

SECTION - B

186. Answer (2)

Hint: Anterior lobe is related with portal circulation.

Sol.: A – Posterior pituitary

B – Portal circulation

C – Hypothalamic neurons

D – Hypothalamus

Hypothalamus is the basal part of diencephalon, forebrain.

Hormones originating in the hypothalamic neurons, pass through axons and are released from their nerve endings. These hormones reach pituitary through a portal circulation and regulate the functions of anterior pituitary.

187. Answer (3)

Hint: Steroids are derivatives of cholesterol

Sol.: Steroids and iodothyronines are fat soluble hormones and interact with intracellular receptors. They regulate gene expression by the interaction of hormone-receptor complex with the genome. Fat soluble hormones do not generate second messengers.

188. Answer (3)

Hint: Endocrine system is not directly connected with part under control.

Sol.: The neural coordination is fast but short lived.

The response of chemical coordination is slow but it lasts long.

189. Answer (3)

Hint: Testosterone is a male sex hormone.

Sol.: Testosterone acts on CNS and influences the male sexual behavior (libido). These hormones stimulate muscular growth, growth of facial and axillary hair, aggressiveness, low pitch of voice etc. Female sexual behaviour is influenced by female sex hormone, oestrogen.

190. Answer (1)

Hint: Granulosa cells

Sol.: Development of primary follicle upto mature Graafian follicle occurs during follicular phase of menstrual cycle. These developing ovarian follicles synthesize oestrogen.

191. Answer (1)

Hint: Oestrogen causes mineralisation of bones

Sol.: Parathormone increases the activity of bone dissolving cells called osteoclasts. So, hyperparathyroidism and/or hyposecretion of oestrogen leads to osteoporosis. During pregnancy, GnRH is inhibited by sex hormones, so, secretion of gonadotropins is also inhibited. ACTH mainly regulates the secretion of glucocorticoids.

192. Answer (3)

Hint: Present from the segment to which crop extends.

Sol.: Male reproductive system consists of a pair of testes, one lying on each lateral side of the 4^{th}-6^{th} abdominal segments. In female cockroach, two large ovaries are present in the lateral side of 2^{nd}-6^{th} abdominal segments.

193. Answer (4)

Hint: Nurse cells secrete inhibin

Sol.: Sertoli cells are present in seminiferous tubules and secrete inhibin, ABP (androgen binding protein) and mullerian regression factor. Oestrogen is secreted from growing follicles and progesterone is mainly secreted from corpus luteum. α and β cells are present in islets of Langerhans of pancreas.

194. Answer (3)

Hint: Somatotrophic hormone

Sol.: Hypersecretion of growth hormone before epiphyseal fusion in bone leads to gigantism.

Excess secretion of GH in adults, especially in middle age can result in severe disfigurement, particularly in bones of face is called acromegaly. Hyposecretion of thyroxine causes cretinism.

195. Answer (3)

Hint: Hypoglycemic hormone

Sol.: Insulin acts mainly on hepatocytes and adipocytes and increases permeability of glucose which results in rapid movement of glucose from blood to hepatocytes and adipocytes. As a result, blood glucose level decreases, resulting in hypoglycemia.

Pancreas is mixed or composite or heterocrine gland of endodermal origin. It acts as both exocrine and endocrine gland.

196. Answer (3)

Hint: Colourless blood called haemolymph.

Sol.: Cockroach possess open circulatory system and blood is devoid of any respiratory pigment so called haemolymph. It does not assist in respiration.

197. Answer (2)

Hint: Also called neck

Sol.: The head of cockroach is connected with thorax by a short extension of prothorax which is called as neck.

198. Answer (3)

Hint: Has sensory receptors

Sol.: Mouth parts of cockroach consist of labrum or upper lip, a pair of mandibles, a pair of maxillae, the labium or lower lip and the hypopharynx (act as tongue).

In cockroach, the duct of salivary gland opens at the base of hypopharynx.

The maxilla has maxillary palp which possess sensory receptors.

199. Answer (2)

Hint: Between 10 to 15

Sol.: In *Periplaneta*, the nymph grows by moulting about 13 times to reach the adult form. Moulting is regulated by several hormones. This development includes wings formation, growth of body size, colouration change and development of genitalia.

200. Answer (1)

Hint: Carries sperm from testis to seminal vesicle

Sol.: Male cockroach possess one pair of testes lying one on each lateral side of 4^{th} to 6^{th} abdominal segments, and from each testis a single vas deferens arises.

Vas deferens carries sperms from testis to ejaculatory duct through seminal vesicle.

❑ ❑ ❑

All India Aakash Test Series for NEET-2023

TEST - 6 (Code-D)

Test Date : 20/03/2022

ANSWERS

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

HINTS & SOLUTIONS

[PHYSICS]

SECTION - A

1. Answer (1)

Hint and Sol.: At rigid end, wave is reflected with inverted amplitude.

The phase of wave after reflection from a rigid boundary changes by π radian.

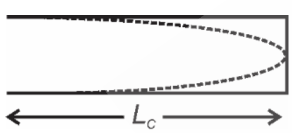
2. Answer (3)

Hint: Only odd harmonics are observed in closed organ pipe.

Sol.: f = 50 Hz, 150 Hz, 250 Hz

These are odd multiples of 50 Hz. Hence, organ pipe is closed at one end, with fundamental frequency of 50 Hz.

$$\frac{\lambda}{4} = L_C \qquad \therefore \lambda = 4L_C$$



$$n = \frac{V}{\lambda} \Rightarrow 50 = \frac{340}{4 \times L_C}$$

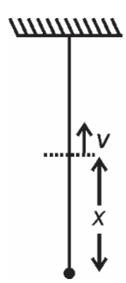
$$4L_C = \frac{340}{50} \quad \therefore \quad L_C = \frac{340}{200} = 1.7 \text{ m}$$

3. Answer (1)

Hint: $a = \frac{g}{2}$ for wave climbing on a freely hanging string

Sol.: Speed of wave at distance x from lower end

$$V = \sqrt{\frac{T}{\mu}} = \sqrt{\frac{\mu g x}{\mu}} = \sqrt{gx}$$



$$\therefore a = \frac{dv}{dt} = \frac{d}{dt}\left(\sqrt{g}\sqrt{x}\right) = \sqrt{g} \cdot \frac{1}{2} \cdot \frac{1}{(x)^{\frac{1}{2}}} \cdot \frac{dx}{dt}$$

$$a = \frac{1}{2} \times \sqrt{g} \times \frac{1}{(x)^{\frac{1}{2}}} \times \sqrt{gx} = \frac{g}{2}$$

$$S = 0 \times t + \frac{1}{2}at^2$$

$$\therefore T = \sqrt{\frac{2S}{a}} = \sqrt{\frac{2 \times L}{\frac{g}{2}}}$$

$$T = \sqrt{\frac{2 \times 2 \times L}{g}} = \sqrt{\frac{4 \times 2.45}{9.8}} = 1 \text{ s}$$

4. Answer (4)

Hint: For two adjacent segments, particles are out of phase.

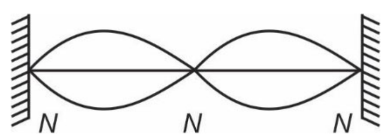
Sol.: Separation between two successive nodes and two successive antinodes is $\frac{\lambda}{2}$.

The speed of particle crossing equilibrium position in segments at different location is different due to their different amplitudes. Between any two adjacent segments particles are 180º out of phase.

5. Answer (3)

Hint: $V = n\lambda, \qquad n = \frac{V}{\lambda}$

Sol.: In second harmonic string vibrates in two loops.



$$\frac{\lambda}{2} + \frac{\lambda}{2} = L \quad \therefore \lambda = L$$

$\therefore \lambda$ = 1.50 m

6. Answer (2)

Hint and Sol.: Particle of medium executes SHM with frequency of source. Hence, speed of particle varies from zero to maximum value and depends on amplitude and frequency of source.

7. Answer (3)

Hint: $n' = n \times \frac{V_{so}}{V_{ss}}$

Sol.: If there is no relative motion between source and detector, then there is no change in frequency.

$$n' = n \times \frac{V_{SO}}{V_{SS}}$$

As $V_{SO} = V_{SS}$

$\therefore n' = n$

8. Answer (2)

Hint: $\text{PE} = \frac{1}{2}Kx^2$, $\text{KE} = \frac{1}{2}K\left(A^2 - x^2\right)$

Sol.: At displacement x

$\text{PE} = \frac{1}{2}Kx^2$ [as x increases PE also increases]

$\text{KE} = \frac{1}{2}K\left(A^2 - x^2\right)$ [as x increases KE decreases.]

9. Answer (1)

Hint: $v = \omega\sqrt{A^2 - x^2}$ and $a = -\omega^2 x$

Sol.: $x = 2\sqrt{2}$ cm, $A = 4$ cm

given $|a| = |v|$

$$\omega^2 x = \omega\sqrt{A^2 - x^2}$$

$$\omega^2 \times \left(2\sqrt{2}\right) = \omega \times \sqrt{(4)^2 - \left(2\sqrt{2}\right)^2}$$

$$\Rightarrow \omega \times 2\sqrt{2} = \sqrt{16 - 8}$$

$$\omega = \frac{2\sqrt{2}}{2\sqrt{2}} = 1 \text{ rad s}^{-1}$$

$$T = \frac{2\pi}{\omega} = \frac{2\pi}{1} = 2\pi \text{ s}$$

10. Answer (3)

Hint and Sol.: Total mechanical energy remains constant throughout so frequency of oscillations is zero.

