All India Aakash Test Series for NEET-2024

TEST - 7 (Code-C)

Test Date : 26/03/2023

ANSWERS

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

HINTS & SOLUTIONS

[PHYSICS]

SECTION - A

1. Answer (3)

Hint and Sol.: From principle of homogeneity

$[bV] = [T]$

$[MLT^{-2}] = [M^xL^yT^z]\,[LT^{-1}]$

$[M^xL^yT^z] = [ML^0T^{-1}]$

Then dimension formula for b is $[ML^0T^{-1}]$

2. Answer (3)

Hint: From concept of errors, $\frac{\Delta V}{V} = \frac{3\Delta R}{R}$

Sol.: $\frac{\Delta V}{V}\% = 3 \times 2.5\% = 7.5\%$

3. Answer (3)

Hint: $a = \frac{dv}{dt}$

Sol.: $-4v = \frac{dv}{dt}$

$\Rightarrow \int_8^v \frac{dv}{v} = \int_0^t -4dt$

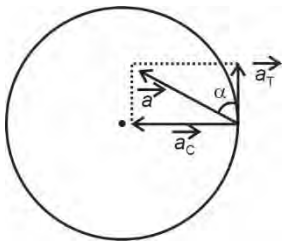
$\ln v\Big|_8^v = -4t\Big|_0^t$

$v = 8e^{-4t}$

4. Answer (3)

Hint: $\tan\alpha = \frac{a_c}{a_t}$

Sol.:



$\because \tan\alpha = \frac{a_c}{a_t} = \sqrt{3}$

$\Rightarrow \alpha = 60°$

5. Answer (1)

Hint: $W = \Delta KE$ (Work – energy theorem)

Sol.: $W_{\text{air resistance}} + W_{\text{gravity}} = \Delta\text{KE}$

$W_{\text{air resistance}} + 4 \times 10 \times 10 = \frac{1}{2} \times 4 \times 10^2$

$W_{\text{air resistance}} = -200$ J

6. Answer (2)

Hint: Static friction is a self-adjusting force.

Sol.: $f_{\text{static}} \le f_{s,\,\text{max}}$

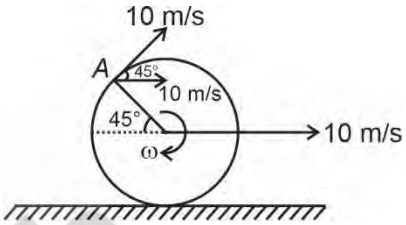
$f_{s,\,\text{max}} = \mu \times N = 0.3 \times 5g = 15$ N

$f_{\text{static}} = 10$ N

7. Answer (4)

Hint: Use conditions of pure rolling

Sol.:



$V_A = \sqrt{10^2 + 10^2 + 2.10.10\cos(45°)}$

$V_A = \sqrt{200(1+\cos 45°)}$

$V_A \approx \sqrt{340}$ m/s

8. Answer (1)

Hint: Longitudinal stress $= \frac{F_N}{A}$

Tangential stress $= \frac{F_T}{A}$

Sol.: $\sigma_N = \frac{F\sin 30°}{A} = \frac{25\text{N}}{4 \times 2.5\ \text{m}^2} = 2.5\ \text{N/m}^2$

$\sigma_T = \frac{F\cos 30°}{A} = \frac{25\sqrt{3}\text{N}}{4 \times 2.5\ \text{m}^2} = 2.5\sqrt{3}\ \text{N/m}^2$

9. Answer (1)

Hint: $\frac{mv_0^2}{r} = \frac{GmM}{r^{3/2}}$

Sol.: $v_0 = \frac{\sqrt{GM}}{r^{1/4}}$

$\Rightarrow v_0 = \sqrt{GM}\ r^{-1/4}$

$In(v_0) = \frac{-1}{4}\ln(r) + \text{constant}$

10. Answer (3)

Hint: $PV = nRT$

Sol.: $\because n_1 = \frac{P_1V}{RT}$; $n_2 = \frac{P_2V}{RT}$

$\Rightarrow$ amount leaked $= n_1 - n_2 = \left(\frac{P_1 - P_2}{RT}\right)V$

$= \frac{150 \times 10^3 \times 4 \times 10^{-3}}{8.314 \times 300}$

≈ 0.24 moles

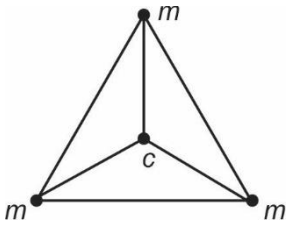
11. Answer (3)

Hint and Sol.: Frequency of potential energy will be $2F$

12. Answer (4)

Hint: $I = mr^2$

Sol.:



Distance of each particle from centroid $= \frac{2}{3} \times a\sin 60° = \frac{a}{\sqrt{3}}$

$I = 3 \times m\left(\frac{a}{\sqrt{3}}\right)^2$

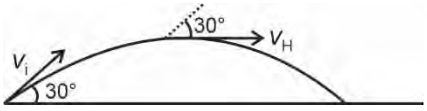
$= ma^2$

13. Answer (1)

Hint and Sol.:

Time of flight = 2.5 s

$\therefore$ The particle will be at highest point of trajectory at $t = 1.25$ s.

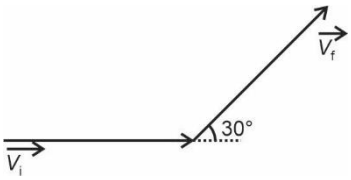


At highest point of trajectory angle will be 30°

14. Answer (3)

Hint: Velocity is a vector and speed is a scalar quantity.

Sol.:



$\Delta\vec{v} = v_f - v_i$

$|\Delta\vec{v}| = \sqrt{10^2 + 10^2 - 200\cos 30°} = \sqrt{200(1 - \cos 30°)}$

$= \sqrt{2} \times 10 \times \sqrt{2\sin^2 15°} = 20\sin(15°)$

15. Answer (3)

Hint and Sol.: $y = A\cos\omega t + B\sin\omega t$

$\Rightarrow \frac{y}{\sqrt{A^2 + B^2}} = \frac{A}{\sqrt{A^2 + B^2}}\cos\omega t + \frac{B}{\sqrt{A^2 + B^2}}\sin\omega t$

$\Rightarrow y = \sqrt{A^2 + B^2}\sin(\omega t + \phi)$

16. Answer (2)

Hint: Use work energy theorem

Sol.: The work done by force in moving from $x = 0$ to $x = 2$ is zero.

