All India Aakash Test Series for NEET-2023

TEST - 8 (Code-C)

Test Date : 03/04/2022

ANSWERS

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

HINTS & SOLUTIONS

[PHYSICS]

SECTION - A

1. Answer (4)

Hint: Use principle of homogeneity

Sol.: $Z = \frac{P}{Q}$

$\Rightarrow [Q] = \frac{[P]}{[Z]} = \frac{[MLT^{-1}]}{[ML^{-2}]}$

$\Rightarrow [Q] = [L^3T^{-1}]$

2. Answer (4)

Hint: Power consumed by resistor (P) = I^2R

Sol.: Power (P) = I^2R

$\Rightarrow \frac{\Delta P}{P} = 2\frac{\Delta I}{I} + \frac{\Delta R}{R}$

$\Rightarrow \frac{\Delta P}{P} \times 100 = 2 \times 2\% + 1\% = 5\%$

3. Answer (3)

Hint: Velocity of ball at ground $(v) = \sqrt{u^2 + 2gh}$

Sol.: When ball fall on ground then its velocity

$\Rightarrow v = \sqrt{u^2 + 2gh}$

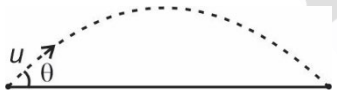
$\Rightarrow$ 2500 = 900 + 2gh

$\Rightarrow h$ = 80 m

4. Answer (1)

Hint: $v_{avg.} = \frac{\text{Total displacement}}{\text{Total time}}$

Sol.:



$v_{avg.} = \frac{\text{Range}}{\text{Time of flight}}$

$v_{avg.} = \frac{u^2 \times 2\sin\theta\cos\theta}{g \times \left(\frac{2u\sin\theta}{g}\right)} = u\cos\theta$

5. Answer (4)

Hint: Work done (W) = $\int \vec{F} \cdot d\vec{r}$

Sol.: Work done (W) = $\int F \cdot dx$

$\Rightarrow W = \int_0^4 (4 - 2x)\, dx$

$\Rightarrow W = [4x - x^2]_0^4$

W = 16 – 16 = 0 J

6. Answer (1)

Hint: Centripetal force (F) = $mr\omega^2$

and angular velocity $(\omega) = \frac{2\pi}{T}$

Sol.:

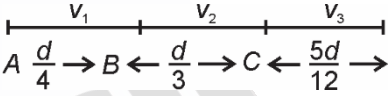
$\frac{(\text{Centripetal force})_1}{(\text{Centripetal force})_2} = \frac{F_1}{F_2} = \frac{m_1 r_1 \omega^2}{m_2 r_2 \omega^2}$ $(\because T_1 = T_2)$

$\Rightarrow \frac{F_1}{F_2} = \frac{2 \times 2R}{4 \times R} = \frac{1}{1}$

7. Answer (2)

Hint: Average speed < v > = $\frac{\text{Total distance}}{\text{Total time}}$

Sol.:



$< v > = \frac{d}{\frac{d}{4v_1} + \frac{d}{3v_2} + \frac{5d}{12v_3}} = \frac{12v_1v_2v_3}{3v_2v_3 + 4v_1v_3 + 5v_1v_2}$

8. Answer (4)

Hint: $\vec{A} \cdot \vec{B} = |\vec{A}| \cdot |\vec{B}| \cos\theta$

Sol.: $\cos\theta = \frac{8 + 12 - 8}{\sqrt{24} \times \sqrt{56}} = \frac{12}{\sqrt{24}\sqrt{56}} = \frac{\sqrt{3}}{2\sqrt{7}}$

$\Rightarrow \tan\theta = \frac{5}{\sqrt{3}} \Rightarrow \theta = \tan^{-1}\left(\frac{5}{\sqrt{3}}\right)$

9. Answer (3)

Hint: In vertical circular motion speed of particle at (to just complete circular motion)

(i) Lower point $= \sqrt{5gR}$

(ii) Topmost point $= \sqrt{gR}$

Sol.: Speed of ball at lowest position $= \sqrt{5gR}$

Speed of ball at highest position $= \sqrt{gR}$

$\Rightarrow$ Difference in speeds $= \sqrt{5gR} - \sqrt{gR}$

$= \sqrt{5 \times 10 \times 10} - \sqrt{10 \times 10}$

= 12.36 m/s

10. Answer (3)

Hint: Work done against gravity (W) = $FS\cos\theta$ = mgh

Sol.:

$W_1 = FS\cos\theta = mgh = m \times g \times 10 = 10\ mg$

$W_2 = FS\cos\theta = mgh = m \times g \times 10 = 10\ mg$

$W_1 : W_2 = 1 : 1$

11. Answer (4)

Hint: When source is delivering constant power

$W = \int mvdv = \int Pdt$

Sol.: $P = \vec{F}\cdot\vec{v} = mav$

$\Rightarrow P = mv\left(v\frac{dv}{ds}\right) \quad \left(\because a = v\frac{dv}{ds}\right)$

$\Rightarrow \int_{v_1}^{v_2} v^2 dv = \frac{P}{m}\int_0^s ds$

$\Rightarrow s = \frac{m}{P}\left(\frac{v_2^3 - v_1^3}{3}\right) = \frac{1}{10}\times\left(\frac{7000}{3}\right)$

$\Rightarrow s = \frac{700}{3}\text{m}$

12. Answer (4)

Hint: In explosion, linear momentum is conserved.

Sol.: $(P_i)_{system} = (P_f)_{system}$

$\Rightarrow 0 = 2\vec{v}_1 + 3\vec{v}_2$

$\Rightarrow$ Kinetic energy of 2 kg $= \frac{1}{2}\times 2\times v_1^2 = 100$

$\Rightarrow v_1 = 10$ m/s

$\Rightarrow$ Kinetic energy of 3 kg $= \frac{1}{2}\times 3\times v_2^2$

$\Rightarrow \text{KE} = \frac{1}{2}\times 3\times\frac{4}{9}v_1^2 = \frac{1}{2}\times 3\times\frac{4}{9}\times 100$

$\Rightarrow \text{KE} = \frac{200}{3}$ J

13. Answer (2)

Hint: Terminal speed $(V_T) = \frac{2r^2 g(\rho-\sigma)}{9\eta}$

Sol.: Terminal speed $(V_T) \propto r^2$

$\Rightarrow \frac{V_1}{V_2} = \frac{r_1^2}{r_2^2}$

$\Rightarrow \frac{V_1}{V_2} = \frac{4}{1}$

14. Answer (4)

Hint: Least count = 1 M.S.D. –1 V.S.D.

Sol.: Given that

N M.S.D. = $(N + 2)$ V.S.D.

$\Rightarrow$ 1 V.S.D. = $\left(\frac{N}{N+2}\right)$ M.S.D.

$\Rightarrow$ Least count = 1 M.S.D. — 1 V.S.D.

$\Rightarrow$ LC = 1 MSD – $\left(\frac{N}{N+2}\right)$ M.S.D

LC = $\left(\frac{2}{N+2}\right)$ M.S.D = $\left(\frac{2}{N+2}\right)$ mm

15. Answer (3)

Hint: For adiabatic process: $TV^{\gamma-1}$ = Constant and $v_{rms} \propto \sqrt{T}$

Sol.: For adiabatic process: $T_1V_1^{\gamma-1} = T_2V_2^{\gamma-1}$

Given that : $(v_{rms})_f = \frac{1}{2}(v_{rms})_i$

$\Rightarrow \frac{v_2}{v_1} = \sqrt{\frac{T_2}{T_1}} = \frac{1}{2}$

$\Rightarrow \frac{T_1}{T_2} = 4$

$\Rightarrow \frac{T_1}{T_2} = \left(\frac{V_2}{V_1}\right)^{\gamma-1}$

$\Rightarrow (4)^{\frac{1}{\gamma-1}} = \frac{V_2}{V_1}$

$\frac{V_2}{V_1} = (4)^{\frac{5}{2}} = 2^5 = 32$

16. Answer (4)

Hint: Change in internal energy $(\Delta U) = nC_v\Delta T$

Sol.: $\Delta U = nC_v\Delta T = \frac{nR}{(\gamma-1)}(T_2 - T_1)$

$\Delta U = \frac{nR}{(\gamma-1)}\times\left(\frac{P_2V_2}{nR} - \frac{P_1V_1}{nR}\right) = \frac{P_2V_2 - P_1V_1}{\gamma-1}$

$\Delta U = \frac{6\times 6 - 2\times 3}{\frac{1}{3}} = 90$ J

17. Answer (4)

Hint: Time period of satellite $(T) \propto r^{\frac{3}{2}}$

Sol.: $\Rightarrow \frac{T_1}{T_2} = \left(\frac{r_1}{r_2}\right)^{\frac{3}{2}}$

$\Rightarrow \frac{T}{T_2} = \left(\frac{R}{4R}\right)^{\frac{3}{2}} = \frac{1}{8}$

$T_2 = 8T$

18. Answer (3)

Hint: Frequency of closed organ pipe $(f) = \frac{nv}{4l}$

Frequency of open organ pipe $(f) = \frac{nv}{2l}$

Sol.: First overtone of closed pipe $(f_1) = \frac{3v}{4l_1}$

Fourth overtone of open pipe $(f_2) = \frac{5v}{2l_2}$

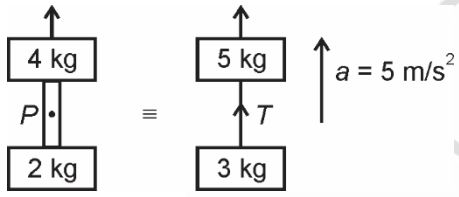
$\Rightarrow \frac{3v}{4l_1} = \frac{5v}{2l_2}$

$\Rightarrow \frac{l_1}{l_2} = \frac{3}{10}$

19. Answer (4)

Hint: Net force on system (F_{net}) = ma

Sol.:



$\Rightarrow$ $T - 30 = 3a = 3 \times 5$

$T = 45$ N

20. Answer (3)

Hint: In damped oscillation: $A = A_0e^{-bt}$

Sol.: Amplitude (A) = A_0e^{-bt}

$\Rightarrow \frac{A_0}{2} = A_0e^{-b(20T)}$

$\Rightarrow A = A_0e^{-b(100T)}$

$\Rightarrow A = A_0\left[e^{-b(20T)}\right]^5$

$\Rightarrow A = A_0\left(\frac{1}{2}\right)^5 = \frac{A_0}{32}$

21. Answer (4)

Hint: Molar specific heat $(\dot{C})$ = Specific heat (C) × Molecular mass

Sol.: $\because$ $\dot{C}_p - \dot{C}_v = R$

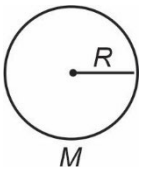
$32\,(C_p - C_v) = R$

$C_p - C_v = \frac{R}{32}$

22. Answer (4)

Hint: Moment of inertia of ring (I) = $\int dmr^2$

Sol.:



Now an arc length $\frac{\pi R}{3}$ is removed then

Mass of $2\pi R$ arc length = M

Mass of $\left(2\pi R - \frac{\pi R}{3}\right)$ arc length

$(M') = \frac{M}{2\pi R} \times \left(2\pi R - \frac{\pi R}{3}\right)$

$\Rightarrow M' = \frac{M}{2} \times \frac{5}{3} = \frac{5M}{6}$

then MOI of remaining portion $(I') = \int dmR^2$

$I' = \frac{5MR^2}{6}$

23. Answer (3)

Hint: Time taken by rigid body to roll down

$(t) = \sqrt{\frac{2h}{g\sin^2\theta}\left(1 + \frac{k^2}{R^2}\right)}$

Sol.: $\frac{k^2}{R^2}$ for a solid cylinder $= \frac{1}{2}$

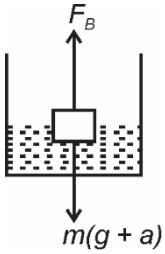
$\frac{k^2}{R^2}$ for a hollow sphere $= \frac{2}{3}$

$\Rightarrow \frac{t_1}{t_2} = \sqrt{\frac{(3/2)}{(5/3)}} = \sqrt{\frac{9}{10}}$

24. Answer (3)

Hint: When body starts accelerating, pseudo force act on the system. Then $g_{eff} = g + a$

Sol.:



When beaker is accelerating upward then

$W' = m(g + a)$

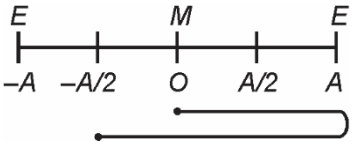
$F_B' = V\rho\,(g + a)$

So part of body immersed in liquid remains same.

25. Answer (4)

Hint & Sol.:

Distance $= \frac{5}{8}(4A) = \frac{5}{2}A$



$t = \frac{T}{2} + \frac{T}{12} = \frac{7T}{12}$

26. Answer (4)

Hint & Sol.: Temperature of sink remains same.

27. Answer (2)

Hint & Sol.: (B) is suitable for shock absorber as area is more under stress–strain curve. To minimize heating, (A) is suitable for car tyres.

28. Answer (4)

Hint: No. of beats produced per second = $f_2 - f_1$

Sol.: Let lowest frequency is f, then next consecutive frequencies are $f + 3$; $f + 6$; $f + 9$ …

Given $f_{20} = 2f_1$

$\Rightarrow f + 57 = 2f$

$\Rightarrow f = 57$ Hz

$\Rightarrow f_{20} = 114$ Hz

29. Answer (2)

Hint: When source is moving $(f') = f\left[\frac{v}{v \pm v_S}\right]$

Sol.:

Case-(i) $f_1 = f\left[\frac{325}{325-25}\right] = \frac{325f}{300}$

Case-(ii) $f_2 = f\left[\frac{325}{325-15}\right] = \frac{325f}{310}$

$\Rightarrow \frac{f_1}{f_2} = \frac{31}{30}$

30. Answer (4)

Hint & Sol.: $|V_{\text{inside}}| = \left|-\frac{GM(3R^2 - r^2)}{2R^3}\right|$

$|V_{\text{surface}}| = \left|-\frac{GM}{R}\right|$

$|V_{\text{outside}}| = \left|-\frac{GM}{r}\right|$

31. Answer (2)

Hint & Sol.: Given process $P^{1-\gamma} T^{\gamma}$ = constant is an adiabatic process.

For adiabatic process, Bulk modulus = γP

32. Answer (2)

Hint: Time period of revolution $(T) \propto r^{3/2}$

Sol.: $\Rightarrow \frac{T_1}{T_2} = \left(\frac{r_1}{r_2}\right)^{3/2}$

$\Rightarrow T_2 = T\left(\frac{2R}{R}\right)^{3/2}$

$T_2 = 2\sqrt{2}T$

33. Answer (3)

Hint: When pendulum is immersed into liquid then

$\Rightarrow Mg' = Mg - F_B$

Sol.: $F_B = V\sigma g$ (σ = density of liquid)

$\Rightarrow Mg' = Mg - F_B$

$\Rightarrow g' = g - \frac{\sigma}{\rho}g = \left(1 - \frac{\sigma}{\rho}\right)g$

New time period $(T') = 2\pi\sqrt{\frac{l}{g'}} = 2\pi\sqrt{\frac{l}{\left(1-\frac{\sigma}{\rho}\right)g}}$

$T' = \sqrt{5}T$

34. Answer (2)

Hint: Sound level $(\beta) = 10 \log\left(\frac{I}{I_0}\right)$

Sol.: Sound level $(\beta_1) = 10 \log\left(\frac{I_1}{I_0}\right)$

$\Rightarrow \beta_2 = 10 \log\left(\frac{I_2}{I_0}\right)$

$\Rightarrow \beta_2 - \beta_1 = 10 = 10 \log\left(\frac{I_2}{I_1}\right)$

$\Rightarrow I_2 = 10I_1 = 0.1$ W/m^2

35. Answer (1)

Hint: Energy of wave $(E) \alpha\, n^2A^2$

Sol.: $\frac{E_1}{E_2} = \frac{n_1^2A_1^2}{n_2^2A_2^2}$

$\Rightarrow \frac{4}{1} = \frac{(2n)^2A_1^2}{n^2A_2^2}$

$\frac{A_1}{A_2} = \frac{1}{1}$

SECTION - B

36. Answer (1)

Hint: As per first law of thermodynamics.

$Q = \Delta U + W$

Sol.:

Isochoric heating	:	$\Delta W = 0$	$\Delta Q > 0$	;	$\Delta U > 0$
Isothermal expansion	:	$\Delta W > 0$	$\Delta Q > 0$	;	$\Delta U = 0$
Isobaric expansion	:	$\Delta Q > 0$	$\Delta W > 0$	;	$\Delta U > 0$
Adiabatic expansion	:	$\Delta Q = 0$	$\Delta W > 0$	;	$\Delta U < 0$

37. Answer (3)

Hint: Thermal stress = $Y \times$ thermal strain

Sol.: Thermal strain produced in rod $= \frac{\Delta l}{l} = \alpha \Delta T$

Thermal stress = $Y\alpha\Delta T$

$= 2 \times 10^9 \times 5 \times 10^{-6} \times 60$

$= 6 \times 10^5$ N/m^2

38. Answer (1)

Hint: Frequency $(f) = \frac{1}{2l}\sqrt{\frac{T}{\mu}}$

Sol.: $\frac{f_1}{f_2} = \sqrt{\frac{T_1}{T_2}}$

$\Rightarrow \frac{f}{3f} = \sqrt{\frac{T}{T+10}}$

$\Rightarrow \frac{1}{9} = \frac{T}{T+10}$

$\Rightarrow T + 10 = 9T$

$T = \frac{10}{8} = 1.25$ N

39. Answer (4)

Hint: $A_T = \left(\frac{2v_2}{v_1 + v_2}\right) A_i$

Sol.: $\Rightarrow \frac{A_T}{A_i} = \frac{2 \times 60}{160} = \frac{3}{4}$

40. Answer (2)

Hint: Velocity of wave at distance x, $(v) = \sqrt{gx}$

Sol.: Velocity $(v) = \sqrt{gx}$

$\frac{dx}{dt} = \sqrt{gx}$

$\Rightarrow \int_0^{l/2} \frac{dx}{\sqrt{x}} = \int_0^t \sqrt{g}\, dt$

$\Rightarrow (2\sqrt{x})_0^{l/2} = \sqrt{g}\, t$

$\Rightarrow \sqrt{\frac{2l}{g}}$

41. Answer (4)

Hint & Sol.: $f = 3 + 3 + 4 = 10$

One vibrational mode gives two degrees of freedom.