11. Answer (2)

Hint and Sol.: The system in forced oscillations at resonance oscillates with frequency of applied force.

12. Answer (2)

Hint: $T = 2\pi\sqrt{\frac{m}{K}}$ for oscillating spring pendulum

Sol.: $K = 180\ \frac{\text{N}}{\text{m}}$, $m = 20$ kg

$$T = 2\pi\sqrt{\frac{m}{K}} = 2\pi \times \sqrt{\frac{20}{180}} = 2\pi \times \sqrt{\frac{1}{9}} = \frac{2\pi}{3} \text{ s}$$

13. Answer (2)

Hint: $\because$ $\text{PE} = \frac{1}{2}Kx^2$, $\text{KE} = \frac{1}{2}K\left(A^2 - x^2\right)$

Sol.: Given PE = KE

$$\frac{1}{2}Kx^2 = \frac{1}{2}K\left(A^2 - x^2\right)$$

$x^2 = A^2 - x^2$

$\therefore 2x^2 = A^2$

$$x = \pm\frac{A}{\sqrt{2}}$$

14. Answer (1)

Hint and Sol.:

$$y = 10\cos\left(2\pi t + \frac{\pi}{4}\right)$$

at $t = 2$ s

$$y = 10\cos\left(2\pi \times (2) + \frac{\pi}{4}\right)$$

$$= 10\cos\left(4\pi + \frac{\pi}{4}\right) = 10\cos\left(\frac{\pi}{4}\right)$$

$$y = 10 \times \frac{1}{\sqrt{2}} = 5\sqrt{2} \text{ m}$$

15. Answer (2)

Hint: For simple pendulum

$$T = 2\pi\sqrt{\frac{L}{g}}$$

Sol.: $T = 2\pi\sqrt{\frac{L}{g}}$

$$\therefore T^2 = \frac{4\pi^2}{g}L \Rightarrow T^2 \propto L$$

$\therefore$ T^2 versus L graph will be straight line passing through origin

16. Answer (3)

Hint: If $x = A\sin\omega t + B\cos\omega t$, then its amplitude is $\sqrt{A^2 + B^2}$

Sol.: $x = 3\sin(2\pi t) + 4\cos(2\pi t)$

$$= \sqrt{3^2 + 4^2}\left[\sin(2\pi t) \times \frac{3}{\sqrt{3^2 + 4^2}} + \cos(2\pi t) \times \frac{4}{\sqrt{3^2 + 4^2}}\right]$$

$$x = 5\left[\sin 2\pi t \times \frac{3}{5} + \cos 2\pi t \times \frac{4}{5}\right]$$

$x = 5\sin(2\pi t + \phi)$ (S.H.M)

Where $\phi = \tan^{-1}\left(\frac{4}{3}\right)$

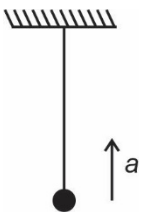
$A = 5$ cm, $T = \frac{2\pi}{\omega} = 1$ s

17. Answer (2)

Hint: Time period of pendulum.

$$T = 2\pi\sqrt{\frac{l_{\text{eff}}}{g_{\text{eff}}}}$$

Sol.: A pendulum in lift is moving down under retardation



$g_{\text{eff}} = g + a$

$$\therefore T = 2\pi\sqrt{\frac{L}{g_{\text{eff}}}} = 2\pi\sqrt{\frac{L}{g + \frac{g}{4}}} = 2\pi\sqrt{\frac{4L}{5g}}$$

$$T = 4\pi\sqrt{\frac{L}{5g}}$$

18. Answer (1)

Hint: $\vec{F} \propto -\vec{x}$ or $\vec{F} = -k\vec{x}$ (for SHM)

Sol.: For SHM, $\vec{F} \propto -\vec{x}$

$\therefore \vec{F} = -k\vec{x}$

Graph F vs x is straight line with negative slope passing through origin

19. Answer (4)

Hint: COP = $\frac{\text{heat extracted}}{\text{work performed}}$

Sol.: COP = $\frac{Q_2}{W}$ where $W = Q_1 - Q_2$

$$\therefore \text{COP} = \frac{Q_2}{Q_1 - Q_2} \text{ or } 8 = \frac{300}{Q_1 - 300}$$

$8Q_1 - 2400 = 300$

$\therefore Q_1 = \frac{2700}{8} = 337.5$ J (heat rejected)

20. Answer (3)

Hint:

$\Delta Q = \Delta U + \Delta W$ and $\Delta W = 0$

$\Delta Q = nC_v \Delta T$

Sol.: $\Delta Q = \Delta U = nC_v \Delta T$ $(\Delta W = 0)$

$$\Delta Q = n \times \frac{R}{(\gamma - 1)} \times \Delta T = \frac{2 \times R}{\left(\frac{5}{3} - 1\right)} \times (380 - 280)$$

$$= \frac{2 \times 100R}{\frac{2}{3}}$$

$\Delta Q = 300R$

21. Answer (2)

Hint: $PV = nRT$

$$\therefore P = \frac{n}{V}RT = \frac{m}{M(V)}RT = \frac{\rho RT}{M}$$

Sol.: $\frac{P}{\rho} =$ slope of graph $= \frac{RT}{M}$

$\therefore \frac{P}{\rho} \propto T$ for a gas

$\therefore T_2 > T_1$

22. Answer (1)

Hint: $U = nC_V T$; $v_{\text{rms}} = \sqrt{\frac{3RT}{M}}$

Sol.: $C_v = \frac{5R}{2}$ for diatomic gas

$\therefore$ N_2 and O_2 will have same internal energy since, $M_{O_2} > M_{N_2}$

$\therefore$ $v_{\text{rms}(O_2)} < v_{\text{rms}(N_2)}$

23. Answer (3)

Hint: $\frac{\Delta T}{\Delta t} = -k(T_{av} - T_0)$ where $T_{av} = \frac{T_1 + T_2}{2}$

Sol.: From 70°C to 60°C by Newton's cooling law

$\frac{70 - 60}{t} = k[65 - 30]$ ...(i)

From 60 to 45°C

$\frac{60 - 45}{t'} = k[52.5 - 30]$ ...(ii)

(now dividing Equations (i) and (ii))

$$\frac{t'}{t} \times \frac{10}{15} = \frac{35}{22.5}$$

$$t' = t \times \frac{15}{10} \times \frac{35}{22.5} = 6 \times 2.33 = 14 \text{ min}$$

24. Answer (3)

Hint: By Wein's displacement law: $\lambda_m T$= constant

Sol.: $\lambda_{m_1} T_1 = \lambda_{m_2} T_2$

$6500 \times T_1 = 5200 \times T_2$

$$\frac{T_1}{T_2} = \frac{5200}{6500} = \frac{4}{5}$$

25. Answer (2)

Hint: $\eta = \frac{\text{Work done in one cycle}}{\text{heat intake}}$

Sol.: Heat intake = $Q_1 + Q_3$ = 100 + 45 = 145 J

Heat rejected = (80 + 20) = 100 J

Work done in one cycle = heat intake – heat rejected

W = 145 J –100 J = 45 J

$$\eta = \frac{\text{Work}}{\text{heat intake}} = \frac{45}{145} = 0.31$$

$\therefore$ η = 31%

26. Answer (4)

Hint: $V_{mp} = \sqrt{\frac{2RT}{M}}, \quad V_{av} = \sqrt{\frac{8RT}{\pi M}}$

Sol.: $\frac{V_{mp}}{V_{av}} = \sqrt{\frac{2RT}{M}} \times \sqrt{\frac{\pi M}{8RT}} = \sqrt{\frac{\pi}{4}} = \frac{\sqrt{\pi}}{2}$

27. Answer (3)

Hint: Mean free path length = $\lambda = \frac{1}{\sqrt{2}\pi d^2 xn}$

Sol.: $P = nKT \quad \therefore n = \frac{P}{KT}$

$$\lambda = \frac{KT}{\sqrt{2}\pi d^2 \times P}$$

$\therefore$ If T is constant, then

$$\lambda \propto \frac{1}{P}$$

$\lambda P = \lambda' \times 5P$

$$\therefore \lambda' = \frac{\lambda}{5}$$

28. Answer (2)

Hint: $PV = nRT$ and V = Constant, for closed rigid vessel

Sol.: V = Constant, then by gas equation

$\frac{P_1}{T_1} = \frac{P_2}{T_2}$ (where T is in kelvin)

$$P_2 = P_1 + \frac{0.4}{100} P_1 = \left(1 + \frac{0.4}{100}\right) P_1$$

ΔT = 1°C $\quad \therefore T_2 = T_1 + 1$

$$\frac{P_1}{T_1} = \frac{\left(1 + \frac{0.4}{100}\right) P_1}{(T_1 + 1)}$$

$$\frac{T_1 + 1}{T_1} = 1 + \frac{0.4}{100}$$

$$\frac{1}{T_1} = \frac{0.4}{100} \quad \therefore T_1 = \frac{100}{0.4} = 250 \text{ K}$$

29. Answer (3)

Hint: Heat loss = Heat gain

Heat required to melt m gram of ice = mL_f

Heat released in converting steam to water at 100ºC = $m \times L_v$

Sol.: Heat required to melt whole ice

= 1000 × 80 = 80,000 cal

Heat required to convert water from 0°C further to 100°C

= 1000 × 1 × 100 = 1,00,000 cal

Total heat required by ice to become 100°C water = 80,000 + 100000 = 1,80,000

Heat given by steam to reach 0°C water

= 200 × 540 + 200 × 1 × 100

= 1,08,000 + 20,000 cal

= 1,28,000 cal

So temperature reached is not 100ºC as steam can not give sufficient heat.