$W = \Delta K \cdot E \Rightarrow$ since

There is zero work

$\Rightarrow K \cdot E_i = K \cdot E_F = \frac{1}{2} \times 1 \times 4 = 2$ J

17. Answer (4)

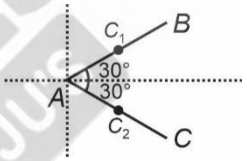
Hint: $W = \int F_x dx$

Sol.: $W = \int_2^4 \frac{-4}{x^2} dx = 4\left[\frac{1}{x}\right]_2^4 = 4\left[\frac{1}{4} - \frac{1}{2}\right] = -1$ J

18. Answer (2)

Hint: $x_{CM} = \frac{M_1x_1 + M_2x_2}{M_1 + M_2}$

Sol.:



$x_1 = \frac{I}{2}\cos 30°$

$x_2 = \frac{I}{2}\cos 30°$

$\Rightarrow x_{CM} = \frac{\frac{M}{2} \times \frac{I}{2}\frac{\sqrt{3}}{2} \times 2}{M} = \frac{I\sqrt{3}}{4}$

$y_{CM} = 0$ (by symmetry)

19. Answer (4)

Hint and Sol.: $\because \vec{F}_{ext} = m\vec{a}_{CM}$

Thus if $\left|\vec{F}_{ext}\right| = 0 \Rightarrow \left|\vec{a}_{CM}\right| = 0$

20. Answer (2)

Hint: $\vec{F} = m\vec{a}$

Sol.: $Mg - T = M \times a$

$500 - T = 50 \times 5$

$T = 500 - 250$

$= 250$ N

21. Answer (3)

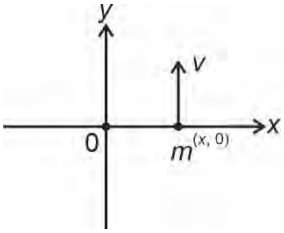
Hint and Sol.: In elastic collision kinetic energy before and after collision remains same but during collision it converts into elastic potential energy.

22. Answer (2)

Hint and Sol.: $\vec{p} = mu\hat{j}$

$\vec{r} = x\hat{i} + ut\hat{j}$

$|\vec{r} \times \vec{p}| = |\vec{p} \times \vec{r}| = mux$



therefore constant

23. Answer (3)

Hint: $KE_{Total} = \frac{1}{2}I\omega^2 + \frac{1}{2}mv_{cm}^2$

Sol.: $(K.E)_{Total} = \frac{1}{2} \times \left(mR^2\right)\left(\frac{v^2}{R^2}\right) + \frac{1}{2}mv^2$

$(K.E)_{Rotation} = \frac{1}{2} \times mR^2 \times \frac{v^2}{R^2} = \frac{mv^2}{2}$

$\Rightarrow \frac{(K \cdot E)_R}{(K \cdot E)_T} = \frac{1}{2}$

24. Answer (4)

Hint: $L = I\omega$ and $\omega_f^2 = \omega_i^2 + 2\alpha\theta$

Sol.: $\omega = \frac{L}{I} = 10$ rad/s

$\because \quad \omega_f = \omega_i + \alpha t$

$\Rightarrow \alpha = \frac{10}{5} = 2$ rad/s^2

$\omega_f^2 = \omega_i^2 + 2\alpha\theta$

$\Rightarrow$ 100 = 2.2.θ

$\Rightarrow$ θ = 25 rad

25. Answer (1)

Hint: $\frac{\Delta V}{V} = \frac{2\Delta R}{R} + \frac{\Delta L}{L}$ (for cylinder)

Sol.: $\because \frac{\Delta V}{V} = 0$

$\Rightarrow -2\frac{\Delta R}{R} = \frac{\Delta L}{L}$

$\Rightarrow \mu = \frac{-\Delta R / R}{\Delta L / L} = \frac{1}{2}$

26. Answer (1)

Hint: $B = \frac{\Delta P}{-\frac{\Delta V}{V}}$

Sol.: $2000 \times 10^6 = \frac{\Delta P}{5 \times 10^{-5}}$

$\Rightarrow$ ΔP = 100 kPa

27. Answer (3)

Hint and Sol.: $V = \sqrt{2gh} \Rightarrow V^2 = 2gh$, variation will be parabolic symmetric about single power

28. Answer (1)

Hint: Surface tension acts on both surfaces of film

Sol.: $F = 2sl$

$F = 2 \times 0.125 \times \frac{4}{100} = 0.01$ N

29. Answer (4)

Hint: Buoyant force balances weight of sphere

Sol.: $F_b = \frac{V_S}{2} \times \rho_{water} \times g + \frac{V_S}{2} \times \rho_{oil} \times g$

$\rho_s \times V_s \times g = \rho_{oil} \times \frac{V_s}{2} \times g + \rho_{water} \times \frac{V_S}{2} \times g$

$\Rightarrow \rho_s = \frac{\rho_{oil} + \rho_{water}}{2} = 0.8 \text{ g cm}^{-3} = 800 \text{ kg m}^{-3}$

30. Answer (1)

Hint: $g_h = g\left(1 - \frac{2h}{R}\right) \quad g_d = g\left(1 - \frac{d}{R}\right)$

Sol.: $\because \ g_h = g_d$

$\Rightarrow 1 - \frac{2h}{R_e} = 1 - \frac{d}{R_e}$

$\Rightarrow$ $2h = d$

31. Answer (4)

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

Sol.: $\because v = \omega\sqrt{A^2 - x^2} \Rightarrow v^2 = \omega^2A^2 - \omega^2x^2$

$\Rightarrow \frac{v^2}{\omega^2A^2} + \frac{x^2}{A^2} = 1$

$\Rightarrow$ Graph of v vs x will be circle if ω = 1 rad/s

$\Rightarrow$ $T = 2\pi$ s

32. Answer (2)

Hint: Maximum value of $A\sin\omega t + B\cos\omega t$ is $\sqrt{A^2 + B^2}$

Sol.: $x_{max} = \sqrt{3^2 + 4^2}$

$x_{max} = 5\,m$

33. Answer (2)

Hint and Sol.: $E = \frac{1}{2}KA^2$ (independent of x)

34. Answer (3)

Hint: $f_{apparent} = \left(\frac{v}{v - v_s}\right) f_{original}$

Sol.: $5000 = \left(\frac{350}{350 - v}\right) 4500$

$\Rightarrow$ v = 35 m/s

35. Answer (3)

Hint and Sol.: Pressure change is minimum at both ends in case of vibration of air column in open organ pipe.