42. Answer (3)

Hint: $A \propto T^4$

Sol.: $\frac{A_1}{A_2} = \left(\frac{T_1}{T_2}\right)^4$

$\frac{A_1}{A_2} = \left(\frac{400}{800}\right)^4$

$\frac{A_1}{A_2} = \frac{1}{16}$

43. Answer (4)

Hint & Sol.:

$$|\vec{a}_{avg.}| = \frac{|\Delta \vec{v}|}{\Delta t} = \frac{2v \sin\left(\frac{180°}{2}\right)}{\frac{\pi r}{v}} = \frac{2v^2}{\pi r}$$

44. Answer (1)

Hint: Time of fall $(t) = \sqrt{\frac{2h}{g}}$

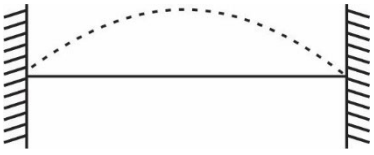
Sol.: $\Rightarrow t \propto \sqrt{h}$

$\Rightarrow \frac{t}{t'} = \sqrt{\frac{h \times 3}{h}}$

$t' = \frac{t}{\sqrt{3}}$

45. Answer (4)

Hint & Sol.:



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

$\lambda = 2L$

$\lambda = 100$ cm

46. Answer (3)

Hint: Temperature scale of thermometer are related as linear relation between temperature and length.

Sol.: $\frac{x-10}{130-10}=\frac{50}{100}$

$x = 60 + 10 = 70°C$

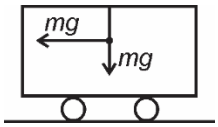
47. Answer (4)

Hint: Time period of simple pendulum

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

Sol.: Given that : $x=\frac{gt^2}{2}$

$\Rightarrow v=\frac{dx}{dt}=\frac{2gt}{2}=gt$



$a=\frac{dv}{dt}=g$ in horizontal direction

In frame of car

$\Rightarrow g_{eff}=\sqrt{g^2+g^2}=\sqrt{2}g$

So Time period $(T')=2\pi\sqrt{\frac{l}{g\sqrt{2}}}=\pi\sqrt{\frac{2\sqrt{2}l}{g}}$

48. Answer (3)

Hint: Use displacement equation of SHM

$x = A\sin\omega t$

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

$v = A\omega\cos\omega t$

$a = -A\omega^2\sin\omega t \quad \Rightarrow \quad a = -\omega^2 x$

So, graph of displacement-time will be sine graph.

Graph of velocity- time will be cosine graph.

Acceleration – displacement graph will be straight line.

$\because \left(\frac{x}{A}\right)^2+\left(\frac{v}{A\omega}\right)^2=1$ so, $v - x$ graph will be ellipse (if $\omega \neq 1$ rad/s)

49. Answer (3)

Hint & Sol.: In an elliptical orbit, angular momentum of planet is constant but its speed and distance changes. Also, total energy is conserved.

50. Answer (1)

Hint & Sol.: $e=\frac{r_A-r_p}{r_A+r_p}$

$e=\frac{6R-3R}{6R+3R}$

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

[CHEMISTRY]

SECTION - A

51. Answer (4)

Hint: $M_RV_R = M_1V_1 + M_2V_2$

Sol.: $M_R (V_1 + V_2) = M_1V_1 + M_2V_2$

[R = Resultant solution]

$M_R (250 + 150) = 0.2 \times 250 + 0.4 \times 150$

$=\frac{50+60}{400}=0.275\simeq 0.28$ M

52. Answer (2)

Hint: 1 mol of any gas occupies 22.4 L at STP.

Sol.: $N_2(g)+3H_2(g)\longrightarrow 2NH_3(g)$

1 mol 3 mol 2 mol

(22.4 L) (3 × 22.4 L) (2 × 22.4 L) [at STP]

$\therefore$ H_2 is limiting agent

Number of moles of $H_2=\frac{5.6}{22.4}=\frac{1}{4}$ mol

Volume of NH_3 produced by 5.6 L H_2 is $\frac{2}{3}\times\frac{1}{4}\times 22.4\text{ L}=3.73\text{ L}$

53. Answer (1)

Hint: Number of atoms = Number of moles of molecules × atomicity × N_A

Sol.: Number of atoms in $CO_2=\frac{44}{44}\times 3\times N_A=3N_A$

Number of atoms in $CH_4=\frac{32}{16}\times 5\times N_A=10N_A$

Number of atoms in $NO_2=\frac{23}{46}\times 3\times N_A=1.5N_A$

Number of atoms in $H_2O=\frac{54}{18}\times 3\times N_A=9N_A$

54. Answer (2)

Hint: Higher is the electron density on benzene ring, faster is aromatic electrophilic substitution reaction.

Sol.: $-CH_3$ is electron donating in nature hence, toluene reacts at fastest rate towards aromatic electrophilic substitution reaction.

- $-NO_2$ and –Cl are electron withdrawing groups.

55. Answer (1)

Hint: Radial nodes = n – ℓ – 1

Angular nodes = ℓ

Sol.: For 4*p* orbital, n = 4

$\ell = 1$

Radial nodes = n – 1 – 1 = 4 – 1 – 1 = 2

Angular node = 1

56. Answer (4)

Hint & Sol.: Mathematically, Heisenberg uncertainty principle is presented as

$$\Delta v_x . \Delta x \geq \frac{h}{4\pi m}$$

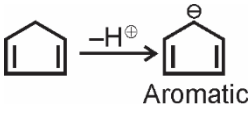
57. Answer (2)

Hint: Shape of an orbital depends upon the value of 'ℓ'.

Sol.: Azimuthal quantum number tells about the orbital angular momentum and defines the three-dimensional shape of the orbital.

58. Answer (1)

Hint: Higher is the stability of conjugate base, more will be the acidity of compound.

Sol.: 

- Conjugate base of  is most stable due to its aromatic nature.

59. Answer (2)

Hint:

Generally electron gain enthalpy become less negative on going down the group.

Sol.:

Element	$\Delta_{eg}H$ (kJmol^{-1})
O	– 141
S	– 200
Se	– 195
Te	– 190

- Electron gain enthalpy of O is less negative than S. This is because when an electron is added to O, the added electron goes to the smaller n = 2 quantum level and suffers significant repulsion from other electron present in this level.

60. Answer (3)

Hint: Molecule having unpaired electrons is paramagnetic in nature.

Sol.:

$$B_2\left(10e^-\right):(\sigma 1s)^2\left(\sigma^* 1s\right)^2(\sigma 2s)^2\left(\sigma^* 2s\right)^2\left(\pi 2p_x^{\,1} \equiv \pi 2p_y^{\,1}\right)$$

$$C_2\left(12e^-\right):(\sigma 1s)^2\left(\sigma^* 1s\right)^2(\sigma 2s)^2\left(\sigma^* 2s\right)^2\left(\pi 2p_x^{\,2} \equiv \pi 2p_y^{\,2}\right)$$

$$N_2\left(14e^-\right):(\sigma 1s)^2\left(\sigma^* 1s\right)^2(\sigma 2s)^2\left(\sigma^* 2s\right)^2$$
$$\left(\pi 2p_x^{\,2} \equiv \pi 2p_y^{\,2}\right)(\sigma 2p_z)^2$$

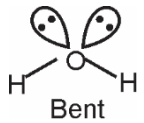
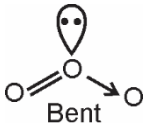
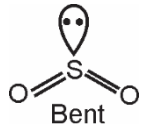
$$F_2\left(18e^-\right):(\sigma 1s)^2\left(\sigma^* 1s\right)^2(\sigma 2s)^2\left(\sigma^* 2s\right)^2(\sigma 2p_z)^2$$
$$\left(\pi 2p_x^{\,2} \equiv \pi 2p_y^{\,2}\right)\left(\pi^* 2p_x^{\,2} \equiv \pi^* 2p_y^{\,2}\right)$$

$\therefore$ B_2 is paramagnetic in nature.

61. Answer (1)

Hint: Species having 2 bond pairs and 0 lone pair around central atom is linear in shape.

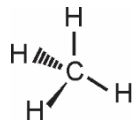
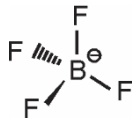
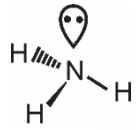
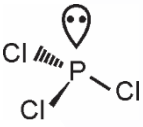
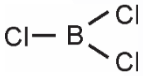
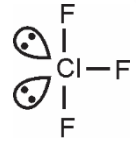
Sol.:

Molecule	Shape
$HgCl_2$	Cl – Hg – Cl Linear
H_2O	 Bent
O_3	 Bent
SO_2	 Bent

62. Answer (3)

Hint: Species having same number of bond pairs and lone pairs around central atom will be isostructural.

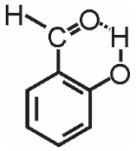
Sol.:

Species	Arrangement of electron pairs	Shape
CH_4		Tetrahedral
SF_4		See-saw
BF_4^-		Tetrahedral
XeF_4		Square planar
NH_3		Pyramidal
PCl_3		Pyramidal
BCl_3		Trigonal planar
ClF_3		T-shape

63. Answer (2)

Hint: Intramolecular H bonding is formed within the same molecule.

Sol.: Intramolecular H bond is formed when H atom is in between the two highly electronegative (F, O, N) atoms present within the same molecule.



64. Answer (2)

Hint: $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$

Sol.: According to combined gas law,

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

$$\frac{760 \times 500}{300} = \frac{P_2 \times 580}{290}$$

$P_2 = 633.3$ mm Hg

65. Answer (3)

Hint: Molecules possessing permanent dipoles interact with dipole-dipole forces.

Sol.: Polar molecules which are thought to be neutral but possess permanent dipoles interact with dipole-dipole forces e.g:- HCl and HF

- He – HF and HCl – O_2 interact with dipole-induced dipole forces.
- H_2 and N_2 possess London forces as the intermolecular forces.

66. Answer (4)

Hint: According to Graham's law of diffusion,

$$\frac{r_1}{r_2} = \sqrt{\frac{M_2}{M_1}}$$

Sol.:

$$\Rightarrow \frac{r_1}{r_{H_2}} = \sqrt{\frac{M_{H_2}}{M_1}}$$

$\Rightarrow$ Rate of effusion of H_2 is twice than the given gas.

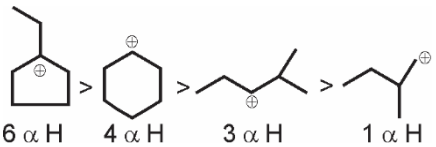
$$\Rightarrow \frac{r_1}{2r_1} = \sqrt{\frac{2}{M_1}}$$

$\Rightarrow$ $M_1 = 8$ u

67. Answer (2)

Hint: More is the number of hyperconjugative structures, more is the stability of carbocation.

Sol.: More the number of α hydrogen atoms, more will be the hyperconjugative structures.



68. Answer (2)

Hint: $\Delta H = \Delta U + \Delta n_g RT$

Sol.: The reaction for which $\Delta n_g = 0$ will have $\Delta H = \Delta U$.

[Δn_g = difference in the number of moles of gaseous products and reactants]

for $N_2(g) + O_2(g) \rightarrow 2NO(g)$

$\because \quad \Delta n_g = 2 - (1 + 1) = 0$

$\therefore \quad \Delta H = \Delta U + 0 \times RT = \Delta U$

69. Answer (2)

Hint: $\Delta T = 0$ for isothermal process.

Sol.:

- For reversible isothermal process, since

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

- For reversible isothermal expansion

$$\Delta S = nR\ln\frac{V_f}{V_i}$$

For expansion, $V_f > V_i$

therefore $\Delta S_{sys} > 0$

$\therefore \quad \Delta S = +ve \ (\neq 0)$

70. Answer (2)

Hint: $\Delta G = \Delta H - T\Delta S$

Reaction is spontaneous when $\Delta G < 0$

Sol.: Reaction is spontaneous when $\Delta G < 0$.

i.e $\Delta H - T\Delta S < 0$

$18 \times 10^3 - T(36) < 0$

$500\ K < T$

$\therefore$ Reaction will be spontaneous above 500 K

71. Answer (4)

Hint: γ remains same when equal volumes of monoatomic gases are mixed.

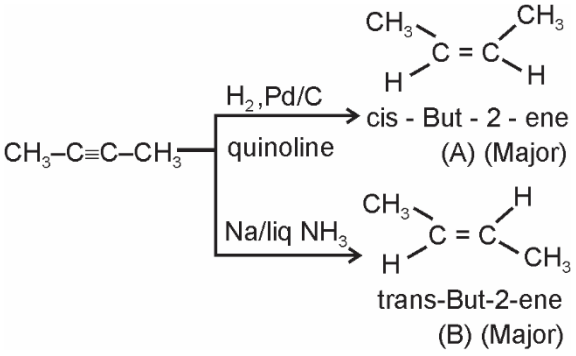
Sol.: For monoatomic gases, (He and Ne),

$$\gamma = \frac{C_p}{C_v} = \frac{\frac{5R}{2}}{\frac{3R}{2}} = 1.66 \simeq 1.67$$

72. Answer (3)

Hint: H_2, Pd/C, quinoline produce cis-alkene and Na/liq NH_3 produces trans – alkene.

Sol.:



(A) and (B) are geometrical isomers.

73. Answer (4)

Hint:

$|M_1V_1 - M_2V_2| = M_RV_R$

Sol.: $M_1V_1 - M_2V_2 = M_RV_R$.

$0.2x - 0.02x = M_R\ (x + x)$

$$\frac{0.18x}{2x} = M_R$$

$M_R = 0.09M = [OH^-]$

$pOH = -\log [OH^-] = -\log [0.09] = 1.04$

$pH = 14 - 1.04 = 12.96 \simeq 13$

74. Answer (2)

Hint: For $MgSO_4$, $K_{sp} = S^2$ where S is solubility of salt in mol L^{-1}

Sol.: Solubility of $MgSO_4 = \frac{1.20 \times 10^{-3}}{120}$

$= 1.0 \times 10^{-5}$ mol L^{-1}

$$MgSO_4 \rightleftharpoons \underset{s}{Mg^{2+}} + \underset{s}{SO_4^{2-}}$$

$K_{sp} = S^2 = [1.0 \times 10^{-5}]^2$

$= 1.0 \times 10^{-10}\ mol^2\ L^{-2}$

75. Answer (1)

Hint: $K_P = K_C(RT)^{\Delta n_g}$

Sol.: $2NOCl(g) \rightleftharpoons 2NO(g) + Cl_2(g)$

$K_p = K_c(RT)^{\Delta n_g}$

$\Delta n_g = (2 + 1) - 2 = 1$

$$\frac{K_p}{K_c} = (RT)^1$$

$$\frac{K_c}{K_p} = (RT)^{-1}$$

76. Answer (1)

Hint: Reduction takes place at cathode.

Sol.:

$$CH_3COO^-Na^+ \rightleftharpoons 2CH_3 - \overset{O}{\overset{\|}{C}} - O^- + 2Na^+$$

$\Rightarrow$ At anode:

$$2CH_3 - \overset{O}{\overset{\|}{C}} - O^- \xrightleftharpoons{-2e^-} 2\dot{C}H_3 + 2CO_2\uparrow$$

$$\dot{C}H_3 + \dot{C}H_3 \longrightarrow CH_3 - CH_3\uparrow$$

$\Rightarrow$ At cathode:

$$H_2O + e^- \longrightarrow OH^{\ominus} + \overset{\bullet}{H}$$

$$2\overset{\bullet}{H} \longrightarrow H_2 \uparrow$$

77. Answer (3)

Hint: The algebraic sum of oxidation state of all atoms in a compound must be zero.

Sol.: $\overset{+1+5\ \ -2}{2KClO_3}(s) \longrightarrow \overset{+1\ \ -1}{2KCl}(s) + \overset{0}{3O_2}(g)$

The oxidation number of Cl changes from +5 to –1.

78. Answer (3)

Hint: Element in its highest or lowest oxidation state cannot undergo disproportionation reaction.

Sol.:

Species	Oxidation State of Nitrogen
NO	+2
NO_2	+4
N_2O_3	+3
N_2O_5	+5

In N_2O_5, N is in its highest oxidation state hence cannot undergo disproportionation reaction.

79. Answer (3)

Hint: Higher is the oxidising power, higher is the ability of a species to get reduced itself.

Sol.: Higher the standard reduction potential of a species, higher will be its oxidising power. So correct order of oxidising power is

$\therefore$ I > III > II

80. Answer (1)

Hint & Sol.:

On commercial scale water gas is prepared by the passage of steam over hot coke. The mixture of CO and H_2 thus produced is known as water gas or synthesis gas.

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

81. Answer (3)

Hint: Alkyne will be obtained.

Sol.: $CaC_2 + 2D_2O \longrightarrow C_2D_2 + Ca(OD)_2$

82. Answer (4)

Hint & Sol.:

Metal	Colour of flame
Li	Crimson red
K	Violet
Rb	Red violet
Cs	Blue

83. Answer (3)

Hint: Hydration enthalpy of alkaline earth metal ions decreases as ionic size increases.

Sol.: Hydration enthalpy: $Mg^{2+} > Ca^{2+} > Sr^{2+} > Ba^{2+}$

84. Answer (3)

Hint: $Be(OH)_2$ form $[Be(OH)_4]^{2-}$ on reaction with alkali.

Sol.: $Be(OH)_2 + 2OH^- \longrightarrow \left[Be(OH)_4\right]^{2-}$

$\Rightarrow$ The hybridisation of Be in $[Be(OH)_4]^{2-}$ is sp^3.