$\therefore$ Let common temperature be T

1000 × 80 + 1000 × 1 × (T – 0) = 200 × 540 + 200 × 1 × (100 – T)

$\Rightarrow$ 80,000 + 1000T = 1,08,000 + 20000 – 200T

$\Rightarrow$ 1200T = 48,000

T = 40ºC

30. Answer (3)

Hint: PV^γ = constant for adiabatic process, PV = constant for isothermal process

Sol.: For isothermal process

$PV = P' \times 3V$

$$P' = \frac{P}{3} \quad \text{...(1)}$$

Now for adiabatic process

$P' \times (3V)^{\gamma} = P'' \times (V)^{\gamma}$

$P'' = \left(\frac{P}{3}\right) \times \left(\frac{3V}{V}\right)^{\gamma} = \frac{P}{3} \times (3)^{\frac{5}{3}} = P \times (3)^{\frac{5}{3}-1}$

$= P \times (3)^{\frac{2}{3}}$

31. Answer (3)

Hint: For constant pressure

$\Delta W = P\Delta V = nR\Delta T$

$\Delta U = nC_v\Delta T$ and $\Delta Q = nC_p \Delta T$

Sol.: $\Delta U : \Delta W : \Delta Q$

$nC_v\Delta T : nR\Delta T : nC_p\Delta T$

$\frac{C_v}{C_p} : \frac{R}{C_p} : 1 = \frac{1}{\gamma} : \frac{\gamma - 1}{\gamma} : 1$

$\left(\text{given } \gamma = \frac{7}{5}\right)$

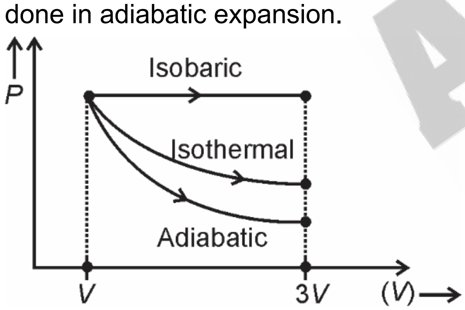
$= \frac{5}{7} : \frac{\frac{7}{5} - 1}{\frac{7}{5}} : 1$

$\Rightarrow$ 5 : 2 : 7

32. Answer (2)

Hint: Work done is equal to area under *PV* diagram.

Sol.: When *PV* diagram is drawn, maximum area is under isobaric expansion and minimum under adiabatic expansion. Therefore minimum work is done in adiabatic expansion.



33. Answer (3)

Hint: $\Delta Q = \Delta U + \Delta W$

Sol.: $\Delta V = 0$ $\therefore \Delta W = 0$

$U_i = \frac{3P_0V_0}{2}$, $U_f = \frac{9P_0V_0}{2}$

$\Delta Q = \Delta U + \Delta W$

$\Delta Q = \left(\frac{9P_0V_0}{2} - \frac{3P_0V_0}{2}\right) + 0 = 3P_0V_0$

34. Answer (3)

Hint: $\Delta Q = \Delta U + \Delta W$ and $\Delta Q = 0$

Sol.: Adiabatic expansion of gas is at the cost of decrease in its internal energy, hence temperature falls.

35. Answer (4)

Hint and Sol.:

- Heat flow automatically takes place from higher temperature towards lower temperature.
- Zeroth law defines temperature and concept of thermal equilibrium.

SECTION - B

36. Answer (2)

Hint: $f_C = \frac{v}{4L_C}$ and $f_O = \frac{v}{2L_O}$

Sol.: 2nd overtone of open pipe $= \frac{3v}{2L_O}$

2nd overtone of closed pipe $= \frac{5v}{4L_C}$

Given two frequencies are unison

$\frac{3v}{2L_O} = \frac{5v}{4L_C}$ $\therefore \frac{L_C}{L_O} = \frac{10}{12} = \frac{5}{6}$

37. Answer (1)

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

Sol.: The distance between particles

$\Delta x = \left(\frac{\lambda}{2} - \frac{\lambda}{8}\right) + \frac{\lambda}{4} = \frac{5\lambda}{8}$

$\Delta\phi = \frac{2\pi}{\lambda} \cdot \Delta x = \frac{2\pi}{\lambda} \cdot \frac{5\lambda}{8} = \frac{10\pi}{8} = \frac{5\pi}{4}$ rad

38. Answer (1)

Hint: $v = \frac{\omega}{k}$

Sol.: $y = 1.5\sin(328t - 4.27x)$

$\omega = 328$ rad/s, $k = 4.27$ cm^{-1}

$v = \frac{\omega}{k} = \frac{328}{4.27} = 76.8$ cm s^{-1}

39. Answer (3)

Hint: $T = 2\pi\sqrt{\frac{L}{g_{\text{eff}}}}$ and for length comparable to radius of earth $T = 2\pi\sqrt{\frac{1}{g\left(\frac{1}{L} + \frac{1}{R}\right)}}$

Sol.: In a liquid, upthrust acts against gravity, restoring force decreases and period increases.

$$T = 2\pi\sqrt{\frac{L}{g\left(1-\frac{d}{d_B}\right)}}$$

here d is density of liquid and d_B is density of bob

- In moving lift as it is accelerating upwards

$T = 2\pi\sqrt{\frac{L}{(g+a)}}$, it will decrease.

- For pendulum $L = R_e$

$$\therefore\ T = 2\pi\sqrt{\frac{1}{g\left(\frac{1}{R_e}+\frac{1}{R_e}\right)}} = 2\pi\sqrt{\frac{R_e}{2g}} = 1\text{ hour}$$

On curved track $T = 2\pi\sqrt{\frac{l}{\sqrt{(g)^2+\left(\frac{v^2}{r}\right)^2}}}$

it will decrease.

40. Answer (3)

Hint: Time period of spring pendulum $T = 2\pi\sqrt{\frac{m}{k}}$

Sol.: In first case $T = 2\pi\sqrt{\frac{m}{k}}$ ...(i)

In second case $T' = 2\pi\sqrt{\frac{m+2}{k}}$ ...(ii)

dividing equations

$$\frac{3}{2} = \frac{\sqrt{m+2}}{\sqrt{m}} \quad \Rightarrow \frac{9}{4} = \frac{m+2}{m} \quad \left(\because \frac{T'}{T} = \frac{3}{2}\right)$$

$9m = 4m + 8 \quad \Rightarrow 5m = 8$ or $m = 1.6$ kg

41. Answer (1)

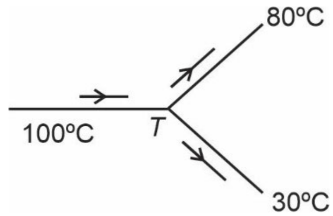
Hint and Sol.: Laplace corrected Newton's formula on velocity of sound in gases by saying that sound propagation through gases is an adiabatic process, rather than an isothermal process thought by Newton.

42. Answer (3)

Hint: Rate of heat flow = $\frac{\Delta T}{R}$

Where $R = \frac{l}{KA}$ (Thermal resistance)

Sol.:



$\frac{dH_1}{dt} = \frac{dH_2}{dt} + \frac{dH_3}{dt}$ T = junction temperature

$\frac{100-T}{R_1} = \frac{T-80}{R_2} + \frac{T-30}{R_3}$ $(R_1 = R_2 = R_3 = R)$

$100 - T = T - 80 + T - 30$

$100 + 80 + 30 = 3T$

$3T = 210$

$\therefore\ T = 70$ºC

43. Answer (4)

Hint:

$T V^{\gamma-1}$ = const.

Sol.: $T \times \left(\frac{m}{\rho}\right)^{\gamma-1} = \text{constant}$

$T \propto (\rho)^{\gamma-1}$

or $\rho \propto (T)^{\frac{1}{\gamma-1}}$

given $\rho \propto T^3$

$\therefore 3 = \frac{1}{\gamma-1}$

$\therefore \gamma - 1 = \frac{1}{3}$

$\gamma = \frac{4}{3}$

Since $\gamma = 1 + \frac{2}{f}$

$1 + \frac{2}{f} = \frac{4}{3}$ or $\frac{2}{f} = \frac{1}{3}$ or $f = 6$

44. Answer (4)

Hint:

$n_1 : n_2 : n_3 = \frac{1}{l_1} : \frac{1}{l_2} : \frac{1}{l_3}$

Sol.:

$4 : 3 : 2 = \frac{1}{l_1} : \frac{1}{l_2} : \frac{1}{l_3}$

$l_1 : l_2 : l_3 = \frac{1}{4} : \frac{1}{3} : \frac{1}{2}$

$l_1 : l_2 : l_3 = 3 : 4 : 6$

45. Answer (2)

Hint: There is an end correction because second resonance length is not 3 times the first-length.