$\therefore$ In case of vibration of air column in closed organ pipe, odd harmonics of fundamental frequency are generated.

$\therefore$ Pressure antinode exists at the place of displacement nodes.

SECTION - B

36. Answer (4)

Hint: $\Delta Q = nC_p\Delta T$

$\Delta U = nC_V\Delta T$

Sol.: $\frac{\Delta U}{Q} = \frac{C_V}{C_P}$

Diatomic gas $C_V = \frac{5}{2}R,\ C_P = \frac{7}{2}R$

$\Delta U = \frac{5}{7} \times 140$

= 100 J

37. Answer (2)

Hint and Sol.: For any polytropic process, PV^n = constant.

Slope of $P - V$ curve $= -\frac{nP}{V}$

38. Answer (2)

Hint and Sol.: $\because$ PV^n = constant

$\Rightarrow \frac{T_2}{T_1} = \left(\frac{P_2}{P_1}\right)^{\frac{n-1}{n}} = \left(\frac{V_1}{V_2}\right)^{n-1}$

39. Answer (1)

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

Sol.: $\eta_E = 1 - \frac{300}{600} = \frac{1}{2} \Rightarrow 50\%$

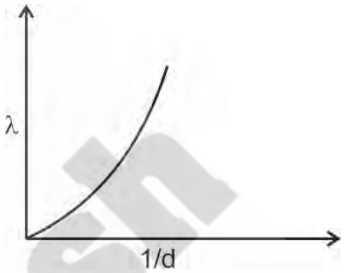
$\Rightarrow$ $W = \frac{1}{2} \times 120\ J = 60\ J$

40. Answer (2)

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

Sol.: $\lambda \propto \frac{1}{d^2}$

$\Rightarrow$ $y = kx^2$



41. Answer (2)

Hint: $Q = mC\Delta T$

Sol.: $Q = m \times 0.9 \times \Delta T$ ___(I) (Aluminium)

$Q = 5 \times 4.2 \times \Delta T$ ___(II) (Water)

Using (I) and (II)

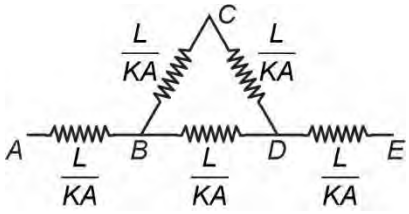
$m = \frac{5 \times 4.2}{0.9} = 23.3\ kg$

42. Answer (3)

Hint: $R_s = R_1 + R_2$ and $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2}$

Sol.: Thermal resistance of each rod $= \frac{L}{KA}$

$\Rightarrow$



$R_{th} = \frac{2L}{KA} + \frac{\left(\frac{2L}{KA}\right)\frac{L}{KA}}{\frac{3L}{KA}}$

$R_{th} = \frac{8L}{3KA}$

43. Answer (2)

Hint: $\gamma = 1+\frac{2}{f}$

Sol.: $\frac{f_{Rot}}{f_{trans}} = \frac{2}{3} \Rightarrow f = 5$

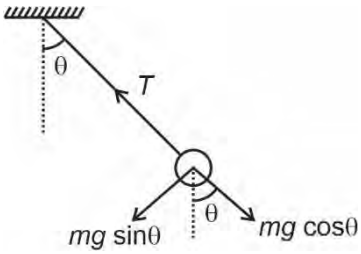
$\Rightarrow \quad \gamma = 1+\frac{2}{5} = \frac{7}{5}$

$\Rightarrow$ Gas is diatomic

44. Answer (3)

Hint: $F_{centripetal} = \frac{mv^2}{R}$

Sol.:



$T - mg\cos\theta = \frac{mv^2}{1}$

$T = mv^2 + mg\cos\theta$

$T = m\left(v^2 + g\left(1-\frac{\theta^2}{2}\right)\right)$

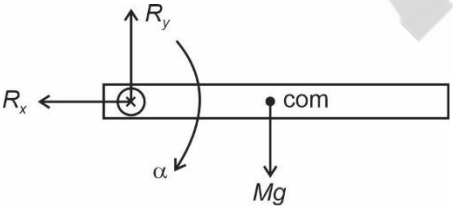
$T = 0.1\left(2.25 + 10\left(1-\frac{9}{200}\right)\right)$

T = 1.18 N

45. Answer (2)

Hint: Just after cutting, angular velocity of rod is zero

Sol.:



$\because \tau = I\alpha = \frac{ML^2}{3}\alpha$

$\Rightarrow \frac{MgL}{2} = \frac{ML^2}{3}\alpha$

$\Rightarrow \alpha = \frac{3g}{2L}$

$a_{com} = \frac{3g}{2L}\times\frac{L}{2} = \frac{3g}{4}(\text{downwards})$

$\because \quad R_x = M\omega^2 L = 0$ (as ω just after release is zero)

$M_g - R_y = \frac{3Mg}{4}$

$R_y = \frac{Mg}{4} \Rightarrow$ so hinge force $= \sqrt{R_x^2 + R_y^2} = \frac{Mg}{4}$

46. Answer (2)

Hint: $P = \vec{F}.\vec{v}$

Sol.: $P = Fv\cos\theta = Fv$ (here $\cos\theta = 1$)

$P = M\frac{dv}{dt}v$

$\frac{P}{M}\int_0^t dt = \int_0^v v dv$

$\frac{Pt}{M} = \frac{v^2}{2}$

$\Rightarrow v = \sqrt{\frac{2Pt}{M}}$

$\Rightarrow \quad v \propto t^{1/2}$

47. Answer (2)

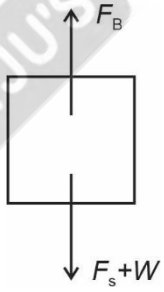
Hint and Sol.: For spring-block system

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

48. Answer (3)

Hint: In equilibrium $\sum F_y = 0$

Sol.:



$F_B = F_s + W$

$10^{-2} \times 600 \times 10 = F_s + 40$

$\Rightarrow \quad F_s = 20$ N

$\Rightarrow \quad Kx = 20$ N

$x = \frac{20}{100} = 20$ cm

State of spring $\rightarrow$ 20 cm stretched

49. Answer (4)

Hint: $v_{min} = \sqrt{5g\ell}$

Sol.: Minimum speed which should be given to the object is $\sqrt{5g\ell}$

$v_{min} = \sqrt{5\times10\times\frac{20}{100}} = \sqrt{10}$ m/s

50. Answer (3)

Hint: $g = \frac{GM}{R^2}$

Sol.: $g = \frac{GM}{R^2}$

$$= \frac{G \times \rho \times \frac{4}{3}\pi R^3}{R^2}$$

$$\Rightarrow \quad g \propto R$$

$$\Rightarrow \quad \frac{g_A}{g_B} = \frac{R_A}{R_B}$$

[CHEMISTRY]