85. Answer (3)

Hint & Sol.:

- NaOH is called as caustic soda.
- $Ca(OH)_2$ is slaked lime.

SECTION -B

86. Answer (2)

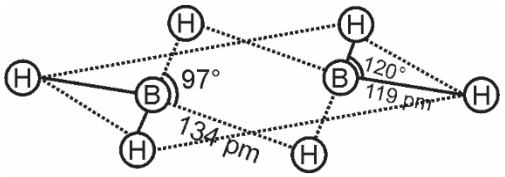
Hint: More is the back donation of electrons from halogen atom to boron atom, weaker is the acidic nature of boron halide.

Sol.: Tendency of back donation of electrons from halogen to boron follows the order: F > Cl > Br

Lewis acidity order: $BF_3 < BCl_3 < BBr_3$

87. Answer (3)

Hint:



The structure of diborane, B_2H_6

Sol.: In B_2H_6, the four terminal H and two B atoms lie in one plane and 2 H lie above and below this plane.

88. Answer (4)

Hint: Stability of dihalides of group 14 elements increases down the group.

Sol.: Stability of higher oxidation state of elements decreases down the group due to inert pair effect.

89. Answer (4)

Hint: The tendency to show catenation decreases down the group.

Sol.: As the atomic size increases and electronegativity decreases down the group, thereby the tendency to show catenation decrease

Catenation: $C >> Si > Ge \simeq Sn$

- Pb does not show catenation.

90. Answer (3)

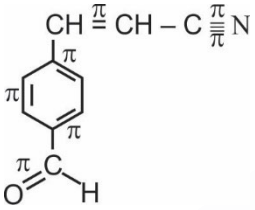
Hint and Sol.: CO_2 is commercially obtained by heating limestone.

- In laboratory, it is prepared by action of dil. HCl on $CaCO_3$.

91. Answer (2)

Hint: C – C single bond contain one σ bond, double bond contain one σ and one π bond and triple bond contain one σ and 2π bonds.

Sol.:



$\Rightarrow$ $\sigma : \pi = 19 : 7$

92. Answer (3)

Hint: Oxides of alkaline earth metals are usually basic in nature.

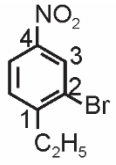
Sol.:

Column A (Oxide)	Column B (Nature)
B_2O_3	Acidic
CaO	Basic
PbO_2	Amphoteric
N_2O	Neutral

93. Answer (2)

Hint: For tri or higher substituted benzene derivatives, IUPAC naming of the compound is done following lowest locant rule.

Sol.:



2-Bromo-1-ethyl-4-nitrobenzene

94. Answer (3)

Hint: Pressure fraction = mole fraction

Sol.: Let x g of each gas is present

Let total pressure of the gas mixture be P atm

$$\text{Moles of } CH_4 = \frac{x}{16} \text{ mol}$$

$$\text{Moles of } SO_2 = \frac{x}{64} \text{ mol}$$

$$X_{CH_4} = \frac{x/16}{\frac{x}{16}+\frac{x}{64}} = \frac{4}{5} = \text{Pressure fraction of } CH_4$$

95. Answer (3)

Hint: pH of an acidic solution should be less than 7 at 25°C.

Sol.: $\left[H^+\right]_{total} = \left[H^+\right]_{HCl} + \left[H^+\right]_{H_2O}$

$= 10^{-8} + 10^{-7}$

$= 10^{-8}[1 + 10] = 11 \times 10^{-8}$

$pH = -\log[11 \times 10^{-8}] = 6.95$

96. Answer (2)

Hint: 1.5 m aqueous solution means 1.5 moles of solute is present in 1000 g of water.

Sol.:

$\therefore$ Number of moles of solute = 1.5 mol

Number of moles of solvent (water)

$$= \frac{1000}{18} = 55.55 \text{ mol}$$

$$X_B = \frac{1.5}{1.5+55.55} = 0.026$$

97. Answer (1)

Hint: $K_c' = K_c^n$ [when reaction coefficients are multiplied by n]

Sol.: $2AB \rightleftharpoons A_2 + B_2$; $K_c = 49$

$AB \rightleftharpoons \frac{1}{2}A_2 + \frac{1}{2}B_2$; $K_{c'} = ?$

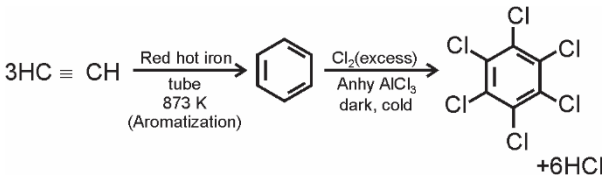
$K_c' = K_c^{\frac{1}{2}} = (49)^{\frac{1}{2}}$

$K_c' = 7$

98. Answer (4)

Hint: In excess of electrophilic reagent, all H atoms of benzene ring undergo substitution.

Sol.:



99. Answer (2)

Hint & Sol.: Greenhouse effect is responsible for global warming and the major greenhouse gases are CO_2, CH_4, H_2O, N_2O, CFCs and O_3

100. Answer (2)

Hint & Sol.:

	Species	Maximum prescribed concentration in drinking water
I	Zn	5.0 ppm
II	NO_3^-	50 ppm
III	Pb	50 ppb
IV	Fe	0.2 ppm

[BOTANY]

SECTION - A

101. Answer (3)

Hint: In *Pinus*, male or female cone are borne on same tree.

Sol.: *Cycas* is dioecious species as male and female plants are separate. *Pinus* is monoecious.

102. Answer (2)

Hint: Members of Phycomycetes have aseptate and coenocytic mycelium.

Sol.: In members of Ascomycetes, mycelium consists of septate hyphae.

103. Answer (4)

Hint: *Albugo* is the parasitic fungi causes white rust of crucifers.

Sol.: *Puccinia* is the rust fungus belongs to Basidiomycetes and causes black rust of wheat.

104. Answer (2)

Hint: In J shaped chromosomes, one arm is very short and one arm is very long.

Sol.: In acrocentric chromosome, the centromere is present very close to one end forming one extremely short and one very long arm.

105. Answer (1)

Hint: Epitepalous condition is found in the members of Liliaceae family

Sol.: *Colchicum autumnale* have epitepalous androecium. This plant belongs to family Liliaceae.

106. Answer (3)

Hint: Members of Solanaceae family have berry or capsule type of fruit.

Sol.: Tomato belongs to family Solanaceae and its fruit is berry. Drupe fruits are one seeded, *e.g.*, mango, coconut.

107. Answer (1)

Hint: Cotyledon of maize grain is called scutellum and it is diploid.

Sol.: In maize grain, diploid chromosome number is 20, thus the number of chromosomes in the cell of scutellum will be 20.

108. Answer (4)

Hint.: Zygote formation is the result of syngamy.

Sol.: Syngamy involves fusion of male and female gametes. After getting fused with one male gamete, secondary nucleus forms primary endosperm nucleus.

109. Answer (1)

Hint: Mitochondria produces ATP and is not a part of endomembrane system.

Sol.: In plant cell, vacuole (a part of endomembrane system) can occupy upto 90% of the volume of the cell. In *Amoeba* contractile vacuole are important for excretion.

110. Answer (4)

Hint: Bog moss or cotton moss is used for trans-shipment of living material.

Sol.: *Sphagnum* have high capacity to hold water and it is used as packing material for trans-shipment of living material.

111. Answer (1)

Hint: Cells of pericycle play an important role during secondary growth in dicot roots and pith is small and inconspicuous in them.

Sol.: During secondary growth in the dicot root cells of pericycle become meristematic and give rise to lateral roots and part of vascular cambium.

Pith is large and well developed in monocot root.

112. Answer (3)

Hint: Conduction of water from root to leaf, is performed by sapwood.

Sol.: In heartwood, deposition of tannins, resins, oils, etc. result in blockage of xylary elements. Hence, they become non-functional w.r.t. conduction of materials.

113. Answer (4)

Hint: Uniport in facilitated diffusion is a passive process.

Sol.: Facilitated diffusion does not require energy to occur.

114. Answer (4)

Hint: Tracheids are dead cells.

Sol.: Elongated and tube like tracheid cells do not have protoplasm.

115. Answer (1)

Hint: Mutual attraction between water molecule is called cohesion.

Sol.: Tensile strength is an ability to resist a pulling force.

Capillarity is the ability of liquid to rise in thin tubes.

Adhesion is attraction of water molecules to polar surfaces.

116. Answer (1)

Hint: *Sorghum*, sugarcane and maize are C_4 plants in which photorespiration does not occur.

Sol.: C_4 plants have mechanism that increase the concentration of CO_2 at the enzyme site and minimise the water loss.

117. Answer (3)

Hint: Movement of sucrose out of phloem sap and into the cell requires energy.

Sol.: Active transport is required to move the sucrose out of phloem sap and into the cells.

118. Answer (4)

Hint: *Pseudomonas* and *Thiobacillus* are denitrifying bacteria.

Sol.: *Nitrosomonas* and *Nitrococcus* bacteria oxidise ammonia to nitrites.

119. Answer (3)

Hint: In Binomial nomenclature system the first word denoting genus starts with capital letter, while specific epithet starts with small letter. Both genus and specific epithet should be italic, if printed.

Sol.: *Mangifera indica* is correctly printed scientific name of Mango.

120. Answer (2)

Sol.: Slime moulds are saprotrophic protist and *Plasmodium* is a sporozoan which do not have locomotory structures.

121. Answer (2)

Hint: Pneumatophores occur in plants growing in swampy area.

Sol.: In *Rhizophora,* many roots come out of the ground grow vertically called pneumatophore helps to get oxygen for respiration.

122. Answer (4)

Sol: Glucose is the most preferred substrate for biological oxidation.

123. Answer (3)

Hint: Hydathodes are meant for water loss in liquid form.

Sol.: Stomata help in gaseous exchange in the plant.

124. Answer (2)

Hint: PFK (or pacemaker enzyme) regulates rate limiting step of EMP pathway.

Sol.: PFK catalyses conversion of fructose-6-phosphate to fructose-1,6-bisphosphate.

125. Answer (3)

Hint: The partial breakdown of glucose to pyruvic acid is called glycolysis.

Sol.: Glycolysis is often referred to as EMP pathway. It does not require oxygen.

126. Answer (2)

Hint: Lactic acid fermentation releases lactic acid.

Sol.: Alcoholic fermentation results in the release of ethanol along with CO_2.

127. Answer (3)

Hint: Oxidation of one NADH + H^+ yields 3 ATP and oxidation of one $FADH_2$ yields 2 ATP

Sol.: From $10\ NADH + H^+ \xrightarrow{ETS} 30\ ATP$

$5\ FADH_2 \xrightarrow{ETS} 10\ ATP$

Total production of ATP from 10 NADH + H^+ and 5 $FADH_2$ via ETS is 40 ATP.

128. Answer (2)

Sol.: Zinc is required for biosynthesis of indole-3-acetic acid or auxin in plants.

129. Answer (4)

Hint: Ethylene is a gaseous PGR.

Sol.: Ethylene involve in breaking of dormancy of seeds, buds and initiate the germination of seeds.

130. Answer (1)

Hint: This hormone is also known as stress hormone.

Sol.: Abscisic acid is the derivative of carotenoids.

131. Answer (4)

Hint: In the fronds of brown algae, air bladder is seen.

Sol.: In *Fucus*, air bladder is present.

132. Answer (3)

Hint: Redifferentiated tissue are formed when the dedifferentiated cells produce the cells that loose their ability to divide and form permanent cells.

Sol.: Secondary xylem is a redifferentiated tissue.

133. Answer (3)

Hint: Cyclic photophosphorylation occurs in stroma lamellae membrane.

Sol.: Non-cyclic photophosphorylation occurs in granal thylakoids.

134. Answer (4)

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

135. Answer (1)

Hint: Pyruvate dehydrogenase catalyse link reaction and pyruvate decarboxylase catalyse alcoholic fermentation.

Sol.: Invertase converts sucrose into glucose and fructose.

In muscles of animal during exercise, when oxygen is inadequate for cellular respiration, pyruvic acid is reduced to lactic acid by lactic dehydrogenase.

SECTION - B

136. Answer (2)

Hint: Fungal cell wall is composed of chitin.

Sol.: Algal cell wall is composed of cellulose, mannans, galactans and mineral like calcium carbonate.

137. Answer (3)

Sol.: Carbon dioxide is major limiting factor influencing the rate of photosynthesis.

138. Answer (2)

Hint: Inclusion bodies store reserve material in prokaryotic cells.

Sol.: Polysome is a chain of ribosomes attached to a single mRNA.

139. Answer (3)

Hint: In C_3 cycle, 18 ATP molecules are required for synthesis of one glucose molecule

Sol.: Sucrose = glucose + fructose

2 sucrose $\rightarrow$ 2 glucose + 2 fructose

$= 18 \times 2 + 18 \times 2 = 72$

Therefore 72 molecules of ATP are required to make two molecules of sucrose in C_3 cycle.

140. Answer (3)

Hint: For PS II, absorption maxima is at 680 nm.

Sol.: Chlorophyll *a* appears bright or blue green in the chromatogram.

Chlorophyll *a* along with accessory pigments form LHC.

PS-II is associated with splitting of water.

141. Answer (3)

Hint: The biological nitrogen fixation reaction is as follows:

$N_2 + 8e^- + 8H^+ + 16\ ATP \rightarrow 2NH_3 + H_2 + 16\ ADP + 16\ Pi$

Sol.: To fix one molecule of ammonia, 8 molecules of ATP are required.

142. Answer (1)

Sol.: The two most important amides –asparagine and glutamine are found in plants. These are structural part of proteins.

143. Answer (3)

Hint: *In-vitro* culture of explant is called tissue culture

Sol.: Soil-less culture in which plants are grown in a nutrient medium is known as hydroponics.

144. Answer (3)

Hint: Only human beings have self consciousness.

Sol.: Defining property are exclusively present in the living organisms only.

Consciousness and cellular organisation of the body are the defining features of all life forms.

145. Answer (2)

Hint: Water-impermeable layer of cells consists of waxy material i.e. suberin, forms casparian strips.

Sol.: Casparian strip occurs in endodermal cells.

146. Answer (4)

Hint: The final stage of meiotic prophase I is marked by terminalisation of chiasmata.

Sol.: Beginning of diplotene is recognised by dissolution of synaptonemal complex.

- During pachytene stage, recombination nodule is formed.
- During zygotene stage, chromosomes start pairing and this process of association is called synapsis.

147. Answer (2)

Hint: Chromosome are thickest and shortest in metaphase.

Sol.: During metaphase stage, morphology of chromosome is best studied.

148. Answer (3)

Hint: *Selaginella* is heterosporous.

Sol.: Embryo development upto certain stages take place inside the female gametophyte which is retained on the parent sporophyte for variable periods. This event is precursor to seed habit and considered as important step in evolution.

149. Answer (2)

Sol.: Brown algae have fucoxanthin, chlorophyll *a* and *c* as major pigments.

150. Answer (4)

Hint: Robert Brown discovered the nucleus.

Sol.: Anton van Leeuwenhoek first saw and described a living cell.

[ZOOLOGY]

SECTION - A

151. Answer (3)

Hint: Exhibits dorso-ventrally flattened body.

Sol.: *Obelia* belongs to phylum Coelenterata. In *Obelia*, polyps produce medusae asexually and medusae form the polyps sexually.

Pleurobrachia and *Ctenoplana* belong to phylum Ctenophora. They possess radial symmetry along with tissue level of organisation.

Taenia belongs to phylum Platyhelminthes. They have dorso-ventrally flattened body, hence are called flatworms.

152. Answer (2)

Hint: Possesses nephridia for excretion.

Sol.: *Ascaris* belongs to phylum Aschelminthes.

Nereis belongs to phylum Annelida. It possesses closed circulatory system. *Nereis*, an aquatic form, is dioecious. It possesses nephridia for osmoregulation and excretion.

Pinctada belongs to phylum Mollusca. They have feather-like gills which perform respiratory and excretory functions.

Ophiura belongs to phylum Echinodermata. It exhibits water vascular system which helps in locomotion, capture and transport of food and respiration.

153. Answer (4)

Hint: *Delphinus* exhibits CNS which is dorsally placed.

Sol.:

S. No.	Chordates	Non-chordates
1.	Notochord is present.	Notochord is absent.
2	Central nervous system is dorsal, hollow and single.	Central nervous system is ventral, solid and double.
3.	Pharynx is perforated by gill slits.	Gill slits are absent.
4.	Heart is ventral.	Heart is dorsal (if present).
5.	A post-anal part (tail) is present.	Post-anal tail is absent.

154. Answer (3)

Hint: Placoid scales are present in the skin of cartilaginous fishes.

Sol.: *Trygon* (belongs to class Chondrichthyes): Notochord is persistent throughout life; skin is covered with placoid scales.

Pterophyllum (belongs to class Osteichthyes): Gills are covered by an operculum on each side.

Salamandra (belongs to class Amphibia): Presence of tympanum; respiration is through gills, lungs and skin.

Naja (belongs to class Reptilia): Poikilothermic; shed its scales as skin cast.

155. Answer (4)

Hint: Coelenterates exhibit radial symmetry.

Sol.: *Gorgonia* and *Meandrina* (belong to phylum Coelenterata) possess radial symmetry.

Aedes, Bombyx and *Culex* (belong to phylum Arthropoda) possess bilateral symmetry.

Fasciola (belongs to phylum Platyhelminthes) possesses bilateral symmetry.

Loligo (belongs to phylum Mollusca) possesses bilateral symmetry.

156. Answer (3)

Hint: Present in heart

Sol.: Bone: specialized connective tissue; hard and non-pliable ground substance rich in calcium salts and collagen fibres which give bone its strength.

Striated muscle (skeletal muscle)	Non-striated muscle (smooth muscle)	Cardiac muscle
1. Voluntary in action	1. Involuntary in action	1. Involuntary in action
2. They soon get fatigued	2. They do not get fatigued	2. They never get fatigued
3. Intercalated discs are absent	3. Intercalated discs are absent	3. Intercalated discs are present
4. Fibres are unbranched	4. Fibres are unbranched	4. Fibres are branched

157. Answer (2)

Hint: Moist surface of oral cavity is lined by multi layered epithelium.