Sol.:

$L_1 + e = \frac{\lambda}{4}$ (for 1st resonance)

$L_2 + e = \frac{\lambda}{4} + \frac{\lambda}{2}$ (for 2nd resonance)

$L_3 + e = \frac{\lambda}{4} + \frac{\lambda}{2} + \frac{\lambda}{2}$ (for 3rd resonance)

$\Rightarrow \quad L_2 - L_1 = \frac{\lambda}{2}$

and, $L_3 - L_2 = \frac{\lambda}{2}$

$\Rightarrow L_2 - L_1 = L_3 - L_2$

$53 - 17 = L_3 - 53$

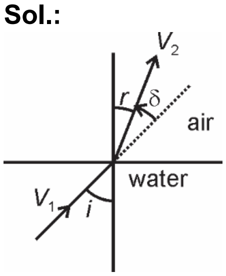
$L_3 = 53 - 17 + 53 = 89$ cm

46. Answer (1)

Hint:

Velocity of sound in water is more than in air, so when ray travels from rarer (water) to denser (air) medium, it bends towards normal.

Sol.:



$\frac{\sin i}{\sin r} = \frac{V_1}{V_2} > 1$ (law of refraction)

$\therefore$ sin r < sin i

$\Rightarrow \angle r < \angle i$ It bends towards normal.

47. Answer (1)

Hint: $n = \frac{1}{2l}\sqrt{\frac{T}{\mu}}$

Sol.: $n_1 = \frac{1}{2l_1} \times \sqrt{\frac{T}{\mu}}, \quad n_2 = \frac{1}{2l_2} \times \sqrt{\frac{T}{\mu}}$

$n_2 - n_1 = 2$ and $\frac{n_1}{n_2} = \frac{l_2}{l_1} = \frac{25}{30} = \frac{5}{6}$

$n_2 - \frac{5}{6}n_2 = 2$

$\frac{1}{6}n_2 = 2 \qquad \therefore n_2 = 12$ Hz

$n_2 - n_1 = 2$

$12 - n_1 = 2$

$\therefore n_1 = 10$ Hz

48. Answer (1)

Hint: By principle of superposition:

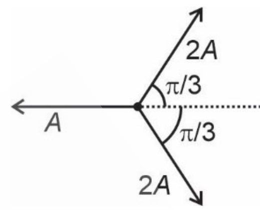
$y = y_1 + y_2 + y_3$: use phasor diagram for resultant amplitude.

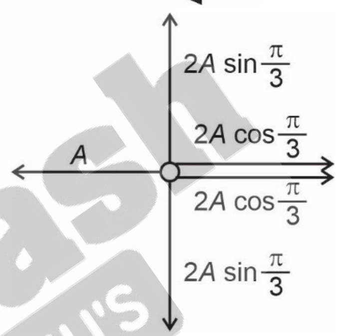
Sol.: $y_1 = 2A\sin\left(\omega t + \frac{\pi}{3}\right)$

$y_2 = 2A\sin\left(\omega t - \frac{\pi}{3}\right)$

$y_3 = A\sin(\omega t + \pi)$

By phasor diagram





$\therefore R = 2A\cos\frac{\pi}{3} + 2A\cos\frac{\pi}{3} - A$

$= 2A \times \frac{1}{2} + 2A \times \frac{1}{2} - A$

$R = A + A - A = A$

49. Answer (3)

Hint: Due to slightly different source frequencies, beats are formed.

$n = n_2 - n_1$ where $n = \frac{v}{\lambda}$

Sol.: $n_1 = \frac{v}{\lambda_1}$ and $n_2 = \frac{v}{\lambda_2}$

And beats per second

$n = n_1 - n_2 = \frac{v}{\lambda_1} - \frac{v}{\lambda_2} = \frac{v(\lambda_2 - \lambda_1)}{\lambda_1\lambda_2}$

$\therefore v = \frac{n \times \lambda_1\lambda_2}{(\lambda_2 - \lambda_1)}$

50. Answer (4)

Hint: $\Delta L = 10\log\frac{I_2}{I_1}$ dB (in decibel)

Sol.: ΔL = 30 dB

$\therefore\ \Delta L = 10\log\frac{I_2}{I_1}$

$\frac{30}{10} = \log\left(\frac{I_2}{I_1}\right)$

$\therefore\ \frac{I_2}{I_1} = 10^3 = 1000$

[CHEMISTRY]

SECTION - A

51. Answer (4)

Hint: $2CH_4 + O_2 \xrightarrow{Cu/523K/100\ atm} \underset{\text{Methanol}}{2CH_3OH}$

Sol.:

- $CH_4 + O_2 \xrightarrow[\Delta]{Mo_2O_3} \underset{\text{Methanal}}{HCHO} + H_2O$
- $2CH_3CH_3 + 3O_2 \xrightarrow[\Delta]{(CH_3COO)_2Mn} \underset{\text{Ethanoic acid}}{2CH_3COOH} + 2H_2O$
- $CH_4 + H_2O \xrightarrow[\Delta]{Ni} CO + 3H_2$

52. Answer (3)

Hint: Negative charge is more stable on *sp* hybridised carbon than sp^2 or sp^3 hybridised carbon.

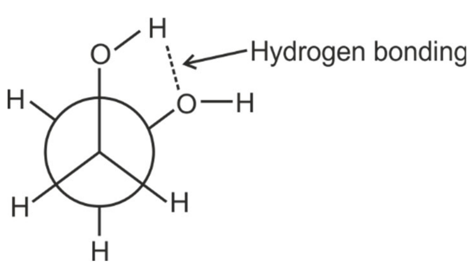
Sol.: Acidic strength order.

$CH \equiv CH > CH_3 - C \equiv CH > CH_2 = CH_2 > CH_3 - CH_3$

53. Answer (2)

Hint: Hydrogen bonding stabilizes gauche form of Ethane-1, 2-diol.

Sol.:



Gauche form of Ethane-1, 2-diol is most stable due to hydrogen bonding.

54. Answer (4)

Hint: – $NHCOCH_3$ group is activating group.

Sol.:

- $-NHCOCH_3$, $-OH$, $-NH_2$ are electron donating groups therefore these are ring activating groups.
- $-NO_2$ is an electron withdrawing group therefore it is ring deactivating group.

55. Answer (3)

Hint: *sp* hybridised carbon forms two sigma and two pi bonds.

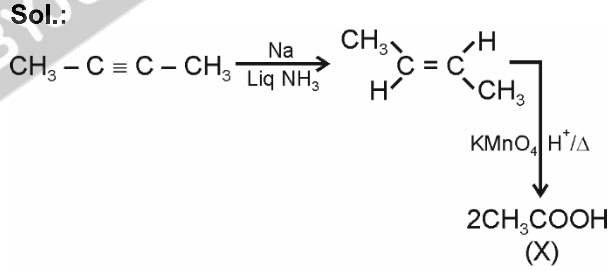
Sol.: $\underset{1}{CH_3} - \overset{sp^2}{\underset{2}{CH}} = \underset{3}{CH} - \underset{4}{CH} = \overset{sp}{\underset{5}{C}} = \underset{6}{CH_2}$

- C-2 sp^2 hybridised.
- C-5 is *sp* hybridised.

56. Answer (4)

Hint: Partial hydrogenation of alkynes takes place with Na in liquid NH_3.

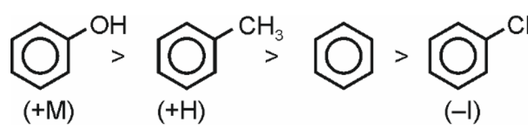
Sol.:



57. Answer (4)

Hint: Greater is the electron density on the ring, greater is its reactivity towards electrophilic aromatic substitution.

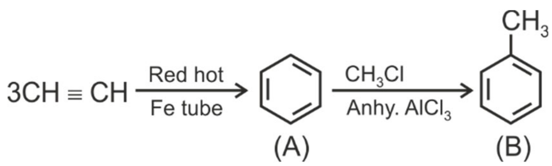
Sol.: Correct order of reactivity towards electrophilic aromatic substitutions is

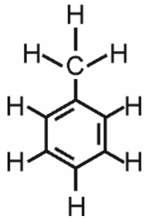


58. Answer (3)

Hint: Acetylene gives benzene on passing through red hot iron tube.

Sol.:



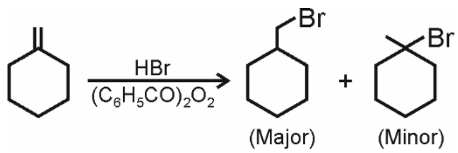


contains 15 σ bonds.

59. Answer (1)

Hint: HBr in presence of benzoyl peroxide with unsymmetrical alkenes gives anti Markovnikov addition product

Sol.:



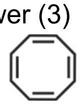
60. Answer (1)

Hint: Al_2O_3 is amphoteric in nature.

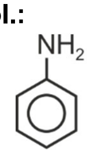
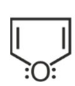
Sol.:

- B_2O_3 is acidic in nature
- In_2O_3 and Tl_2O_3 are basic in nature.

61. Answer (3)

Hint:  has tub shaped like structure.

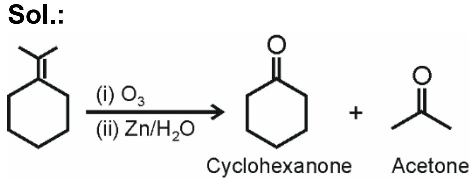
Sol.:

-  → Planar → Homocyclic → Aromatic
-  → Non planar → Homocyclic → Non aromatic
-  → Planar → Heterocyclic → Aromatic
-  → Planar → Homocyclic → Antiaromatic

62. Answer (2)

Hint: Double bond are cleaved and carbonyl compounds are obtained during ozonolysis.

