All India Aakash Test Series for NEET-2024

TEST-6 (Code-C)

Test Date : 26/02/2023

ANSWERS

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

HINTS & SOLUTIONS

[PHYSICS]

SECTION - A

1. Answer (2)

Hint & Sol.: $v_{RMS} = \sqrt{\frac{(2u)^2 + (4u)^2 + (5u)^2 + (10u)^2}{4}}$

$= \sqrt{\frac{4u^2 + 16u^2 + 25u^2 + 100u^2}{4}}$

$= \frac{u}{2}\sqrt{145}$

2. Answer (4)

Hint: $C_P - C_V = R$

and $\frac{C_P}{C_V} = \gamma$

Sol.: $C_P - C_V = R$

$\Rightarrow C_V = \frac{3}{2}R$

$\Rightarrow \gamma = \frac{C_P}{C_V} = \frac{\frac{5}{2}R}{\frac{3}{2}R} = \frac{5}{3}$

3. Answer (3)

Hint: $W = nR\Delta T$

$Q = nC_P\Delta T$

Sol.: $\frac{W}{Q} = \frac{nR\Delta T}{nC_P\Delta T} = \frac{R}{\frac{7}{2}R}$

$= \frac{2}{7}$

4. Answer (3)

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

and T = Constant (for isothermal process)

Sol.: T = Constant

$\Delta U = nC_V\Delta T$

$\Delta U = 0$ $(\Delta T = 0)$

Applying first law of thermodynamics

$\Delta Q = W + \Delta U$

$\Delta Q = 200$ J

5. Answer (4)

Hint: $\eta = 1 - \frac{T_L}{T_H}$

Sol.: $T_L = 27°C = 300$ K

$T_H = 427°C = 700$ K

$\eta = 1 - \frac{T_L}{T_H} \Rightarrow \eta = \left(1 - \frac{3}{7}\right)$

$\eta(\%) = \frac{400}{7}\%$

6. Answer (2)

Hint: $Q = nC\Delta T$

Sol.: $Q = nC\Delta T$

$Q = 0$

$\therefore C = 0$

7. Answer (2)

Hint: Work done by gas = Area under P-V graph.

Sol.: If cyclic process is clockwise then work done by gas is positive.

$W = \pi ab = \pi \frac{(5P_0 - 3P_0)}{2}\frac{(2V_0 - V_0)}{2}$

$= \frac{\pi}{2}P_0V_0$

8. Answer (2)

Hint: At STP 22.4 litre of gas contains 1 mole of gas.

Sol.: At STP volume of 1 mole of gas = 22.4 litre

Number of moles

$n = \frac{5.6}{22.4} = \frac{1}{4}$

Total number of molecules $= \frac{1}{4} \times 6.02 \times 10^{23}$

$= 1.505 \times 10^{23}$

9. Answer (3)

Hint: $P = \frac{m}{3V}v_{RMS}^2$

Sol.: $P_i = \frac{m}{3V}v_{RMS}^2$ ...(i)

$P_f = \frac{\left(\frac{m}{2}\right)}{3V}(3v_{RMS})^2$,...(ii)

By equation (i) and (ii)

$$\frac{P_f}{P_i}=\frac{\left(\frac{m/2}{3V}\right)9v_{RMS}^2}{\frac{m}{3V}v_{RMS}^2}=\frac{9}{2}$$

10. Answer (2)

Hint: $a_{max}=\omega^2A$

Sol.: $a_{max}=\omega^2A$

$$=\left(\frac{2\pi}{2}\right)^2\times 30$$

$= 30\pi^2$ cm/s^2

11. Answer (3)

Hint: Average velocity = $\frac{\text{Displacement}}{\text{time}}$

Sol.: $x_0 = 5\cos0° = 5$ cm

$$x_{2/3}=5\cos\left(\frac{\pi}{2}\times\frac{2}{3}\right)=\frac{5}{2}=2.5$$

Average velocity = $\frac{\text{Displacement}}{\text{time}}$

$$=\frac{5-2.5}{2/3}$$

$$=\frac{7.5}{2}=3.75 \text{ cm/s}$$

12. Answer (2)

Hint & Sol.: $A=\frac{F_0}{\left\{m^2\left(\omega^2-\omega_d^2\right)^2+\omega_d^2b^2\right\}^{\frac{1}{2}}}$ (formula)

13. Answer (3)

Hint: $|V_{max}|=A\omega$

$|a_{max}|=A\omega^2$

Sol.: $A\omega = 10$ cm/s …(i)

$A\omega^2 = 100\pi$ cm/s^2 …(ii)

By equation (i) and (ii)

$$\omega=\frac{100\pi}{10}=10\pi$$

$\Rightarrow A(10\pi) = 10$

$$\Rightarrow A=\frac{1}{\pi}\text{ cm}$$

14. Answer (1)

Hint: Loudness = $10\log_{10}\frac{I}{I_0}$

Sol.: $20=10\log_{10}\frac{I}{10^{-12}}$

$\Rightarrow I = 10^{-10}$ W/m^2

15. Answer (1)

Hint: Since all odd and even harmonics are produced it should be an open organ pipe.

Sol.: Fundamental frequency is HCF of all the values

$\therefore$ Fundamental frequency = 140 Hz

First overtone = 280 Hz

16. Answer (3)

Hint: Time Period = $\frac{1}{\nu_1-\nu_2}$

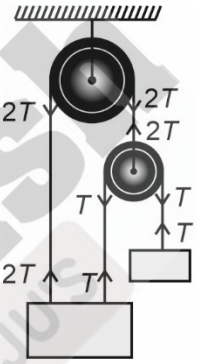
Sol.: $T=\frac{1}{705-700}=\frac{1}{5}$

= 0.2 s

17. Answer (3)

Hint: $V=\sqrt{\frac{T}{\mu}}$

Sol.:



$$V_1=\sqrt{\frac{T}{\mu}}$$

$$V_2=\sqrt{\frac{2T}{\mu}}$$

Ratio $\frac{V_1}{V_2}=\frac{\sqrt{\frac{T}{\mu}}}{\sqrt{\frac{2T}{\mu}}}=\frac{1}{\sqrt{2}}$

18. Answer (2)

Hint: $V_P=-\frac{dy}{dx}\times$ wave velocity

Sol.: $V_P=-\frac{dy}{dx}\times$ wave velocity

Wave velocity is negative.

If slope of point is positive then it is going up at the moment.

If slope of point is negative then point is coming down at the moment.

19. Answer (3)

Hint: $f' = \frac{v}{v - v_s} f$

Sol.: $f' = \frac{v}{v - v_s} f$

Frequency is maximum for point *A*.

Frequency is minimum for point *B*.

20. Answer (3)

Hint: Beat frequency = $|f_1 - f_2|$

Sol.: $|f - f_1| = 4$

f = 154 Hz or 146 Hz

Second harmonic of 154 Hz produces 6 beats with 302 Hz.

21. Answer (4)

Hint: $L = 10\log_{10}\frac{I}{I_0}$

Sol.: $10\log_{10}\frac{I}{I_0} = 20$

$I = 10^{-10}$ W/m^2

New Intensity = $\left(\sqrt{I} + \sqrt{I}\right)^2 = 4I$

$L' = 10\log_{10}\frac{4I}{I_0}$

$= 10\log_{10}\frac{I}{I_0} + 10\log_{10} 4$

= 20 + 6 = 26 dB

22. Answer (2)

Hint & Sol.: n^{th} overtone is $(2n + 1)$ harmonic

$\therefore$ $(n - 1)^{th}$ overtone is $(2(n - 1) + 1)$ harmonic

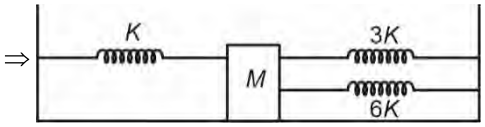
$= (2n - 1)$

23. Answer (1)

Hint: $T = 2\pi\sqrt{\frac{M}{K_{eff}}}$

Sol.: 2*K* and 2*K* are in series their effective spring constant is *K*.

6*K* and 6*K* are in series combination and the effective spring constant is 3*K*



$K_{eff} = K + 3K + 6K = 10K$

$T = 2\pi\sqrt{\frac{M}{10K}}$

24. Answer (1)

Hint: $T = 2\pi\sqrt{\frac{L}{g_{eff}}}$

Sol.: $g_{eff} = g - a$

$= \pi^2 - \frac{\pi^2}{4} = \frac{3\pi^2}{4} \approx \frac{3}{4}g$

$T' = 2\pi\sqrt{\frac{4L}{3g}} \Rightarrow T' = \sqrt{\frac{4}{3}}T$

25. Answer (3)

Hint: Total mechanical energy = $\frac{1}{2}m\omega^2A^2$

Sol.: $Y_1 = A\sin\omega t$

$Y_2 = 2A\sin\left(\omega t + \frac{\pi}{2}\right)$

$A' = \sqrt{A^2 + (2A)^2} = A\sqrt{5}$

Total oscillation energy = $\frac{1}{2}m\omega^2\left(A\sqrt{5}\right)^2$

$= \frac{5}{2}m\omega^2A^2$

26. Answer (1)

Hint & Sol.: At same pressure, $V \propto T$

Hence, $T_1 > T_2 > T_3$

27. Answer (3)

Hint: $\Delta KE = nC_V\Delta T$

Sol.: $\frac{1}{2}nM(2v)^2 = n \times \frac{3}{2}R\Delta T$

$\frac{M \times 4v^2}{3R} = \Delta T$

$\Delta T = \frac{4Mv^2}{3R}$

28. Answer (3)

Hint: $f_{mix} = \frac{n_1f_1 + n_2f_2}{n_1 + n_2}$

Sol.: $f_{mix} = \frac{n_1f_1 + n_2f_2}{n_1 + n_2}$

$= \frac{\frac{7n}{10} \times 5 + \frac{6n}{10} \times 3}{\frac{7n}{10} + \frac{6n}{10}}$

$= \frac{53}{13}$

29. Answer (1)

Hint: Process is adiabatic in nature.

For adiabatic process PV^{γ} = constant

Sol.: $PV^{5/3} = P'\left(\frac{V}{27}\right)^{5/3}$

At NTP, P = 1 atm

$P' = 3^5P$

$= 243P$

= 243 atm

30. Answer (2)

Hint: $C = C_V + \frac{R}{1-\alpha}$

Sol.: $U = nC_VT = a(V)^{1/3}$

$\frac{3}{2}PV = a(V)^{1/3}$

$\Rightarrow PV^{2/3}$ = Constant

$C = C_V + \frac{R}{1-\left(\frac{2}{3}\right)}$

$= \frac{3}{2}R + 3R = \frac{9R}{2}$

31. Answer (3)

Hint: $\Delta U = nC_V\Delta T$

Sol.: Let final temperature T_1, T_2, T_3 and T_4

$T_1 > T_2 > T_3 > T_4$ ($PV = nRT$)

Hence, $|\Delta U_1| > |\Delta U_2| > |\Delta U_3| > |\Delta U_4|$

32. Answer (4)

Hint & Sol.: Since there is no force of attraction or repulsion between gas molecules.

$\therefore$ Potential energy will be zero.

33. Answer (2)

Hint: $Q = W + \Delta U$

Sol.: $80 = -20 + (U_f - U_i)$

$100 = U_f - 250$

U_f = 350 J

34. Answer (2)

Hint: $B = \frac{-dP}{\frac{dV}{V}}$

Sol.: For adiabatic process PV^{γ} = Constant

Differentiating above equation with respect to V

$P\gamma V^{\gamma-1} + V^{\gamma}\frac{dP}{dV} = 0$

$\Rightarrow B = \frac{-dP}{\frac{dV}{V}} = \gamma P$

$\Rightarrow B = \frac{5}{3}P$

35. Answer (4)

Hint: $\eta = 1 - \frac{T_2}{T_1}$

Sol.: $\eta_i = 1 - \frac{304}{380} = \frac{1}{5}$

$\eta_f = 1 - \frac{304-19}{380} = \frac{1}{4}$

$\frac{\eta_f}{\eta_i} = \frac{\frac{1}{4}}{\frac{1}{5}} = \frac{5}{4}$

SECTION - B

36. Answer (1)

Hint & Sol.: $Q = W + \Delta U$

ΔU is same for both path (1) and (2) as it is state function.

$W_1 > W_2$ (Work = Area under P-V graph)

$\therefore Q_1 > Q_2$

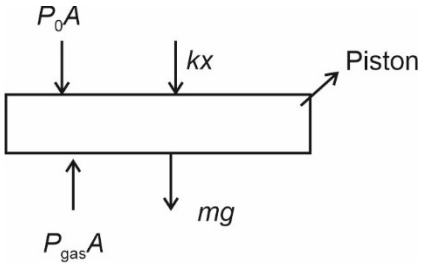
$\frac{Q_1}{Q_2} > 1$

37. Answer (3)

Hint: At equilibrium

$F_{net} = 0$

Sol.:



$PA = Kx + P_0A + mg$

$\frac{(P-P_0)A}{K} - \frac{mg}{K} = x$

38. Answer (2)

Hint: $PV = nRT$

Sol.: $P_i = \frac{P_0}{1+\left(\frac{V_0}{V_0}\right)^3} = \frac{P_0}{2}$

$$P_f = \frac{P_0}{1+\left(\frac{V_0}{2V_0}\right)^3} = \frac{P_0}{1+\frac{1}{8}} = \frac{8P_0}{9}$$

$P_fV_f - P_iV_i = nR\Delta T$

$$\frac{8P_0}{9}\times 2V_0 - \frac{P_0}{2}\times V_0 = R\Delta T$$

$$\frac{16P_0V_0}{9} - \frac{P_0V_0}{2} = R\Delta T$$

$$\frac{23P_0V_0}{18R} = \Delta T$$

39. Answer (2)

Hint: $\eta = \frac{W}{Q}$

Sol.: W = Area under P-V graph

$= P_0 \times 3V_0 = 3P_0V_0$

$Q_{AB} = nC_V\Delta T$

$$= \frac{3}{2}(P_BV_B - P_AV_A)$$

$$= \frac{3}{2}(2P_0V_0 - P_0V_0)$$

$$= \frac{3}{2}P_0V_0$$

$$Q_{BC} = nC_P\Delta T = \frac{5}{2}(P_CV_C - P_BV_B)$$

$$= \frac{5}{2}(2P_0\times 4V_0 - 2P_0\times V_0)$$

$$= \frac{5}{2}(6P_0V_0) = 15P_0V_0$$

$$Q = Q_{AB} + Q_{BC} = \left(\frac{3}{2}+15\right)P_0V_0$$

$$= \frac{33}{2}P_0V_0$$

$$\eta = \frac{W}{Q} = \frac{3P_0V_0}{\frac{33}{2}P_0V_0} = \frac{2}{11} = \frac{200}{11}\%$$

40. Answer (2)

Hint: $Q = \Delta U + W$

Sol.: $T_i = \frac{10P_0\times V_0}{nR} = T_f$

$\therefore \Delta T = 0 \Rightarrow \Delta U = 0$

Therefore, heat supplied is equal to the work done

$Q = W$

$$Q = \frac{1}{2}\times\frac{7}{3}V_0\times 7P_0 + 7P_0V_0$$

$$Q = \frac{91P_0V_0}{6}$$

41. Answer (2)

Hint: $\lambda = \frac{1}{\sqrt{2}\,n\pi d^2}$

Sol.: Number density

$$n = \frac{N}{V} = \frac{P}{K_BT} = \frac{101\times 10^3}{1.381\times 10^{-23}\times 350}$$

$\approx 2.09 \times 10^{25}$ molecules/m^3

$$\lambda = \frac{1}{\sqrt{2}\times\pi\times\left(2.09\times 10^{25}\right)\times\left(0.6\times 10^{-10}\right)^2}$$

$= 0.299 \times 10^{-5}$ m

42. Answer (3)

Hint: Oxygen has 2 degree of freedom for rotational kinetic energy.

Sol.: $f_R = 2$

$$U_R = \frac{nf_R}{2}RT$$

$$= \frac{5}{2}2RT$$

$\Rightarrow x = 2$

43. Answer (2)

Hint & Sol.: In $t_1 \Rightarrow 2$ cm

Next $t_2 \Rightarrow 3$ cm

$t_1 + t_2 = 2$ s

Since, $T = 8$ s, then particle will reach mean from extreme position in 2s.