SECTION - A

51. Answer (3)

Hint: Mass = moles × molar mass

Sol.:

- 0.1 gram molecule O_2 = 0.1 mol O_2 = 3.2 g O_2
- 6.02×10^{22} molecules of SO_3

$$\equiv 0.1 \text{ mol } SO_3 \equiv 8 \text{ g}$$

- 224 ml CO_2 at STP = 0.01 mol = 0.44 g CO_2

52. Answer (3)

Hint: Principal quantum number 'n' is always more than azimuthal quantum number 'l' by one in same shell

Sol.: For n = 3; l $\Rightarrow$ 0, 1, 2

hence

$n = 3, l = 3, m = -2, s = +\frac{1}{2}$, is a wrong set

53. Answer (1)

Hint: Generally on moving left to right in a period, ionization energy increases.

Sol.:

- Nitrogen has higher ionisation energy than oxygen due to stable half filled p subshell.
- Be, gives higher IP than B due to more penetration power.

Hence order - B < Be < O < N

54. Answer (2)

Hint and Sol.: Odd number of carbon cannot be obtained by Wurtz reaction in product.

55. Answer (3)

Hint and sol.: A gas below the critical temperature can be liquified by applying pressure and is called vapour of the substance. At critical temperature liquid passes into gaseous state continuously.

56. Answer (3)

Hint: Change in Gibbs free energy is negative for spontaneous processes which can be calculated as.

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

Sol.: For exothermic reaction with increasing entropy

$\Delta H < 0$ and $\Delta S > 0$

Hence from $\Delta G = \Delta H - T\Delta S$.

ΔG will be negative at any temperature.

57. Answer (4)

Hint: Precipitation of salt takes place if ionic product exceeds to solubility product

Sol.: Since water is more dense than ice on increasing pressure more melting of ice will take place.

Water expands on freezing because of hydrogen bonding.

58. Answer (3)

Hint: For adiabatic process q = 0

Sol.: During adiabatic process $\Delta U = W$

Since during expansion

$W < 0$, ΔS = constant

$\therefore$ $\Delta U < 0$ and temperature will decrease

59. Answer (2)

Hint: During a redox change both oxidation and reduction take place simultaneously.

Sol.:

- $PCl_5 \xrightarrow[\text{oxidation}]{\text{reduction}} PCl_3 + Cl_2$
- $CaCO_3 \rightarrow CaO + CO_2$

No change in oxidation state hence it is non-redox

- $2H_2 + O_2 \xrightarrow[\text{oxidation}]{\text{reduction}} H_2O$
- $2HI \xrightarrow[\text{oxidation}]{\text{reduction}} H_2 + I_2$

60. Answer (3)

Hint and Sol.: Metal with positive standard electrode potential doesn't given H_2 with dilute mineral acids hence 'Pt' will not give H_2 with dil. HCl.

61. Answer (1)

Hint: Alkali metal carbonates are thermally stable.

Sol.: Only Li_2CO_3 decomposes on heating

$$Li_2CO_3 \xrightarrow{\Delta} Li_2O + CO_2 \uparrow$$

62. Answer (4)

Hint and sol.: For oxides of nitrogen N_2O, NO $\Rightarrow$ neutral

N_2O_3, N_2O_4, N_2O_5 $\Rightarrow$ acidic

63. Answer (2)

Hint: Allyl bromide is

$CH_2 = CH - CH_2 - Br$

Sol.: $^1CH_2 = {}^2CH - {}^3CH_2 - Br$

3-Bromoprop-1-ene

64. Answer (2)

Hint: Compounds with same molecular formula and different position of either substituent, multiple bond or functional group are known as position isomers.

Sol.: n-propyl alcohol $\Rightarrow$ $CH_3-CH_2-CH_2-OH$

Isopropyl alcohol $\Rightarrow$ $CH_3-\underset{\displaystyle OH}{\underset{|}{CH}}-CH_3$

65. Answer (2)

Hint and Sol.: Maximum permissible limit of nitrate in drinking water is 50 ppm.

66. Answer (1)

Hint: Combustion of hydrocarbon gives CO_2, and H_2O.

Sol.: $CH_4(g) + 2O_2(g) \longrightarrow CO_2(g) + 2H_2O(g)$

1 mol *i.e.* 16 g CH_4 will give $\rightarrow$ 1 mol CO_2

= 1 × 22.4 L

= 22.4 L at STP.

67. Answer (2)

Hint: For single electron species

$IE = 13.6 \times Z^2$ eV

Sol.: Energy required to remove both electron from He: $E = IE_1 + IE_2$

Where IE_1 **first** ionization energy that is x eV and IE_2 is the ionization energy of removing second e^- from He^+ and it behaves as hydrogen like species.

$E = IE_1 + IE_2$

$= x + 13.6 \times (2)^2$

= (x + 54.4) e.V.

68. Answer (4)

Hint: Electron affinity of 3rd period element is more than 2nd period element in same group, due to less electronic repulsion.

Sol.: For oxygen family order of electron affinity is as following

S > Se > Te > O

69. Answer (2)

Hint and Sol.: BF_3 $\Rightarrow$ Trigonal planar

NH_3 $\Rightarrow$ Pyramidal

XeF_4 $\Rightarrow$ Square planar

ClF_3 $\Rightarrow$ Bent T shaped

70. Answer (1)

Hint: Rate of diffusion

$$r \propto \frac{1}{\sqrt{M}}$$

M $\Rightarrow$ molar mass of gas

Sol.: Order of ease of diffusion

$H_2 > He > N_2 > O_2$

71. Answer (2)

Hint: Heat at constant volume $\Rightarrow \Delta U$

Heat at constant pressure $\Rightarrow \Delta H$

Sol.: $CH_4(g) + 2O_2(g) \Rightarrow CO_2(g) + 2H_2O(g)$

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

$\because \quad \Delta n_g = 0$

$\Delta H = \Delta U = -40$ kJ

72. Answer (4)

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

Sol.: Reaction for which $\Delta n_g = 0$;

$K_p = K_c$

$H_2 + Cl_2 \rightarrow 2HCl$

$\Delta n_g = 2 - 2 = 0$

73. Answer (2)

Hint: During any redox reaction

$(n_{eq})_{oxidant} = (n_{eq})_{Reductant}$

Sol.: $\left(n_{eq}\right)_{KMnO_4} = \left(n_{eq}\right)_{FeC_2O_4}$

$\text{Mole} \times \left(n - \text{factor}\right)_{KMnO_4} = 3 \times 0.1$

$n \times 5 = 0.3$

n = 0.06 mol

74. Answer (2)

Hint: Volume strength = molarity × 11.2

Sol.: Volume strength $= \frac{0.34}{34} \times 11.2$

= 0.112 V

75. Answer (1)

Hint and Sol.: The stability of the peroxide or superoxide increases as the size of the metal ion increases.