Sol.:

a.	Squamous epithelium	(ii)	Found in the walls of blood vessels and air sacs of lungs
b.	Cuboidal epithelium	(i)	Found in ducts of glands and tubular parts of nephrons in kidneys
c.	Columnar epithelium	(iv)	Found in the lining of stomach and intestine
d.	Compound epithelium	(iii)	Covers the dry surface of the skin, the moist surface of the buccal cavity, pharynx, inner lining of ducts of salivary glands and of pancreatic ducts

158. Answer (4)

Hint: Gizzard possesses teeth

Sol.: Oesophagus opens into crop, which is used for storing of food.

The crop is followed by gizzard or proventriculus. It has an outer layer of thick circular muscles and thick inner cuticle forming six highly chitinous plates called teeth. Gizzard helps in grinding the food particles.

159. Answer (2)

Hint: 6^{th} abdominal segment is common between the given structures.

Sol.: Mushroom shaped gland : 6^{th}-7^{th} abdominal segments. A pair of testes : 4^{th}-6^{th} abdominal segments.

160. Answer (3)

Hint: Gastric caeca is digestive gland.

Sol.: Malpighian tubules, fat body, nephrocytes and urecose glands help in excretion in cockroach.

Gastric/Hepatic caecae secrete digestive juice.

161. Answer (2)

Hint: Ductus choledochus carries bile juice to duct of Wirsung.

Sol.: The bile secreted by the hepatic cells passes through the hepatic ducts and is stored and concentrated in a thin muscular sac called the gall bladder. The duct of gall bladder (cystic duct) along with the hepatic duct from the liver forms the common bile duct.

The common bile duct and the pancreatic duct open together into the duodenum as the common hepato-pancreatic duct which is guarded by a sphincter called the sphincter of Oddi.

162. Answer (3)

Hint: Nucleases are present in pancreatic juice.

Sol.: Succus entericus contains a variety of enzymes which includes maltase, lactase, sucrase, dipeptidases, lipases, nucleotidases, nucleosidases.

163. Answer (3)

Hint: In marasmus, no oedema is seen.

Sol.: Marasmus is produced by a simultaneous deficiency of proteins and calories. It is found in infants less than a year in age.

Kwashiorkor is produced by protein deficiency unaccompanied by calorie deficiency. It is found in a child who is more than one year in age.

164. Answer (4)

Hint: Gross calorific value of carbohydrates, proteins and fats are 4.1 kcal/g, 5.65 kcal/g and 9.45 kcal/g respectively.

Sol.: Gross calorific value of food = $[(15 \times 4.1) + (10 \times 5.65) + (5 \times 9.45)]$ kcal

$= (61.5 + 56.5 + 47.25)$ kcal

$= 165.25$ kcal

Physiological calorific value of food = [(15 × 4) + (10 × 4) + (5 × 9)] kcal

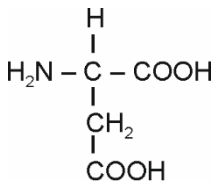
= (60 + 40 + 45) kcal

= 145 kcal

165. Answer (1)

Hint: Identify an acidic amino acid.

Sol.: Aspartic acid is an acidic amino acid (possesses –COOH group in its –R group).



(Aspartic acid)

Sulphur containing amino acids possess sulphur in their –R group.

Heterocyclic amino acids exhibit nitrogen in their ring.

Aromatic amino acids contain cyclic structure in which benzene ring is present in their –R group.

166. Answer (1)

Hint: Protein coated fat globules

Sol.: Chylomicron is a lipoprotein which contains lipid as its prosthetic group. Other proteins (given in the options) do not contain lipid.

167. Answer (3)

Hint: The first amino acid is called N-terminal amino acid.

Sol.: It is a tetrapeptide compound which comprises:

Serine – Glutamine – Tyrosine – Phenylalanine

↓ ↓

(N-terminal amino acid) (C-terminal amino acid)

168. Answer (2)

Hint: Product is formed from substrate.

Sol.: Rate of process is rate of product formation

i.e., Rate $= \frac{\delta P}{\delta t}$

169. Answer (4)

Hint: Protease acts by hydrolysis.

Sol.: Most of the enzymes involved in the process of digestion belong to class hydrolases.

Oxidoreductases/dehydrogenases: Enzymes which catalyse oxidoreduction between two substrates S and S' e.g.,

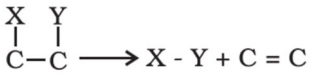
S reduced + S' oxidised → S oxidised + S' reduced

Transferases: Enzymes catalysing a transfer of a group, G (other than hydrogen) between a pair of substrate S and S' e.g.,

S - G + S' ⟶ S + S' - G

Hydrolases: Enzymes catalysing hydrolysis of ester, ether, peptide, glycosidic, C-C, C-halide or P-N bonds.

Lyases: Enzymes that catalyse removal of groups from substrates by mechanisms other than hydrolysis leaving double bonds.



170. Answer (1)

Hint: Cellular respiration occurs in the end so as to complete the process of respiration.

Sol.: Respiration involves the following steps:

(i) Breathing or pulmonary ventilation by which atmospheric air is drawn in and CO_2 rich alveolar air is released out.

(ii) Diffusion of gases (O_2 and CO_2) across alveolar membrane.

(iii) Transport of gases by the blood.

(iv) Diffusion of O_2 and CO_2 between blood and tissues.

(v) Utilisation of O_2 by the cells for catabolic reactions and resultant release of CO_2.

171. Answer (2)

Hint: It can't be measured by spirometer

Sol.: TLC → RV + TV + IRV + ERV

VC → TV + IRV + ERV

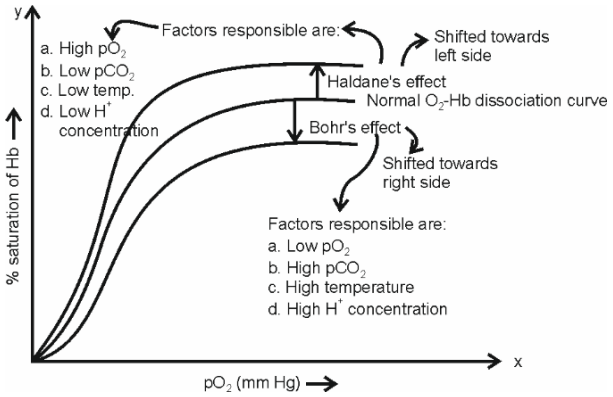
IC → TV + IRV

RV, TLC and FRC can't be measured by spirometer.

172. Answer (4)

Hint: Acidosis favours the curve to shift towards right-side.

Sol.:



173. Answer (3)

Hint: Coronary artery disease leads to hypertension.

Sol.: Atherosclerosis (coronary artery disease) makes the lumen of arteries narrower because of the deposition of Ca^{+2}, cholesterol, fat and fibrous tissue.

174. Answer (4)

Hint: Stroke volume = End diastolic volume – End systolic volume

Sol.: CO = SV × HR

CO = (EDV – ESV) × HR

CO = (100 – 60) × 55

CO = 40 × 55

CO = 2200 mL

CO = 2.2 litres per minute

175. Answer (1)

Hint: AB blood group: Universal recipient

Sol.:

Blood group	Antigens on RBCs	Antibodies in Plasma	Donor's group
A	A	anti-B	A, O
B	B	anti-A	B, O
AB	A, B	nil	AB, A, B, O
O	nil	anti-A, B	O

176. Answer (1)

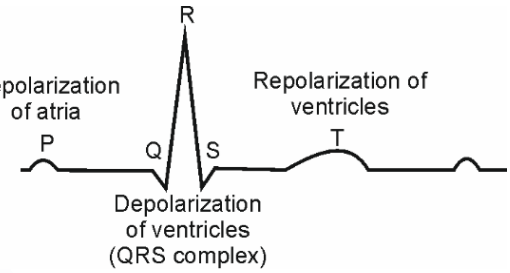
Hint: Congestion of lungs is the main symptom

Sol.: Heart failure means the state of heart when it is not pumping blood effectively enough to meet the needs of the body. It is sometimes called congestive heart failure because congestion of the lungs is one of the main symptoms of this disease. Heart failure is not the same as cardiac arrest (when the heart stops beating) or a heart attack (when the heart muscle is suddenly damaged by an inadequate blood supply).

177. Answer (2)

Hint: The end of T-wave marks the end of ventricular systole.

Sol.:



178. Answer (1)

Hint: Activation of sympathetic nervous system lowers the level of urine output.

Sol.: Blood vessels of the kidney are innervated by nerve fibres of the sympathetic nervous system. When activated, the nerve fibres bring about constriction of renal arteries and cause decrease in renal blood flow as well as GFR.

179. Answer (2)

Hint: Cortical nephrons are more abundant in number.

Sol.: Juxta-medullary nephrons constitute 15% of the nephrons in the kidney whereas cortical nephrons constitute 85% of the nephrons in the kidney.

180. Answer (1)

Hint: Maximum reabsorption of water and sodium occurs at this site.

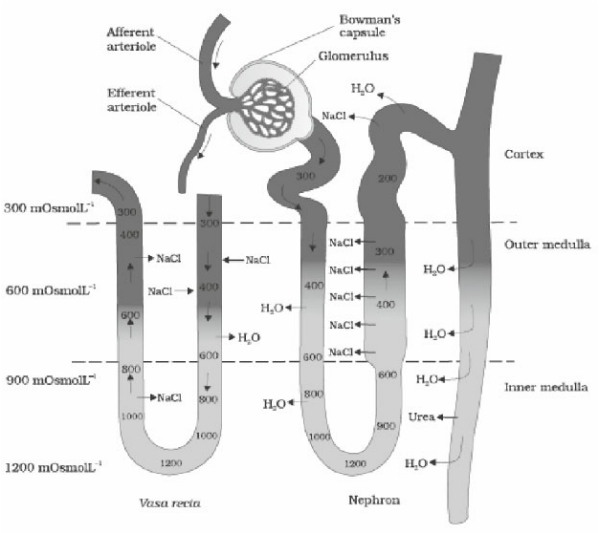
Sol.:

Small intestine	–	Brush bordered columnar epithelium
PCT	–	Brush-bordered cuboidal epithelium.
Fallopian tubes	–	Ciliated columnar epithelium.
Alveoli	–	Simple flattened squamous epithelium

181. Answer (2)

Hint: Osmotic concentration of blood plasma is 300 $mOsmL^{-1}$

Sol.:



182. Answer (1)

Hint: Atlas supports the head and consists of a complete ring of bone.

Sol.: The first vertebra is called atlas and the second vertebra is called axis.

Only thoracic vertebrae are connected with ribs. Seven cervical vertebrae are present in most of the mammals.

183. Answer (4)

Hint: Forms a depression called sella turcica which lodges hypophysis.

Sol.:

Bone	Number	Location
Sphenoid bone	1	Lies at the middle part of the base of skull and holds all the cranial bones together. It has saddle shaped structure, sella turcica to lodge pituitary gland (hypophysis).

184. Answer (4)

Hint: Endoskeleton in case of vertebrates is made up of bones and cartilages.

Sol.: Skeleton is of two types:

(a) Exoskeleton: The skeleton which is external is called exoskeleton. It is rigid, protective and supportive covering (framework) present outside the body.

(b) Endoskeleton: The skeleton which is internal is called endoskeleton. It is hard, supporting structural framework which occurs inside the body. The bones have hard and non-pliable matrix.

185. Answer (4)

Hint: M-line and H-zone almost disappears during muscle contraction.

Sol.: Effects of muscle contraction:

1. H-zone almost disappears
2. M-line almost disappears
3. Z-lines come close to each other
4. Length of I-band decreases
5. Length of sarcomere decreases
6. Length of A-band remains same

SECTION - B

186. Answer (1)

Hint: Fall under the category of synovial joints.

Sol.: Synovial joints are characterised by the presence of a fluid filled synovial cavity between the articulating surfaces of the two bones. Such an arrangement allows considerable movement. These joints help in locomotion and many other movements. Ball and socket joint (between humerus and pectoral girdle), hinge joint (knee joint), pivot joint (between atlas and axis), gliding joint (between the carpals) and saddle joint (between carpal and metacarpal of thumb side) are some examples.

187. Answer (4)

Hint: Found in cerebral cortex, retina of eye and during embryonic stage.

Sol.: Based on the number of axon and dendrites, the neurons are divided into three types, *i.e.*, multipolar (with one axon and two or more dendrites, found in the cerebral cortex), bipolar (with one axon and one dendrite, found in the retina of eye) and unipolar (cell body with one axon only, found usually in the embryonic stage).

188. Answer (3)

Hint: Transports $3Na^+$ outwards for $2K^+$ into the axon.

Sol.: The Na^+–K^+ ATPase pump transports $3Na^+$ outwards and $2K^+$ into the axon maintaining the polarization state when the neuron is resting. This

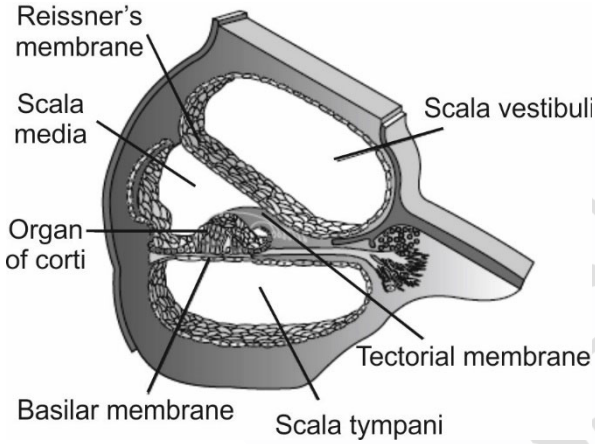
transport occurs at an expense of the consumption of an ATP molecule.

During the process of depolarization, the voltage gated Na^+ channels open whereas the voltage gated K^+ channels remain closed.

189. Answer (3)

Hint: Organ of Corti is located on it.

Sol.: Basilar membrane gives the human beings the ability to discriminate different pitches of the sound. This is because the different regions of the basilar membrane vibrate best at different frequencies of the sound, from which the brain infers the pitch.



190. Answer (2)

Hint: Released by myocytes of atrial wall of the heart.

Sol.: ANP/ANF is released by the myocytes of the atrial wall of the heart. It reduces the blood pressure. It checks on RAAS.

Epinephrine and Norepinephrine are released by adrenal medulla. Angiotensinogen and aldosterone are involved in RAAS.

191. Answer (4)

Hint: Primary sex organ of the female reproductive system; present in lower abdomen.

Sol.: Hypothalamus produces releasing hormones and inhibiting hormones. Ovaries produce estrogen, relaxin and progesterone. They do not produce hCG (hCG is produced by placenta).

192. Answer (3)

Hint: Type-I diabetes is an auto-immune disorder.

Sol.: IDDM or Type-I diabetes is an example of auto-immune disorder which is caused by deficiency of insulin.

NIDDM or Type-II diabetes is initially caused by decreased sensitivity of receptors of target tissues to the insulin. This reduced sensitivity to insulin is often called insulin-resistance.

193. Answer (2)

Hint: With increase in age, reduces in size

Sol.: Thymus gland is quite large at the time of birth but keeps reducing in size after puberty.

194. Answer (4)

Hint: Melatonin is secreted from a gland which is ectodermal in origin.

Sol.: Thyroid gland, parathyroid gland, thymus gland and pancreas are endodermal in origin. Pineal gland is ectodermal in origin.

195. Answer (3)

Hint: Micturition is the process of release of urine.

Sol.: Withdrawal reflex is a spinal reflex intended to protect the body from damaging stimuli. Foetal-ejection reflex encompasses the mild uterine contractions in response to the signals that originate from the fully developed foetus and the placenta.

Hering-Breuer reflex is a reflex triggered to prevent the over-inflation of the lungs.

Micturition reflex is the neural mechanism which is responsible for causing micturition.

196. Answer (4)

Hint: They cover the hind wings when at rest.

Sol.: Forewings (mesothoracic) called tegmina are opaque, dark and leathery and cover the hind wings when at rest. The hind wings are transparent, membranous and are used in flight.

197. Answer (4)

Hint: A pair of jointed filamentous structures is present in their last segment of abdomen.

Sol.: The abdomen in both males and females consists of 10 segments. 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 collaterial glands. In males, genital pouch or chamber lies at the hind end of abdomen bounded dorsally by 9^{th} and 10^{th} terga and ventrally by the 9^{th} sternum. It contains dorsal anus, ventral male genital pore and gonapophysis. Males bear a pair of short,

threadlike anal styles which are absent in females. In both sexes, the 10th segment bears a pair of jointed filamentous structures called anal cerci.

198. Answer (4)

Hint: Their body is supported by a skeleton made up of spongin fibres and spicules.

Sol.: Sponges have a water transport or canal system. Water enters through minute pores (ostia) in the body wall into a central cavity, spongocoel, from where it goes out through the osculum. This pathway of water transport is helpful in food gathering, respiratory exchange and removal of wastes.

199. Answer (1)

Hint: Exhibits cnidocytes

Sol.: The name, 'cnidaria' is derived from the cnidoblasts or cnidocytes (which contain the stinging capsules or nematocysts) present on the tentacles and the body. Cnidoblasts are used for anchorage, defense and for the capture of prey. Cnidarians exhibit tissue level of organisation and are diploblastic. They have a central gastro-vascular cavity with a single opening, mouth on hypostome.

200. Answer (4)

Hint: Purine bonds with their respective pyrimidine with hydrogen bonds.