44. Answer (2)

Hint & Sol.: $U = 2\left(1-\cos\frac{x}{2}\right)$

$$\frac{1}{2}m\omega^2x^2 = 2.2\sin^2\left(\frac{x}{4}\right)$$

$$\frac{1}{2}\omega^2x^2 \approx 4\times\frac{x^2}{16}$$

$$\omega^2 = \frac{1}{2} \Rightarrow \omega = \frac{1}{\sqrt{2}}$$

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

45. Answer (3)

Hint: $f = \frac{(n+1)V}{2L}$ for n^{th} overtone (open pipe)

$f = \frac{(2n+1)V}{4L}$ for n^{th} overtone (closed pipe)

Sol.: $\frac{f_1}{f_2} = \frac{\frac{6V}{2L}}{\frac{11V}{4L}} = \frac{12}{11}$

46. Answer (1)

Hint: 

$L = \frac{5\lambda}{2}$

Sol.: $k = \frac{2\pi}{\lambda} = 0.6 \text{ cm}^{-1}$

$\lambda = \frac{2\pi}{0.6}$

$L = \frac{5\lambda}{2} = \frac{5\pi}{0.6}$ cm

= 26.17 cm

47. Answer (1)

Hint: Beats = $|f_1 - f_2|$

Sol.: $2f_0 = \frac{v}{2L}$

Beats = $f_1 - f_2$

$= \frac{v}{2\left(\frac{L}{2} - \Delta L\right)} - \frac{v}{2\left(\frac{L}{2} + \Delta L\right)}$

$\approx \frac{16 f_0 \Delta L}{L}$

48. Answer (4)

Hint: $f = \left(\frac{v + v_0}{v}\right) f_0$

Sol.: $v_0 = gt$

$f = f_0 + \left(\frac{f_0 g}{v}\right) t$

Slope = $\frac{f_0 g}{v}$

$v = \frac{f_0 g}{\text{Slope}} = \frac{10^3 \times 10}{\frac{500}{15}} = 300$ m/s

49. Answer (2)

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

Sol.: $v = \omega\sqrt{A^2 - \frac{3A^2}{4}} = \frac{\omega A}{2}$

$= \frac{2\pi}{T}\frac{A}{2} = \frac{\pi A}{T}$

50. Answer (4)

Hint: $v = \sqrt{\frac{T}{\mu}} = \sqrt{\frac{T}{\rho A}}$

Sol.: $T = \frac{\Delta L A Y}{L}$ …(i)

$v = \sqrt{\frac{T}{\rho A}} = \sqrt{\frac{\Delta L A Y}{L \cdot \rho A}} = \sqrt{\frac{\Delta L Y}{L\rho}}$ …(ii)

$\therefore \frac{v'}{v} = \sqrt{5}$

$v' = \sqrt{5}\, v$

[CHEMISTRY]

SECTION - A

51. Answer (2)

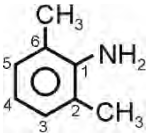
Hint: Structure of But-2-enal is

$CH_3 - CH = CH - CHO$

Sol.: Number of σ bonds and π bonds are 10 and 2 respectively.

52. Answer (4)

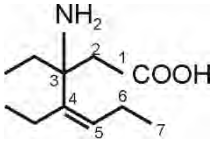
Hint: In aniline $-NH_2$ is principal functional group

Sol.: 

2,6-Dimethylaniline

53. Answer (4)

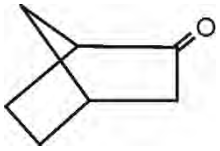
Hint: In IUPAC naming –COOH is highest priority functional group

Sol.: 

3-Amino-3,4-diethylhept-4-enoic acid

54. Answer (2)

Hint: Carbonyl carbon having α-H (not attached to bridgehead carbon) shows tautomerism.

Sol.:  it has 2α–H atoms so shows tautomerism.

55. Answer (3)

Hint: The compound having more stable conjugate base is more acidic.

Sol.: Stability of conjugate bases is, as

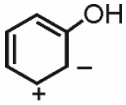
$$\overset{\ominus}{C}\equiv CH > \overset{\ominus}{C}H = CH_2 > \overset{\ominus}{C}H_2 - CH_3$$

Hence, Acidity order is

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

56. Answer (4)

Hint: Resonating structures having its octet complete are more stable.

Sol.: 

Incomplete octet of carbon with positive charge.

57. Answer (1)

Hint: More the electron withdrawing nature of a group, more will be the –I effect.

Sol.: –I effect order is found as

$$-\overset{+}{N}R_3 > -NO_2 > -OH$$

58. Answer (4)

Hint: Stability of carbocation decreases with increase in –I effect.

Sol.: $\overset{\oplus}{C}H_2 - \underset{\alpha}{CH_2} - \underset{\beta}{CH_2} - \underset{\gamma}{CH_2}$ (δ-CH_2–F)

fluorine atom is attached to δ-carbon hence minimum –I effect is observed.

59. Answer (3)

Hint: Greater the electron donating effect of alkyl group, less acidic the molecule is

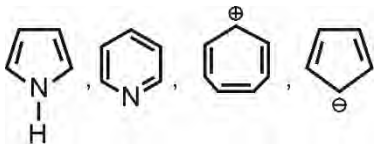
Sol.: As, +I effect increases in the order $-CH_3 < -C_2H_5 < -C_3H_7$

So, acidic strength decreases as methanoic acid > ethanoic acid > propanoic acid.

60. Answer (4)

Hint : For species to be aromatic, the ring should be cyclic, planar and should contain $(4n + 2)\pi$ electron in conjugation.

Sol.:



are aromatic species.

61. Answer (2)

Hint: Electron donating groups destabilise carbanions.

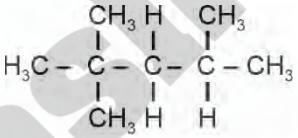
Sol.: $CH_3 - \overset{\ominus}{\underset{CH_3}{C}} - CH_2 - CH_3$ is least stable due to more +I effect.

62. Answer (1)

Hint & Sol.: $-CH_2 - \underset{CH_3}{\overset{CH_3}{C}} - CH_3$ is neopentyl group

63. Answer (1)

Hint: Structure of isooctane is



Sol.: IUPAC name of isooctane is 2,2,4-trimethyl pentane.

64. Answer (1)

Hint: Steam distillation is applied to separate substances which are volatile and are immiscible with water.

Sol.: Aniline and water mixture is separated by steam distillation.

65. Answer (3)

Hint: $\%N = \dfrac{\text{weight of 'N'}}{\text{weight of organic compound}} \times 100$

Sol.: $n_{N_2} = \dfrac{22.4}{22400} = 10^{-3}$

$w_{N_2} = 10^{-3} \times 28\ g$

$\%N = \dfrac{28 \times 10^{-3}}{0.5} \times 100 = 5.6\%$

66. Answer (4)

Hint & Sol.: Chromatography is the best and latest technique for isolation, purification and separation of organic compounds.

67. Answer (4)

Hint: Molecules having different functional groups are functional isomers of each other

Sol.:

	Functional group
$CH_3-CH_2-CH_2-\overset{\overset{O}{\|\|}}{C}-OH$	Carboxylic acid
$CH_3-CH_2-\underset{\underset{OH}{\|}}{CH}-\overset{\overset{O}{\|\|}}{C}-H$	Alcohol and aldehyde

68. Answer (3)

Hint: Different types of 'H' atoms give isomeric monochloro derivatives.

Sol.: $CH_3-\overset{\overset{CH_3}{|}}{\underset{\underset{H}{|}}{C}}-CH_2-CH_3$

four monochloro derivative possible.

$CH_2(Cl)-\overset{\overset{CH_3}{|}}{\underset{\underset{H}{|}}{C}}-CH_2-CH_3$, $CH_3-\overset{\overset{CH_3}{|}}{\underset{\underset{Cl}{|}}{C}}-CH_2-CH_3$,

$CH_3-\overset{\overset{CH_3}{|}}{\underset{\underset{H}{|}}{C}}-\underset{\underset{Cl}{|}}{CH}-CH_3$, $CH_3-\overset{\overset{CH_3}{|}}{\underset{\underset{H}{|}}{C}}-CH_2-\underset{\underset{Cl}{|}}{CH_2}$,

69. Answer (4)

Hint: Higher the molecular mass or surface area, more will be the van der Waals forces and more will be the boiling point.

Sol.: As branching increases, surface area decreases for isomeric alkanes hence, boiling point also decreases.

Correct order of boiling point:

n-pentane > isopentane > neopentane

70. Answer (2)

Hint & Sol.: Kjeldahl method is not applicable to compounds containing nitrogen in azo groups as nitrogen of these groups can not change to ammonium sulphate.

71. Answer (1)

Hint: Addition of HBr to alkene in presence of peroxide proceeds through free radical intermediate.

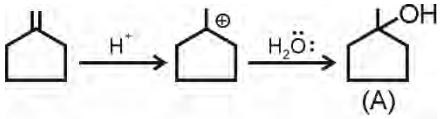
Sol.:

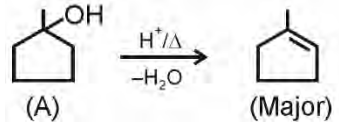
$$CH_3CH_2-CH=CH_2 \xrightarrow[\text{Peroxide}]{HBr} CH_3-CH_2-CH_2-CH_2-Br$$

72. Answer (2)

Hint: Addition of H^+ to alkene produces carbocation intermediate.

Sol.:

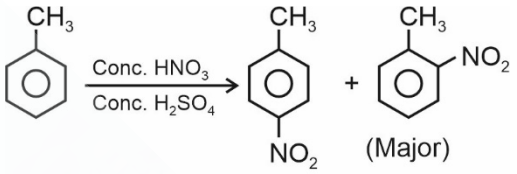




73. Answer (1)

Hint: Mixture of conc. HNO_3 and conc. H_2SO_4 produces $\overset{+}{N}O_2$ electrophile.

Sol.:



74. Answer (4)

Hint:

- Hydroboration-oxidation reaction gives anti-Markovnikov product.
- Oxymercuration-demercuration reaction gives Markovnikov product.

Sol.:

$$CH_3-\overset{\overset{CH_3}{|}}{C}=CH_2 \xrightarrow[(ii)\ H_2O_2/OH^-]{(i)\ BH_3/THF} CH_3-\overset{\overset{CH_3}{|}}{\underset{\underset{H}{|}}{C}}-CH_2-OH \quad (A)$$

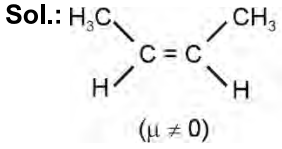
$$CH_3-\overset{\overset{CH_3}{|}}{C}=CH_2 \xrightarrow[(ii)\ NaBH_4/OH^-]{(i)\ (CH_3COO)_2Hg/H_2O} CH_3-\overset{\overset{CH_3}{|}}{\underset{\underset{OH}{|}}{C}}-CH_3 \quad (B)$$

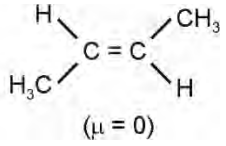
'A' and 'B' are position isomers of each other.

75. Answer (3)

Hint: Cis-but-2-ene and trans-2-butene are geometrical isomers.

Sol.:





76. Answer (2)

Hint & Sol.:

- Wurtz reaction

$$2CH_3Br + 2Na \xrightarrow[\text{ether}]{\text{dry}} CH_3-CH_3$$

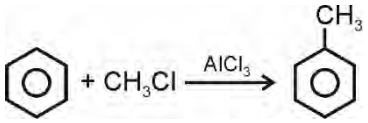
- Sodalime decarboxylation

$CH_3COONa + NaOH \xrightarrow[\Delta]{CaO} CH_4$

- Kolbe's Electrolysis

$CH_3COO^-Na^+(aq) \xrightarrow{\text{electrolysis}} CH_3 - CH_3$

- Friedel-Crafts alkylation



77. Answer (1)

Hint: Fluorine is explosively reactive and react in dark, iodine is unreactive in halogenation of alkanes.

Sol.: Reactivity order of halogens is

$F_2 > Cl_2 > Br_2 > I_2$

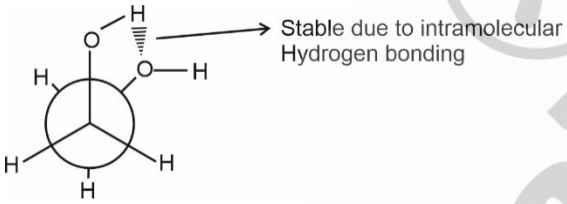
78. Answer (4)

Hint & Sol.: n-Hexane $\xrightarrow[773\ K,\ 10\ atm]{Cr_2O_3}$ 

79. Answer (2)

Hint: Conformer in which effective intramolecular H-bonding can occur, will be stable.

Sol.:



80. Answer (2)

Hint: Hybridization of carbon in CO_2 is *sp*.

Sol.:

$HC \equiv CH + O_2 \longrightarrow CO_2 + H_2O$

sp hybridized *sp* hybridized

81. Answer (4)

Hint: Photochemical smog is oxidising in nature

Sol.: Sulphur dioxide is a component of classical smog.

82. Answer (4)

Hint & Sol.: Ozone, carbondioxide, methane and water vapours are some examples of greenhouse gases.

83. Answer (1)

Hint: BOD is the amount of oxygen required by bacteria to break down the organic matter present in a certain volume of a sample of water.

Sol.: BOD of clean water should be less than 5 ppm.

84. Answer (3)

Hint: Nitrate ion concentration causes blue baby syndrome.

Sol.:

Excessive ion	Harmful effect
Sulphate	Laxative effect
Nitrate	Blue baby syndrome
Fluoride	Brown mottling of teeth

85. Answer (4)

Hint: Carboxyhaemoglobin is 300 times more stable than oxyhaemoglobin.

Sol.:

- Carbon monoxide is produced due to incomplete combustion of hydrocarbon.
- It reduces oxygen carrying ability of blood.

SECTION - B

86. Answer (1)

Hint: Stability of free radical increases as number of α-hydrogen increases.

Sol.:

- $CH_3 - Cl \rightarrow \dot{C}H_3 + \dot{C}l$
- Stability order:

$$\dot{C}H_3 < \dot{C}H_2CH_3 < \dot{C}H(CH_3)_2 < \dot{C}(CH_3)_3$$

87. Answer (3)

Hint: Electrophiles are electron deficient species.

Sol.: BF_3, Cl^+, $CH_3 - \overset{+}{C} = O$, $\overset{+}{N}O_2$ are electrophiles.

88. Answer (2)

Hint: Number of α-Hydrogen = Number of hyper conjugative structures.

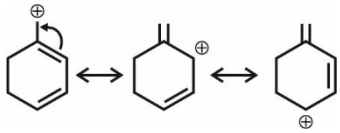
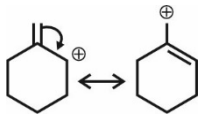
Sol.:

Carbocation	Number of hyper conjugative structures
$CH_3 - \overset{\oplus}{C}H_2$	3
$CH_3 - \overset{\oplus}{C}H - CH_3$	6
$H_3C - \underset{CH_3}{\overset{CH_3}{\overset{\oplus}{C}}}$	9
$(CH_3)_3C - \underset{C(CH_3)_3}{\overset{\oplus}{C}} - C(CH_3)_3$	0

89. Answer (2)

Hint: Carbocation adjacent to double bond carbon will participate in resonance.

Sol.:

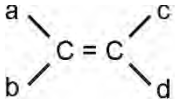
- 
-  (no resonance as no conjugation)
- 
- 

90. Answer (2)

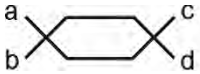
Hint & Sol.: Lone pair that is participating in resonance does not participate in hybridisation.

91. Answer (1)

Hint: Condition of geometrical isomerism for alkene

 $a \neq b$ and $c \neq d$

Condition of geometrical isomerism for cycloalkane

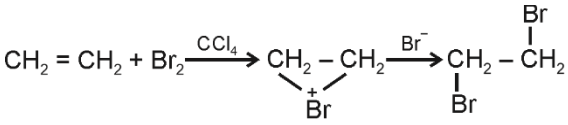
 $a \neq b$ and $c \neq d$

Sol.: $CH_3CH = CH_2$ does not show geometrical isomerism.