- Superoxides $\left(O_2^-\right)$ of alkali metals are paramagnetic in nature.

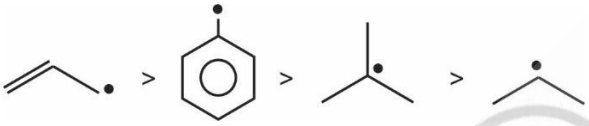
76. Answer (4)

Hint and Sol.: Fullerene is purest form of carbon

77. Answer (2)

Hint: More resonance or hyperconjugation results into higher stability of free radical.

Sol.: Order of stability



78. Answer (2)

Hint and Sol.:

Ion	Effect of excess concentration
Fluoride	Brown mottling of teeth
Nitrate	Blue baby syndrome
Lead	Damage to kidney
Sulphate	Laxative effect

79. Answer (1)

Hint: $CaCO_3 + 2HCl \Rightarrow CaCl_2 + H_2O + CO_2$

Sol.:

	$CaCO_3$	+ 2HCl	$\rightarrow CaCl_2$	+ H_2O	+ CO_2
At initial point	0.1 mol	0.1 mol	–	–	–
Completion of reaction	0.05	–	0.05	0.05	0.05

HCl is limiting reagent

36.5 g HCl gives $\Rightarrow$ 55.5 g $CaCl_2$

Hence 3.65 g HCl will give $\Rightarrow$ 5.55 g $CaCl_2$

80. Answer (2)

Hint: $E_n = \frac{-IP}{n^2}$

Sol.: $-60 = \frac{-960}{n^2}$

n = 4

number of lines $= \frac{n(n-1)}{2} = \frac{4 \times 3}{2} = 6$

81. Answer (3)

Hint: Electronegativity generally increases moving left to right in period. Moving down the group electronegativity decreases.

Sol.: r (atomic radius)

r(Be) = 111 pm

r(B) = 88 pm

- P has greater negative electron gain enthalpy than N due to less electronic repulsion.
- Electronegativities of C and Br are 2.5 and 2.8 respectively.
- Na is more metallic than Mg due to less ionisation energy.

82. Answer (4)

Hint: Electronic configuration of F_2 molecule is,

$$\sigma 1s^2 \sigma^* 1s^2 \sigma 2s^2 \sigma^* 2s^2 \sigma 2p_z^2 \begin{pmatrix} \pi 2px^2 \\ \pi 2p_y^2 \end{pmatrix} \begin{pmatrix} \pi^* 2p_x^2 \\ \pi^* 2p_y^2 \end{pmatrix}$$

Sol.:

Molecule	Number of electrons in ABMO
C_2	4
O_2	6
N_2	4
F_2	8

83. Answer (2)

Hint: $W_{rev} = -2.303\ nRT \log \left(\frac{V_2}{V_1}\right)$

Sol.: $W = -2.303 \times 2 \times 2 \times 400 \log \left(\frac{20}{2}\right)$

= –3.68 kcal

84. Answer (4)

Hint: On mixing a strong acid with weak acid results into decrease in dissociation of weak acid.

Sol.: Due to very less dissociation of CH_3COOH, total H^+ is approximately equal to (H^+) ion furnished by HCl only.

$$\left[H^+\right] = \frac{0.15 \times 200}{400}$$

$= 7.5 \times 10^{-2}$M

pH = $-\log (7.5 \times 10^{-2})$

= 1.12

85. Answer (4)

Hint: Element with minimum standard reduction potential will be strongest reducing agent.

Sol.: Li is strongest reducing agent as it has minimum standard reduction potential.

SECTION - B

86. Answer (1)

Hint: Central element contains lone pair of electron in case of electron rich hydride

Sol.: d-block elements form interstitial hydride like CrH.

87. Answer (4)

Hint and Sol.: Only LiCl among alkali metal chlorides get hydrated.

88. Answer (2)

Hint: Two oxygen per unit is shared to form straight chain polymer of silicones.

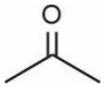
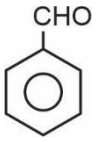
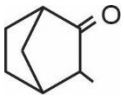
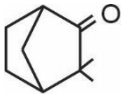
Sol.:

$R_2SiCl_2 \xrightarrow{H^+/H_2O} R_2Si(OH)_2 \xrightarrow{\Delta}$ straight chain silicone polymer.

89. Answer (1)

Hint: Carbonyl compounds with α-hydrogen can show tautomerism.

Sol.:

-  It has 6 enolisable hydrogen
-  It does not have enolisable hydrogen
-  It has one enolisable hydrgoen
-  It has enolsiable hydrogen on bridgehead, hence no tautomerism.

90. Answer (3)

Hint: Wurtz reaction, Kolbe's electrolysis are some of the processes which result into new carbon-carbon bond formation.

Sol.: $CH_3Cl \xrightarrow{Na,\ dry\ ether} CH_3-CH_3+NaCl$

$CH_3COONa \xrightarrow{electrolysis} CH_3-CH_3+CO_2$

$CH_2(COONa)-CH_2(COONa) \xrightarrow{electrolysis} CH_2=CH_2$

$CH_3COONa \xrightarrow{NaOH+CaO} CH_4$

91. Answer (3)

Hint and Sol.:

Clean water would have BOD value of less than 5 ppm whereas highly polluted water could have a BOD value of 17 ppm or more.

Highly polluted water could have 17 ppm BOD value.

92. Answer (2)

Hint: Rate of diffusion $\propto \frac{1}{\sqrt{M}}$

Sol.: $\frac{r_{SO_2}}{r_{He}} = \sqrt{\frac{4}{64}}$

$\frac{n_{SO_2} \times 2}{5 \times n_{He}} = \sqrt{\frac{1}{16}} \quad \left(\because r = \frac{v}{t} = \frac{n}{t}\right)$

$\frac{n_{SO_2} \times 2 \times 4}{5 \times 10} = \frac{1}{4}$

$n_{SO_2} = \frac{25}{16}$

$W_{SO_2} = \frac{25}{16} \times 64 = 100\ g$

93. Answer (2)

Hint: Vapour density $= \frac{\text{molar mass}}{2}$

Sol.: Molar mass of hydrocarbon = 2 × 15

= 30

Hence hydrocarbon is C_2H_6.