Sol.: Adenine (A) and guanine (G) of one strand compulsorily base pairs with thymine (T) and cytosine (C) respectively, on the other strand.

$$A = T$$
$$\downarrow$$
(double H-bonds)

$$G \equiv C$$
$$\downarrow$$
(Triple H – bonds)

❑ ❑ ❑

All India Aakash Test Series for NEET-2023

TEST - 8 (Code-D)

Test Date : 03/04/2022

ANSWERS

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

HINTS & SOLUTIONS

[PHYSICS]

SECTION - A

1. Answer (1)

Hint: Energy of wave (E) α n^2A^2

Sol.: $\frac{E_1}{E_2} = \frac{n_1^2 A_1^2}{n_2^2 A_2^2}$

$\Rightarrow \frac{4}{1} = \frac{(2n)^2 A_1^2}{n^2 A_2^2}$

$\frac{A_1}{A_2} = \frac{1}{1}$

2. Answer (2)

Hint: Sound level $(\beta) = 10 \log\left(\frac{I}{I_0}\right)$

Sol.: Sound level $(\beta_1) = 10 \log\left(\frac{I_1}{I_0}\right)$

$\Rightarrow \beta_2 = 10 \log\left(\frac{I_2}{I_0}\right)$

$\Rightarrow \beta_2 - \beta_1 = 10 = 10 \log\left(\frac{I_2}{I_1}\right)$

$\Rightarrow I_2 = 10 I_1 = 0.1$ W/m^2

3. Answer (3)

Hint: When pendulum is immersed into liquid then

$\Rightarrow Mg' = Mg - F_B$

Sol.: $F_B = V\sigma g$ (σ = density of liquid)

$\Rightarrow Mg' = Mg - F_B$

$\Rightarrow g' = g - \frac{\sigma}{\rho} g = \left(1 - \frac{\sigma}{\rho}\right) g$

New time period $(T') = 2\pi\sqrt{\frac{l}{g'}} = 2\pi\sqrt{\frac{l}{\left(1-\frac{\sigma}{\rho}\right)g}}$

$T' = \sqrt{5}T$

4. Answer (2)

Hint: Time period of revolution (T) $\propto r^{3/2}$

Sol.: $\Rightarrow \frac{T_1}{T_2} = \left(\frac{r_1}{r_2}\right)^{3/2}$

$\Rightarrow T_2 = T\left(\frac{2R}{R}\right)^{3/2}$

$T_2 = 2\sqrt{2}T$

5. Answer (2)

Hint & Sol.: Given process $P^{1-\gamma} T^{\gamma}$ = constant is an adiabatic process.

For adiabatic process, Bulk modulus = γP

6. Answer (4)

Hint & Sol.: $|V_{\text{inside}}| = \left|-\frac{GM(3R^2 - r^2)}{2R^3}\right|$

$|V_{\text{surface}}| = \left|-\frac{GM}{R}\right|$

$|V_{\text{outside}}| = \left|-\frac{GM}{r}\right|$

7. Answer (2)

Hint: When source is moving $(f') = f\left[\frac{v}{v \pm v_S}\right]$

Sol.:

Case-(i) $f_1 = f\left[\frac{325}{325 - 25}\right] = \frac{325f}{300}$

Case-(ii) $f_2 = f\left[\frac{325}{325 - 15}\right] = \frac{325f}{310}$

$\Rightarrow \frac{f_1}{f_2} = \frac{31}{30}$

8. Answer (4)

Hint: No. of beats produced per second = $f_2 - f_1$

Sol.: Let lowest frequency is f, then next consecutive frequencies are $f + 3$; $f + 6$; $f + 9$ …

Given $f_{20} = 2f_1$

$\Rightarrow f + 57 = 2f$

$\Rightarrow f = 57$ Hz

$\Rightarrow f_{20} = 114$ Hz

9. Answer (2)

Hint & Sol.: (B) is suitable for shock absorber as area is more under stress–strain curve. To minimize heating, (A) is suitable for car tyres.

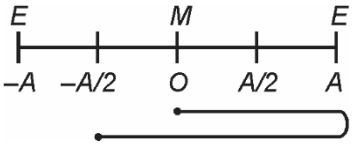
10. Answer (4)

Hint & Sol.: Temperature of sink remains same.

11. Answer (4)

Hint & Sol.:

Distance $= \frac{5}{8}(4A) = \frac{5}{2}A$

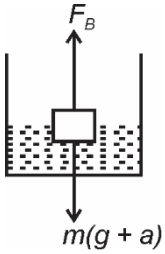


$t = \frac{T}{2} + \frac{T}{12} = \frac{7T}{12}$

12. Answer (3)

Hint: When body starts accelerating, pseudo force act on the system. Then $g_{eff} = g + a$

Sol.:



When beaker is accelerating upward then

$W' = m(g + a)$

$F_B' = V\rho\ (g + a)$

So part of body immersed in liquid remains same.

13. Answer (3)

Hint: Time taken by rigid body to roll down

$(t) = \sqrt{\frac{2h}{g\sin^2\theta}\left(1 + \frac{k^2}{R^2}\right)}$

Sol.: $\frac{k^2}{R^2}$ for a solid cylinder $= \frac{1}{2}$

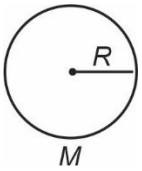
$\frac{k^2}{R^2}$ for a hollow sphere $= \frac{2}{3}$

$\Rightarrow \frac{t_1}{t_2} = \sqrt{\frac{(3/2)}{(5/3)}} = \sqrt{\frac{9}{10}}$

14. Answer (4)

Hint: Moment of inertia of ring (I) = $\int dmr^2$

Sol.:



Now an arc length $\frac{\pi R}{3}$ is removed then

Mass of $2\pi R$ arc length = M

Mass of $\left(2\pi R - \frac{\pi R}{3}\right)$ arc length

$(M') = \frac{M}{2\pi R} \times \left(2\pi R - \frac{\pi R}{3}\right)$

$\Rightarrow M' = \frac{M}{2} \times \frac{5}{3} = \frac{5M}{6}$

then MOI of remaining portion $(I') = \int dmR^2$

$I' = \frac{5MR^2}{6}$

15. Answer (4)

Hint: Molar specific heat $(\dot{C})$ = Specific heat (C) × Molecular mass

Sol.: $\because\ \dot{C}_p - \dot{C}_v = R$

$32\ (C_p - C_v) = R$

$C_p - C_v = \frac{R}{32}$

16. Answer (3)

Hint: In damped oscillation: $A = A_0e^{-bt}$

Sol.: Amplitude (A) = A_0e^{-bt}

$\Rightarrow \frac{A_0}{2} = A_0e^{-b(20T)}$

$\Rightarrow A = A_0e^{-b(100T)}$

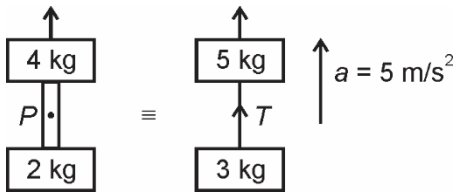
$\Rightarrow A = A_0\left[e^{-b(20T)}\right]^5$

$\Rightarrow A = A_0\left(\frac{1}{2}\right)^5 = \frac{A_0}{32}$

17. Answer (4)

Hint: Net force on system (F_{net}) = ma

Sol.:



$\Rightarrow\ T - 30 = 3a = 3 \times 5$

$T = 45$ N

18. Answer (3)

Hint: Frequency of closed organ pipe $(f) = \frac{nv}{4l}$

Frequency of open organ pipe $(f) = \frac{nv}{2l}$

Sol.: First overtone of closed pipe $(f_1) = \frac{3v}{4l_1}$

Fourth overtone of open pipe $(f_2) = \frac{5v}{2l_2}$

$\Rightarrow \frac{3v}{4l_1} = \frac{5v}{2l_2}$

$\Rightarrow \frac{l_1}{l_2} = \frac{3}{10}$

19. Answer (4)

Hint: Time period of satellite $(T) \propto r^{\frac{3}{2}}$

Sol.: $\Rightarrow \frac{T_1}{T_2} = \left(\frac{r_1}{r_2}\right)^{\frac{3}{2}}$

$\Rightarrow \frac{T}{T_2} = \left(\frac{R}{4R}\right)^{\frac{3}{2}} = \frac{1}{8}$

$T_2 = 8T$

20. Answer (4)

Hint: Change in internal energy $(\Delta U) = nC_v\Delta T$

Sol.: $\Delta U = nC_v\Delta T = \frac{nR}{(\gamma-1)}\left(T_2 - T_1\right)$

$\Delta U = \frac{nR}{(\gamma-1)} \times \left(\frac{P_2V_2}{nR} - \frac{P_1V_1}{nR}\right) = \frac{P_2V_2 - P_1V_1}{\gamma - 1}$

$\Delta U = \frac{6\times 6 - 2\times 3}{\frac{1}{3}} = 90 \text{ J}$

21. Answer (3)

Hint: For adiabatic process: $TV^{\gamma-1}$ = Constant

and $v_{rms} \propto \sqrt{T}$

Sol.: For adiabatic process: $T_1V_1^{\gamma-1} = T_2V_2^{\gamma-1}$

Given that : $(v_{rms})_f = \frac{1}{2}\left(v_{rms}\right)_i$

$\Rightarrow \frac{v_2}{v_1} = \sqrt{\frac{T_2}{T_1}} = \frac{1}{2}$

$\Rightarrow \frac{T_1}{T_2} = 4$

$\Rightarrow \frac{T_1}{T_2} = \left(\frac{V_2}{V_1}\right)^{\gamma-1}$

$\Rightarrow (4)^{\frac{1}{\gamma-1}} = \frac{V_2}{V_1}$

$\frac{V_2}{V_1} = (4)^{\frac{5}{2}} = 2^5 = 32$

22. Answer (4)

Hint: Least count = 1 M.S.D. –1 V.S.D.

Sol.: Given that

N M.S.D. = $(N + 2)$ V.S.D.

$\Rightarrow$ 1 V.S.D. = $\left(\frac{N}{N+2}\right)$ M.S.D.

$\Rightarrow$ Least count = 1 M.S.D. — 1 V.S.D.

$\Rightarrow$ LC = 1 MSD – $\left(\frac{N}{N+2}\right)$ M.S.D

LC = $\left(\frac{2}{N+2}\right)$ M.S.D = $\left(\frac{2}{N+2}\right)$ mm

23. Answer (2)

Hint: Terminal speed $(V_T) = \frac{2r^2g(\rho-\sigma)}{9\eta}$

Sol.: Terminal speed $(V_T) \propto r^2$

$\Rightarrow \frac{V_1}{V_2} = \frac{r_1^2}{r_2^2}$

$\Rightarrow \frac{V_1}{V_2} = \frac{4}{1}$

24. Answer (4)

Hint: In explosion, linear momentum is conserved.

Sol.: $(P_i)_{system} = (P_f)_{system}$

$\Rightarrow 0 = 2\vec{v}_1 + 3\vec{v}_2$

$\Rightarrow$ Kinetic energy of 2 kg $= \frac{1}{2}\times 2\times v_1^2 = 100$

$\Rightarrow v_1 = 10$ m/s

$\Rightarrow$ Kinetic energy of 3 kg $= \frac{1}{2}\times 3\times v_2^2$

$\Rightarrow \text{KE} = \frac{1}{2}\times 3\times \frac{4}{9}v_1^2 = \frac{1}{2}\times 3\times \frac{4}{9}\times 100$

$\Rightarrow \text{KE} = \frac{200}{3}$ J

25. Answer (4)

Hint: When source is delivering constant power

$W = \int mvdv = \int Pdt$

Sol.: $P = \vec{F}\cdot\vec{v} = mav$

$$\Rightarrow P = mv\left(v\frac{dv}{ds}\right) \quad \left(\because a = v\frac{dv}{ds}\right)$$

$$\Rightarrow \int_{v_1}^{v_2} v^2 dv = \frac{P}{m}\int_0^s ds$$

$$\Rightarrow s = \frac{m}{P}\left(\frac{v_2^3 - v_1^3}{3}\right) = \frac{1}{10}\times\left(\frac{7000}{3}\right)$$

$$\Rightarrow s = \frac{700}{3}\text{m}$$

26. Answer (3)

Hint: Work done against gravity (W) = $FS\cos\theta$ = mgh

Sol.:

$W_1 = FS\cos\theta = mgh = m \times g \times 10 = 10\ mg$

$W_2 = FS\cos\theta = mgh = m \times g \times 10 = 10\ mg$

$W_1 : W_2 = 1 : 1$

27. Answer (3)

Hint: In vertical circular motion speed of particle at (to just complete circular motion)

(i) Lower point $= \sqrt{5gR}$

(ii) Topmost point $= \sqrt{gR}$

Sol.: Speed of ball at lowest position $= \sqrt{5gR}$

Speed of ball at highest position $= \sqrt{gR}$

$\Rightarrow$ Difference in speeds $= \sqrt{5gR} - \sqrt{gR}$

$= \sqrt{5\times10\times10} - \sqrt{10\times10}$

= 12.36 m/s

28. Answer (4)

Hint: $\vec{A}\cdot\vec{B} = |\vec{A}|\cdot|\vec{B}|\cos\theta$

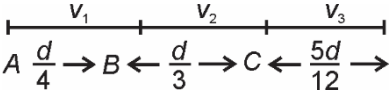
Sol.: $\cos\theta = \frac{8+12-8}{\sqrt{24}\times\sqrt{56}} = \frac{12}{\sqrt{24}\sqrt{56}} = \frac{\sqrt{3}}{2\sqrt{7}}$

$\Rightarrow \tan\theta = \frac{5}{\sqrt{3}} \quad \Rightarrow \theta = \tan^{-1}\left(\frac{5}{\sqrt{3}}\right)$

29. Answer (2)

Hint: Average speed $< v >$ = $\frac{\text{Total distance}}{\text{Total time}}$

Sol.:



$$< v > = \frac{d}{\frac{d}{4v_1} + \frac{d}{3v_2} + \frac{5d}{12v_3}} = \frac{12v_1v_2v_3}{3v_2v_3 + 4v_1v_3 + 5v_1v_2}$$

30. Answer (1)

Hint: Centripetal force (F) = $mr\omega^2$

and angular velocity $(\omega) = \frac{2\pi}{T}$

Sol.:

$$\frac{(\text{Centripetal force})_1}{(\text{Centripetal force})_2} = \frac{F_1}{F_2} = \frac{m_1r_1\omega^2}{m_2r_2\omega^2} \ (\because T_1 = T_2)$$

$$\Rightarrow \frac{F_1}{F_2} = \frac{2\times2R}{4\times R} = \frac{1}{1}$$

31. Answer (4)

Hint: Work done (W) = $\int\vec{F}\cdot d\vec{r}$

Sol.: Work done (W) = $\int F\cdot dx$

$$\Rightarrow W = \int_0^4 (4-2x)\,dx$$

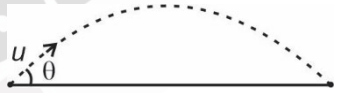
$$\Rightarrow W = [4x - x^2]_0^4$$

W = 16 – 16 = 0 J

32. Answer (1)

Hint: $v_{avg.} = \frac{\text{Total displacement}}{\text{Total time}}$

Sol.:



$$v_{avg.} = \frac{\text{Range}}{\text{Time of flight}}$$

$$v_{avg.} = \frac{u^2\times2\sin\theta\cos\theta}{g\times\left(\frac{2u\sin\theta}{g}\right)} = u\cos\theta$$

33. Answer (3)

Hint: Velocity of ball at ground $(v) = \sqrt{u^2 + 2gh}$

Sol.: When ball fall on ground then its velocity

$\Rightarrow v = \sqrt{u^2 + 2gh}$

$\Rightarrow$ 2500 = 900 + 2gh

$\Rightarrow h$ = 80 m

34. Answer (4)

Hint: Power consumed by resistor (P) = I^2R

Sol.: Power (P) = I^2R

$$\Rightarrow \frac{\Delta P}{P} = 2\frac{\Delta I}{I} + \frac{\Delta R}{R}$$

$$\Rightarrow \frac{\Delta P}{P}\times100 = 2\times2\% + 1\% = 5\%$$

35. Answer (4)

Hint: Use principle of homogeneity

Sol.: $Z = \frac{P}{Q}$

$\Rightarrow [Q] = \frac{[P]}{[Z]} = \frac{[MLT^{-1}]}{[ML^{-2}]}$

$\Rightarrow [Q] = [L^3T^{-1}]$

SECTION - B

36. Answer (1)

Hint & Sol.: $e = \frac{r_A - r_p}{r_A + r_p}$

$e = \frac{6R - 3R}{6R + 3R}$

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

37. Answer (3)

Hint & Sol.: In an elliptical orbit, angular momentum of planet is constant but its speed and distance changes. Also, total energy is conserved.

38. Answer (3)

Hint: Use displacement equation of SHM

$x = A\sin\omega t$

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

$v = A\omega\cos\omega t$

$a = -A\omega^2\sin\omega t \quad \Rightarrow \quad a = -\omega^2 x$

So, graph of displacement-time will be sine graph.

Graph of velocity- time will be cosine graph.

Acceleration – displacement graph will be straight line.

$\because \left(\frac{x}{A}\right)^2 + \left(\frac{v}{A\omega}\right)^2 = 1$ so, $v - x$ graph will be ellipse (if $\omega \neq 1$ rad/s)

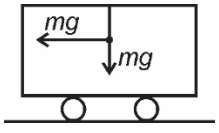
39. Answer (4)

Hint: Time period of simple pendulum

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

Sol.: Given that : $x = \frac{gt^2}{2}$

$\Rightarrow v = \frac{dx}{dt} = \frac{2gt}{2} = gt$



$a = \frac{dv}{dt} = g$ in horizontal direction

In frame of car

$\Rightarrow g_{eff} = \sqrt{g^2 + g^2} = \sqrt{2}g$

So Time period $(T') = 2\pi\sqrt{\frac{l}{g\sqrt{2}}} = \pi\sqrt{\frac{2\sqrt{2}l}{g}}$

40. Answer (3)

Hint: Temperature scale of thermometer are related as linear relation between temperature and length.