Sol.:



63. Answer (3)

Hint: Chlorine gas was used earlier for bleaching paper.

Sol.: Nowadays, hydrogen peroxide (H_2O_2) with suitable catalyst (which promotes the bleaching action of hydrogen peroxide) is used.

64. Answer (3)

Hint: Methemoglobinemia is 'blue baby' syndrome.

Sol.: Excess nitrate in drinking water can cause methemoglobinemia.

65. Answer (2)

Hint and Sol.: Bloom infested water inhibits the growth of other living organisms in the water body. This process in which nutrient enriched water bodies support a dense plant population, which kills animal life by depriving it of oxygen and results in subsequent loss of biodiversity is known as eutrophication.

66. Answer (4)

Hint: Classical smog is a mixture of smoke, fog and sulphur dioxide.

Sol.: Photochemical smog contains nitrogen oxides.

67. Answer (4)

Hint: Water vapour causes greenhouse effect.

Sol.: N_2O and CO_2 cause greenhouse effect while CO does not cause any greenhouse effect.

68. Answer (3)

Hint: C, Si and Ge are not affected by water.

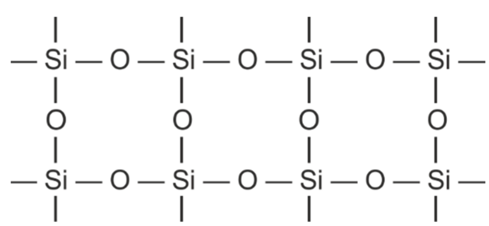
Sol.: Tin decomposes steam to form dioxide and dihydrogen gas.

$$Sn + 2H_2O \xrightarrow{\Delta} SnO_2 + 2H_2$$

69. Answer (3)

Hint: In SiO_2, each Si atom is covalently bonded in a tetrahedral manner to four oxygen atoms.

Sol.: Structure of SiO_2



$\therefore$ Three dimensional structure of SiO_2 has eight membered rings.

70. Answer (4)

Hint: Lesser is the electron density of boron, stronger is its Lewis acid strength.

Sol.: Extent of back bonding decreases from BF_3 to BI_3 therefore the Lewis acidic character increases from BF_3 to BI_3.

71. Answer (4)

Hint: Heat of formations of coke, coal and diamond are non-zero.

Sol.: Graphite is thermodynamically most stable allotrope of carbon and its $\Delta_fH°$ is taken as zero.

72. Answer (2)

Hint: Mixture of CO + H_2 is water gas.

Sol.: Mixture of CO and N_2 gases is known as producer gas.

73. Answer (4)

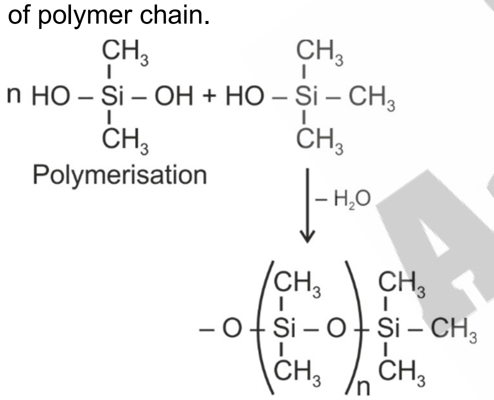
Hint: Bead of $Co(BO_2)_2$ is formed.

Sol.: When borax is heated in a Bunsen burner flame with CoO on a loop of platinum wire it forms $Co(BO_2)_2$ bead which is of blue colour.

74. Answer (3)

Hint: Monohydroxy silicones are used to control chain length of silicones polymer.

Sol.: The chain length of the silicon polymer can be controlled by adding $(CH_3)_3SiCl$ which on hydrolysis gives $(CH_3)_3SiOH$ that blocks the ends of polymer chain.



Silicone

75. Answer (3)

Hint: On small scale pure CO is prepared by dehydration of formic acid with concentrated H_2SO_4 at 373 K.

Sol.: On commercial scale CO is prepared by passage of steam over hot coke.

$$C(s) + H_2O(g) \xrightarrow{473-1273\text{ K}} \underset{\text{Water gas}}{CO(g) + H_2(g)}$$

76. Answer (2)

Hint: Fullerenes are cage like molecules.

Sol.: Fullerenes are the only pure form of carbon because they have smooth structure without having ‘dangling bonds.

77. Answer (4)

Hint & Sol.:

Elements	Si	Ge	Sn	Pb
Electronegativity (on Pauling scale)	1.8	1.8	1.8	1.9

78. Answer (2)

Hint & Sol.:

- CO is stable as carbon can form $p\pi - p\pi$ stable bonds with oxygen.
- SiO only exist at higher temperature.

79. Answer (3)

Hint: Formula of borax is $Na_2[B_4O_5(OH)_4]\cdot 8H_2O$.

Sol.: Borax is a salt of strong base NaOH and weak acid H_3BO_3 therefore on hydrolysis its solution is alkaline in nature.

$$Na_2B_4O_7 + 7H_2O \longrightarrow 2NaOH + 4H_3BO_3$$

80. Answer (4)

Hint: Reaction of ammonia with diborane gives initially $B_2H_6\cdot 2NH_3$.

Sol.:

$$3B_2H_6 + 6NH_3 \longrightarrow \underset{(A)}{3\left[BH_2(NH_3)_2\right]^+\left[BH_4\right]^-} \xrightarrow{\Delta} \underset{\text{(Inorganic benzene)}}{2B_3N_3H_6} + 12H_2$$

81. Answer (2)

Hint: Diborane undergoes cleavage reactions with Lewis bases to give borane adducts.

Sol.: B_2H_6 is an electron deficient species. Two bridge bonds are 3-centre-2-electron bonds or banana bonds.

82. Answer (1)

Hint: Due to Inert pair effect stability of lower oxidation state increases down the group.

Sol.: Order of stability of +1 oxidation state

Al < Ga < In < Tl

83. Answer (3)

Hint: Boron cannot expand its octet due to absence of *d*-orbital.

Sol.:

- Six large chloride ions cannot be accommodated around Si^{4+} due to limitation of its size, so $[SiCl_6]^2$ is not known
- BCl_3 being covalent in nature gets hydrolysed in water to form $[B(OH)_4]^-$.

84. Answer (4)

Hint: Due to poor screening effect of $3d^{10}$ electrons the size of Ga is less than Al.

Sol.: On moving down the group, for each successive member one extra shell of electrons is added therefore atomic radius is expected to increase.

Element	B	Al	Ga	In
Atomic radii (in pm)	88	143	135	167

85. Answer (3)

Hint and Sol.: Quartz crystals are extensively used as piezoelectric material used to develop accurate clocks.

SECTION - B

86. Answer (2)

Hint: Sodium carboxylate undergoes decarboxylation on heating with soda lime mixture.

Sol.:

$$\underset{}{CH_3COONa} \xrightarrow[CaO/\Delta]{NaOH} \underset{(A)}{CH_4} \xrightarrow[h\nu]{Cl_2\,(1\text{ equivalent})}$$

$$\underset{(B)}{CH_3Cl} \xrightarrow[\text{Dry ether}]{Na} \underset{(C)}{C_2H_6}$$

87. Answer (4)

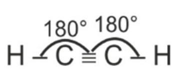
Hint: Pent-1-ene and Pent-2-ene are position isomers.

Sol.: Pent-1-ene and 3-Methylbut-1-ene are chain isomers of each other.

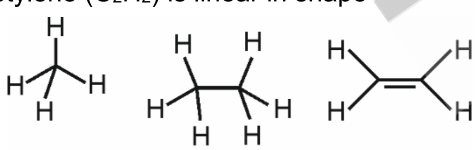
88. Answer (4)

Hint: *sp* hybridised carbon molecule is linear in shape.

Sol.:

- 

Acetylene (C_2H_2) is linear in shape

- 

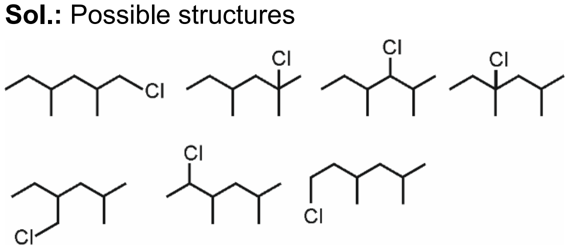
(CH_4) (C_2H_6) (C_2H_4)

Non linear

89. Answer (3)

Hint: 2,4-dimethyl hexane has seven distinct hydrogens.

Sol.: Possible structures



90. Answer (2)

Hint: Greater is the molecular mass and lesser is the number of branch, greater is the boiling point of alkane.

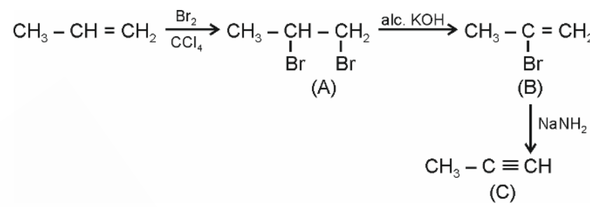
Sol.:

Compound	n-butane	isobutane	isopentane	neopentane
Boiling Point	272.4 K	261 K	301 K	282.5 K

91. Answer (2)

Hint: Alkenes undergo addition reaction with Br_2 in CCl_4.