92. Answer (1)

Hint: Br_2/CCl_4 generates electrophiles.

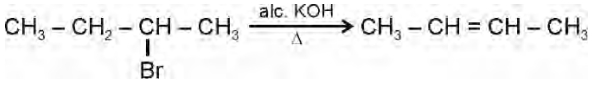
Sol.:



93. Answer (3)

Hint: Heating of alkyl halide in presence of alc. KOH gives Saytzeff alkene as major product.

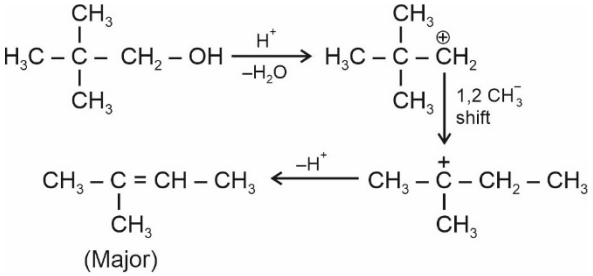
Sol.:



94. Answer (1)

Hint: Carbocation intermediate rearranges to form stable carbocation.

Sol.:

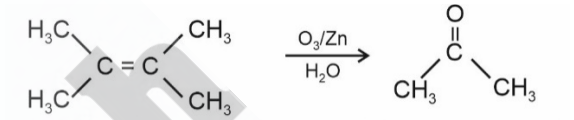


(Major)

95. Answer (4)

Hint: Alkene on reductive ozonolysis gives aldehyde or ketone.

Sol.:



(2,3-dimethyl but-2-ene) (Acetone, 2 moles)

96. Answer (4)

Hint: Calcium carbide on hydrolysis gives ethyne gas.

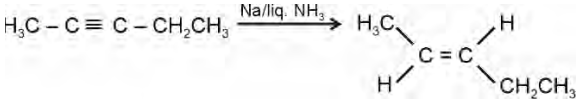
Sol.: $\underset{}{CaC_2} + H_2O \rightarrow \underset{(A)}{C_2H_2} + \underset{(B)}{Ca(OH)_2}$

$C_2H_2 \xrightarrow[\text{Fe tube, 873K}]{\text{Red Hot}} \text{Benzene (C)}$

97. Answer (2)

Hint: Birch reduction is used to convert alkyne to trans alkene.

Sol.:



98. Answer (1)

Hint & Sol.: If pH of rain water falls below 5.6 it is called acid rain.

99. Answer (2)

Hint & Sol.: Maximum limit of nitrate ion in drinking water is 50 ppm.

100. Answer (4)

Hint & Sol.: Microorganism present in the soil acts as a sink for carbon monoxide.

[BOTANY]

SECTION - A

101. Answer (2)

Hint: It occurs in the cytoplasm of the cell.

Sol.:

- It is the first and common step for both the types of respiration.
- The scheme of glycolysis was given by Gustav Embden, Otto Meyerhof and J. Parnas, thus often referred to as EMP pathway.
- It involves partial oxidation of glucose to form two molecules of pyruvic acid.

102. Answer (2)

Hint: Hexokinase catalyses phosphorylation of glucose to glucose-6-phosphate.

Sol.:

- Phosphohexoisomerase catalyses isomerisation of glucose-6-phosphate to fructose-6-phosphate.
- Enolase converts 2-phosphoglycerate to phosphoenolpyruvate (PEP).

103. Answer (2)

Hint: Sucrose is a disaccharide. It is converted into monomeric units glucose and fructose by enzyme invertase.

Sol.:

- Compounds which are oxidised during respiration are respiratory substrates.
- The breakdown of glucose to pyruvic acid is called glycolysis.

104. Answer (3)

Hint: Site of Krebs cycle or TCA cycle is mitochondrial matrix, thus all the enzymes involved are found in matrix except one that convert succinate into fumarate.

Sol.: Succinate dehydrogenase (SDH) enzyme is found attached to inner side (matrix side) of inner mitochondrial membrane.

105. Answer (3)

Hint: Cytochrome *c* acts as mobile carrier for transfer of electrons between complex III and IV.

Sol.: Cytochrome *c* is a small protein attached to the outer surface of inner mitochondrial membrane.

106. Answer (4)

Hint: Mesosomes are present in prokaryotic cells.

Sol.: Site of respiratory ETS in our body is inner mitochondrial membrane.

- Cytoplasm is site of glycolysis.
- Mitochondrial matrix is site of Krebs cycle.

107. Answer (1)

Hint: In lactic acid fermentation, pyruvic acid is converted to lactic acid with no release of CO_2.

Sol.:

- Glycolysis is conversion of glucose into pyruvic acid.
- In Krebs cycle, complete oxidation of acetyl CoA takes place.

108. Answer (4)

Hint: TCA cycle is also known as citric acid cycle because the first product of this cycle is citric acid.

Sol.: The TCA cycle starts with condensation of acetyl CoA with oxalo-acetic acid (OAA).

109. Answer (1)

Hint: $L_t = L_0 + rt$ represents arithmetic growth.

Sol.: Exponential growth is represented by

$W_1 = W_0 e^{rt}$

Where, W_1 = final size

W_0 = initial size

r = growth rate

t = time of growth

e = base of natural logarithms

110. Answer (3)

Hint: The period of growth is generally divided into three phases, namely, meristematic, elongation and maturation phases.

Sol.: Elongation phase shows increased vacuolation, cell enlargement and new cell wall deposition.

In maturation phase cells attain maximal size in terms of wall thickening and protoplasmic modifications.

111. Answer (3)

Hint: ABA is called stress hormone.

Sol.: Auxin is growth hormone, Cytokinin is anti-ageing hormone. Ethylene is called fruit ripening hormone.

112. Answer (2)

Hint: Charles Darwin and his son Francis Darwin first observed bending response to unilateral light in canary grass (coleoptile tips).

Sol.:

- Auxins help in initiating root formation in stem cuttings or callus.
- Auxins cause apical dominance.
- Cytokinin counteracts apical dominance.

113. Answer (2)

Hint: Duration of periodic exposure to light and dark phases and its response w.r.t. flowering is known as photoperiodism.

Sol.: Vernalisation is qualitative or quantitative dependence on exposure to low temperature.

- Seed dormancy is failure of seed germination even when external conditions are favourable.
- Plasticity is ability of certain plants to follow different pathways in response to environment or phases of life to form different kind of structures.

114. Answer (1)

Hint: In developmental plasticity, leaves of the juvenile plant are different in shape from those in mature plants. It is observed in cotton, coriander and larkspur.

Sol.: Buttercup is an example of environmental plasticity, in which difference in shapes of leaves produced in air and in water is observed.

115. Answer (3)

Hint: Decarboxylation is removal of CO_2.

Sol.: Oxalosuccinic acid is 6-C acid from which CO_2 is removed to form α-KGA, (5-C acid).

116. Answer (1)

Hint: Proteins and fats can also be used as respiratory substrates. They are oxidised and catabolised.

Sol.: Proteins are deaminated into pyruvic acid and fats are broken into fatty acids and glycerols. Glycerol will enter in respiratory pathway in the form phosphoglyceraldehyde.

117. Answer (2)

Hint: ATP is directly synthesised during substrate level phosphorylation.

Sol.: During link reaction only $NADH_2$ is released which is further converted into ATP by oxidative phosphorylation via ETS.

118. Answer (2)

Hint: The final electron and hydrogen acceptor in respiratory ETS is O_2. It combines them and forms H_2O. Thus, ATP and H_2O are obtained.

Sol.: Acetyl-CoA is used to synthesise gibberellic acids.

119. Answer (3)

Hint: During Krebs cycle $FADH_2$ is formed at a single step.

Sol.: Krebs cycle occurs in mitochondrial matrix and is also known as citric acid cycle (Tricarboxylic acid cycle). During Krebs cycle $3NADH_2$ and 1 $FADH_2$ are synthesised.

120. Answer (2)

Hint: $FADH_2$ and $NADH_2$ are reduced co-enzymes.

Sol.: 5 $NADH_2$ and 1 $FADH_2$ i.e. total 6 reduced co-enzymes are formed during complete oxidation of one molecule of 3-PGAL.

121. Answer (2)

Hint: ATP synthesis by oxidative phosphorylation is coupled with ETS in respiration.

Sol.: Chemiosmosis requires a proton gradient across the membrane.

122. Answer (1)

Hint: Apical dominance is the phenomenon by which the presence of apical bud does not allow the nearby lateral or axillary buds to grow.

Sol.: Auxins induce apical dominance but cytokinins counteract apical dominance.

123. Answer (4)

Hint: Growth inhibiting activities include dormancy, senescence, abscission etc.

Sol.: ABA is a plant growth inhibitor.

124. Answer (2)

Hint: Chemicals used to kill unwanted plants (weeds) are known as weedicides.

Sol.: 2,4-D (auxin) is widely used as weedicide.

125. Answer (1)

Hint: Photoperiodism is response of plants with respect to changes in the relative lengths of dark and light periods.

Sol.: Photoperiodism does not alter seed viability.

126. Answer (4)

Hint: Abscission is falling of plant parts (leaves, fruits and flowers).

Sol.: Ethylene and ABA both promote abscission.

127. Answer (4)

Hint: Dormancy is inactive period of seed or tuber during which it fails to germinate.

Sol.: Seed and tuber dormancy is induced by plant growth inhibitor ABA.

128. Answer (3)

Hint: Re-differentiated tissues are secondary permanent tissues formed during secondary growth.

Sol.: Cork cambium and intervascular cambium are de-differentiated or secondary meristematic tissues.

Apical meristem is primary meristem. Secondary xylem is re-differentiated or secondary permanent tissue.

129. Answer (3)

Hint: Ethylene is volatile.

Sol.: IAA and IBA are natural auxin.

Ethylene is gaseous and volatile in nature.

130. Answer (1)

Hint: Rooting in stem cuttings is induced by auxins.

Sol.: Ethylene induces development of adventitious roots, lateral roots and growth of root hairs.

131. Answer (3)

Hint: Vernalisation is a process by which flowering is either qualitatively or quantitatively dependent on exposure to low temperature.

Sol.: Vernalisation is applicable to winter annuals and biennials.

132. Answer (4)

Hint: F.W. Went isolated auxin from tips of coleoptiles of oat seedlings.

Sol.: F. Skoog and his co-workers observed cytokinins from tobacco cells. Miller *et.al*. (1955), discovered first cytokinin.

133. Answer (3)

Hint: The 'bakane' (foolish seedling) disease of rice seedlings was caused by a fungal pathogen and the hormone was named after this fungus.

Sol.: Gibberellins were discovered during study of bakane disease.

134. Answer (3)

Sol.: Single maize root apical meristem can give rise to more than 17,500 new cells per hour.

Cells in watermelon may increase in size by upto 3,50,000 times.

135. Answer (1)

Hint: Auxins are synthesised from an amino acid.

Sol.: Tryptophan is an aromatic amino acid that acts as precursor for biosynthesis of auxins.

SECTION - B

136. Answer (3)

Hint: A five carbon molecule acts as substrate for synthesis of amino acid.

Sol.:

- Succinyl CoA is raw material for synthesis of chlorophyll, cytochrome etc.
- Acetyl CoA is raw material for carotenoids, terpenes, gibberellins etc.
- α-KGA is raw material for amino acid synthesis.
- Oxaloacetic acid is raw material for alkaloids, pyrimidines etc.

137. Answer (1)

Hint: Respiratory quotient (RQ) is the ratio of the volume of CO_2 evolved to the volume of O_2 consumed in respiration.

Sol.:

- Organic acids have RQ > 1 like RQ for malic acid is 1.33.
- RQ for carbohydrate is 1.
- RQ for proteins is 0.9.
- RQ for fatty acids (Tripalmitin) is 0.7.

138. Answer (4)

Hint: Plant growth is unique because plants retain the capacity for unlimited growth throughout their life.

Sol.: This ability of unlimited growth is due to presence of meristematic tissues.

139. Answer (3)

Hint: Cells of meristematic zone are living.

Sol.: Cell walls of cells of meristematic zone are primary in nature, thin and cellulosic.

140. Answer (2)

Hint: An amino acid is precursor of ethylene.

Sol.: Abscisic acid is carotenoid derivative. Cytokinin is adenine derivative.

Gibberellins are terpene derivative.

141. Answer (3)

Hint: S-shaped curve is obtained in exponential growth.

Sol.: On plotting the length of the organ against time, a linear curve is obtained in arithmetic growth.

142. Answer (1)

Hint: NADPH is not synthesised during Krebs cycle.

Sol.: The conversion of succinyl CoA to succinic acid in Krebs cycle results in synthesis of GTP.

143. Answer (1)

Hint: Vernalisation prevents early reproductive development in winter annuals.

Sol.: Spring crops do not depend on vernalisation for reproductive development.

144. Answer (3)

Sol.: Tomato is a day neutral plant. Wheat and henbane are LDP while tobacco is SDP.

145. Answer (4)

Hint: There are more than 100 types of known gibberellins.

Sol.: GA_3 was one of the first gibberellins to be discovered and remains the most extensively studied form.

146. Answer (4)

Hint: Glycolysis is conversion of one molecule of glucose into two molecules of pyruvic acid.

Sol.: No CO_2 is released during glycolysis process.

147. Answer (4)

Hint: Yeasts poison themselves to death when alcohol concentration reaches about 13%.

Sol.: Cytochrome c is mobile electron carrier of respiratory ETS.

148. Answer (1)

Sol.: Ethylene promotes horizontal growth of seedlings and apical hook formation.

149. Answer (4)

Sol.: Ethylene is the hormone having both growth promotory and inhibitory functions.

150. Answer (2)

Hint: In most situations, ABA acts as an antagonist to GAs.

Sol.: Abscisic acid (ABA) is anti-GA hormone.

[ZOOLOGY]

SECTION - A

151. Answer (2)

Hint: Not a characteristic feature of *Paramecium*

Sol.: No members of kingdom Animalia are unicellular. All are multicellular. Their body is made up of more than one cell. Now some can have hundreds of cells and some others millions or trillions of cells. But, they all are said to exhibit multicellularity.

Notochord is present only in chordates. Pattern of organisation vary from cellular to organ-system level of organisation. They may be acoelomates, pseudocoelomates or coelomates.

152. Answer (1)

Hint: Coelenterates and ctenophores

Sol.: Tissue level of organisation is somewhat higher and complex to cellular level in which similar cells which perform the same function are arranged to form tissues. The tissues perform the various basic functions of animals. This level of organisation is present in coelenterates and ctenophores.

Sycon, *Spongilla* and *Euspongia* belong to the phylum Porifera while *Hydra*, *Adamsia* and *Meandrina* belong to phylum Coelenterata.

Pleurobrachia is a ctenophore.

153. Answer (3)

Hint: Belongs to the category of flatworms

Sol.: When the body can be divided into identical left and right halves in only one plane, it is called bilateral symmetry and the animals possessing this type of symmetry are called bilaterally symmetrical. Animals like platyhelminths, annelids, arthropods, *etc.*, are bilaterally symmetrical.

When any plane passing through the central axis of the body divides the organism into two identical halves, it is called radial symmetry. Coelenterates, ctenophores and adult echinoderms have this kind of symmetry.

Sponges are mostly asymmetrical.

154. Answer (4)

Hint: Possess comb plates

Sol.: Bioluminescence is well-marked in ctenophores. Ctenophores are commonly known as sea walnuts or comb jellies.

Sea mouse (*Aphrodite*) belongs to phylum Annelida.

Sea hare is a mollusc and sea horse is a bony fish.

155. Answer (3)

Hint: Exclusively marine organisms

Sol.: Mesoderm layer is not present between ectoderm and endoderm in diploblastic animals, rather an undifferentiated, jelly-like mesoglea, is present in between them. This mesoglea is called undifferentiated because this layer is not specialised to form any particular tissue/organ of the body.

Coelenterates and ctenophores are diploblastic animals and lack mesoderm. Platyhelminthes are triploblastic.

156. Answer (2)

Hint: Largest phylum of kingdom Animalia

Sol.: Coelenterates and ctenophores exhibit tissue level of organisation.