Sol.: $\frac{x - 10}{130 - 10} = \frac{50}{100}$

$x = 60 + 10 = 70°C$

41. Answer (4)

Hint & Sol.:

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

$\lambda = 2L$

$\lambda = 100$ cm

42. Answer (1)

Hint: Time of fall $(t) = \sqrt{\frac{2h}{g}}$

Sol.: $\Rightarrow t \propto \sqrt{h}$

$\Rightarrow \frac{t}{t'} = \sqrt{\frac{h \times 3}{h}}$

$t' = \frac{t}{\sqrt{3}}$

43. Answer (4)

Hint & Sol.:

$|\vec{a}_{avg.}| = \frac{|\Delta\vec{v}|}{\Delta t} = \frac{2v\sin\left(\frac{180°}{2}\right)}{\frac{\pi r}{v}} = \frac{2v^2}{\pi r}$

44. Answer (3)

Hint: $A \propto T^4$

Sol.: $\frac{A_1}{A_2} = \left(\frac{T_1}{T_2}\right)^4$

$\frac{A_1}{A_2} = \left(\frac{400}{800}\right)^4$

$\frac{A_1}{A_2} = \frac{1}{16}$

45. Answer (4)

Hint & Sol.: $f = 3 + 3 + 4 = 10$

One vibrational mode gives two degrees of freedom.

46. Answer (2)

Hint: Velocity of wave at distance x, $(v) = \sqrt{gx}$

Sol.: Velocity $(v) = \sqrt{gx}$

$$\frac{dx}{dt} = \sqrt{gx}$$

$$\Rightarrow \int_0^{l/2} \frac{dx}{\sqrt{x}} = \int_0^t \sqrt{g}\, dt$$

$$\Rightarrow (2\sqrt{x})_0^{l/2} = \sqrt{g}\, t$$

$$\Rightarrow \sqrt{\frac{2l}{g}}$$

47. Answer (4)

Hint: $A_T = \left(\frac{2v_2}{v_1 + v_2}\right) A_i$

Sol.: $\Rightarrow \frac{A_T}{A_i} = \frac{2 \times 60}{160} = \frac{3}{4}$

48. Answer (1)

Hint: Frequency $(f) = \frac{1}{2l}\sqrt{\frac{T}{\mu}}$

Sol.: $\frac{f_1}{f_2} = \sqrt{\frac{T_1}{T_2}}$

$$\Rightarrow \frac{f}{3f} = \sqrt{\frac{T}{T+10}}$$

$$\Rightarrow \frac{1}{9} = \frac{T}{T+10}$$

$$\Rightarrow T + 10 = 9T$$

$$T = \frac{10}{8} = 1.25 \text{ N}$$

49. Answer (3)

Hint: Thermal stress = $Y \times$ thermal strain

Sol.: Thermal strain produced in rod $= \frac{\Delta l}{l} = \alpha \Delta T$

Thermal stress = $Y\alpha\Delta T$

$= 2 \times 10^9 \times 5 \times 10^{-6} \times 60$

$= 6 \times 10^5 \text{ N/m}^2$

50. Answer (1)

Hint: As per first law of thermodynamics.

$Q = \Delta U + W$

Sol.:

Isochoric heating	:	$\Delta W = 0$	$\Delta Q > 0$	;	$\Delta U > 0$
Isothermal expansion	:	$\Delta W > 0$	$\Delta Q > 0$	;	$\Delta U = 0$
Isobaric expansion	:	$\Delta Q > 0$	$\Delta W > 0$	;	$\Delta U > 0$
Adiabatic expansion	:	$\Delta Q = 0$	$\Delta W > 0$	;	$\Delta U < 0$

[CHEMISTRY]

SECTION - A

51. Answer (3)

Hint & Sol.:

- NaOH is called as caustic soda.
- $Ca(OH)_2$ is slaked lime.

52. Answer (3)

Hint: $Be(OH)_2$ form $[Be(OH)_4]^{2-}$ on reaction with alkali.

Sol.: $Be(OH)_2 + 2OH^- \longrightarrow \left[Be(OH)_4\right]^{2-}$

$\Rightarrow$ The hybridisation of Be in $[Be(OH)_4]^{2-}$ is sp^3.

53. Answer (3)

Hint: Hydration enthalpy of alkaline earth metal ions decreases as ionic size increases.

Sol.: Hydration enthalpy: $Mg^{2+} > Ca^{2+} > Sr^{2+} > Ba^{2+}$

54. Answer (4)

Hint & Sol.:

Metal	Colour of flame
Li	Crimson red
K	Violet
Rb	Red violet
Cs	Blue

55. Answer (3)

Hint: Alkyne will be obtained.

Sol.: $CaC_2 + 2D_2O \longrightarrow C_2D_2 + Ca(OD)_2$

56. Answer (1)

Hint & Sol.:

On commercial scale water gas is prepared by the passage of steam over hot coke. The mixture of CO and H_2 thus produced is known as water gas or synthesis gas.

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

57. Answer (3)

Hint: Higher is the oxidising power, higher is the ability of a species to get reduced itself.

Sol.: Higher the standard reduction potential of a species, higher will be its oxidising power. So correct order of oxidising power is

$\therefore$ I > III > II

58. Answer (3)

Hint: Element in its highest or lowest oxidation state cannot undergo disproportionation reaction.

Sol.:

Species	Oxidation State of Nitrogen
NO	+2
NO_2	+4
N_2O_3	+3
N_2O_5	+5

In N_2O_5, N is in its highest oxidation state hence cannot undergo disproportionation reaction.

59. Answer (3)

Hint: The algebraic sum of oxidation state of all atoms in a compound must be zero.

Sol.: $\overset{+1+5\ \ -2}{2KClO_3(s)} \longrightarrow \overset{+1\ \ -1}{2KCl(s)} + \overset{0}{3O_2(g)}$

The oxidation number of Cl changes from +5 to –1.

60. Answer (1)

Hint: Reduction takes place at cathode.

Sol.:

$$CH_3COO^-Na^+ \rightleftharpoons 2CH_3 - \overset{\overset{O}{\|}}{C} - O^- + 2Na^+$$

$\Rightarrow$ At anode:

$$2CH_3 - \overset{\overset{O}{\|}}{C} - O^- \xrightleftharpoons{-2e^-} 2\dot{C}H_3 + 2CO_2\uparrow$$

$$\dot{C}H_3 + \dot{C}H_3 \longrightarrow CH_3 - CH_3\uparrow$$

$\Rightarrow$ At cathode:

$$H_2O + e^- \longrightarrow OH^{\ominus} + \dot{H}$$

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

61. Answer (1)

Hint: $K_P = K_C(RT)^{\Delta n_g}$

Sol.: $2NOCl(g) \rightleftharpoons 2NO(g) + Cl_2(g)$

$K_p = K_c(RT)^{\Delta n_g}$

$\Delta n_g = (2 + 1) - 2 = 1$

$\frac{K_p}{K_c} = (RT)^1$

$\frac{K_c}{K_p} = (RT)^{-1}$

62. Answer (2)

Hint: For $MgSO_4$, $K_{sp} = S^2$ where S is solubility of salt in mol L^{-1}

Sol.: Solubility of $MgSO_4 = \frac{1.20 \times 10^{-3}}{120}$

$= 1.0 \times 10^{-5}$ mol L^{-1}

$MgSO_4 \rightleftharpoons \underset{s}{Mg^{2+}} + \underset{s}{SO_4^{2-}}$

$K_{sp} = S^2 = [1.0 \times 10^{-5}]^2$

$= 1.0 \times 10^{-10}$ mol^2 L^{-2}

63. Answer (4)

Hint:

$|M_1V_1 - M_2V_2| = M_RV_R$

Sol.: $M_1V_1 - M_2V_2 = M_RV_R$.

$0.2x - 0.02x = M_R\ (x + x)$

$\frac{0.18x}{2x} = M_R$

$M_R = 0.09M = [OH^-]$

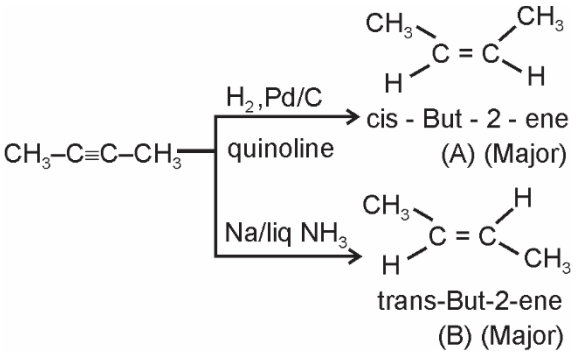
$pOH = -\log [OH^-] = -\log [0.09] = 1.04$

$pH = 14 - 1.04 = 12.96 \simeq 13$

64. Answer (3)

Hint: H_2, Pd/C, quinoline produce cis-alkene and Na/liq NH_3 produces trans – alkene.

Sol.:



(A) and (B) are geometrical isomers.

65. Answer (4)

Hint: γ remains same when equal volumes of monoatomic gases are mixed.

Sol.: For monoatomic gases, (He and Ne),

$$\gamma = \frac{C_p}{C_v} = \frac{\frac{5R}{2}}{\frac{3R}{2}} = 1.66 \simeq 1.67$$

66. Answer (2)

Hint: $\Delta G = \Delta H - T\Delta S$

Reaction is spontaneous when $\Delta G < 0$

Sol.: Reaction is spontaneous when $\Delta G < 0$.

i.e $\Delta H - T\Delta S < 0$

$18 \times 10^3 - T(36) < 0$

$500\ K < T$

$\therefore$ Reaction will be spontaneous above 500 K

67. Answer (2)

Hint: $\Delta T = 0$ for isothermal process.

Sol.:

- For reversible isothermal process, since

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

- For reversible isothermal expansion

$$\Delta S = nR\ln\frac{V_f}{V_i}$$

For expansion, $V_f > V_i$

therefore $\Delta S_{sys} > 0$

$\therefore$ ΔS = +ve ($\neq 0$)

68. Answer (2)

Hint: $\Delta H = \Delta U + \Delta n_g RT$

Sol.: The reaction for which $\Delta n_g = 0$ will have $\Delta H = \Delta U$.

[Δn_g = difference in the number of moles of gaseous products and reactants]

for $N_2(g) + O_2(g) \rightarrow 2NO(g)$

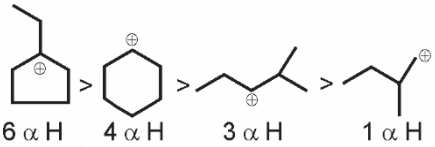
$\because$ $\Delta n_g = 2 - (1 + 1) = 0$

$\therefore$ $\Delta H = \Delta U + 0 \times RT = \Delta U$

69. Answer (2)

Hint: More is the number of hyperconjugative structures, more is the stability of carbocation.

Sol.: More the number of α hydrogen atoms, more will be the hyperconjugative structures.



70. Answer (4)

Hint: According to Graham's law of diffusion,

$$\frac{r_1}{r_2} = \sqrt{\frac{M_2}{M_1}}$$

Sol.:

$$\Rightarrow \frac{r_1}{r_{H_2}} = \sqrt{\frac{M_{H_2}}{M_1}}$$

$\Rightarrow$ Rate of effusion of H_2 is twice than the given gas.

$$\Rightarrow \frac{r_1}{2r_1} = \sqrt{\frac{2}{M_1}}$$

$\Rightarrow$ $M_1 = 8$ u

71. Answer (3)

Hint: Molecules possessing permanent dipoles interact with dipole-dipole forces.

Sol.: Polar molecules which are thought to be neutral but possess permanent dipoles interact with dipole-dipole forces e.g:- HCl and HF

- He – HF and HCl – O_2 interact with dipole-induced dipole forces.
- H_2 and N_2 possess London forces as the intermolecular forces.

72. Answer (2)

Hint: $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$

Sol.: According to combined gas law,

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

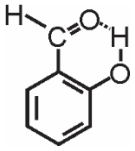
$$\frac{760\times500}{300}=\frac{P_2\times580}{290}$$

P_2 = 633.3 mm Hg

73. Answer (2)

Hint: Intramolecular H bonding is formed within the same molecule.

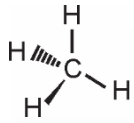
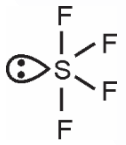
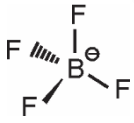
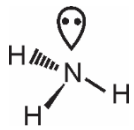
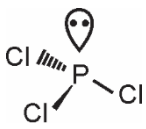
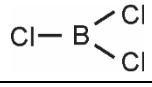
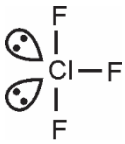
Sol.: Intramolecular H bond is formed when H atom is in between the two highly electronegative (F, O, N) atoms present within the same molecule.



74. Answer (3)

Hint: Species having same number of bond pairs and lone pairs around central atom will be isostructural.

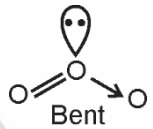
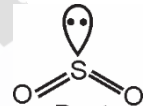
Sol.:

Species	Arrangement of electron pairs	Shape
CH_4		Tetrahedral
SF_4		See-saw
BF_4^-		Tetrahedral
XeF_4		Square planar
NH_3		Pyramidal
PCl_3		Pyramidal
BCl_3		Trigonal planar
ClF_3		T-shape

75. Answer (1)

Hint: Species having 2 bond pairs and 0 lone pair around central atom is linear in shape.

Sol.:

Molecule	Shape
$HgCl_2$	Cl – Hg – Cl Linear
H_2O	 Bent
O_3	 Bent
SO_2	 Bent

76. Answer (3)

Hint: Molecule having unpaired electrons is paramagnetic in nature.

Sol.:

$$B_2\,(10e^-):(\sigma1s)^2(\sigma^*1s)^2(\sigma2s)^2(\sigma^*2s)^2(\pi2p_x^{\,1}\equiv\pi2p_y^{\,1})$$

$$C_2\,(12e^-):(\sigma1s)^2(\sigma^*1s)^2(\sigma2s)^2(\sigma^*2s)^2(\pi2p_x^{\,2}\equiv\pi2p_y^{\,2})$$

$$N_2\,(14e^-):(\sigma1s)^2(\sigma^*1s)^2(\sigma2s)^2(\sigma^*2s)^2$$

$$(\pi2p_x^{\,2}\equiv\pi2p_y^{\,2})(\sigma2p_z)^2$$

$$F_2\,(18e^-):(\sigma1s)^2(\sigma^*1s)^2(\sigma2s)^2(\sigma^*2s)^2(\sigma2p_z)^2$$

$$(\pi2p_x^{\,2}\equiv\pi2p_y^{\,2})(\pi^*2p_x^{\,2}\equiv\pi^*2p_y^{\,2})$$

$\therefore$ B_2 is paramagnetic in nature.

77. Answer (2)

Hint:

Generally electron gain enthalpy become less negative on going down the group.

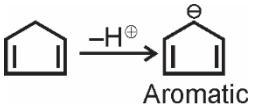
Sol.:

Element	$\Delta_{eg}H$ (kJmol^{-1})
O	– 141
S	– 200
Se	– 195
Te	– 190

- Electron gain enthalpy of O is less negative than S. This is because when an electron is added to O, the added electron goes to the smaller n = 2 quantum level and suffers significant repulsion from other electron present in this level.

78. Answer (1)

Hint: Higher is the stability of conjugate base, more will be the acidity of compound.

Sol.: 

- Conjugate base of  is most stable due to its aromatic nature.

79. Answer (2)

Hint: Shape of an orbital depends upon the value of 'ℓ'.

Sol.: Azimuthal quantum number tells about the orbital angular momentum and defines the three-dimensional shape of the orbital.

80. Answer (4)

Hint & Sol.: Mathematically, Heisenberg uncertainty principle is presented as

$$\Delta v_x . \Delta x \geq \frac{h}{4\pi m}$$

81. Answer (1)

Hint: Radial nodes = n – ℓ – 1

Angular nodes = ℓ

Sol.: For 4*p* orbital, n = 4

ℓ = 1

Radial nodes = n – 1 – 1 = 4 – 1 – 1 = 2

Angular node = 1

82. Answer (2)

Hint: Higher is the electron density on benzene ring, faster is aromatic electrophilic substitution reaction.

Sol.: $-CH_3$ is electron donating in nature hence, toluene reacts at fastest rate towards aromatic electrophilic substitution reaction.

- $-NO_2$ and –Cl are electron withdrawing groups.

83. Answer (1)

Hint: Number of atoms = Number of moles of molecules × atomicity × N_A

Sol.: Number of atoms in $CO_2 = \frac{44}{44} \times 3 \times N_A = 3N_A$

Number of atoms in $CH_4 = \frac{32}{16} \times 5 \times N_A = 10N_A$

Number of atoms in $NO_2 = \frac{23}{46} \times 3 \times N_A = 1.5N_A$

Number of atoms in $H_2O = \frac{54}{18} \times 3 \times N_A = 9N_A$

84. Answer (2)

Hint: 1 mol of any gas occupies 22.4 L at STP.

Sol.: $N_2(g) + 3H_2(g) \longrightarrow 2NH_3(g)$

1 mol 3 mol 2 mol

(22.4 L) (3 × 22.4 L) (2 × 22.4 L) [at STP]

$\therefore$ H_2 is limiting agent

Number of moles of $H_2 = \frac{5.6}{22.4} = \frac{1}{4}$ mol

Volume of NH_3 produced by 5.6 L H_2 is $\frac{2}{3} \times \frac{1}{4} \times 22.4 \text{ L} = 3.73 \text{ L}$

85. Answer (4)

Hint: $M_R V_R = M_1V_1 + M_2V_2$

Sol.: $M_R (V_1 + V_2) = M_1V_1 + M_2V_2$

[R = Resultant solution]

$M_R (250 + 150) = 0.2 \times 250 + 0.4 \times 150$

$= \frac{50 + 60}{400} = 0.275 \simeq 0.28$ M

SECTION -B

86. Answer (2)

Hint & Sol.:

	Species	Maximum prescribed concentration in drinking water
I	Zn	5.0 ppm
II	NO_3^-	50 ppm
III	Pb	50 ppb
IV	Fe	0.2 ppm

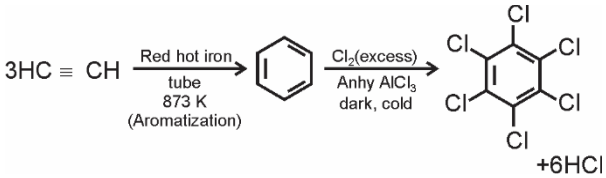
87. Answer (2)

Hint & Sol.: Greenhouse effect is responsible for global warming and the major greenhouse gases are CO_2, CH_4, H_2O, N_2O, CFCs and O_3

88. Answer (4)

Hint: In excess of electrophilic reagent, all H atoms of benzene ring undergo substitution.