94. Answer (2)

Hint and Sol.:

- Splitting of spectral line in electric field is known as Stark effect.
- Splitting of spectral lines in magnetic field is known as Zeeman effect.

95. Answer (2)

Hint: On adding two chemical reactions, their enthalpies get added to get enthalpy of resultant reaction.

Sol.: $P \rightarrow Q;\ \Delta H_1 = 310.4\ kJ$ ...(i)

$2Q \rightarrow R+S;\ \Delta H_2 = -570.8\ kJ$ ...(ii)

Using 2(i) + (ii)

$2P \rightarrow R+S;\ \Delta H$

$\Delta H = 2\Delta H_1 + \Delta H_2$

= 620.8 – 570.8

= 50 kJ mol^{-1}

96. Answer (2)

Hint: For $B(OH)_2$; $K_{sp} = [B^{2+}] [OH^-]^2$

Sol.: $B(OH)_2(s) \rightleftharpoons \underset{S}{B^{2+}}(aq) + \underset{2S+10^{-2}}{2OH^-}(aq)$

$K_{sp} = S (2S + 10^{-2})^2$

$\because S << 10^{-2}$

$\therefore S + 10^{-2} \simeq 10^{-2}$

$K_{sp} = S \times 10^{-4}$

$S = 10^{-8}M$

97. Answer (1)

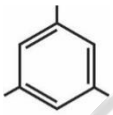
Hint: Halogen gets disproportionated in presence of NaOH

Sol.: $3Br_2 + 6NaOH \rightarrow 5NaBr + NaBrO_3 + 3H_2O$

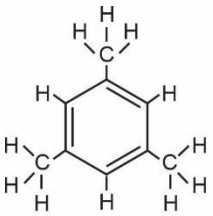
a = 3, b = 6, c = 5, d = 1

98. Answer (4)

Hint and Sol.:

$CH_3 - C \equiv CH \xrightarrow{\text{red hot iron tube}}$ 

(A)



A has 21 σ bonds and 3 pi bonds

(A)

99. Answer (3)

Hint and Sol.:

- Smallest alkane that can show chain isomerism is C_4H_{10} butane

 and  are chain isomers

100. Answer (2)

Hint: Alcohols are weaker acid than phenols. Weaker the acid, higher the pK_a value of acid.

Sol.: Order of pK_a values is

$\underset{(c)}{C_2H_5OH} > \underset{(a)}{CH_3OH} > \underset{(b)}{C_6H_5OH} > \underset{(d)}{HCOOH}$

[BOTANY]

SECTION - A

101. Answer (4)

Hint: Angiosperms show diplontic life cycle.

Sol.: The dominant phase in the life cycle of angiosperms is the photosynthetic independent diploid sporophytic plant.

102. Answer (3)

Hint: This organelle principally performs the function of packaging.

Sol.: Glycolipids and glycoproteins are formed in golgi apparatus.

103. Answer (3)

Hint: A wider range of wavelength of incoming light is utilised for photosynthesis due to the presence of accessory photosynthetic pigments.

Sol.: The accessory photosynthetic pigments absorb light of different wavelengths and transfer the energy to chlorophyll molecules, thus they are also called antenna molecules.

104. Answer (3)

Hint: This metal ion is an activator of both RuBisCO and PEP carboxylase enzymes.

Sol.: Mg^{2+} is required by pyruvate dehydrogenase for converting pyruvic acid into acetyl CoA.

Pyruvic acid + CoA + NAD^+ $\xrightarrow[\text{Pyruvate dehydrogenase}]{Mg^{2+}}$ Acetyl CoA + CO_2 + NADH + H^+

105. Answer (2)

Hint: This type of meristem regenerate the part of grasses removed by herbivores.

Sol.: Intercalary meristem is intercalated between mature tissues.

106. Answer (3)

Hint: Water and dissolved minerals are translocated from roots to stem.

Sol.: The movement of water in xylem is unidirectional.

107. Answer (3)

Hint: Stomata open in light due to formation of malic acid and influx of K^+ ions into the guard cells.

Sol.: In the dark, the K^+ ions are transported back to the epidermal cells from the guard cells, leading to closing of stomata.

108. Answer (3)

Hint: Active transport is an uphill transport.

Sol.: Active transport occurs against the concentration gradient and requires ATP. It is highly selective and is sensitive to protein inhibitors.

109. Answer (4)

Hint: *Nitrosomonas* and *Nitrobacter* help in conversion of ammonia to nitrate.

Sol.:

N_2 fixation is conversion of atmospheric N_2 into ammonia.

Denitrification is reduction of soil nitrates into N_2.

Ammonification is decomposition of organic nitrogen into ammonia.

110. Answer (3)

Hint: *Rhizobium* and *Frankia* can fix atmospheric nitrogen as symbionts

Sol.: *Rhodospirillum* – anaerobic free-living N_2 fixer.

Azotobacter – aerobic free-living N_2 fixer.

111. Answer (1)

Hint: Nitrogen is absorbed in the form of nitrites and nitrates and potassium is absorbed as a monovalent cation.

Sol.: The forms in which different elements are absorbed by plants are as follows:

N – NO_3^-, NO_2^- or NH_4^+

K – K^+

P – $H_2PO_4^-$ or HPO_4^{2-}

S – SO_4^{2-}

Mg, Zn, Cu – bivalent cations

112. Answer (4)

Hint: The morphological characteristics of the plant specimen are not mentioned on the herbarium sheet.

Sol.: The local name of plant specimen is provided in Herbarium.

113. Answer (1)

Hint: In botanical gardens, plants are grown and labelled for identification and keys are based on similarities and dissimilarities.

Sol.: Botanical gardens – Collection of living plants for reference.

Museums – Collection of preserved plants and animals.

Keys – Based on contrasting characters in a pair called couplet.

Flora – Contains the actual account of habitat and distribution of plants in a given area.

114. Answer (2)

Hint: One molecule of $NADH_2$ produces 3 ATP molecules in the ETS by donating electrons.

Sol.: The terminal electron acceptor in aerobic respiration is O_2.

115. Answer (1)

Hint: Ovary is said to be superior when the gynoecium occupies the highest position on the thalamus.

Sol.: Mustard – Ovary is superior

Ray florets of sunflower and guava – Ovary is inferior.