Porifers (sponges) show cellular level of organisation while platyhelminthes exhibit organ level of organisation and arthropods have organ-system level of organisation.

157. Answer (4)

Hint: Equal to the number of ganglia present in abdomen of *Periplaneta*

Sol.: In *Periplaneta*, head is small and roughly triangular in shape. It lies anteriorly at right angle (perpendicularly) to the longitudinal body axis. It is formed by the fusion of six embryonic segments.

158. Answer (3)

Hint: Possess grinding and incising region

Sol.: The mouthparts of cockroach consists of a labium (lower lip), a labrum (upper lip), a pair of mandibles and a pair of maxillae.

A median flexible lobe, acting as tongue (hypopharynx), lies within the cavity enclosed by the mouthparts.

159. Answer (3)

Hint: In sponges, fertilisation does not occur in water

Sol.: In sponges, choanocytes or collar cells line the spongocoel and the canals.

In sponges, sexes are not separate (hermaphrodite), *i.e.*, eggs and sperms are produced by the same individual. Sponges reproduce asexually by fragmentation and sexually by formation of gametes. Fertilisation is internal and development is indirect having a larval stage which is morphologically distinct from the adult.

160. Answer (2)

Hint: True coelom is found from annelids to chordates

Sol.: The true coelom is a body cavity which arises from embryonic mesoderm. True coelom is found from annelids to chordates.

In open type of circulation, the body cells and tissues are directly bathed in the blood pumped out of the heart as the blood flows in open spaces. Present in arthropods, non-cephalopod molluscs, hemichordates and tunicates.

Development is indirect in molluscs, hemichordates, echinoderms and some arthropods.

161. Answer (2)

Hint: Possess well-developed muscular pharynx

Sol.: *Ascaris* belongs to the phylum Aschelminthes which possess the pseudocoelom and hence called pseudocoelomates. In these, the body cavity is present but is not lined by the mesoderm, instead the mesoderm is present as scattered pouches in between the ectoderm and endoderm.

Segmentation is seen in annelids, arthropods and chordates, while it is absent in molluscs and echinoderms.

162. Answer (3)

Hint: Parapodia assists in swimming in aquatic annelids

Sol.: Malpighian tubules are the excretory structures of most of the insects including cockroaches. *Laccifer* belongs to the phylum Arthropoda.

Flame cells are the excretory structures of Platyhelminthes.

Radula is a file-like rasping organ for feeding in molluscs.

Aquatic annelids like *Nereis* possess lateral appendages, parapodia, which help in swimming.

163. Answer (4)

Hint: Sun basking is common in reptiles.

Sol.: Reptiles are poikilotherms while mammals are homeotherms.

In reptiles, birds and mammals, fertilisation is internal and mode of respiration is by lungs. Direct development is seen in reptiles and mammals.

164. Answer (2)

Hint: One of the earliest domesticated animal

Sol.: *Felis* is the genus of cats and *Canis* is the genus of dogs.

165. Answer (2)

Hint: Belongs to category known as tunicata

Sol.: *Salamandra* (Salamander) belongs to the class Amphibia and can live in aquatic as well as terrestrial habitats.

Amphioxus belongs to subphylum Cephalochordata in which notochord extends from head to tail region and is persistent throughout their life.

Petromyzon belongs to class Cyclostomata.

166. Answer (2)

Hint: Possess cartilaginous vertebral column

Sol.: The number of cervical vertebrae are seven in almost all mammals including human beings except certain mammals, eg., sloth and manatee.

In reptiles, heart is usually three-chambered, but four-chambered in crocodiles.

Open circulatory system is present in non-cephalopod molluscs while closed circulatory system is present in cephalopod molluscs.

Cyclostomes have a sucking and circular mouth but lack jaws (Agnatha), scales and paired fins.

167. Answer (1)

Hint: Male members of this class bear claspers.

Sol.: Reptiles are mostly terrestrial and their body is covered by dry and cornified skin.

The skin of amphibians are usually without scales, but scales if present are hidden beneath the skin. *e.g., Ichthyophis.*

Mammals are viviparous with few exceptions, *e.g., Ornithorhynchus.*

Members of class Chondrichthyes possess two-chambered heart with one auricle and one ventricle.

168. Answer (3)

Hint: Characteristic of bony fishes

Sol.: Sting ray (*Trygon*) belongs to class Chondrichthyes in which gill slits are separate and without operculum (gill cover).

Mouth is located ventrally and their skin is tough, containing minute placoid scales.

They are marine fishes with streamlined body and have cartilaginous endoskeleton.

169. Answer (4)

Hint: Ventral hardened plate

Sol.: The entire body of *Periplaneta americana* is covered externally by a non-living brown-coloured, hard and chitinous exoskeleton composed of several plates called sclerites.

Exoskeleton for each segment consists of a dorsal tergum, a ventral sternum and lateral pleura; these plates are joined to each other by a thin and flexible articular membrane (arthrodial membrane).

170. Answer (4)

Hint: Also termed as elytra

Sol.: Forewings (mesothoracic wings) are thick, leathery, opaque and dark coloured structures, which are somewhat narrow at the distal end. They are larger than the second pair of wings. They are not used for flight, instead they cover and protect the metathoracic wings. Hence, they are also called wing covers or tegmina or elytra.

Hind wings (metathoracic wings) are delicate, thin, transparent and membranous structures with broad terminal end. They are used for flight, but in the resting position, they lie folded below the tegmina.

171. Answer (3)

Hint: Supra-oesophageal ganglion supplies nerves to antennae.

Sol.: If the head of cockroach is removed, it may live for few days because the head holds a small proportion of nervous system while the rest is situated along the ventral part of its body.

Brain is represented by supra-oesophageal ganglion which is a large, bilobed mass located in the head above oesophagus. It supplies nerves to antennae and compound eyes. The sub-oesophageal ganglion lies below oesophagus.

172. Answer (3)

Hint: Also present in birds

Sol.: At the junction of midgut and hindgut, there is a ring of 100-150 yellow coloured thin filamentous Malpighian tubules.

- Heart of cockroach consists of elongated muscular tube lying along mid-dorsal line of thorax and abdomen.
- The respiratory system consists of a network of trachea, that open through 10 pairs of small holes called spiracles present on the lateral side of the body.
- Gizzard has an outer layer of thick circular muscles which are needed by the gizzard for grinding.

173. Answer (2)

Hint: Structure which is filled with spermatozoa in females

Sol.: Male reproductive system consists of a pair of testes one lying on each lateral side in the 4^{th} -6^{th} abdominal segments. A characteristic mushroom shaped gland is present in the 6^{th} -7^{th} abdominal segments which functions as an accessory reproductive gland.

- The female reproductive system consists of two large ovaries, lying laterally in the 2^{nd} -6^{th} abdominal segments.
- A pair of spermatheca is present in the 6^{th} abdominal segment which opens into the female genital chamber.

174. Answer (1)

Hint: Type of epithelium present in uterus

Sol.: Malpighian tubules are attached to the alimentary canal at the junction of midgut and hindgut. These are fine, long, unbranched, yellowish blind tubules lying freely in the haemolymph.

Each tubule is lined by glandular epithelium with characteristic ciliated cells. They absorb nitrogenous waste products and convert them into uric acid which is excreted through hindgut.

175. Answer (3)

Hint: External genitalia

Sol.: Anal cerci are long and thick structures found in both male and female cockroach and are sensitive to sound and other vibrations.

Anal styles project backwardly from the sides of the 9^{th} sternum of the male cockroach only. They are sensitive to touch.

In both the sexes, the genital aperture is surrounded by sclerites known as gonapophyses or phallomeres.

176. Answer (3)

Hint: Transparent and more or less hexagonal biconvex areas

Sol.: The most important sense organs in cockroach are a pair of large, sessile, compound eyes which are situated at the dorsal surface of the head. These eyes are black and kidney-shaped. Each consists of about 2,000 visual elements or units, called ommatidia; which are transparent and more or less hexagonal biconvex areas, capable of forming an image.

Each ovary consists of eight elongated, tapering and beaded, blind tubules called ovarioles.

From each testis arise a thin vas deferens, which opens into ejaculatory duct through seminal vesicle.

177. Answer (1)

Hint: Spermatophore

Sol.: The sperms are stored in the seminal vesicles and are glued together in the form of bundles called spermatophores which are discharged during copulation.

The external genitalia are represented by male gonapophysis or phallomere (chitinous asymmetrical structures, surrounding the male gonopore).

Fertilised eggs become surrounded by the secretion of collaterial glands, which hardens to form an egg case or ootheca.

178. Answer (3)

Hint: Equals to the number of heart chambers in *Pavo*

Sol.: In females, the 7th sternum is boat shaped and together with the 8th and 9th sterna forms a brood or genital pouch whose anterior part contains female gonopore, spermathecal pores and two separate openings of collaterial glands.

179. Answer (1)

Hint: Sponges and flatworms are bisexual

Sol.:

- (a) *Spongilla* and (c) *Taenia*, both of them are hermaphrodites (monoecious).
- (b) *Adamsia* is an acoelomate, diploblastic coelenterate.
- (d) *Ascaris* shows sexual dimorphism.

180. Answer (4)

Hint: Possess water canal system

Sol.: *Planaria* belongs to the phylum Platyhelminthes and have the ability to replace its lost or damaged parts. It shows high regeneration power.

The body of coelenterates bears a central gastrovascular cavity which opens to the outside through a single opening which performs function of both mouth and anus.

181. Answer (3)

Hint: Diploid sexual stages

Sol.: *Nereis* (sand worm) belongs to the phylum Annelida and is dioecious. They possess longitudinal and circular muscles which help in locomotion.

Obelia belongs to the phylum Coelenterata and is radially symmetrical, exhibits metagenesis or alternation of generation between sexual and asexual stages of life cycle.

Limulus belongs to phylum Arthropoda and exhibits jointed appendages.

182. Answer (1)

Hint: Seen in annelids as well

Sol.: *Periplaneta americana* belongs to the phylum Arthropoda and body cavity of arthropods is called haemocoel. In arthropods, true coelom is of schizocoelom type, which develops by the splitting up of mesoderm.

The development of cockroach is through gradual metamorphosis *i.e.*, occurs through series of nymphal stages and is known as paurometabolous.

183. Answer (4)

Hint: Assists in storage of uric acid

Sol.: Excretory system regulates the amount of nitrogenous material, inorganic salts and water in the blood or hemolymph.

Excretory system of both male and female includes the following:

Malpighian tubules, fat bodies and nephrocytes while uricose gland is present in male cockroach only.

184. Answer (3)

Hint: Largest part of the foregut

Sol.: Oesophagus opens into a sac like structure called crop used for storage of food. It is followed by gizzard or proventriculus. Gizzard helps in grinding of the food particles. Gastric caecae are present at the junction of foregut and midgut, which secrete digestive juice.

185. Answer (4)

Hint: Possess direct development

Sol.:

- Cuttlefish belongs to the phylum Mollusca.
- Hagfish is a cyclostome.
- Sea hare is a mollusc.
- Sea urchin is an echinoderm.
- Silkworm is an arthropod.

SECTION - B

186. Answer (1)

Hint: Endoskeleton is made up of cartilage

Sol.: Silver fish, star fish and devil fish belong to the phylum Arthropoda, Echinodermata and Mollusca respectively.

Dog fish is a cartilaginous fish belonging to class Chondrichthyes of superclass Pisces.

187. Answer (3)

Hint: Worm-like marine animals

Sol.: Hemichordates have a rudimentary structure in the collar region called stomochord, a structure similar to notochord.

This phylum consists of a small group of worm-like marine animals with organ-system level of organisation. Excretory organ is proboscis gland.

188. Answer (3)

Hint: Teeth are backwardly directed

Sol.: *Carcharodon* (Great white shark) belongs to class Chondrichthyes which possess minute placoid scales. The members of class Osteichthyes possess cycloid/ctenoid scales.

189. Answer (2)

Hint: Contains dorsal anus and gonapophyses

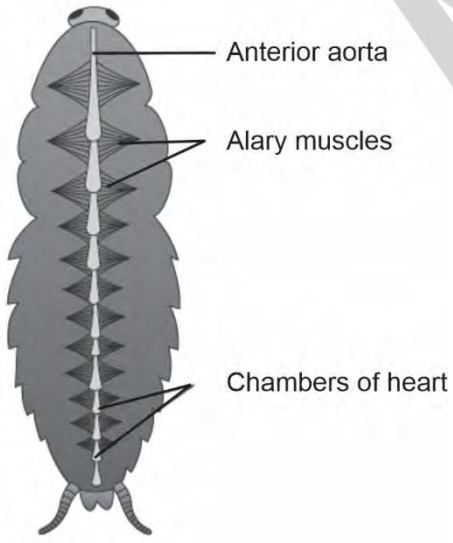
Sol.: Male genital pouch contains the dorsal anus, ventral male genital pore and gonapophyses.

- *Periplaneta americana* are about 34-53 mm long with wings that extend beyond the tip of the abdomen in males.
- In both the sexes, the 10^{th} segment bears a pair of jointed filamentous structures called anal cerci.

190. Answer (3)

Hint: Equal to the times of moulting in a cockroach

Sol.:



191. Answer (4)

Hint: Possess monocondylic skull and are aquatic

Sol.:

Calotes	–	3-chambered heart
Wuchereria and *Schistosoma*	–	Unsegmented body
Equus	–	Viviparous

192. Answer (1)

Hint: Excludes largest living bird species

Sol.: *Struthio* (ostrich) and *Aptenodytes* (penguin) are flightless birds and have well-developed powerful legs, small head and rudimentary wings.

Corvus (crow), *Columba* (pigeon), *Psittacula* (parrot), *Neophron* (vulture) and *Pavo* (peacock) are flying birds.

193. Answer (1)

Hint: An echinoderm and a mollusc

Sol.: Echinoderms are exclusively marine while molluscs are found in all habitats: oceans, coral reefs, deserts, forests, rivers, lakes and even underground.

- Both echinoderms and molluscs are triploblastic, have unsegmented body and organ system level of organisation.
- Echinoderms lack an excretory organ while in molluscs, the gills perform the excretion along with respiration.

194. Answer (2)

Hint: Possess excretory pore

Sol.: Round worm, hookworm and filarial worm belong to the phylum Aschelminthes.

- Sea lily and sea cucumber are echinoderms while sea horse belongs to class Osteichthyes.
- Lancelet is a cephalochordate, lamprey is a cyclostome and tusk shell is a mollusc.
- Flying fish is a chordate while jelly fish is a non-chordate.

195. Answer (3)

Hint: Gnathostomata includes pisces and tetrapods

Sol.:

Catla	– Freshwater fish
Pristis	– Marine fish
Gnathostomata	– Division
Cyclostomata	– Class
Pisces and Tetrapoda	– Superclass

196. Answer (1)

Hint: Member of Urochordata

Sol.:

- *Doliolum* belongs to sub-phylum Urochordata, in which notochord is present only in the tail of the larva and disappears in the adult form.
- In cephalochordates, notochord persists throughout their life.

197. Answer (4)

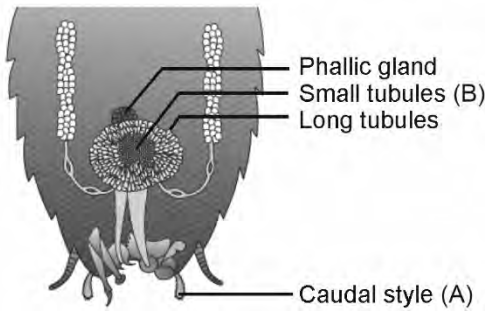
Hint: Cockroach is a non-chordate

Sol.: In cockroach, central nervous system is ventral, solid and double. The nervous system of cockroach consists of a series of fused, segmentally arranged ganglia joined by paired longitudinal connectives on the ventral side.

198. Answer (3)

Hint: Present only in males

Sol.: The diagram represents male cockroach's reproductive system.



199. Answer (4)

Hint: Present in thorax region

Sol.: Head region of cockroach comprises sense organs like eyes, antennae and mouth parts.

Pronotum is a part of thorax.

200. Answer (1)

Hint: Tapeworm

Sol.: Hooks and suckers are present in the parasitic forms of phylum Platyhelminthes.

Ascaris and *Ancylostoma* belong to the phylum Aschelminthes.