Sol.:



89. Answer (1)

Hint: $K_c' = K_c^n$ [when reaction coefficients are multiplied by n]

Sol.: $2AB \rightleftharpoons A_2 + B_2$; $K_c = 49$

$AB \rightleftharpoons \frac{1}{2}A_2 + \frac{1}{2}B_2$; $K_{c'} = ?$

$K_c' = K_c^{\frac{1}{2}} = (49)^{\frac{1}{2}}$

$K_c' = 7$

90. Answer (2)

Hint: 1.5 m aqueous solution means 1.5 moles of solute is present in 1000 g of water.

Sol.:

$\therefore$ Number of moles of solute = 1.5 mol

Number of moles of solvent (water)

$= \frac{1000}{18} = 55.55$ mol

$X_B = \frac{1.5}{1.5 + 55.55} = 0.026$

91. Answer (3)

Hint: pH of an acidic solution should be less than 7 at 25°C.

Sol.: $\left[H^+\right]_{total} = \left[H^+\right]_{HCl} + \left[H^+\right]_{H_2O}$

$= 10^{-8} + 10^{-7}$

$= 10^{-8}[1 + 10] = 11 \times 10^{-8}$

$pH = -\log[11 \times 10^{-8}] = 6.95$

92. Answer (3)

Hint: Pressure fraction = mole fraction

Sol.: Let x g of each gas is present

Let total pressure of the gas mixture be P atm

Moles of $CH_4 = \frac{x}{16}$ mol

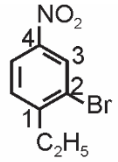
Moles of $SO_2 = \frac{x}{64}$ mol

$X_{CH_4} = \frac{x/16}{\frac{x}{16} + \frac{x}{64}} = \frac{4}{5} =$ Pressure fraction of CH_4

93. Answer (2)

Hint: For tri or higher substituted benzene derivatives, IUPAC naming of the compound is done following lowest locant rule.

Sol.:



2-Bromo-1-ethyl-4-nitrobenzene

94. Answer (3)

Hint: Oxides of alkaline earth metals are usually basic in nature.

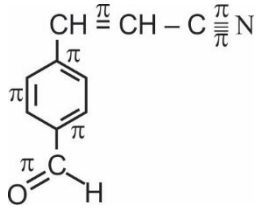
Sol.:

Column A (Oxide)	**Column B** (Nature)
B_2O_3	Acidic
CaO	Basic
PbO_2	Amphoteric
N_2O	Neutral

95. Answer (2)

Hint: C – C single bond contain one σ bond, double bond contain one σ and one π bond and triple bond contain one σ and 2π bonds.

Sol.:



$\Rightarrow$ $\sigma : \pi = 19 : 7$

96. Answer (3)

Hint and Sol.: CO_2 is commercially obtained by heating limestone.

- In laboratory, it is prepared by action of dil. HCl on $CaCO_3$.

97. Answer (4)

Hint: The tendency to show catenation decreases down the group.

Sol.: As the atomic size increases and electronegativity decreases down the group, thereby the tendency to show catenation decrease

Catenation: C >> Si > Ge ≃ Sn

- Pb does not show catenation.

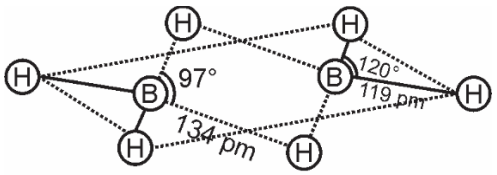
98. Answer (4)

Hint: Stability of dihalides of group 14 elements increases down the group.

Sol.: Stability of higher oxidation state of elements decreases down the group due to inert pair effect.

99. Answer (3)

Hint:



The structure of diborane, B_2H_6

Sol.: In B_2H_6, the four terminal H and two B atoms lie in one plane and 2 H lie above and below this plane.

100. Answer (2)

Hint: More is the back donation of electrons from halogen atom to boron atom, weaker is the acidic nature of boron halide.

Sol.: Tendency of back donation of electrons from halogen to boron follows the order: F > Cl > Br

Lewis acidity order: $BF_3 < BCl_3 < BBr_3$

[BOTANY]

SECTION - A

101. Answer (1)

Hint: Pyruvate dehydrogenase catalyse link reaction and pyruvate decarboxylase catalyse alcoholic fermentation.

Sol.: Invertase converts sucrose into glucose and fructose.

In muscles of animal during exercise, when oxygen is inadequate for cellular respiration, pyruvic acid is reduced to lactic acid by lactic dehydrogenase.

102. Answer (4)

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

103. Answer (3)

Hint: Cyclic photophosphorylation occurs in stroma lamellae membrane.

Sol.: Non-cyclic photophosphorylation occurs in granal thylakoids.

104. Answer (3)

Hint: Redifferentiated tissue are formed when the dedifferentiated cells produce the cells that loose their ability to divide and form permanent cells.

Sol.: Secondary xylem is a redifferentiated tissue.

105. Answer (4)

Hint: In the fronds of brown algae, air bladder is seen.

Sol.: In *Fucus*, air bladder is present.

106. Answer (1)

Hint: This hormone is also known as stress hormone.

Sol.: Abscisic acid is the derivative of carotenoids.

107. Answer (4)

Hint: Ethylene is a gaseous PGR.

Sol.: Ethylene involve in breaking of dormancy of seeds, buds and initiate the germination of seeds.

108. Answer (2)

Sol.: Zinc is required for biosynthesis of indole-3-acetic acid or auxin in plants.

109. Answer (3)

Hint: Oxidation of one NADH + H^+ yields 3 ATP and oxidation of one $FADH_2$ yields 2 ATP

Sol.: From 10 NADH + $H^+ \xrightarrow{ETS}$ 30 ATP

5 $FADH_2 \xrightarrow{ETS}$ 10 ATP

Total production of ATP from 10 NADH + H^+ and 5 $FADH_2$ via ETS is 40 ATP.

110. Answer (2)

Hint: Lactic acid fermentation releases lactic acid.

Sol.: Alcoholic fermentation results in the release of ethanol along with CO_2.

111. Answer (3)

Hint: The partial breakdown of glucose to pyruvic acid is called glycolysis.

Sol.: Glycolysis is often referred to as EMP pathway. It does not require oxygen.

112. Answer (2)

Hint: PFK (or pacemaker enzyme) regulates rate limiting step of EMP pathway.

Sol.: PFK catalyses conversion of fructose-6-phosphate to fructose-1,6-bisphosphate.

113. Answer (3)

Hint: Hydathodes are meant for water loss in liquid form.

Sol.: Stomata help in gaseous exchange in the plant.

114. Answer (4)

Sol: Glucose is the most preferred substrate for biological oxidation.

115. Answer (2)

Hint: Pneumatophores occur in plants growing in swampy area.

Sol.: In *Rhizophora,* many roots come out of the ground grow vertically called pneumatophore helps to get oxygen for respiration.

116. Answer (2)

Sol.: Slime moulds are saprotrophic protist and *Plasmodium* is a sporozoan which do not have locomotory structures.

117. Answer (3)

Hint: In Binomial nomenclature system the first word denoting genus starts with capital letter, while specific epithet starts with small letter. Both genus and specific epithet should be italic, if printed.

Sol.: *Mangifera indica* is correctly printed scientific name of Mango.

118. Answer (4)

Hint: *Pseudomonas* and *Thiobacillus* are denitrifying bacteria.

Sol.: *Nitrosomonas* and *Nitrococcus* bacteria oxidise ammonia to nitrites.

119. Answer (3)

Hint: Movement of sucrose out of phloem sap and into the cell requires energy.

Sol.: Active transport is required to move the sucrose out of phloem sap and into the cells.

120. Answer (1)

Hint: *Sorghum*, sugarcane and maize are C_4 plants in which photorespiration does not occur.

Sol.: C_4 plants have mechanism that increase the concentration of CO_2 at the enzyme site and minimise the water loss.

121. Answer (1)

Hint: Mutual attraction between water molecule is called cohesion.

Sol.: Tensile strength is an ability to resist a pulling force.

Capillarity is the ability of liquid to rise in thin tubes.

Adhesion is attraction of water molecules to polar surfaces.

122. Answer (4)

Hint: Tracheids are dead cells.

Sol.: Elongated and tube like tracheid cells do not have protoplasm.

123. Answer (4)

Hint: Uniport in facilitated diffusion is a passive process.

Sol.: Facilitated diffusion does not require energy to occur.

124. Answer (3)

Hint: Conduction of water from root to leaf, is performed by sapwood.

Sol.: In heartwood, deposition of tannins, resins, oils, etc. result in blockage of xylary elements. Hence, they become non-functional w.r.t. conduction of materials.

125. Answer (1)

Hint: Cells of pericycle play an important role during secondary growth in dicot roots and pith is small and inconspicuous in them.

Sol.: During secondary growth in the dicot root cells of pericycle become meristematic and give rise to lateral roots and part of vascular cambium.

Pith is large and well developed in monocot root.

126. Answer (4)

Hint: Bog moss or cotton moss is used for trans-shipment of living material.

Sol.: *Sphagnum* have high capacity to hold water and it is used as packing material for trans-shipment of living material.

127. Answer (1)

Hint: Mitochondria produces ATP and is not a part of endomembrane system.

Sol.: In plant cell, vacuole (a part of endomembrane system) can occupy upto 90% of the volume of the cell. In *Amoeba* contractile vacuole are important for excretion.

128. Answer (4)

Hint.: Zygote formation is the result of syngamy.

Sol.: Syngamy involves fusion of male and female gametes. After getting fused with one male gamete, secondary nucleus forms primary endosperm nucleus.

129. Answer (1)

Hint: Cotyledon of maize grain is called scutellum and it is diploid.

Sol.: In maize grain, diploid chromosome number is 20, thus the number of chromosomes in the cell of scutellum will be 20.

130. Answer (3)

Hint: Members of Solanaceae family have berry or capsule type of fruit.

Sol.: Tomato belongs to family Solanaceae and its fruit is berry. Drupe fruits are one seeded, *e.g.*, mango, coconut.

131. Answer (1)

Hint: Epitepalous condition is found in the members of Liliaceae family

Sol.: *Colchicum autumnale* have epitepalous androecium. This plant belongs to family Liliaceae.

132. Answer (2)

Hint: In J shaped chromosomes, one arm is very short and one arm is very long.

Sol.: In acrocentric chromosome, the centromere is present very close to one end forming one extremely short and one very long arm.

133. Answer (4)

Hint: *Albugo* is the parasitic fungi causes white rust of crucifers.

Sol.: *Puccinia* is the rust fungus belongs to Basidiomycetes and causes black rust of wheat.

134. Answer (2)

Hint: Members of Phycomycetes have aseptate and coenocytic mycelium.

Sol.: In members of Ascomycetes, mycelium consists of septate hyphae.

135. Answer (3)

Hint: In *Pinus*, male or female cone are borne on same tree.

Sol.: *Cycas* is dioecious species as male and female plants are separate. *Pinus* is monoecious.

SECTION - B

136. Answer (4)

Hint: Robert Brown discovered the nucleus.

Sol.: Anton van Leeuwenhoek first saw and described a living cell.

137. Answer (2)

Sol.: Brown algae have fucoxanthin, chlorophyll *a* and *c* as major pigments.

138. Answer (3)

Hint: *Selaginella* is heterosporous.

Sol.: Embryo development upto certain stages take place inside the female gametophyte which is retained on the parent sporophyte for variable periods. This event is precursor to seed habit and considered as important step in evolution.

139. Answer (2)

Hint: Chromosome are thickest and shortest in metaphase.

Sol.: During metaphase stage, morphology of chromosome is best studied.

140. Answer (4)

Hint: The final stage of meiotic prophase I is marked by terminalisation of chiasmata.

Sol.: Beginning of diplotene is recognised by dissolution of synaptonemal complex.

- During pachytene stage, recombination nodule is formed.
- During zygotene stage, chromosomes start pairing and this process of association is called synapsis.

141. Answer (2)

Hint: Water-impermeable layer of cells consists of waxy material i.e. suberin, forms casparian strips.

Sol.: Casparian strip occurs in endodermal cells.

142. Answer (3)

Hint: Only human beings have self consciousness.

Sol.: Defining property are exclusively present in the living organisms only.

Consciousness and cellular organisation of the body are the defining features of all life forms.

143. Answer (3)

Hint: *In-vitro* culture of explant is called tissue culture

Sol.: Soil-less culture in which plants are grown in a nutrient medium is known as hydroponics.

144. Answer (1)

Sol.: The two most important amides –asparagine and glutamine are found in plants. These are structural part of proteins.

145. Answer (3)

Hint: The biological nitrogen fixation reaction is as follows:

$N_2 + 8e^- + 8H^+ + 16\ ATP \rightarrow 2NH_3 + H_2 + 16\ ADP + 16\ Pi$

Sol.: To fix one molecule of ammonia, 8 molecules of ATP are required.

146. Answer (3)

Hint: For PS II, absorption maxima is at 680 nm.

Sol.: Chlorophyll *a* appears bright or blue green in the chromatogram.

Chlorophyll *a* along with accessory pigments form LHC.

PS-II is associated with splitting of water.

147. Answer (3)

Hint: In C_3 cycle, 18 ATP molecules are required for synthesis of one glucose molecule

Sol.: Sucrose = glucose + fructose

2 sucrose $\rightarrow$ 2 glucose + 2 fructose

$= 18 \times 2 + 18 \times 2 = 72$

Therefore 72 molecules of ATP are required to make two molecules of sucrose in C_3 cycle.

148. Answer (2)

Hint: Inclusion bodies store reserve material in prokaryotic cells.

Sol.: Polysome is a chain of ribosomes attached to a single mRNA.

149. Answer (3)

Sol.: Carbon dioxide is major limiting factor influencing the rate of photosynthesis.

150. Answer (2)

Hint: Fungal cell wall is composed of chitin.

Sol.: Algal cell wall is composed of cellulose, mannans, galactans and mineral like calcium carbonate.

[ZOOLOGY]

SECTION - A

151. Answer (4)

Hint: M-line and H-zone almost disappears during muscle contraction.

Sol.: Effects of muscle contraction:

1. H-zone almost disappears
2. M-line almost disappears
3. Z-lines come close to each other
4. Length of I-band decreases
5. Length of sarcomere decreases
6. Length of A-band remains same

152. Answer (4)

Hint: Endoskeleton in case of vertebrates is made up of bones and cartilages.

Sol.: Skeleton is of two types:

(a) Exoskeleton: The skeleton which is external is called exoskeleton. It is rigid, protective and supportive covering (framework) present outside the body.

(b) Endoskeleton: The skeleton which is internal is called endoskeleton. It is hard, supporting structural framework which occurs inside the body. The bones have hard and non-pliable matrix.

153. Answer (4)

Hint: Forms a depression called sella turcica which lodges hypophysis.

Sol.:

Bone	Number	Location
Sphenoid bone	1	Lies at the middle part of the base of skull and holds all the cranial bones together. It has saddle shaped structure, sella turcica to lodge pituitary gland (hypophysis).

154. Answer (1)

Hint: Atlas supports the head and consists of a complete ring of bone.

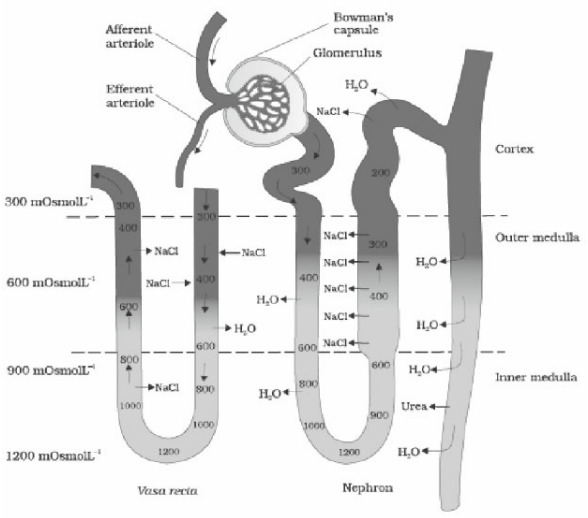
Sol.: The first vertebra is called atlas and the second vertebra is called axis.

Only thoracic vertebrae are connected with ribs. Seven cervical vertebrae are present in most of the mammals.

155. Answer (2)

Hint: Osmotic concentration of blood plasma is 300 $mOsmL^{-1}$

Sol.:



156. Answer (1)

Hint: Maximum reabsorption of water and sodium occurs at this site.

Sol.:

Small intestine	–	Brush bordered columnar epithelium
PCT	–	Brush-bordered cuboidal epithelium.
Fallopian tubes	–	Ciliated columnar epithelium.
Alveoli	–	Simple flattened squamous epithelium

157. Answer (2)

Hint: Cortical nephrons are more abundant in number.

Sol.: Juxta-medullary nephrons constitute 15% of the nephrons in the kidney whereas cortical nephrons constitute 85% of the nephrons in the kidney.

158. Answer (1)

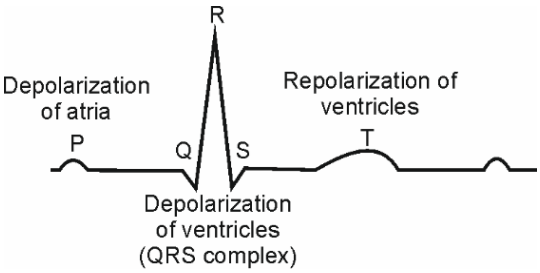
Hint: Activation of sympathetic nervous system lowers the level of urine output.