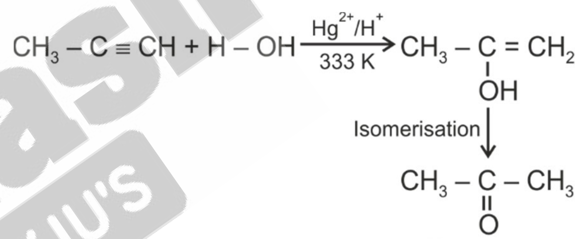
Sol.:



92. Answer (3)

Hint: Alkynes on hydration gives carbonyl compounds.

Sol.:

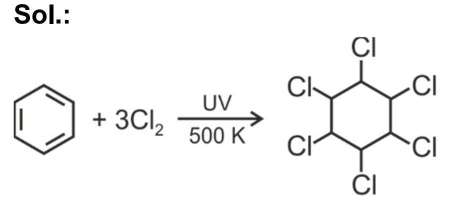


Propanone

93. Answer (3)

Hint: Free radical addition reaction take place

Sol.:

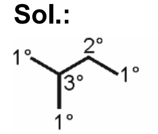


Benzene hexachloride (BHC)

94. Answer (1)

Hint: Carbon joined with two other carbon is considered as 2° carbon.

Sol.:



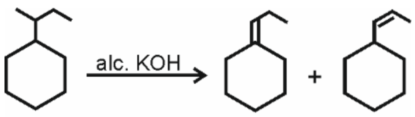
(Isopentane)

Isopentane contains 1 two degree (2°) carbon and 2 hydrogens are attached to that carbon.

95. Answer (2)

Hint: alc. KOH performs dehydrohalogenation reaction.

Sol.:



Major (Saytzeff product) Minor

96. Answer (1)

Hint: Sodium or potassium salt of carboxylic acid on electrolysis gives alkane.

Sol.:

$$2CH_3CH_2CO\bar{O}\overset{+}{N}a \rightleftharpoons 2CH_3CH_2-\overset{O}{\overset{\|}{C}}-\bar{O} + 2Na^+$$

At anode:

$$2CH_3-CH_2-\overset{O}{\overset{\|}{C}}-\bar{O} \xrightarrow{2e^-} 2CH_3-CH_2-\overset{O}{\overset{\|}{C}}-\ddot{O}: \longrightarrow 2CH_3\dot{C}H_2 + 2CO_2\uparrow$$

$$CH_3\dot{C}H_2 + \dot{C}H_2CH_3 \longrightarrow CH_3-CH_2-CH_2-CH_3$$

At cathode:

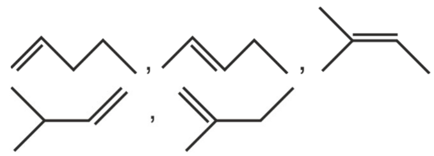
$$H_2O + \bar{e} \longrightarrow \bar{O}H + \dot{H}$$

$$2\dot{H} \longrightarrow H_2\uparrow$$

97. Answer (3)

Hint: C_5H_{10} has one degree of unsaturation.

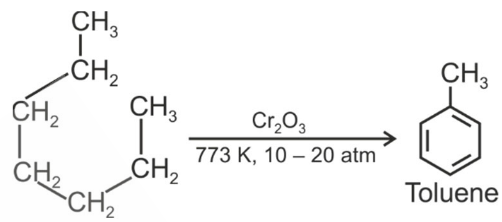
Sol.: Possible structures



98. Answer (2)

Hint: Cr_2O_3 at 773 K and 10-20 atm causes aromatization.

Sol.:



Toluene

99. Answer (3)

Hint: Dipole moment is a vector quantity.

Sol.: Order of dipole moment:

cis-Pent-2-ene > cis-But-2-ene > trans-Pent-2-ene > trans-But-2-ene.

100. Answer (2)

Hint: Formation of triozonide indicates the three double bonds in benzene.

Sol.: Formation of only one monosubstituted derivative which indicates that all six carbon and six hydrogen atoms of benzene are identical.

[BOTANY]

SECTION - A

101. Answer (3)

Sol.: Rate of respiration in seeds increases rapidly during germination.

102. Answer (1)

Hint: Maximum growth is observed in sub-terminal part.

Sol.: Bending is due to higher growth in one side as compare to other side due to auxin.

103. Answer (4)

Hint: Appearance of different forms of leaves on the same plant is called heterophylly.

Sol.: China rose does not show heterophylly.

104. Answer (3)

Hint: Root hairs are epidermal outgrowth present in mature zone/zone of differentiation.

Sol.: Root cap cells are present below the root apical meristem. Epidermis is peripheral outermost layer.

105. Answer (2)

Hint: 1 Pyruvic acid forms 1 acetyl CoA.

Sol.: 1 ATP/GTP is formed by substrate level phosphorylation per Acetyl CoA used for oxidation in Krebs cycle.

106. Answer (3)

Sol.: Acetyl CoA is common to respiration mediated break down of carbohydrates, fats and proteins.

107. Answer (2)

Hint: 1 glucose $\xrightarrow{\text{Zymase}}$ 2 alcohol + $2CO_2$

Sol.: Aerobic respiration

$C_6H_{12}O_6 + 6O_2 \longrightarrow 6CO_2 + 6H_2O$

108. Answer (1)

Hint: Total 10 molecules of NADH + H^+ and 2 molecules of $FADH_2$ are formed from one glucose molecule through glycolysis and Krebs cycle.

Sol.: In aerobic respiration net ATP formed is as follows

From $NADH_2$ = 10 × 3 = 30

From $FADH_2$ = 2 × 2 = 4

Direct = 6

Used = 2

Net gain = 30 + 4 + 6 – 2 = 38

109. Answer (3)

Hint: Assumptions are not really valid in a living system.

Sol.: If NADH undergoes oxidative phosphorylation, creates proton-gradient and ATP is formed then correct assumptions can be made.

110. Answer (3)

Hint: Reduced ubiquinone is ubiquinol

Sol.: Ubiquinol is oxidised with the transfer of electrons to Cyt c.

111. Answer (2)

Hint: Cytochrome c is mobile electron carrier.

Sol.: Complex IV is Cytochrome *c* oxidase complex containing Cyt. a, Cyt. a_3, and two copper centres.

112. Answer (1)

Hint: GA_3 promotes the seed germination.

Sol.: ABA plays important role in seed development, maturation and dormancy.

113. Answer (3)

Hint: Apical dominance is caused by auxin.

Sol.: Apical dominance is counteracted by cytokinin.

114. Answer (4)

Hint: ABA induces seed dormancy

Sol.: Endogenous factors-chemical inhibitors like ABA, Phenolic acids, para-ascorbic acid etc cause seed dormancy.

115. Answer (3)

Hint: Exposure to low temperature for flowering is called vernalization.

Sol.: By vernalization, even some winter varieties are harvested around mid-summer, normally these varieties fail to flower in spring.

116. Answer (3)

Hint: Carotenoid derivative is abscisic acid.

Adenine derivative is cytokinin.

Sol.: In juvenile conifer, maturity is reached early by application of GA.

117. Answer (2)

Hint: Absolute growth is total growth per unit time.

Sol.: Absolute growth rate

$$\frac{30-20}{t} = \frac{10}{5} = 2\ cm^2/day$$

118. Answer (1)

Hint: The permanent cells are present in zone of differentiation.

Sol.: After differentiation, the mature cells can become meristematic again.

119. Answer (3)

Hint: Ethephon hastens fruit ripening

Sol.: It is artificially prepared commercial product.

120. Answer (1)

Hint: Growth in plant continues throughout the life.

Sol.: Meristems are the cells which are capable of self perpetuation.

121. Answer (3)

Hint: Conversion of stage should be permanent and irrerversible.

Sol.: Turgid cells $\underset{\text{Endosmosis}}{\overset{\text{Exosmosis}}{\rightleftarrows}}$ Flaccid cells

122. Answer (1)

Sol.: Development is the sequence of changes related to structure and function of organ and organisms.

123. Answer (1)

Hint: Kinetin is cytokinin which is not found naturally in plants.

Sol.: IAA is natural Auxin. Dormin induces seed dormancy. GA increases size of the apple.

124. Answer (4)

Hint: NADH + H^+ is oxidised through ETC in aerobic respiration.

Sol.: NADH + H^+ is oxidised to NAD^+ slowly in fermentation/anaerobic respiration.

125. Answer (4)

Hint: There is conversion of pyruvate into acetyl CoA in Link reaction.

Sol.: Pyruvate is 3C compound whereas acetyl CoA is 2C compound. Hence one CO_2 molecule is released in Link reaction.

126. Answer (2)

Hint: Krebs cycle takes place in mitochondria.

Sol.: It is also called citric acid cycle, starts with OAA and acetyl CoA.

127. Answer (3)

Hint: Tripalmitin = $C_{51}H_{98}O_6$

Sol.: $2(C_{51}H_{98}O_6) + 145O_2 \rightarrow 102CO_2 + 98\ H_2O$ + energy

128. Answer (4)

Hint: RQ of proteins and fats is less than 1.

Sol.: RQ for proteins is 0.9 and for fats it is 0.7.

129. Answer (3)

Hint: Complete oxidation of one pyruvate gives 15 ATP

Sol.: 1 pyruvate gives 3 ATP from Link reaction and 12 ATP from Krebs' cycle

Total = 3 + 12 = 15

So, 15 × 6 = 90

130. Answer (4)

Sol.: Sugarbeet is biennial as well as long day plant.