Culex is an arthropod

❑ ❑ ❑

All India Aakash Test Series for NEET-2024

TEST-6 (Code-D)

Test Date : 26/02/2023

ANSWERS

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

HINTS & SOLUTIONS

[PHYSICS]

SECTION - A

1. Answer (4)

Hint: $\eta = 1 - \frac{T_2}{T_1}$

Sol.: $\eta_i = 1 - \frac{304}{380} = \frac{1}{5}$

$\eta_f = 1 - \frac{304 - 19}{380} = \frac{1}{4}$

$\frac{\eta_f}{\eta_i} = \frac{\frac{1}{4}}{\frac{1}{5}} = \frac{5}{4}$

2. Answer (2)

Hint: $B = \frac{-dP}{\frac{dV}{V}}$

Sol.: For adiabatic process PV^{γ} = Constant

Differentiating above equation with respect to V

$P\gamma V^{\gamma-1} + V^{\gamma}\frac{dP}{dV} = 0$

$\Rightarrow B = \frac{-dP}{\frac{dV}{V}} = \gamma P$

$\Rightarrow B = \frac{5}{3}P$

3. Answer (2)

Hint: $Q = W + \Delta U$

Sol.: $80 = -20 + (U_f - U_i)$

$100 = U_f - 250$

$U_f = 350$ J

4. Answer (4)

Hint & Sol.: Since there is no force of attraction or repulsion between gas molecules.

$\therefore$ Potential energy will be zero.

5. Answer (3)

Hint: $\Delta U = nC_V\Delta T$

Sol.: Let final temperature T_1, T_2, T_3 and T_4

$T_1 > T_2 > T_3 > T_4$ $(PV = nRT)$

Hence, $|\Delta U_1| > |\Delta U_2| > |\Delta U_3| > |\Delta U_4|$

6. Answer (2)

Hint: $C = C_V + \frac{R}{1-\alpha}$

Sol.: $U = nC_VT = a(V)^{1/3}$

$\frac{3}{2}PV = a(V)^{1/3}$

$\Rightarrow PV^{2/3}$ = Constant

$C = C_V + \frac{R}{1-\left(\frac{2}{3}\right)}$

$= \frac{3}{2}R + 3R = \frac{9R}{2}$

7. Answer (1)

Hint: Process is adiabatic in nature.

For adiabatic process PV^{γ} = constant

Sol.: $PV^{5/3} = P'\left(\frac{V}{27}\right)^{5/3}$

At NTP, P = 1 atm

$P' = 3^5P$

$= 243P$

= 243 atm

8. Answer (3)

Hint: $f_{mix} = \frac{n_1f_1 + n_2f_2}{n_1 + n_2}$

Sol.: $f_{mix} = \frac{n_1f_1 + n_2f_2}{n_1 + n_2}$

$= \frac{\frac{7n}{10}\times 5 + \frac{6n}{10}\times 3}{\frac{7n}{10} + \frac{6n}{10}}$

$= \frac{53}{13}$

9. Answer (3)

Hint: $\Delta KE = nC_V\Delta T$

Sol.: $\frac{1}{2}nM(2v)^2 = n\times\frac{3}{2}R\Delta T$

$\frac{M\times 4v^2}{3R} = \Delta T$

$\Delta T = \frac{4Mv^2}{3R}$

10. Answer (1)

Hint & Sol.: At same pressure, $V \propto T$

Hence, $T_1 > T_2 > T_3$

11. Answer (3)

Hint: Total mechanical energy = $\frac{1}{2}m\omega^2A^2$

Sol.: $Y_1 = A\sin\omega t$

$Y_2 = 2A\sin\left(\omega t + \frac{\pi}{2}\right)$

$A' = \sqrt{A^2 + (2A)^2} = A\sqrt{5}$

Total oscillation energy = $\frac{1}{2}m\omega^2\left(A\sqrt{5}\right)^2$

$= \frac{5}{2}m\omega^2A^2$

12. Answer (1)

Hint: $T = 2\pi\sqrt{\frac{L}{g_{eff}}}$

Sol.: $g_{eff} = g - a$

$= \pi^2 - \frac{\pi^2}{4} = \frac{3\pi^2}{4} \approx \frac{3}{4}g$

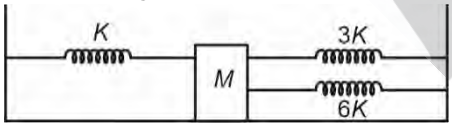
$T' = 2\pi\sqrt{\frac{4L}{3g}} \Rightarrow T' = \sqrt{\frac{4}{3}}T$

13. Answer (1)

Hint: $T = 2\pi\sqrt{\frac{M}{K_{eff}}}$

Sol.: $2K$ and $2K$ are in series their effective spring constant is K.

$6K$ and $6K$ are in series combination and the effective spring constant is $3K$

$\Rightarrow$ 

$K_{eff} = K + 3K + 6K = 10K$

$T = 2\pi\sqrt{\frac{M}{10K}}$

14. Answer (2)

Hint & Sol.: n^{th} overtone is $(2n + 1)$ harmonic

$\therefore$ $(n - 1)^{th}$ overtone is $(2(n - 1) + 1)$ harmonic

$= (2n - 1)$

15. Answer (4)

Hint: $L = 10\log_{10}\frac{I}{I_0}$

Sol.: $10\log_{10}\frac{I}{I_0} = 20$

$I = 10^{-10}$ W/m^2

New Intensity = $\left(\sqrt{I} + \sqrt{I}\right)^2 = 4I$

$L' = 10\log_{10}\frac{4I}{I_0}$

$= 10\log_{10}\frac{I}{I_0} + 10\log_{10}4$

= 20 + 6 = 26 dB

16. Answer (3)

Hint: Beat frequency = $|f_1 - f_2|$

Sol.: $|f - f_1| = 4$

f = 154 Hz or 146 Hz

Second harmonic of 154 Hz produces 6 beats with 302 Hz.

17. Answer (3)

Hint: $f' = \frac{v}{v - v_s}f$

Sol.: $f' = \frac{v}{v - v_s}f$

Frequency is maximum for point A.

Frequency is minimum for point B.

18. Answer (2)

Hint: $V_P = -\frac{dy}{dx} \times$ wave velocity

Sol.: $V_P = -\frac{dy}{dx} \times$ wave velocity

Wave velocity is negative.

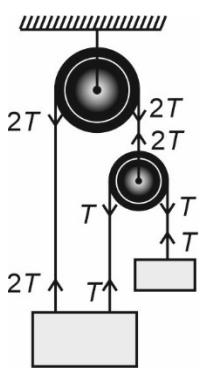
If slope of point is positive then it is going up at the moment.

If slope of point is negative then point is coming down at the moment.

19. Answer (3)

Hint: $V = \sqrt{\frac{T}{\mu}}$

Sol.:



$V_1 = \sqrt{\frac{T}{\mu}}$

$V_2 = \sqrt{\frac{2T}{\mu}}$

Ratio $\frac{V_1}{V_2} = \frac{\sqrt{\frac{T}{\mu}}}{\sqrt{\frac{2T}{\mu}}} = \frac{1}{\sqrt{2}}$

20. Answer (3)

Hint: Time Period = $\frac{1}{\nu_1 - \nu_2}$

Sol.: $T = \frac{1}{705-700} = \frac{1}{5}$

= 0.2 s

21. Answer (1)

Hint: Since all add and even harmonics are produced it should be an open organ pipe.

Sol.: Fundamental frequency is HCF of all the values

$\therefore$ Fundamental frequency = 140 Hz

First overtone = 280 Hz

22. Answer (1)

Hint: Loudness = $10\log_{10}\frac{I}{I_0}$

Sol.: $20 = 10\log_{10}\frac{I}{10^{-12}}$

$\Rightarrow I = 10^{-10}$ W/m^2

23. Answer (3)

Hint: $|V_{max}| = A\omega$

$|a_{max}| = A\omega^2$

Sol.: $A\omega$ = 10 cm/s …(i)

$A\omega^2 = 100\pi$ cm/s^2 …(ii)

By equation (i) and (ii)

$\omega = \frac{100\pi}{10} = 10\pi$

$\Rightarrow A(10\pi) = 10$

$\Rightarrow A = \frac{1}{\pi}$ cm

24. Answer (2)

Hint & Sol.: $A = \frac{F_0}{\left\{m^2\left(\omega^2 - \omega_d^2\right)^2 + \omega_d^2 b^2\right\}^{\frac{1}{2}}}$ (formula)

25. Answer (3)

Hint: Average velocity = $\frac{\text{Displacement}}{\text{time}}$

Sol.: $x_0 = 5\cos 0° = 5$ cm

$x_{2/3} = 5\cos\left(\frac{\pi}{2}\times\frac{2}{3}\right) = \frac{5}{2} = 2.5$

Average velocity = $\frac{\text{Displacement}}{\text{time}}$

$= \frac{5-2.5}{2/3}$

$= \frac{7.5}{2} = 3.75$ cm/s

26. Answer (2)

Hint: $a_{max} = \omega^2 A$

Sol.: $a_{max} = \omega^2 A$

$= \left(\frac{2\pi}{2}\right)^2 \times 30$

= $30\pi^2$ cm/s^2

27. Answer (3)

Hint: $P = \frac{m}{3V} v_{RMS}^2$

Sol.: $P_i = \frac{m}{3V} v_{RMS}^2$ …(i)

$P_f = \frac{\left(\frac{m}{2}\right)}{3V}\left(3v_{RMS}\right)^2$,…(ii)

By equation (i) and (ii)

$\frac{P_f}{P_i} = \frac{\left(\frac{m/2}{3V}\right)9v_{RMS}^2}{\frac{m}{3V}v_{RMS}^2} = \frac{9}{2}$

28. Answer (2)

Hint: At STP 22.4 litre of gas contains 1 mole of gas.

Sol.: At STP volume of 1 mole of gas = 22.4 litre

Number of moles

$n = \frac{5.6}{22.4} = \frac{1}{4}$

Total number of molecules $= \frac{1}{4}\times 6.02\times 10^{23}$

= 1.505×10^{23}

29. Answer (2)

Hint: Work done by gas = Area under *P*-*V* graph.

Sol.: If cyclic process is clockwise then work done by gas is positive.

$$W = \pi ab = \pi \frac{(5P_0 - 3P_0)}{2}\frac{(2V_0 - V_0)}{2}$$

$$= \frac{\pi}{2}P_0V_0$$

30. Answer (2)

Hint: $Q = nC\Delta T$

Sol.: $Q = nC\Delta T$

$Q = 0$

$\therefore C = 0$

31. Answer (4)

Hint: $\eta = 1 - \frac{T_L}{T_H}$

Sol.: $T_L = 27°C = 300$ K

$T_H = 427°C = 700$ K

$$\eta = 1 - \frac{T_L}{T_H} \Rightarrow \eta = \left(1 - \frac{3}{7}\right)$$

$$\eta(\%) = \frac{400}{7}\%$$

32. Answer (3)

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

and T = Constant (for isothermal process)

Sol.: T = Constant

$\Delta U = nC_V\Delta T$

$\Delta U = 0$ $(\Delta T = 0)$

Applying first law of thermodynamics

$\Delta Q = W + \Delta U$

$\Delta Q = 200$ J

33. Answer (3)

Hint: $W = nR\Delta T$

$Q = nC_P\Delta T$

Sol.: $$\frac{W}{Q} = \frac{nR\Delta T}{nC_P\Delta T} = \frac{R}{\frac{7}{2}R}$$

$$= \frac{2}{7}$$

34. Answer (4)

Hint: $C_P - C_V = R$

and $\frac{C_P}{C_V} = \gamma$

Sol.: $C_P - C_V = R$

$$\Rightarrow C_V = \frac{3}{2}R$$

$$\Rightarrow \gamma = \frac{C_P}{C_V} = \frac{\frac{5}{2}R}{\frac{3}{2}R} = \frac{5}{3}$$

35. Answer (2)

Hint & Sol.: $$v_{RMS} = \sqrt{\frac{(2u)^2 + (4u)^2 + (5u)^2 + (10u)^2}{4}}$$

$$= \sqrt{\frac{4u^2 + 16u^2 + 25u^2 + 100u^2}{4}}$$

$$= \frac{u}{2}\sqrt{145}$$

SECTION - B

36. Answer (4)

Hint: $v = \sqrt{\frac{T}{\mu}} = \sqrt{\frac{T}{\rho A}}$

Sol.: $T = \frac{\Delta LAY}{L}$ …(i)

$$v = \sqrt{\frac{T}{\rho A}} = \sqrt{\frac{\Delta LAY}{L \cdot \rho A}} = \sqrt{\frac{\Delta LY}{L\rho}}$$ …(ii)

$$\therefore \frac{v'}{v} = \sqrt{5}$$

$v' = \sqrt{5}\,v$

37. Answer (2)

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

Sol.: $$v = \omega\sqrt{A^2 - \frac{3A^2}{4}} = \frac{\omega A}{2}$$

$$= \frac{2\pi}{T}\frac{A}{2} = \frac{\pi A}{T}$$

38. Answer (4)

Hint: $f = \left(\frac{v + v_0}{v}\right)f_0$

Sol.: $v_0 = gt$

$$f = f_0 + \left(\frac{f_0 g}{v}\right)t$$

Slope = $\frac{f_0 g}{v}$

$$v = \frac{f_0 g}{\text{Slope}} = \frac{10^3 \times 10}{\frac{500}{15}} = 300 \text{ m/s}$$

39. Answer (1)

Hint: Beats = $|f_1 - f_2|$

Sol.: $2f_0 = \frac{v}{2L}$

Beats = $f_1 - f_2$

$$= \frac{v}{2\left(\frac{L}{2} - \Delta L\right)} - \frac{v}{2\left(\frac{L}{2} + \Delta L\right)}$$

$$\approx \frac{16 f_0 \Delta L}{L}$$

40. Answer (1)

Hint: 

$L = \frac{5\lambda}{2}$

Sol.: $k = \frac{2\pi}{\lambda} = 0.6 \text{ cm}^{-1}$

$\lambda = \frac{2\pi}{0.6}$

$L = \frac{5\lambda}{2} = \frac{5\pi}{0.6}$ cm

= 26.17 cm

41. Answer (3)

Hint: $f = \frac{(n+1)V}{2L}$ for n^{th} overtone (open pipe)

$f = \frac{(2n+1)V}{4L}$ for n^{th} overtone (closed pipe)

Sol.: $\frac{f_1}{f_2} = \frac{\frac{6V}{2L}}{\frac{11V}{4L}} = \frac{12}{11}$

42. Answer (2)

Hint & Sol.: $U = 2\left(1 - \cos\frac{x}{2}\right)$

$\frac{1}{2} m\omega^2 x^2 = 2.2 \sin^2\left(\frac{x}{4}\right)$

$\frac{1}{2}\omega^2 x^2 \approx 4 \times \frac{x^2}{16}$

$\omega^2 = \frac{1}{2} \Rightarrow \omega = \frac{1}{\sqrt{2}}$

$T = \frac{2\pi}{\omega} = 2\pi\sqrt{2}$ s

43. Answer (2)

Hint & Sol.: In $t_1 \Rightarrow$ 2 cm

Next $t_2 \Rightarrow$ 3 cm

$t_1 + t_2 = 2$ s

Since, T = 8 s, then particle will reach mean from extreme position in 2s.

44. Answer (3)

Hint: Oxygen has 2 degree of freedom for rotational kinetic energy.