Plum – Ovary is half inferior.

116. Answer (4)

Hint: Axile placentation is found in tomato.

Sol.: Mustard – Parietal placentation

Pea – Marginal placentation

Sunflower – Basal placentation

117. Answer (1)

Hint: In Guava and *Calotropis*, a pair of leaves arise at each node on opposite side.

Sol.: Mustard – Alternate phyllotaxy.

Guava and *Calotropis* – Opposite phyllotaxy.

Alstonia – Whorled phyllotaxy.

118. Answer (3)

Hint: Root modification is seen in turnip.

Sol.: In turnip, tap root is modified for the storage of food.

119. Answer (2)

Hint: In a dicot stem cambium is present between xylem and phloem and dicot root cells do not perform photosynthesis.

Sol.: The given description matches for a monocot leaf in which the vascular bundles are conjoint and closed and ground tissue is composed of mesophyll cells.

120. Answer (3)

Hint: Hexokinase catalyses the addition of phosphate group to a monosaccharide during glycolysis.

Sol.: Hexokinase catalyses the first step of EMP pathway (present in both aerobic and anaerobic organisms) in which glucose is converted to glucose-6-phosphate

121. Answer (4)

Hint: These cells are large, empty and colourless.

Sol.: The cells of the adaxial epidermis in leaves modify into large, empty and colourless cells which help in rolling of leaves during drought conditions. These cells are called bulliform cells.

122. Answer (1)

Hint: In monocots, the guard cells are dumb-bell shaped.

Sol.: In mango leaves, the guard cells are bean or kidney shaped.

In rice, the guard cells are dumb-bell shaped.

123. Answer (4)

Hint: Acrocentric chromosome has one very long arm and one very short arm. Metacentric chromosome has equal arms.

Sol.: In sub-metacentric chromosome, the centromere is present slightly away from the centre.

124. Answer (1)

Hint: Cells divide by cell plate formation in plant cells and pairing of homologous chromosomes occur before crossing over.

Sol.: Dissolution of synaptonemal complex occurs in diplotene.

Cell plate is formed during cytokinesis in plant cell.

Formation of tetrad occurs in zygotene.

Separation of homologous chromosomes occurs in anaphase I.

125. Answer (2)

Hint: The size of bacterial filter is 0.45 μm through which the *Mycoplasma* are passed.

Sol.: *Mycoplasma* – 0.3 μm

Bacteria – 3 to 5 μm

RBC – 7.0 μm

126. Answer (4)

Hint: High concentration of CO_2 and photosynthetic products are inversely related to rate of photosynthesis

Sol.: Light intensity beyond a point damages chlorophyll, and thus leads to decrease in photosynthesis.

127. Answer (1)

Hint: Crossing over takes place during third sub stage of prophase I.

Sol.: Crossing over takes place between non-sister chromatids of homologous chromosomes in pachytene stage.

128. Answer (3)

Hint: Cells enter G_0 phase before DNA replication.

Sol.: Cells that do not divide further exit G_1 phase to enter G_0 stage.

129. Answer (4)

Hint: Crossing over takes place in meiosis.

Sol.: The correct sequence of events in mitosis is:

Condensation of chromosomes → disappearance of nuclear membrane → arrangement of chromosomes at equator → movement of chromosomes to opposite poles → cytokinesis.

130. Answer (2)

Hint: In C_4 plants and C_3 plants primary CO_2 acceptors are 3C compound and 5C compound respectively.

Sol.: In C_3 plants, primary CO_2 acceptor is RuBP and in C_4 plants, primary CO_2 acceptor is PEP.

131. Answer (4)

Hint: They cause mad cow disease in cattle.

Sol.: In prions, the protein is abnormally folded.

132. Answer (3)

Hint: Methanogens can live in extreme habitat and decompose organic matter to produce CH_4, CO_2 etc.

Sol.: Methanogens are a type of archaebacteria which are present in marshy areas and gut of ruminants. They produce biogas.

133. Answer (1)

Hint: Membrane bound organelles are absent in the prokaryotes.

Sol.: Double membrane bound organelles such as mitochondria are not present in bacteria. TCA cycle in bacteria occurs in cytosol.

134. Answer (2)

Hint: Axillary buds are inhibited for growth due to presence of apical buds.

Sol.: Auxins synthesized in apical buds inhibit axillary bud growth.

135. Answer (3)

Hint: Growth is slow during early phase of life and when the nutrient supply is limited.

Sol.: Growth is slow during lag phase and just prior to stationary phase.

SECTION - B

136. Answer (1)

Sol.: The exponential growth can be represented as

$W_1 = W_0 e^{rt}$

Where, W_1 = final size

W_0 = initial size

r = growth rate

t = time of growth

e = base of natural logarithm

137. Answer (3)

Hint: For complete oxidation of carbohydrates, number of CO_2 generated is equal to the number of O_2 consumed.

Sol.: For carbohydrates, RQ = 1

For fats, RQ is less than 1

138. Answer (3)

Hint: The secondary vascular tissues are produced by the activity of vascular cambial ring present within the stele.

Sol.: The cork cambium or phellogen gives rise to secondary cortex and cork. It is the extra-stelar cambium.

139. Answer (3)

Hint: Biological names are Latinised and italicised to follow the rules of binomial nomenclature.

Sol.: Generic name, specific epithet and author citation collectively form binomial epithet.

140. Answer (1)

Hint: Diatoms are autotrophs and their cell walls are embedded with silica.

Sol.: Diatoms are the chief 'producers' in the ocean.

141. Answer (2)

Hint: The movement of protons across complex V produces ATP.

Sol.: The protons move from mitochondrial matrix to intermembrane space when electrons are donated by NADH + H^+ and $FADH_2$ in the ETS.

142. Answer (4)

Hint: All the organelles included in endomembrane system are membrane bound.

Sol.: Ribosomes are not included in endomembrane system since their function is not co-ordinated with this system.

143. Answer (2)

Hint: Photolysis of water and photophosphorylation take place during light reaction.

Sol.: ATP, NADPH and O_2 are produced during light reaction of photosynthesis.

144. Answer (3)

Hint: Root pressure leads to guttation and decreases as the day advances.

Sol.: Root pressure can be seen during early morning and at night, when transpiration is low.

145. Answer (3)

Hint: In some pteridophytes, the sporophylls may be compactly arranged into strobili or cones.

Sol.: *Marchantia* belongs to Bryophyta and lacks strobili.

146. Answer (3)

Hint: It is a phase between G_1 and G_2 phases.

Sol.: DNA replicates in the S-phase of cell cycle.