Sol.: Blood vessels of the kidney are innervated by nerve fibres of the sympathetic nervous system. When activated, the nerve fibres bring about constriction of renal arteries and cause decrease in renal blood flow as well as GFR.

159. Answer (2)

Hint: The end of T-wave marks the end of ventricular systole.

Sol.:



160. Answer (1)

Hint: Congestion of lungs is the main symptom

Sol.: Heart failure means the state of heart when it is not pumping blood effectively enough to meet the needs of the body. It is sometimes called congestive heart failure because congestion of the lungs is one of the main symptoms of this disease. Heart failure is not the same as cardiac arrest (when the heart stops beating) or a heart attack (when the heart muscle is suddenly damaged by an inadequate blood supply).

161. Answer (1)

Hint: AB blood group: Universal recipient

Sol.:

Blood group	Antigens on RBCs	Antibodies in Plasma	Donor's group
A	A	anti-B	A, O
B	B	anti-A	B, O
AB	A, B	nil	AB, A, B, O
O	nil	anti-A, B	O

162. Answer (4)

Hint: Stroke volume = End diastolic volume – End systolic volume

Sol.: CO = SV × HR

CO = (EDV – ESV) × HR

CO = (100 – 60) × 55

CO = 40 × 55

CO = 2200 mL

CO = 2.2 litres per minute

163. Answer (3)

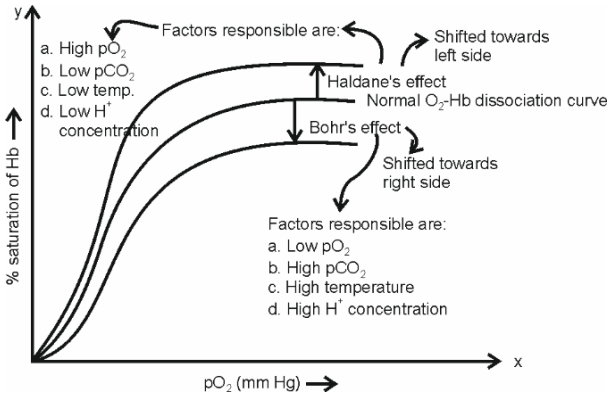
Hint: Coronary artery disease leads to hypertension.

Sol.: Atherosclerosis (coronary artery disease) makes the lumen of arteries narrower because of the deposition of Ca^{+2}, cholesterol, fat and fibrous tissue.

164. Answer (4)

Hint: Acidosis favours the curve to shift towards right-side.

Sol.:



165. Answer (2)

Hint: It can't be measured by spirometer

Sol.: TLC $\rightarrow$ RV + TV + IRV + ERV

VC $\rightarrow$ TV + IRV + ERV

IC $\rightarrow$ TV + IRV

RV, TLC and FRC can't be measured by spirometer.

166. Answer (1)

Hint: Cellular respiration occurs in the end so as to complete the process of respiration.

Sol.: Respiration involves the following steps:

(i) Breathing or pulmonary ventilation by which atmospheric air is drawn in and CO_2 rich alveolar air is released out.

(ii) Diffusion of gases (O_2 and CO_2) across alveolar membrane.

(iii) Transport of gases by the blood.

(iv) Diffusion of O_2 and CO_2 between blood and tissues.

(v) Utilisation of O_2 by the cells for catabolic reactions and resultant release of CO_2.

167. Answer (4)

Hint: Protease acts by hydrolysis.

Sol.: Most of the enzymes involved in the process of digestion belong to class hydrolases.

Oxidoreductases/dehydrogenases: Enzymes which catalyse oxidoreduction between two substrates S and S' e.g.,

S reduced + S' oxidised $\rightarrow$ S oxidised + S' reduced

Transferases: Enzymes catalysing a transfer of a group, G (other than hydrogen) between a pair of substrate S and S' e.g.,

$$S - G + S' \longrightarrow S + S' - G$$

Hydrolases: Enzymes catalysing hydrolysis of ester, ether, peptide, glycosidic, C-C, C-halide or P-N bonds.

Lyases: Enzymes that catalyse removal of groups from substrates by mechanisms other than hydrolysis leaving double bonds.

$$\begin{array}{l} X \quad Y \\ | \quad | \\ C-C \end{array} \longrightarrow X - Y + C = C$$

168. Answer (2)

Hint: Product is formed from substrate.

Sol.: Rate of process is rate of product formation *i.e.*, Rate $= \frac{\delta P}{\delta t}$

169. Answer (3)

Hint: The first amino acid is called N-terminal amino acid.

Sol.: It is a tetrapeptide compound which comprises:

Serine – Glutamine – Tyrosine – Phenylalanine

$\downarrow$ $\downarrow$

(N-terminal amino acid) (C-terminal amino acid)

170. Answer (1)

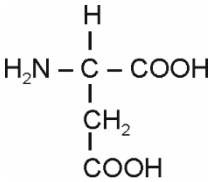
Hint: Protein coated fat globules

Sol.: Chylomicron is a lipoprotein which contains lipid as its prosthetic group. Other proteins (given in the options) do not contain lipid.

171. Answer (1)

Hint: Identify an acidic amino acid.

Sol.: Aspartic acid is an acidic amino acid (possesses –COOH group in its –R group).



(Aspartic acid)

Sulphur containing amino acids possess sulphur in their –R group.

Heterocyclic amino acids exhibit nitrogen in their ring.

Aromatic amino acids contain cyclic structure in which benzene ring is present in their –R group.

172. Answer (4)

Hint: Gross calorific value of carbohydrates, proteins and fats are 4.1 kcal/g, 5.65 kcal/g and 9.45 kcal/g respectively.

Sol.: Gross calorific value of food = [(15 × 4.1) + (10 × 5.65) + (5 × 9.45)] kcal

= (61.5 + 56.5 + 47.25) kcal

= 165.25 kcal

Physiological calorific value of food = [(15 × 4) + (10 × 4) + (5 × 9)] kcal

= (60 + 40 + 45) kcal

= 145 kcal

173. Answer (3)

Hint: In marasmus, no oedema is seen.

Sol.: Marasmus is produced by a simultaneous deficiency of proteins and calories. It is found in infants less than a year in age.

Kwashiorkor is produced by protein deficiency unaccompanied by calorie deficiency. It is found in a child who is more than one year in age.

174. Answer (3)

Hint: Nucleases are present in pancreatic juice.

Sol.: Succus entericus contains a variety of enzymes which includes maltase, lactase, sucrase, dipeptidases, lipases, nucleotidases, nucleosidases.

175. Answer (2)

Hint: Ductus choledochus carries bile juice to duct of Wirsung.

Sol.: The bile secreted by the hepatic cells passes through the hepatic ducts and is stored and concentrated in a thin muscular sac called the gall bladder. The duct of gall bladder (cystic duct) along with the hepatic duct from the liver forms the common bile duct.

The common bile duct and the pancreatic duct open together into the duodenum as the common hepato-pancreatic duct which is guarded by a sphincter called the sphincter of Oddi.

176. Answer (3)

Hint: Gastric caeca is digestive gland.

Sol.: Malpighian tubules, fat body, nephrocytes and urecose glands help in excretion in cockroach.

Gastric/Hepatic caecae secrete digestive juice.

177. Answer (2)

Hint: 6^{th} abdominal segment is common between the given structures.

Sol.: Mushroom shaped gland : 6^{th}-7^{th} abdominal segments. A pair of testes : 4^{th}-6^{th} abdominal segments.

178. Answer (4)

Hint: Gizzard possesses teeth

Sol.: Oesophagus opens into crop, which is used for storing of food.

The crop is followed by gizzard or proventriculus. It has an outer layer of thick circular muscles and thick inner cuticle forming six highly chitinous plates called teeth. Gizzard helps in grinding the food particles.

179. Answer (2)

Hint: Moist surface of oral cavity is lined by multi layered epithelium.

Sol.:

a.	Squamous epithelium	(ii)	Found in the walls of blood vessels and air sacs of lungs
b.	Cuboidal epithelium	(i)	Found in ducts of glands and tubular parts of nephrons in kidneys
c.	Columnar epithelium	(iv)	Found in the lining of stomach and intestine
d.	Compound epithelium	(iii)	Covers the dry surface of the skin, the moist surface of the buccal cavity, pharynx, inner lining of ducts of salivary glands and of pancreatic ducts

180. Answer (3)

Hint: Present in heart

Sol.: Bone: specialized connective tissue; hard and non-pliable ground substance rich in calcium salts and collagen fibres which give bone its strength.

Striated muscle (skeletal muscle)	Non-striated muscle (smooth muscle)	Cardiac muscle
1. Voluntary in action	1. Involuntary in action	1. Involuntary in action
2. They soon get fatigued	2. They do not get fatigued	2. They never get fatigued
3. Intercalated discs are absent	3. Intercalated discs are absent	3. Intercalated discs are present
4. Fibres are unbranched	4. Fibres are unbranched	4. Fibres are branched

181. Answer (4)

Hint: Coelenterates exhibit radial symmetry.

Sol.: *Gorgonia* and *Meandrina* (belong to phylum Coelenterata) possess radial symmetry.

Aedes, Bombyx and *Culex* (belong to phylum Arthropoda) possess bilateral symmetry.

Fasciola (belongs to phylum Platyhelminthes) possesses bilateral symmetry.

Loligo (belongs to phylum Mollusca) possesses bilateral symmetry.

182. Answer (3)

Hint: Placoid scales are present in the skin of cartilaginous fishes.

Sol.: *Trygon* (belongs to class Chondrichthyes): Notochord is persistent throughout life; skin is covered with placoid scales.

Pterophyllum (belongs to class Osteichthyes): Gills are covered by an operculum on each side.

Salamandra (belongs to class Amphibia): Presence of tympanum; respiration is through gills, lungs and skin.

Naja (belongs to class Reptilia): Poikilothermic; shed its scales as skin cast.

183. Answer (4)

Hint: *Delphinus* exhibits CNS which is dorsally placed.

Sol.:

S. No.	Chordates	Non-chordates
1.	Notochord is present.	Notochord is absent.
2	Central nervous system is dorsal, hollow and single.	Central nervous system is ventral, solid and double.
3.	Pharynx is perforated by gill slits.	Gill slits are absent.
4.	Heart is ventral.	Heart is dorsal (if present).
5.	A post-anal part (tail) is present.	Post-anal tail is absent.

184. Answer (2)

Hint: Possesses nephridia for excretion.

Sol.: *Ascaris* belongs to phylum Aschelminthes.

Nereis belongs to phylum Annelida. It possesses closed circulatory system. *Nereis*, an aquatic form, is dioecious. It possesses nephridia for osmoregulation and excretion.

Pinctada belongs to phylum Mollusca. They have feather-like gills which perform respiratory and excretory functions.

Ophiura belongs to phylum Echinodermata. It exhibits water vascular system which helps in locomotion, capture and transport of food and respiration.

185. Answer (3)

Hint: Exhibits dorso-ventrally flattened body.

Sol.: *Obelia* belongs to phylum Coelenterata. In *Obelia*, polyps produce medusae asexually and medusae form the polyps sexually.

Pleurobrachia and *Ctenoplana* belong to phylum Ctenophora. They possess radial symmetry along with tissue level of organisation.

Taenia belongs to phylum Platyhelminthes. They have dorso-ventrally flattened body, hence are called flatworms.

SECTION - B

186. Answer (4)

Hint: Purine bonds with their respective pyrimidine with hydrogen bonds.

Sol.: Adenine (A) and guanine (G) of one strand compulsorily base pairs with thymine (T) and cytosine (C) respectively, on the other strand.

$$A = T$$
$$\downarrow$$
(double H-bonds)

$$G \equiv C$$
$$\downarrow$$
(Triple H – bonds)

187. Answer (1)

Hint: Exhibits cnidocytes

Sol.: The name, 'cnidaria' is derived from the cnidoblasts or cnidocytes (which contain the stinging capsules or nematocysts) present on the tentacles and the body. Cnidoblasts are used for anchorage, defense and for the capture of prey. Cnidarians exhibit tissue level of organisation and are diploblastic. They have a central gastro-vascular cavity with a single opening, mouth on hypostome.

188. Answer (4)

Hint: Their body is supported by a skeleton made up of spongin fibres and spicules.

Sol.: Sponges have a water transport or canal system. Water enters through minute pores (ostia) in the body wall into a central cavity, spongocoel, from where it goes out through the osculum. This pathway of water transport is helpful in food gathering, respiratory exchange and removal of wastes.

189. Answer (4)

Hint: A pair of jointed filamentous structures is present in their last segment of abdomen.

Sol.: The abdomen in both males and females consists of 10 segments. 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 collaterial glands. In males, genital pouch or chamber lies at the hind end of abdomen bounded dorsally by 9^{th} and 10^{th} terga and ventrally by the 9^{th} sternum. It contains dorsal anus, ventral male genital pore and gonapophysis. Males bear a pair of short, threadlike anal styles which are absent in females. In both sexes, the 10^{th} segment bears a pair of jointed filamentous structures called anal cerci.

190. Answer (4)

Hint: They cover the hind wings when at rest.

Sol.: Forewings (mesothoracic) called tegmina are opaque, dark and leathery and cover the hind wings when at rest. The hind wings are transparent, membranous and are used in flight.

191. Answer (3)

Hint: Micturition is the process of release of urine.

Sol.: Withdrawal reflex is a spinal reflex intended to protect the body from damaging stimuli. Foetal-ejection reflex encompasses the mild uterine contractions in response to the signals that originate from the fully developed foetus and the placenta.

Hering-Breuer reflex is a reflex triggered to prevent the over-inflation of the lungs.

Micturition reflex is the neural mechanism which is responsible for causing micturition.

192. Answer (4)

Hint: Melatonin is secreted from a gland which is ectodermal in origin.

Sol.: Thyroid gland, parathyroid gland, thymus gland and pancreas are endodermal in origin. Pineal gland is ectodermal in origin.

193. Answer (2)

Hint: With increase in age, reduces in size

Sol.: Thymus gland is quite large at the time of birth but keeps reducing in size after puberty.

194. Answer (3)

Hint: Type-I diabetes is an auto-immune disorder.

Sol.: IDDM or Type-I diabetes is an example of auto-immune disorder which is caused by deficiency of insulin.

NIDDM or Type-II diabetes is initially caused by decreased sensitivity of receptors of target tissues to the insulin. This reduced sensitivity to insulin is often called insulin-resistance.

195. Answer (4)

Hint: Primary sex organ of the female reproductive system; present in lower abdomen.

Sol.: Hypothalamus produces releasing hormones and inhibiting hormones. Ovaries produce estrogen, relaxin and progesterone. They do not produce hCG (hCG is produced by placenta).

196. Answer (2)

Hint: Released by myocytes of atrial wall of the heart.

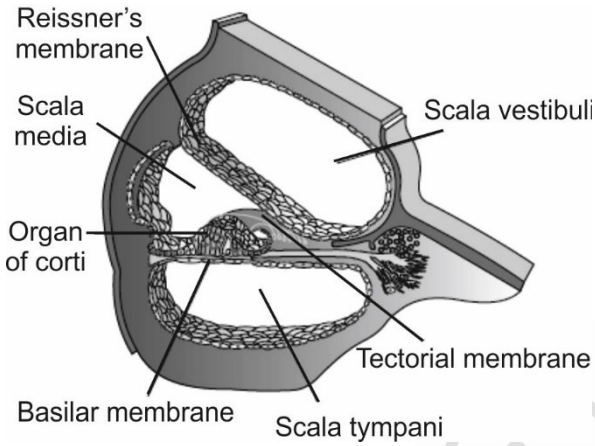
Sol.: ANP/ANF is released by the myocytes of the atrial wall of the heart. It reduces the blood pressure. It checks on RAAS.

Epinephrine and Norepinephrine are released by adrenal medulla. Angiotensinogen and aldosterone are involved in RAAS.

197. Answer (3)

Hint: Organ of Corti is located on it.

Sol.: Basilar membrane gives the human beings the ability to discriminate different pitches of the sound. This is because the different regions of the basilar membrane vibrate best at different frequencies of the sound, from which the brain infers the pitch.



198. Answer (3)

Hint: Transports $3Na^+$ outwards for $2K^+$ into the axon.

Sol.: The Na^+–K^+ ATPase pump transports $3Na^+$ outwards and $2K^+$ into the axon maintaining the polarization state when the neuron is resting. This transport occurs at an expense of the consumption of an ATP molecule.

During the process of depolarization, the voltage gated Na^+ channels open whereas the voltage gated K^+ channels remain closed.

199. Answer (4)

Hint: Found in cerebral cortex, retina of eye and during embryonic stage.

Sol.: Based on the number of axon and dendrites, the neurons are divided into three types, *i.e.*, multipolar (with one axon and two or more dendrites, found in the cerebral cortex), bipolar (with one axon and one dendrite, found in the retina of eye) and unipolar (cell body with one axon only, found usually in the embryonic stage).

200. Answer (1)

Hint: Fall under the category of synovial joints.

Sol.: Synovial joints are characterised by the presence of a fluid filled synovial cavity between the articulating surfaces of the two bones. Such an arrangement allows considerable movement. These joints help in locomotion and many other movements. Ball and socket joint (between humerus and pectoral girdle), hinge joint (knee joint), pivot joint (between atlas and axis), gliding joint (between the carpals) and saddle joint (between carpal and metacarpal of thumb side) are some examples.

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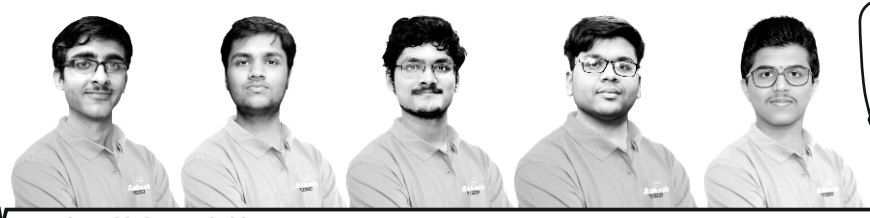

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