Sol.: $f_R = 2$

$U_R = \frac{nf_R}{2} RT$

$= \frac{5}{2} 2RT$

$\Rightarrow x = 2$

45. Answer (2)

Hint: $\lambda = \frac{1}{\sqrt{2}\, n\pi d^2}$

Sol.: Number density

$$n = \frac{N}{V} = \frac{P}{K_B T} = \frac{101 \times 10^3}{1.381 \times 10^{-23} \times 350}$$

$\approx 2.09 \times 10^{25}$ molecules/m^3

$$\lambda = \frac{1}{\sqrt{2} \times \pi \times \left(2.09 \times 10^{25}\right) \times \left(0.6 \times 10^{-10}\right)^2}$$

$= 0.299 \times 10^{-5}$ m

46. Answer (2)

Hint: $Q = \Delta U + W$

Sol.: $T_i = \frac{10P_0 \times V_0}{nR} = T_f$

$\therefore \Delta T = 0 \Rightarrow \Delta U = 0$

Therefore, heat supplied is equal to the work done

$Q = W$

$Q = \frac{1}{2} \times \frac{7}{3} V_0 \times 7P_0 + 7P_0 V_0$

$Q = \frac{91 P_0 V_0}{6}$

47. Answer (2)

Hint: $\eta = \frac{W}{Q}$

Sol.: W = Area under P-V graph

$= P_0 \times 3V_0 = 3P_0 V_0$

$Q_{AB} = nC_V \Delta T$

$= \frac{3}{2}\left(P_B V_B - P_A V_A\right)$

$$= \frac{3}{2}(2P_0V_0 - P_0V_0)$$

$$= \frac{3}{2}P_0V_0$$

$$Q_{BC} = nC_P\Delta T = \frac{5}{2}(P_CV_C - P_BV_B)$$

$$= \frac{5}{2}(2P_0 \times 4V_0 - 2P_0 \times V_0)$$

$$= \frac{5}{2}(6P_0V_0) = 15P_0V_0$$

$$Q = Q_{AB} + Q_{BC} = \left(\frac{3}{2} + 15\right)P_0V_0$$

$$= \frac{33}{2}P_0V_0$$

$$\eta = \frac{W}{Q} = \frac{3P_0V_0}{\frac{33}{2}P_0V_0} = \frac{2}{11} = \frac{200}{11}\%$$

48. Answer (2)

Hint: $PV = nRT$

Sol.: $P_i = \frac{P_0}{1+\left(\frac{V_0}{V_0}\right)^3} = \frac{P_0}{2}$

$$P_f = \frac{P_0}{1+\left(\frac{V_0}{2V_0}\right)^3} = \frac{P_0}{1+\frac{1}{8}} = \frac{8P_0}{9}$$

$P_fV_f - P_iV_i = nR\Delta T$

$$\frac{8P_0}{9} \times 2V_0 - \frac{P_0}{2} \times V_0 = R\Delta T$$

$$\frac{16P_0V_0}{9} - \frac{P_0V_0}{2} = R\Delta T$$

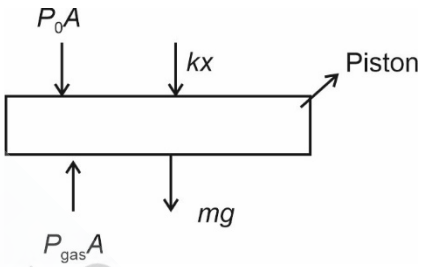
$$\frac{23P_0V_0}{18R} = \Delta T$$

49. Answer (3)

Hint: At equilibrium

$F_{net} = 0$

Sol.:



$PA = Kx + P_0A + mg$

$$\frac{(P - P_0)A}{K} - \frac{mg}{K} = x$$

50. Answer (1)

Hint & Sol.: $Q = W + \Delta U$

ΔU is same for both path (1) and (2) as it is state function.

$W_1 > W_2$ (Work = Area under P-V graph)

$\therefore Q_1 > Q_2$

$$\frac{Q_1}{Q_2} > 1$$

[CHEMISTRY]

SECTION - A

51. Answer (4)

Hint: Carboxyhaemoglobin is 300 times more stable than oxyhaemoglobin.

Sol.:

- Carbon monoxide is produced due to incomplete combustion of hydrocarbon.
- It reduces oxygen carrying ability of blood.

52. Answer (3)

Hint: Nitrate ion concentration causes blue baby syndrome.

Sol.:

Excessive ion	Harmful effect
Sulphate	Laxative effect
Nitrate	Blue baby syndrome
Fluoride	Brown mottling of teeth

53. Answer (1)

Hint: BOD is the amount of oxygen required by bacteria to break down the organic matter present in a certain volume of a sample of water.

Sol.: BOD of clean water should be less than 5 ppm.

54. Answer (4)

Hint & Sol.: Ozone, carbondioxide, methane and water vapours are some examples of greenhouse gases.

55. Answer (4)

Hint: Photochemical smog is oxidising in nature

Sol.: Sulphur dioxide is a component of classical smog.

56. Answer (2)

Hint: Hybridization of carbon in CO_2 is *sp*.

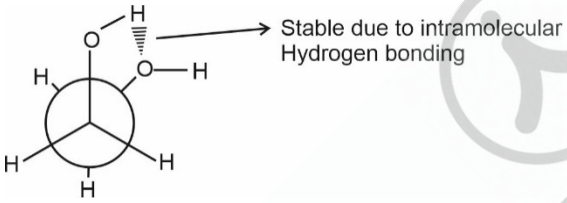
Sol.:

$$\underset{\text{sp hybridized}}{HC \equiv CH} + O_2 \longrightarrow \underset{\text{sp hybridized}}{CO_2} + H_2O$$

57. Answer (2)

Hint: Conformer in which effective intramolecular H-bonding can occur, will be stable.

Sol.:



58. Answer (4)

Hint & Sol.: n-Hexane $\xrightarrow[773\ K,\ 10\ atm]{Cr_2O_3}$ 

59. Answer (1)

Hint: Fluorine is explosively reactive and react in dark, iodine is unreactive in halogenation of alkanes.

Sol.: Reactivity order of halogens is

$F_2 > Cl_2 > Br_2 > I_2$

60. Answer (2)

Hint & Sol.:

- Wurtz reaction

$$2CH_3Br + 2Na \xrightarrow[ether]{dry} CH_3 - CH_3$$

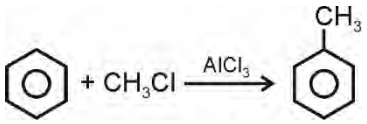
- Sodalime decarboxylation

$$CH_3COONa + NaOH \xrightarrow[\Delta]{CaO} CH_4$$

- Kolbe's Electrolysis

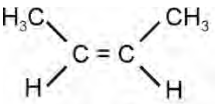
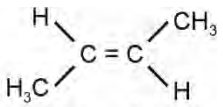
$$CH_3COO^-Na^+(aq) \xrightarrow{electrolysis} CH_3 - CH_3$$

- Friedel-Crafts alkylation



61. Answer (3)

Hint: Cis-but-2-ene and trans-2-butene are geometrical isomers.

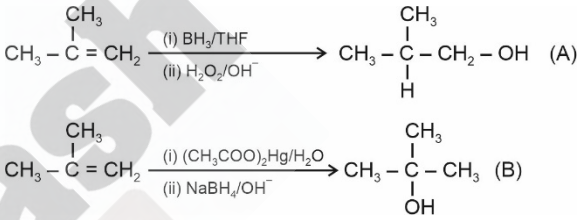
Sol.:  ($\mu \neq 0$)  ($\mu = 0$)

62. Answer (4)

Hint:

- Hydroboration-oxidation reaction gives anti-Markovnikov product.
- Oxymercuration-demercuration reaction gives Markovnikov product.

Sol.:

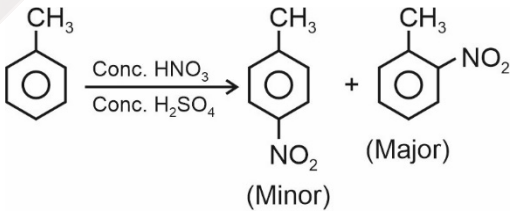


'A' and 'B' are position isomers of each other.

63. Answer (1)

Hint: Mixture of conc. HNO_3 and conc. H_2SO_4 produces $\overset{+}{NO_2}$ electrophile.

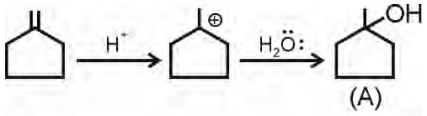
Sol.:

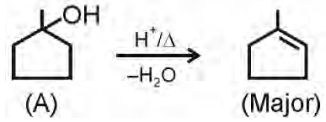


64. Answer (2)

Hint: Addition of H^+ to alkene produces carbocation intermediate.

Sol.:





65. Answer (1)

Hint: Addition of HBr to alkene in presence of peroxide proceeds through free radical intermediate.

Sol.:

$$CH_3CH_2-CH=CH_2 \xrightarrow[\text{Peroxide}]{HBr} CH_3-CH_2-CH_2-CH_2-Br$$

66. Answer (2)

Hint & Sol.: Kjeldahl method is not applicable to compounds containing nitrogen in azo groups as nitrogen of these groups can not change to ammonium sulphate.

67. Answer (4)

Hint: Higher the molecular mass or surface area, more will be the van der Waals forces and more will be the boiling point.

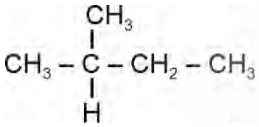
Sol.: As branching increases, surface area decreases for isomeric alkanes hence, boiling point also decreases.

Correct order of boiling point:

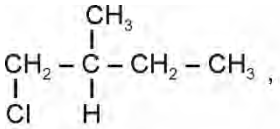
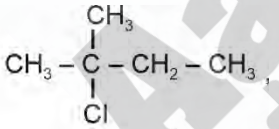
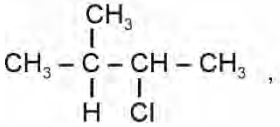
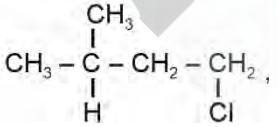
n-pentane > isopentane > neopentane

68. Answer (3)

Hint: Different types of 'H' atoms give isomeric monochloro derivatives.

Sol.: 

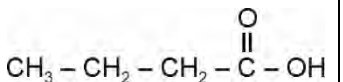
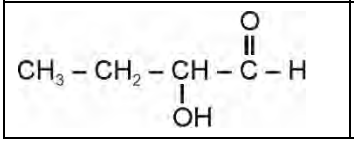
four monochloro derivative possible.

69. Answer (4)

Hint: Molecules having different functional groups are functional isomers of each other

Sol.:

	Functional group
	Carboxylic acid
	Alcohol and aldehyde

70. Answer (4)

Hint & Sol.: Chromatography is the best and latest technique for isolation, purification and separation of organic compounds.

71. Answer (3)

Hint: $\%N = \dfrac{\text{weight of 'N'}}{\text{weight of organic compound}} \times 100$

Sol.: $n_{N_2} = \dfrac{22.4}{22400} = 10^{-3}$

$w_{N_2} = 10^{-3} \times 28\ g$

$\%N = \dfrac{28 \times 10^{-3}}{0.5} \times 100 = 5.6\%$

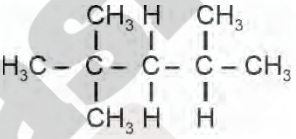
72. Answer (1)

Hint: Steam distillation is applied to separate substances which are volatile and are immiscible with water.

Sol.: Aniline and water mixture is separated by steam distillation.

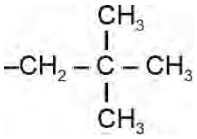
73. Answer (1)

Hint: Structure of isooctane is



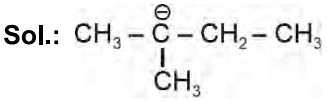
Sol.: IUPAC name of isooctane is 2,2,4-trimethyl pentane.

74. Answer (1)

Hint & Sol.:  is neopentyl group

75. Answer (2)

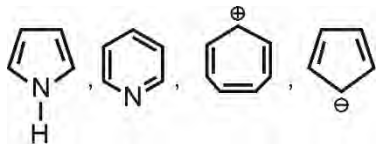
Hint: Electron donating groups destabilise carbanions.

Sol.:  is least stable due to more +I effect.

76. Answer (4)

Hint : For species to be aromatic, the ring should be cyclic, planar and should contain $(4n + 2)\pi$ electron in conjugation.

Sol.:



are aromatic species.

77. Answer (3)

Hint: Greater the electron donating effect of alkyl group, less acidic the molecule is

Sol.: As, +I effect increases in the order $-CH_3 < -C_2H_5 < -C_3H_7$

So, acidic strength decreases as methanoic acid > ethanoic acid > propanoic acid.

78. Answer (4)

Hint: Stability of carbocation decreases with increase in –I effect.

Sol.: $\overset{\oplus}{C}H_2 - \underset{\alpha}{CH_2} - \underset{\beta}{CH_2} - \underset{\gamma}{\overset{\delta}{CH_2}} - CH_2 - F$

fluorine atom is attached to δ-carbon hence minimum –I effect is observed.

79. Answer (1)

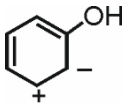
Hint: More the electron withdrawing nature of a group, more will be the –I effect.

Sol.: –I effect order is found as

$-\overset{+}{N}R_3 > -NO_2 > -OH$

80. Answer (4)

Hint: Resonating structures having its octet complete are more stable.

Sol.: 

Incomplete octet of carbon with positive charge.

81. Answer (3)

Hint: The compound having more stable conjugate base is more acidic.

Sol.: Stability of conjugate bases is, as

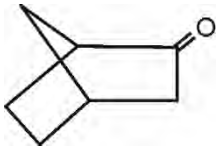
$\overset{\ominus}{C}\equiv CH > \overset{\ominus}{C}H = CH_2 > \overset{\ominus}{C}H_2 - CH_3$

Hence, Acidity order is

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

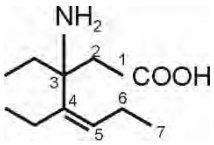
82. Answer (2)

Hint: Carbonyl carbon having α-H (not attached to bridgehead carbon) shows tautomerism.

Sol.:  it has 2α–H atoms so shows tautomerism.

83. Answer (4)

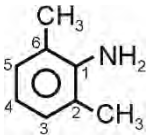
Hint: In IUPAC naming –COOH is highest priority functional group

Sol.: 

3-Amino-3,4-diethylhept-4-enoic acid

84. Answer (4)

Hint: In aniline $-NH_2$ is principal functional group

Sol.:  2,6-Dimethylaniline

85. Answer (2)

Hint: Structure of But-2-enal is

$CH_3 - CH = CH - CHO$

Sol.: Number of σ bonds and π bonds are 10 and 2 respectively.

SECTION - B

86. Answer (4)

Hint & Sol.: Microorganism present in the soil acts as a sink for carbon monoxide.

87. Answer (2)

Hint & Sol.: Maximum limit of nitrate ion in drinking water is 50 ppm.

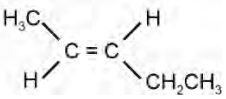
88. Answer (1)

Hint & Sol.: If pH of rain water falls below 5.6 it is called acid rain.

89. Answer (2)

Hint: Birch reduction is used to convert alkyne to trans alkene.

Sol.:

$H_3C - C \equiv C - CH_2CH_3 \xrightarrow{Na/liq.\ NH_3}$ 

90. Answer (4)

Hint: Calcium carbide on hydrolysis gives ethyne gas.

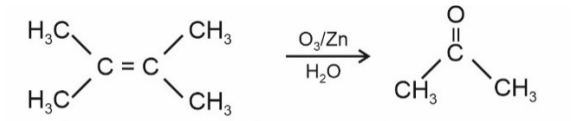
Sol.: $CaC_2 + H_2O \rightarrow \underset{(A)}{C_2H_2} + \underset{(B)}{Ca(OH)_2}$

$C_2H_2 \xrightarrow[Fe\ tube, 873K]{Red\ Hot} Benzene\ (C)$

91. Answer (4)

Hint: Alkene on reductive ozonolysis gives aldehyde or ketone.

Sol.:

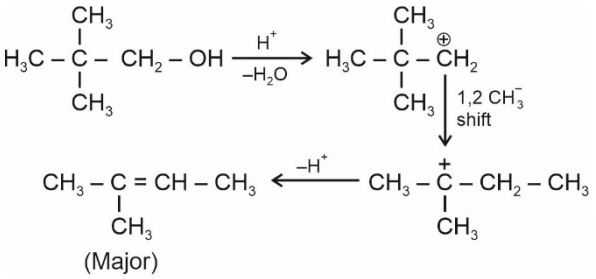


(2,3-dimethyl but-2-ene) (Acetone, 2 moles)

92. Answer (1)

Hint: Carbocation intermediate rearranges to form stable carbocation.

Sol.:

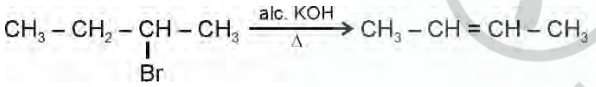


(Major)

93. Answer (3)

Hint: Heating of alkyl halide in presence of alc. KOH gives Saytzeff alkene as major product.