131. Answer (3)

Hint: Ethylene increases the number of fruits.

Sol.: Application of ethylene in cucumber increases the number of female flowers thereby increasing the yield.

132. Answer (2)

Hint: Auxin plays an important role in geotropism.

Sol.: Auxin is responsible for geotropism.

Ethylene shows apogeotropism.

133. Answer (1)

Hint: 2, 4-D kills the dicotyledonous weeds

Sol.: 2, 4-D is weedicide also used by gardeners to prepare weed-free lawns.

134. Answer (1)

Hint: Ethylene is a ripening agent.

Sol.: Ripening of fruits can be delayed by gibberellin.

135. Answer (4)

Hint: Redifferentiation of cork cambium leads to the formation of secondary cortex and cork.

Sol.: Primary medullary rays are group of parenchymatous cells present between the vascular bundles. It is made up of differentiated cells.

SECTION - B

136. Answer (1)

Hint: Decapitation prevents apical dominance.

Sol.: Removal of apical buds enhances the lateral growth or lateral bud formation.

137. Answer (1)

Hint: F_0 is an integral membrane protein.

Sol.: F_1 is a peripheral membrane protein complex. Pure proteins are never used as respiratory substrate.

138. Answer (3)

Hint: 1 GTP is generated in Krebs' cycle.

Sol.: One GTP and one $FADH_2$ are formed in each Krebs cycle.

139. Answer (3)

Hint: Cytokinins promote cell division.

Sol.: Cytokinins delay senescence and stimulate lateral shoot growth.

140. Answer (2)

Hint: Heterophylly is the example of plasticity.

Sol.: Plasticity means the ability of plants to follow different pathways and to produce different structures in response to environment.

141. Answer (1)

Hint: Synthesis of chlorophyll is anabolism where succinyl CoA is used as precursor.

Sol.: The conversion of fatty acid to acetyl CoA involves many steps, collectively called β-oxidation.

142. Answer (1)

Hint: ATP is formed in the last step of glycolysis also.

Sol.:

$$\text{PEP} + \text{ADP} \xrightarrow[\text{Mg}^{2+}]{\text{Pyruvate kinase}} \text{Pyruvic acid + ATP}.$$

143. Answer (2)

Hint: NADH is used in the second step of alcoholic fermentation.

Sol.: First step: Pyruvic acid $\longrightarrow$ Acetaldehyde + CO_2

Second step: Acetaldehyde + NADH + H^+ $\rightarrow$ Ethyl alcohol + NAD^+

144. Answer (3)

Hint: In lactic acid fermentation, 2 ATPs are the net gain.

Sol.: $\text{Glucose} \rightarrow \underset{(C_3H_6O_3)}{\text{Lactic acid}} + 2\,\text{ATP}$

145. Answer (1)

Hint: *Clostridium botulinum* can not survive in presence of O_2.

Sol.: Facultative anaerobe can survive even in the absence of oxygen for some time but obligate anaerobes do not survive when exposed to oxygen.

146. Answer (4)

Hint: Gaseous exchange from atmosphere occurs in plants.

Sol.: Availability of oxygen is not a problem for plants. Plants require CO_2 and O_2 from atmosphere.

147. Answer (4)

Hint: Each plant part takes care of its own gaseous exchange need.

Sol.: Simple diffusion is the only means of gaseous exchange within the plant body. From outside it mainly occurs through stomata.

148. Answer (2)

Hint: There are many steps in respiratory pathway.

Sol.: Respiration is basically amphibolic and multistep process.

149. Answer (3)

Hint: Energy currency in the form of ATP is formed in respiration.

Sol.: Biological oxidation of organic molecules results the release of energy of C– C bond in the form of ATP.

150. Answer (2)

Hint: Succinate dehydrogenase is involved in the formation of $FADH_2$.

Sol.: NADH dehydrogenase complex is complex I and $FADH_2$-succinate dehydrogenase complex is complex-II.

[ZOOLOGY]

SECTION - A

151. Answer (2)

Hint: Present in only male cockroach

Sol.: Uricose glands help in excretion only in male cockroach and they are absent in female cockroach.

Malpighian tubules are associated with excretion and osmoregulation. They are present at the junction of midgut and hindgut.

152. Answer (3)

Hint: Their size ranges from 0.6-7.6 cm.

Sol.: In cockroach, a pair of segmented antennae are present, which possess sensory receptors that help in monitoring the environment *i.e.,* detecting the presence of food and object in front of it.

153. Answer (2)

Hint: Used in flying

Sol.: In cockroach, the mesothoracic wings are also called elytra or tegmina, they protect the hind (metathoracic) wings during rest. The hind wings are delicate, transparent and membranous and are used in flight.

154. Answer (3)

Hint: Excluding structure associated with digestive system

Sol.: In cockroach, the hepatic caecae are present in abdominal region which secretes digestive enzymes into midgut. Rest structures are present in the head region of cockroach.

155. Answer (3)

Hint: Total nine in number

Sol.: In cockroach, three ganglia are present in the thorax region and six ganglia are present in the abdomen region.

156. Answer (1)

Hint: Collaterial glands secrete ootheca around fertilised eggs.

Sol.: Collaterial glands and spermatheca are present in reproductive system of only female cockroach. Alary muscles and anal cerci are present in both male and female cockroach.

157. Answer (3)

Hint: Gastric inhibitory peptide

Sol.: Epinephrine and norepinephrine are synergistic pair of hormones. Growth hormone and thyroxine are also synergistic hormones w.r.t protein synthesis and growth. Parathormone and vitamin-D are also synergistic hormones w.r.t blood calcium level. GIP inhibits gastric motility and secretion and thus, acts antagonistic to gastrin hormone.

158. Answer (4)

Hint: Associated with Ca^{+2} metabolism

Sol.: Osteocytes are mature bone cells responsible for maintaining matrix of bone. Glucagon regulates carbohydrate metabolism and mainly acts on liver. It raises blood glucose level by accelerating breakdown of glycogen into glucose.

159. Answer (4)

Hint: Anti-diabetic hormone

Sol.: Growth hormone and adrenaline are hyperglycemic hormones. Insulin acts through GLUT-4 receptors in order to transport glucose in cells and decreases blood glucose level (hypoglycemia). Insulin inhibits metabolic breakdown of stored glycogen in liver and muscle cells.

160. Answer (3)

Hint: These hormones are called catecholamines

Sol.: Epinephrine and norepinephrine are called catecholamines. They are synthesized from adrenal medulla. They act as neurotransmitters (local hormones) in ANS and as hormones in endocrine system. Melatonin, cortisol, calcitonin and relaxin are hormones which do not act as neurotransmitters.

161. Answer (4)

Hint: Hormone mainly synthesized from corpus luteum.

Sol.: Melatonin is derived from amino acid, tryptophan while adrenaline is derived from amino acid, tyrosine. FSH and LH are hormones of hypophysis. Pepsin is an enzyme but gastrin is a hormone. Progesterone and prolactin both stimulate milk secretion.

162. Answer (3)

Hint: Relaxin is a peptide hormone

Sol.: Cortisol, androgens, oestrogens and progesterone are water insoluble hormones and can cross plasma membrane of cells. Their receptors are present within cells. Relaxin is a proteinaceous, water soluble hormone having membrane bound receptors as they cannot directly pass through the membranes.

163. Answer (1)

Hint: Largest endocrine gland of the body

Sol.: Thyrocalcitonin and PTH together regulate the blood Ca^{+2} levels. Hypothalamus is the source gland for vasopressin. Pineal gland synthesizes hormone called melatonin which regulates diurnal rhythm of the body.

164. Answer (3)

Hint: Disease characterised by exophthalmos

Sol.: Graves' disease is caused due to hyperthyroidism, characterised by enlargement of thyroid gland, protrusion of eyeballs, increased BMR and weight loss. Diabetes insipidus, dwarfism and Addison's disease, all are caused due to hyposecretion of their respective hormones.

165. Answer (2)

Hint: Plays major role in development of immune system

Sol.: Thymus gland secretes the peptide hormones called thymosins. Thymosins play a major role in the differentiation of T-lymphocytes and promote production of antibodies from lymphocytes to provide humoral immunity. Corticosteroids (cortisol) have immunosuppressive effect. Gonadotropins (FSH and LH) act on gonads.

166. Answer (4)

Hint: Thyroxine is commonly known as intelligence hormone.

Sol.: Hypothyroidism during pregnancy causes defective development and maturation of the growing baby leading to stunted growth (cretinism), mental retardation, low I.Q., abnormal skin and deaf-mutism.

167. Answer (1)

Hint: The gland is also called epiphysis cerebri

Sol.: The pineal gland is located on the dorsal side of forebrain.

The thyroid gland is composed of two lobes which are located on either side of the trachea.

Thymus is a lobular structure located between lungs behind sternum on the ventral side of aorta.

Pituitary gland is attached to hypothalamus by a stalk.

168. Answer (4)

Hint: Hormonal functions are receptor specific

Sol.: Glucagon acts on liver cells due to the presence of its receptors on plasma membrane of hepatocytes. Receptors for ACTH are present on the cells of adrenal cortex but not on liver cells. So, ACTH cannot act on liver cells and thus, cannot perform glycogenolysis.