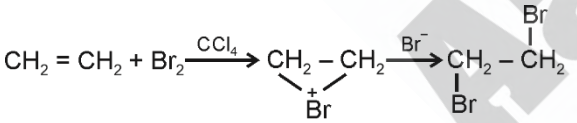
Sol.:



94. Answer (1)

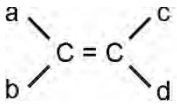
Hint: Br_2/CCl_4 generates electrophiles.

Sol.:



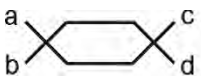
95. Answer (1)

Hint: Condition of geometrical isomerism for alkene



$a \neq b$ and $c \neq d$

Condition of geometrical isomerism for cycloalkane



$a \neq b$ and $c \neq d$

Sol.: $CH_3CH = CH_2$ does not show geometrical isomerism.

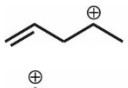
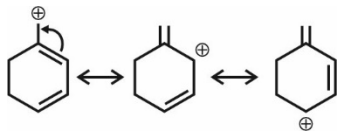
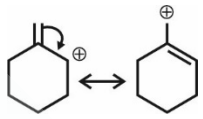
96. Answer (2)

Hint & Sol.: Lone pair that is participating in resonance does not participate in hybridisation.

97. Answer (2)

Hint: Carbocation adjacent to double bond carbon will participate in resonance.

Sol.:

- 
-  (no resonance as no conjugation)
- 
- 

98. Answer (2)

Hint: Number of α-Hydrogen = Number of hyper conjugative structures.

Sol.:

Carbocation	Number of hyper conjugative structures
$CH_3 - \overset{\oplus}{C}H_2$	3
$CH_3 - \overset{\oplus}{C}H - CH_3$	6
$H_3C - \overset{\oplus}{C}(CH_3)_2$	9
$(CH_3)_3C - \overset{\oplus}{C} - C(CH_3)_3$ (with $C(CH_3)_3$)	0

99. Answer (3)

Hint: Electrophiles are electron deficient species.

Sol.: BF_3, Cl^+, $CH_3 - \overset{+}{C} = O$, $\overset{+}{N}O_2$ are electrophiles.

100. Answer (1)

Hint: Stability of free radical increases as number of α-hydrogen increases.

Sol.:

- $CH_3 - Cl \rightarrow \dot{C}H_3 + \dot{C}l$
- Stability order:

$$\dot{C}H_3 < \dot{C}H_2CH_3 < \dot{C}H(CH_3)_2 < \dot{C}(CH_3)_3$$

[BOTANY]

SECTION - A

101. Answer (1)

Hint: Auxins are synthesised from an amino acid.

Sol.: Tryptophan is an aromatic amino acid that acts as precursor for biosynthesis of auxins.

102. Answer (3)

Sol.: Single maize root apical meristem can give rise to more than 17,500 new cells per hour.

Cells in watermelon may increase in size by upto 3,50,000 times.

103. Answer (3)

Hint: The 'bakane' (foolish seedling) disease of rice seedlings was caused by a fungal pathogen and the hormone was named after this fungus.

Sol.: Gibberellins were discovered during study of bakane disease.

104. Answer (4)

Hint: F.W. Went isolated auxin from tips of coleoptiles of oat seedlings.

Sol.: F. Skoog and his co-workers observed cytokinins from tobacco cells. Miller *et.al*. (1955), discovered first cytokinin.

105. Answer (3)

Hint: Vernalisation is a process by which flowering is either qualitatively or quantitatively dependent on exposure to low temperature.

Sol.: Vernalisation is applicable to winter annuals and biennials.

106. Answer (1)

Hint: Rooting in stem cuttings is induced by auxins.

Sol.: Ethylene induces development of adventitious roots, lateral roots and growth of root hairs.

107. Answer (3)

Hint: Ethylene is volatile.

Sol.: IAA and IBA are natural auxin.

Ethylene is gaseous and volatile in nature.

108. Answer (3)

Hint: Re-differentiated tissues are secondary permanent tissues formed during secondary growth.

Sol.: Cork cambium and intervascular cambium are de-differentiated or secondary meristematic tissues.

Apical meristem is primary meristem. Secondary xylem is re-differentiated or secondary permanent tissue.

109. Answer (4)

Hint: Dormancy is inactive period of seed or tuber during which it fails to germinate.

Sol.: Seed and tuber dormancy is induced by plant growth inhibitor ABA.

110. Answer (4)

Hint: Abscission is falling of plant parts (leaves, fruits and flowers).

Sol.: Ethylene and ABA both promote abscission.

111. Answer (1)

Hint: Photoperiodism is response of plants with respect to changes in the relative lengths of dark and light periods.

Sol.: Photoperiodism does not alter seed viability.

112. Answer (2)

Hint: Chemicals used to kill unwanted plants (weeds) are known as weedicides.

Sol.: 2,4-D (auxin) is widely used as weedicide.

113. Answer (4)

Hint: Growth inhibiting activities include dormancy, senescence, abscission etc.

Sol.: ABA is a plant growth inhibitor.

114. Answer (1)

Hint: Apical dominance is the phenomenon by which the presence of apical bud does not allow the nearby lateral or axillary buds to grow.

Sol.: Auxins induce apical dominance but cytokinins counteract apical dominance.

115. Answer (2)

Hint: ATP synthesis by oxidative phosphorylation is coupled with ETS in respiration.

Sol.: Chemiosmosis requires a proton gradient across the membrane.

116. Answer (2)

Hint: $FADH_2$ and $NADH_2$ are reduced co-enzymes.

Sol.: 5 $NADH_2$ and 1 $FADH_2$ i.e. total 6 reduced co-enzymes are formed during complete oxidation of one molecule of 3-PGAL.

117. Answer (3)

Hint: During Krebs cycle $FADH_2$ is formed at a single step.

Sol.: Krebs cycle occurs in mitochondrial matrix and is also known as citric acid cycle (Tricarboxylic acid cycle). During Krebs cycle $3NADH_2$ and 1 $FADH_2$ are synthesised.

118. Answer (2)

Hint: The final electron and hydrogen acceptor in respiratory ETS is O_2. It combines them and forms H_2O. Thus, ATP and H_2O are obtained.

Sol.: Acetyl-CoA is used to synthesise gibberellic acids.

119. Answer (2)

Hint: ATP is directly synthesised during substrate level phosphorylation.

Sol.: During link reaction only $NADH_2$ is released which is further converted into ATP by oxidative phosphorylation via ETS.

120. Answer (1)

Hint: Proteins and fats can also be used as respiratory substrates. They are oxidised and catabolised.

Sol.: Proteins are deaminated into pyruvic acid and fats are broken into fatty acids and glycerols. Glycerol will enter in respiratory pathway in the form phosphoglyceraldehyde.

121. Answer (3)

Hint: Decarboxylation is removal of CO_2.

Sol.: Oxalosuccinic acid is 6-C acid from which CO_2 is removed to form α-KGA, (5-C acid).

122. Answer (1)

Hint: In developmental plasticity, leaves of the juvenile plant are different in shape from those in mature plants. It is observed in cotton, coriander and larkspur.

Sol.: Buttercup is an example of environmental plasticity, in which difference in shapes of leaves produced in air and in water is observed.

123. Answer (2)

Hint: Duration of periodic exposure to light and dark phases and its response w.r.t. flowering is known as photoperiodism.

Sol.: Vernalisation is qualitative or quantitative dependence on exposure to low temperature.

- Seed dormancy is failure of seed germination even when external conditions are favourable.
- Plasticity is ability of certain plants to follow different pathways in response to environment or phases of life to form different kind of structures.

124. Answer (2)

Hint: Charles Darwin and his son Francis Darwin first observed bending response to unilateral light in canary grass (coleoptile tips).

Sol.:

- Auxins help in initiating root formation in stem cuttings or callus.
- Auxins cause apical dominance.
- Cytokinin counteracts apical dominance.

125. Answer (3)

Hint: ABA is called stress hormone.

Sol.: Auxin is growth hormone, Cytokinin is anti-ageing hormone. Ethylene is called fruit ripening hormone.

126. Answer (3)

Hint: The period of growth is generally divided into three phases, namely, meristematic, elongation and maturation phases.

Sol.: Elongation phase shows increased vacuolation, cell enlargement and new cell wall deposition.

In maturation phase cells attain maximal size in terms of wall thickening and protoplasmic modifications.

127. Answer (1)

Hint: $L_t = L_0 + rt$ represents arithmetic growth.

Sol.: Exponential growth is represented by

$W_1 = W_0 e^{rt}$

Where, W_1 = final size

W_0 = initial size

r = growth rate

t = time of growth

e = base of natural logarithms

128. Answer (4)

Hint: TCA cycle is also known as citric acid cycle because the first product of this cycle is citric acid.

Sol.: The TCA cycle starts with condensation of acetyl CoA with oxalo-acetic acid (OAA).

129. Answer (1)

Hint: In lactic acid fermentation, pyruvic acid is converted to lactic acid with no release of CO_2.

Sol.:

- Glycolysis is conversion of glucose into pyruvic acid.
- In Krebs cycle, complete oxidation of acetyl CoA takes place.

130. Answer (4)

Hint: Mesosomes are present in prokaryotic cells.

Sol.: Site of respiratory ETS in our body is inner mitochondrial membrane.

- Cytoplasm is site of glycolysis.
- Mitochondrial matrix is site of Krebs cycle.

131. Answer (3)

Hint: Cytochrome *c* acts as mobile carrier for transfer of electrons between complex III and IV.

Sol.: Cytochrome *c* is a small protein attached to the outer surface of inner mitochondrial membrane.

132. Answer (3)

Hint: Site of Krebs cycle or TCA cycle is mitochondrial matrix, thus all the enzymes involved are found in matrix except one that convert succinate into fumarate.

Sol.: Succinate dehydrogenase (SDH) enzyme is found attached to inner side (matrix side) of inner mitochondrial membrane.

133. Answer (2)

Hint: Sucrose is a disaccharide. It is converted into monomeric units glucose and fructose by enzyme invertase.

Sol.:

- Compounds which are oxidised during respiration are respiratory substrates.
- The breakdown of glucose to pyruvic acid is called glycolysis.

134. Answer (2)

Hint: Hexokinase catalyses phosphorylation of glucose to glucose-6-phosphate.

Sol.:

- Phosphohexoisomerase catalyses isomerisation of glucose-6-phosphate to fructose-6-phosphate.
- Enolase converts 2-phosphoglycerate to phosphoenolpyruvate (PEP).

135. Answer (2)

Hint: It occurs in the cytoplasm of the cell.

Sol.:

- It is the first and common step for both the types of respiration.
- The scheme of glycolysis was given by Gustav Embden, Otto Meyerhof and J. Parnas, thus often referred to as EMP pathway.
- It involves partial oxidation of glucose to form two molecules of pyruvic acid.

SECTION - B

136. Answer (2)

Hint: In most situations, ABA acts as an antagonist to GAs.

Sol.: Abscisic acid (ABA) is anti-GA hormone.

137. Answer (4)

Sol.: Ethylene is the hormone having both growth promotory and inhibitory functions.

138. Answer (1)

Sol.: Ethylene promotes horizontal growth of seedlings and apical hook formation.

139. Answer (4)

Hint: Yeasts poison themselves to death when alcohol concentration reaches about 13%.

Sol.: Cytochrome c is mobile electron carrier of respiratory ETS.

140. Answer (4)

Hint: Glycolysis is conversion of one molecule of glucose into two molecules of pyruvic acid.

Sol.: No CO_2 is released during glycolysis process.

141. Answer (4)

Hint: There are more than 100 types of known gibberellins.

Sol.: GA_3 was one of the first gibberellins to be discovered and remains the most extensively studied form.

142. Answer (3)

Sol.: Tomato is a day neutral plant. Wheat and henbane are LDP while tobacco is SDP.

143. Answer (1)

Hint: Vernalisation prevents early reproductive development in winter annuals.

Sol.: Spring crops do not depend on vernalisation for reproductive development.

144. Answer (1)

Hint: NADPH is not synthesised during Krebs cycle.

Sol.: The conversion of succinyl CoA to succinic acid in Krebs cycle results in synthesis of GTP.

145. Answer (3)

Hint: S-shaped curve is obtained in exponential growth.

Sol.: On plotting the length of the organ against time, a linear curve is obtained in arithmetic growth.

146. Answer (2)

Hint: An amino acid is precursor of ethylene.

Sol.: Abscisic acid is carotenoid derivative. Cytokinin is adenine derivative.

Gibberellins are terpene derivative.

147. Answer (3)

Hint: Cells of meristematic zone are living.

Sol.: Cell walls of cells of meristematic zone are primary in nature, thin and cellulosic.

148. Answer (4)

Hint: Plant growth is unique because plants retain the capacity for unlimited growth throughout their life.

Sol.: This ability of unlimited growth is due to presence of meristematic tissues.

149. Answer (1)

Hint: Respiratory quotient (RQ) is the ratio of the volume of CO_2 evolved to the volume of O_2 consumed in respiration.

Sol.:

- Organic acids have RQ > 1 like RQ for malic acid is 1.33.
- RQ for carbohydrate is 1.
- RQ for proteins is 0.9.
- RQ for fatty acids (Tripalmitin) is 0.7.

150. Answer (3)

Hint: A five carbon molecule acts as substrate for synthesis of amino acid.

Sol.:

- Succinyl CoA is raw material for synthesis of chlorophyll, cytochrome etc.
- Acetyl CoA is raw material for carotenoids, terpenes, gibberellins etc.
- α-KGA is raw material for amino acid synthesis.
- Oxaloacetic acid is raw material for alkaloids, pyrimidines etc.

[ZOOLOGY]

SECTION - A

151. Answer (4)

Hint: Possess direct development

Sol.:

- Cuttlefish belongs to the phylum Mollusca.
- Hagfish is a cyclostome.
- Sea hare is a mollusc.
- Sea urchin is an echinoderm.
- Silkworm is an arthropod.

152. Answer (3)

Hint: Largest part of the foregut

Sol.: Oesophagus opens into a sac like structure called crop used for storage of food. It is followed by gizzard or proventriculus. Gizzard helps in grinding of the food particles. Gastric caecae are present at the junction of foregut and midgut, which secrete digestive juice.

153. Answer (4)

Hint: Assists in storage of uric acid

Sol.: Excretory system regulates the amount of nitrogenous material, inorganic salts and water in the blood or hemolymph.

Excretory system of both male and female includes the following:

Malpighian tubules, fat bodies and nephrocytes while uricose gland is present in male cockroach only.

154. Answer (1)

Hint: Seen in annelids as well

Sol.: *Periplaneta americana* belongs to the phylum Arthropoda and body cavity of arthropods is called

haemocoel. In arthropods, true coelom is of schizocoelom type, which develops by the splitting up of mesoderm.

The development of cockroach is through gradual metamorphosis *i.e.*, occurs through series of nymphal stages and is known as paurometabolous.

155. Answer (3)

Hint: Diploid sexual stages

Sol.: *Nereis* (sand worm) belongs to the phylum Annelida and is dioecious. They possess longitudinal and circular muscles which help in locomotion.

Obelia belongs to the phylum Coelenterata and is radially symmetrical, exhibits metagenesis or alternation of generation between sexual and asexual stages of life cycle.

Limulus belongs to phylum Arthropoda and exhibits jointed appendages.

156. Answer (4)

Hint: Possess water canal system

Sol.: *Planaria* belongs to the phylum Platyhelminthes and have the ability to replace its lost or damaged parts. It shows high regeneration power.

The body of coelenterates bears a central gastrovascular cavity which opens to the outside through a single opening which performs function of both mouth and anus.

157. Answer (1)

Hint: Sponges and flatworms are bisexual

Sol.:

- (a) *Spongilla* and (c) *Taenia*, both of them are hermaphrodites (monoecious).
- (b) *Adamsia* is an acoelomate, diploblastic coelenterate.
- (d) *Ascaris* shows sexual dimorphism.

158. Answer (3)

Hint: Equals to the number of heart chambers in *Pavo*

Sol.: In females, the 7^{th} sternum is boat shaped and together with the 8^{th} and 9^{th} sterna forms a brood or genital pouch whose anterior part contains female gonopore, spermathecal pores and two separate openings of collaterial glands.