169. Answer (2)

Hint: The hormone of pituitary

Sol.: The growth hormone is also known as somatotrophin or somatotrophic hormone. It regulates the growth of the body by promoting protein anabolism, conservation of glucose etc.

Calcitonin decreases blood Ca^{2+} level while parathormone increases blood Ca^{2+} level.

Insulin lowers blood glucose level while glucagon raises blood glucose level.

170. Answer (1)

Hint: Consist of only sterna

Sol.: In female cockroach, the 7th sternum is large, boat-shaped and together with the 8th and 9th sterna forms a brood or genital pouch whose anterior part contains female gonopore and pores of spermatheca and collaterial glands, while its posterior part in which ootheca is formed is called vestibulum.

171. Answer (2)

Hint: Adrenaline causes dilation of pupil

Sol.: Adrenaline and noradrenaline are collectively known as catecholamines which cause pupilary dilation, piloerection (raising of hair), hyperglycemia (increased concentration of blood glucose), sweating, bronchodilation etc.

172. Answer (1)

Hint: Function which decreases blood glucose

Sol.: Glycogenesis is not a function of cortisol. Glucagon and adrenaline are responsible for glycogenolysis which stimulates elevation of blood glucose by converting liver glycogen into glucose.

Cortisol stimulates gluconeogenesis, lipolysis and proteolysis.

173. Answer (1)

Hint: Intercellular messengers

Sol.: Hormones are non-nutrient chemicals which act as intercellular messengers that are produced in trace amounts and generally act on distant cells from site of their secretion.

174. Answer (2)

Hint: Not paired in male cockroach

Sol.: In male, 3 gonapophyses are present, left gonapophyses possess pseudopenis and titillator. A single phallic or conglobate gland is also present in male cockroach. Phallic gland secretes the outer layer of spermatophore.

175. Answer (3)

Hint: Stimulates distribution of melanin

Sol.: MSH is synthesized from the pars intermedia of anterior pituitary. It acts on melanocytes (which contain melanin pigment) and regulates the pigmentation of skin. Trophic hormones are hormones that have other glands as their target and pars distalis of adenohypophyses synthesizes 6 trophic hormones.

176. Answer (3)

Hint: These glands are under the control of hypothalamus.

Sol.: GIT, liver, kidneys and heart are called non-organised endocrine organs.

177. Answer (2)

Hint: Synthesized from atria

Sol.: Atrial natriuretic factor (ANF) is a potent vasodilator (dilate the blood vessels) and thereby decreases the blood pressure and GFR. So, this hormone is considered antagonistic to Renin-Angiotensin-Aldosterone system (RAAS).

178. Answer (3)

Hint: Hormone synthesized from parafollicular cells of thyroid gland

Sol.: TCT is also called as thyrocalcitonin which is synthesized from parafollicular cells of thyroid gland. TCT is responsible for regulating blood calcium levels. It is hypocalcemic hormone. T_4 is thyroxine and PTH is parathormone, a hypercalcemic hormone. GnRH is gonadotrophin releasing hormone.

179. Answer (4)

Hint: Androgens are male sex hormones

Sol.: Thyroxine, erythropoietin, cortisol and testosterone stimulates erythropoiesis, in which only testosterone is a male sex hormone.

180. Answer (3)

Hint: Water soluble hormones

Sol.: Adrenaline, ADH, insulin, calcitonin and parathormone are water soluble hormones and cannot directly pass through the membranes, thus their receptors are present on the cell surface. Cortisol, aldosterone and progesterone are fat soluble hormones and their receptors are intracellular as they can easily pass through plasma membranes of cells and directly enter the cells.

181. Answer (2)

Hint: Hormone which maintains pregnancy

Sol.: Progesterone maintains endometrium lining during secretory phase of menstrual cycle and during pregnancy, progesterone also increases blood supply to endometrium of the uterus. Insulin promotes uptake of amino acids by muscle cells and stimulate protein synthesis.

Catecholamines stimulate the breakdown of glycogen *i.e.*, glycogenolysis.

182. Answer (4)

Hint: Hypercalciuria

Sol.: Parathormone is a hypercalcemic hormone because it increases the blood calcium level by resorption of bones, reabsorption of Ca^{2+} by renal tubules and Ca^{2+} absorption in intestine.

183. Answer (2)

Hint: Disease characterised by glycosuria

Sol.: Diabetes mellitus is caused due to hyposecretion of insulin and is characterised by polyuria, polydipsia (excessive thirst), ketonuria, hyperglycemia (presence of excess glucose in blood) and glycosuria (presence of glucose in urine).

184. Answer (3)

Hint: Between 5 to 10 in numbers

Sol.: 6-8 finger-like structures called hepatic caecae are present at the junction of foregut and midgut. They pour digestive juice into midgut.

185. Answer (2)

Hint: The gland secretes thymosin.

Sol.: Thymus is a bilobed gland situated in mediastinum, ventral side to the aorta. It is responsible for the maturation of T-lymphocytes, which provide cell-mediated immunity.

SECTION - B

186. Answer (1)

Hint: Carries sperm from testis to seminal vesicle

Sol.: Male cockroach possess one pair of testes lying one on each lateral side of 4^{th} to 6^{th} abdominal segments, and from each testis a single vas deferens arises.

Vas deferens carries sperms from testis to ejaculatory duct through seminal vesicle.

187. Answer (2)

Hint: Between 10 to 15

Sol.: In *Periplaneta*, the nymph grows by moulting about 13 times to reach the adult form. Moulting is regulated by several hormones. This development includes wings formation, growth of body size, colouration change and development of genitalia.

188. Answer (3)

Hint: Has sensory receptors

Sol.: Mouth parts of cockroach consist of labrum or upper lip, a pair of mandibles, a pair of maxillae, the labium or lower lip and the hypopharynx (act as tongue).

In cockroach, the duct of salivary gland opens at the base of hypopharynx.

The maxilla has maxillary palp which possess sensory receptors.

189. Answer (2)

Hint: Also called neck

Sol.: The head of cockroach is connected with thorax by a short extension of prothorax which is called as neck.

190. Answer (3)

Hint: Colourless blood called haemolymph.

Sol.: Cockroach possess open circulatory system and blood is devoid of any respiratory pigment so called haemolymph. It does not assist in respiration.

191. Answer (3)

Hint: Hypoglycemic hormone

Sol.: Insulin acts mainly on hepatocytes and adipocytes and increases permeability of glucose which results in rapid movement of glucose from blood to hepatocytes and adipocytes. As a result, blood glucose level decreases, resulting in hypoglycemia.

Pancreas is mixed or composite or heterocrine gland of endodermal origin. It acts as both exocrine and endocrine gland.

192. Answer (3)

Hint: Somatotrophic hormone

Sol.: Hypersecretion of growth hormone before epiphyseal fusion in bone leads to gigantism.

Excess secretion of GH in adults, especially in middle age can result in severe disfigurement, particularly in bones of face is called acromegaly. Hyposecretion of thyroxine causes cretinism.

193. Answer (4)

Hint: Nurse cells secrete inhibin

Sol.: Sertoli cells are present in seminiferous tubules and secrete inhibin, ABP (androgen binding protein) and mullerian regression factor. Oestrogen is secreted from growing follicles and progesterone is mainly secreted from corpus luteum. α and β cells are present in islets of Langerhans of pancreas.

194. Answer (3)

Hint: Present from the segment to which crop extends.

Sol.: Male reproductive system consists of a pair of testes, one lying on each lateral side of the 4^{th}-6^{th} abdominal segments. In female cockroach, two large ovaries are present in the lateral side of 2^{nd}-6^{th} abdominal segments.

195. Answer (1)

Hint: Oestrogen causes mineralisation of bones

Sol.: Parathormone increases the activity of bone dissolving cells called osteoclasts. So, hyperparathyroidism and/or hyposecretion of oestrogen leads to osteoporosis. During pregnancy, GnRH is inhibited by sex hormones, so, secretion of gonadotropins is also inhibited. ACTH mainly regulates the secretion of glucocorticoids.

196. Answer (1)

Hint: Granulosa cells

Sol.: Development of primary follicle upto mature Graafian follicle occurs during follicular phase of menstrual cycle. These developing ovarian follicles synthesize oestrogen.

197. Answer (3)

Hint: Testosterone is a male sex hormone.

Sol.: Testosterone acts on CNS and influences the male sexual behavior (libido). These hormones stimulate muscular growth, growth of facial and axillary hair, aggressiveness, low pitch of voice etc. Female sexual behaviour is influenced by female sex hormone, oestrogen.

198. Answer (3)

Hint: Endocrine system is not directly connected with part under control.

Sol.: The neural coordination is fast but short lived.

The response of chemical coordination is slow but it lasts long.

199. Answer (3)

Hint: Steroids are derivatives of cholesterol

Sol.: Steroids and iodothyronines are fat soluble hormones and interact with intracellular receptors. They regulate gene expression by the interaction of hormone-receptor complex with the genome. Fat soluble hormones do not generate second messengers.

200. Answer (2)

Hint: Anterior lobe is related with portal circulation.

Sol.: A – Posterior pituitary

B – Portal circulation

C – Hypothalamic neurons

D – Hypothalamus

Hypothalamus is the basal part of diencephalon, forebrain.

Hormones originating in the hypothalamic neurons, pass through axons and are released from their nerve endings. These hormones reach pituitary through a portal circulation and regulate the functions of anterior pituitary.

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