159. Answer (1)

Hint: Spermatophore

Sol.: The sperms are stored in the seminal vesicles and are glued together in the form of bundles called spermatophores which are discharged during copulation.

The external genitalia are represented by male gonapophysis or phallomere (chitinous asymmetrical structures, surrounding the male gonopore).

Fertilised eggs become surrounded by the secretion of collaterial glands, which hardens to form an egg case or ootheca.

160. Answer (3)

Hint: Transparent and more or less hexagonal biconvex areas

Sol.: The most important sense organs in cockroach are a pair of large, sessile, compound eyes which are situated at the dorsal surface of the head. These eyes are black and kidney-shaped. Each consists of about 2,000 visual elements or units, called ommatidia; which are transparent and more or less hexagonal biconvex areas, capable of forming an image.

Each ovary consists of eight elongated, tapering and beaded, blind tubules called ovarioles.

From each testis arise a thin vas deferens, which opens into ejaculatory duct through seminal vesicle.

161. Answer (3)

Hint: External genitalia

Sol.: Anal cerci are long and thick structures found in both male and female cockroach and are sensitive to sound and other vibrations.

Anal styles project backwardly from the sides of the 9^{th} sternum of the male cockroach only. They are sensitive to touch.

In both the sexes, the genital aperture is surrounded by sclerites known as gonapophyses or phallomeres.

162. Answer (1)

Hint: Type of epithelium present in uterus

Sol.: Malpighian tubules are attached to the alimentary canal at the junction of midgut and hindgut. These are fine, long, unbranched, yellowish blind tubules lying freely in the haemolymph.

Each tubule is lined by glandular epithelium with characteristic ciliated cells. They absorb nitrogenous waste products and convert them into uric acid which is excreted through hindgut.

163. Answer (2)

Hint: Structure which is filled with spermatozoa in females

Sol.: Male reproductive system consists of a pair of testes one lying on each lateral side in the 4^{th} -6^{th} abdominal segments. A characteristic mushroom shaped gland is present in the 6^{th} -7^{th} abdominal segments which functions as an accessory reproductive gland.

- The female reproductive system consists of two large ovaries, lying laterally in the 2^{nd} -6^{th} abdominal segments.
- A pair of spermatheca is present in the 6^{th} abdominal segment which opens into the female genital chamber.

164. Answer (3)

Hint: Also present in birds

Sol.: At the junction of midgut and hindgut, there is a ring of 100-150 yellow coloured thin filamentous Malpighian tubules.

- Heart of cockroach consists of elongated muscular tube lying along mid-dorsal line of thorax and abdomen.
- The respiratory system consists of a network of trachea, that open through 10 pairs of small holes called spiracles present on the lateral side of the body.
- Gizzard has an outer layer of thick circular muscles which are needed by the gizzard for grinding.

165. Answer (3)

Hint: Supra-oesophageal ganglion supplies nerves to antennae.

Sol.: If the head of cockroach is removed, it may live for few days because the head holds a small proportion of nervous system while the rest is situated along the ventral part of its body.

Brain is represented by supra-oesophageal ganglion which is a large, bilobed mass located in the head above oesophagus. It supplies nerves to antennae and compound eyes. The sub-oesophageal ganglion lies below oesophagus.

166. Answer (4)

Hint: Also termed as elytra

Sol.: Forewings (mesothoracic wings) are thick, leathery, opaque and dark coloured structures, which are somewhat narrow at the distal end. They are larger than the second pair of wings. They are not used for flight, instead they cover and protect the metathoracic wings. Hence, they are also called wing covers or tegmina or elytra.

Hind wings (metathoracic wings) are delicate, thin, transparent and membranous structures with broad terminal end. They are used for flight, but in the resting position, they lie folded below the tegmina.

167. Answer (4)

Hint: Ventral hardened plate

Sol.: The entire body of *Periplaneta americana* is covered externally by a non-living brown-coloured, hard and chitinous exoskeleton composed of several plates called sclerites.

Exoskeleton for each segment consists of a dorsal tergum, a ventral sternum and lateral pleura; these plates are joined to each other by a thin and flexible articular membrane (arthrodial membrane).

168. Answer (3)

Hint: Characteristic of bony fishes

Sol.: Sting ray (*Trygon*) belongs to class Chondrichthyes in which gill slits are separate and without operculum (gill cover).

Mouth is located ventrally and their skin is tough, containing minute placoid scales.

They are marine fishes with streamlined body and have cartilaginous endoskeleton.

169. Answer (1)

Hint: Male members of this class bear claspers.

Sol.: Reptiles are mostly terrestrial and their body is covered by dry and cornified skin.

The skin of amphibians are usually without scales, but scales if present are hidden beneath the skin. *e.g., Ichthyophis.*

Mammals are viviparous with few exceptions, *e.g., Ornithorhynchus.*

Members of class Chondrichthyes possess two-chambered heart with one auricle and one ventricle.

170. Answer (2)

Hint: Possess cartilaginous vertebral column

Sol.: The number of cervical vertebrae are seven in almost all mammals including human beings except certain mammals, eg., sloth and manatee.

In reptiles, heart is usually three-chambered, but four-chambered in crocodiles.

Open circulatory system is present in non-cephalopod molluscs while closed circulatory system is present in cephalopod molluscs.

Cyclostomes have a sucking and circular mouth but lack jaws (Agnatha), scales and paired fins.

171. Answer (2)

Hint: Belongs to category known as tunicata

Sol.: *Salamandra* (Salamander) belongs to the class Amphibia and can live in aquatic as well as terrestrial habitats.

Amphioxus belongs to subphylum Cephalochordata in which notochord extends from head to tail region and is persistent throughout their life.

Petromyzon belongs to class Cyclostomata.

172. Answer (2)

Hint: One of the earliest domesticated animal

Sol.: *Felis* is the genus of cats and *Canis* is the genus of dogs.

173. Answer (4)

Hint: Sun basking is common in reptiles.

Sol.: Reptiles are poikilotherms while mammals are homeotherms.

In reptiles, birds and mammals, fertilisation is internal and mode of respiration is by lungs. Direct development is seen in reptiles and mammals.

174. Answer (3)

Hint: Parapodia assists in swimming in aquatic annelids

Sol.: Malpighian tubules are the excretory structures of most of the insects including cockroaches. *Laccifer* belongs to the phylum Arthropoda.

Flame cells are the excretory structures of Platyhelminthes.

Radula is a file-like rasping organ for feeding in molluscs.

Aquatic annelids like *Nereis* possess lateral appendages, parapodia, which help in swimming.

175. Answer (2)

Hint: Possess well-developed muscular pharynx

Sol.: *Ascaris* belongs to the phylum Aschelminthes which possess the pseudocoelom and hence called pseudocoelomates. In these, the body cavity is present but is not lined by the mesoderm, instead the mesoderm is present as scattered pouches in between the ectoderm and endoderm.

Segmentation is seen in annelids, arthropods and chordates, while it is absent in molluscs and echinoderms.

176. Answer (2)

Hint: True coelom is found from annelids to chordates

Sol.: The true coelom is a body cavity which arises from embryonic mesoderm. True coelom is found from annelids to chordates.

In open type of circulation, the body cells and tissues are directly bathed in the blood pumped out of the heart as the blood flows in open spaces. Present in arthropods, non-cephalopod molluscs, hemichordates and tunicates.

Development is indirect in molluscs, hemichordates, echinoderms and some arthropods.

177. Answer (3)

Hint: In sponges, fertilisation does not occur in water

Sol.: In sponges, choanocytes or collar cells line the spongocoel and the canals.

In sponges, sexes are not separate (hermaphrodite), *i.e.*, eggs and sperms are produced by the same individual. Sponges reproduce asexually by fragmentation and sexually by formation of gametes. Fertilisation is internal and development is indirect having a larval stage which is morphologically distinct from the adult.

178. Answer (3)

Hint: Possess grinding and incising region

Sol.: The mouthparts of cockroach consists of a labium (lower lip), a labrum (upper lip), a pair of mandibles and a pair of maxillae.

A median flexible lobe, acting as tongue (hypopharynx), lies within the cavity enclosed by the mouthparts.

179. Answer (4)

Hint: Equal to the number of ganglia present in abdomen of *Periplaneta*

Sol.: In *Periplaneta*, head is small and roughly triangular in shape. It lies anteriorly at right angle (perpendicularly) to the longitudinal body axis. It is formed by the fusion of six embryonic segments.

180. Answer (2)

Hint: Largest phylum of kingdom Animalia

Sol.: Coelenterates and ctenophores exhibit tissue level of organisation.

Porifers (sponges) show cellular level of organisation while platyhelminthes exhibit organ level of organisation and arthropods have organ-system level of organisation.

181. Answer (3)

Hint: Exclusively marine organisms

Sol.: Mesoderm layer is not present between ectoderm and endoderm in diploblastic animals, rather an undifferentiated, jelly-like mesoglea, is present in between them. This mesoglea is called undifferentiated because this layer is not specialised to form any particular tissue/organ of the body.

Coelenterates and ctenophores are diploblastic animals and lack mesoderm. Platyhelminthes are triploblastic.

182. Answer (4)

Hint: Possess comb plates

Sol.: Bioluminescence is well-marked in ctenophores. Ctenophores are commonly known as sea walnuts or comb jellies.

Sea mouse (*Aphrodite*) belongs to phylum Annelida.

Sea hare is a mollusc and sea horse is a bony fish.

183. Answer (3)

Hint: Belongs to the category of flatworms

Sol.: When the body can be divided into identical left and right halves in only one plane, it is called bilateral symmetry and the animals possessing this type of symmetry are called bilaterally symmetrical. Animals like platyhelminths, annelids, arthropods, *etc.*, are bilaterally symmetrical.

When any plane passing through the central axis of the body divides the organism into two identical halves, it is called radial symmetry. Coelenterates, ctenophores and adult echinoderms have this kind of symmetry.

Sponges are mostly asymmetrical.

184. Answer (1)

Hint: Coelenterates and ctenophores

Sol.: Tissue level of organisation is somewhat higher and complex to cellular level in which similar cells which perform the same function are arranged to form tissues. The tissues perform the various basic functions of animals. This level of organisation is present in coelenterates and ctenophores.

Sycon, *Spongilla* and *Euspongia* belong to the phylum Porifera while *Hydra*, *Adamsia* and *Meandrina* belong to phylum Coelenterata.

Pleurobrachia is a ctenophore.

185. Answer (2)

Hint: Not a characteristic feature of *Paramecium*

Sol.: No members of kingdom Animalia are unicellular. All are multicellular. Their body is made up of more than one cell. Now some can have hundreds of cells and some others millions or trillions of cells. But, they all are said to exhibit multicellularity.

Notochord is present only in chordates. Pattern of organisation vary from cellular to organ-system level of organisation. They may be acoelomates, pseudocoelomates or coelomates.

SECTION - B

186. Answer (1)

Hint: Tapeworm

Sol.: Hooks and suckers are present in the parasitic forms of phylum Platyhelminthes.

Ascaris and *Ancylostoma* belong to the phylum Aschelminthes.

Culex is an arthropod

187. Answer (4)

Hint: Present in thorax region

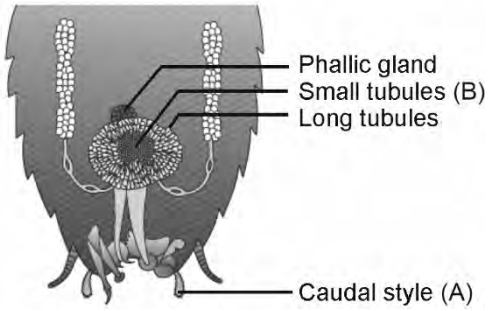
Sol.: Head region of cockroach comprises sense organs like eyes, antennae and mouth parts.

Pronotum is a part of thorax.

188. Answer (3)

Hint: Present only in males

Sol.: The diagram represents male cockroach's reproductive system.



189. Answer (4)

Hint: Cockroach is a non-chordate

Sol.: In cockroach, central nervous system is ventral, solid and double. The nervous system of cockroach consists of a series of fused, segmentally arranged ganglia joined by paired longitudinal connectives on the ventral side.

190. Answer (1)

Hint: Member of Urochordata

Sol.:

- *Doliolum* belongs to sub-phylum Urochordata, in which notochord is present only in the tail of the larva and disappears in the adult form.
- In cephalochordates, notochord persists throughout their life.

191. Answer (3)

Hint: Gnathostomata includes pisces and tetrapods

Sol.: *Catla* – Freshwater fish

Pristis – Marine fish

Gnathostomata – Division

Cyclostomata – Class

Pisces and Tetrapoda – Superclass

192. Answer (2)

Hint: Possess excretory pore

Sol.: Round worm, hookworm and filarial worm belong to the phylum Aschelminthes.

- Sea lily and sea cucumber are echinoderms while sea horse belongs to class Osteichthyes.
- Lancelet is a cephalochordate, lamprey is a cyclostome and tusk shell is a mollusc.
- Flying fish is a chordate while jelly fish is a non-chordate.

193. Answer (1)

Hint: An echinoderm and a mollusc

Sol.: Echinoderms are exclusively marine while molluscs are found in all habitats: oceans, coral reefs, deserts, forests, rivers, lakes and even underground.

- Both echinoderms and molluscs are triploblastic, have unsegmented body and organ system level of organisation.
- Echinoderms lack an excretory organ while in molluscs, the gills perform the excretion along with respiration.

194. Answer (1)

Hint: Excludes largest living bird species

Sol.: *Struthio* (ostrich) and *Aptenodytes* (penguin) are flightless birds and have well-developed powerful legs, small head and rudimentary wings.

Corvus (crow), *Columba* (pigeon), *Psittacula* (parrot), *Neophron* (vulture) and *Pavo* (peacock) are flying birds.

195. Answer (4)

Hint: Possess monocondylic skull and are aquatic

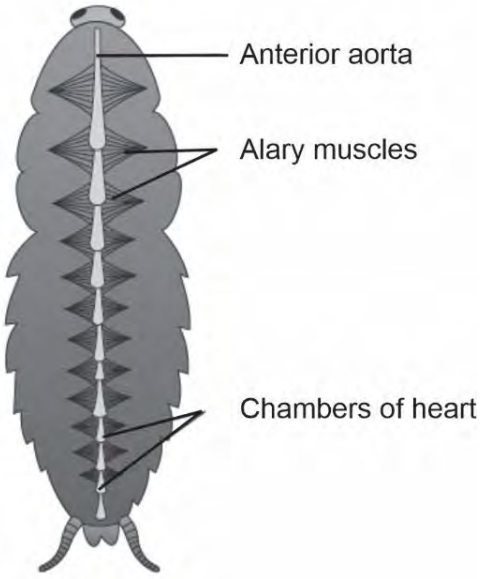
Sol.:

Calotes	–	3-chambered heart
Wuchereria and *Schistosoma*	–	Unsegmented body
Equus	–	Viviparous

196. Answer (3)

Hint: Equal to the times of moulting in a cockroach

Sol.:



197. Answer (2)

Hint: Contains dorsal anus and gonapophyses

Sol.: Male genital pouch contains the dorsal anus, ventral male genital pore and gonapophyses.

- *Periplaneta americana* are about 34-53 mm long with wings that extend beyond the tip of the abdomen in males.
- In both the sexes, the 10^{th} segment bears a pair of jointed filamentous structures called anal cerci.

198. Answer (3)

Hint: Teeth are backwardly directed

Sol.: *Carcharodon* (Great white shark) belongs to class Chondrichthyes which possess minute placoid scales. The members of class Osteichthyes possess cycloid/ctenoid scales.

199. Answer (3)

Hint: Worm-like marine animals

Sol.: Hemichordates have a rudimentary structure in the collar region called stomochord, a structure similar to notochord.

This phylum consists of a small group of worm-like marine animals with organ-system level of organisation. Excretory organ is proboscis gland.

200. Answer (1)

Hint: Endoskeleton is made up of cartilage

Sol.: Silver fish, star fish and devil fish belong to the phylum Arthropoda, Echinodermata and Mollusca respectively.

Dog fish is a cartilaginous fish belonging to class Chondrichthyes of superclass Pisces.

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