147. Answer (3)

Hint: Minerals and compounds like nitrates and nitrites translocate through xylem in dissolved state.

Sol.: Sucrose is a disaccharide product of photosynthetates which is transported through phloem.

148. Answer (3)

Hint: Glycocalyx – bacterial cell envelope

Sol.: Glycogen-granules – inclusion bodies

Cis and *trans* face – golgi apparatus

rRNA synthesis – nucleolus

149. Answer (3)

Hint: Neem has pinnately compound leaf and pea has leaf tendrils.

Sol.: *Nepenthes* is an insectivorous plant. Phylloclade is formed by stem modification in *Euphorbia*. In pea, leaves modify to form tendrils.

150. Answer (1)

Sol.: *Sorghum* is a C_4 plant whereas *Triticum*, tomato and bell pepper are C_3 plants.

[ZOOLOGY]

SECTION - A

151. Answer (4)

Hint: Water-soluble hormone

Sol.: The lipid soluble hormones interact with intracellular receptors and regulate gene expression. It includes steroid hormones (testosterone, cortisol, etc.) and iodothyronines (thyroxine).

Iodothyronines are secreted by thyroid gland which is located on either side of trachea.

Testosterone regulates spermatogenesis.

Cortisol is the main glucocorticoid.

Hypothalamic hormones are proteinaceous and bind to membrane-bound receptors.

152. Answer (2)

Hint: Neurons are excitable cells.

Sol.: Neurons, the unit of neural system are excitable cells. The neuroglial cells constitute the rest of the neural system and protect and support neurons. They have the ability to divide unlike neurons.

153. Answer (4)

Hint: Cuboidal epithelium is found in tubular parts of functional unit of kidneys.

Sol.:

PCT of nephron	–	Cuboidal epithelium
Stomach	–	Columnar epithelium
Pulmonary artery, alveoli of lungs	–	Squamous epithelium
Fallopian tubes, bronchioles	–	Ciliated epithelium
Moist surface of buccal cavity and pharynx	–	Compound epithelium

154. Answer (3)

Hint: Related to reproductive system.

Sol.: Mosaic vision is present in both male and female cockroach.

Anal/caudal style and urecose glands are absent in females.

In female, 7^{th} sternum along with 8^{th} and 9^{th} sterna forms brood or genital pouch.

In male, 9^{th} and 10^{th} terga along with 9^{th} sternum form genital pouch.

155. Answer (4)

Hint: Cartilage is rich in chondroitin salts.

Sol.: Bones have a hard and non-pliable ground substance, are rich in calcium salts and collagen fibres which give bone its strength.

The next to last nymphal stage has wing pads but only adult cockroaches have wings.

156. Answer (1)

Hint: 6-8%

Sol.: Proteins constitute 6-8% of plasma and monocytes constitute 6-8% of total WBCs.

Neutrophils constitute about 60-65% of total WBCs and lymphocytes form about 20-25% of total WBCs.

157. Answer (2)

Hint: Reduce duration of inspiration

Sol.: Pneumotaxic centre is present in the pons region of brain. Strong neural signals from this area result in shallow and fast breathing, that is, increased rate of breathing by shortening duration of inspiration and thereby alter the respiratory rate.

158. Answer (4)

Hint: In marasmus, mother's milk is replaced too early.

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 seen in child more than one year in age.

Both show wasting of muscles, thinning of limbs, failure of growth and brain development.

But unlike marasmus, some fat is still left under the skin, extensive oedema and swelling of body parts are seen in Kwashiorkor.

159. Answer (4)

Hint: X-Glucose

Sol.: Y-Ribose

Cellulose is a homopolymer of glucose and makes up the plant cell wall.

A nucleic acid containing ribose is called ribonucleic acid (RNA).

Glucose is not a component of nucleic acids.

160. Answer (3)

Hint: Substance that produces colour

Sol.: Pigments – Carotenoids, Anthocyanins

Alkaloids – Codeine, Morphine

Terpenoids – Monoterpenes

Drugs – Vinblastine, Curcumin

161. Answer (3)

Hint: Its digestion starts in buccal cavity.

Sol.: Starch is a good storage material in plants.

Glycogen is the storage polysaccharide in animals.

162. Answer (3)

Hint: Part of renal corpuscle

Sol.: The renal tubule begins with a double walled cup-like structure called Bowman's capsule.

The epithelial cells of Bowman's capsule called podocytes are arranged in an intricate manner so as to leave some minute spaces called filtration slits.

Blood is filtered so finely through these slits that almost all the constituents of plasma except proteins pass onto lumen of Bowman's capsule.

70-80% of electrolytes are reabsorbed by PCT.

Conditional reabsorption of Na^+ takes place in DCT.

163. Answer (2)

Hint: P-Scapula

Sol.: The dorsal, flat, triangular body of scapula has a slightly elevated ridge called the spine which projects as a flat, expanded process called the acromion. The clavicle articulates with this. Below the acromion is a depression called the glenoid cavity which articulates with the head of the humerus to form the shoulder joint.

164. Answer (1)

Hint: Equal to the number of fingers in each hand.

Sol.: Trachea is straight tube extending up to the mid-thoracic cavity which divides at the level of 5th thoracic vertebra into right and left primary bronchi.

165. Answer (2)

Hint: Antigens are present on RBC's surface

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

166. Answer (1)

Hint: TLC = IC + FRC

Sol.:

(a) FRC = TLC – IC
= 2100 – 2300 mL

(b) EC = TV + ERV
TV = EC – ERV
= 500 mL

(c) VC = ERV + IC
IC = VC – ERV
= 3000 – 3500 mL

(d) TLC = RV + ERV + TV + IRV
IRV + ERV + TV = TLC – RV
= 4000 – 4600 mL

167. Answer (1)

Hint: Aorta carries oxygenated blood.

Sol.: Left ventricle is the thickest chamber of heart.

Sino-atrial node is the pacemaker of heart.

Vena cava receives deoxygenated blood.

In aorta, the partial pressure of oxygen is 95 mm Hg.

168. Answer (2)

Hint: Mammals have the ability to produce a concentrated urine.

Sol.: The transport of substances facilitated by the special arrangement of Henle's loop and vasa recta is called the counter current mechanism. This mechanism helps to maintain a concentration gradient in the medullary interstitium. Presence of such interstitial gradient helps in an easy passage of water from the collecting tubule thereby, concentrating the filtrate (urine).

So, if Henle's loop is removed, then there will be production of dilute urine.

169. Answer (4)

Hint: Ureotelic organism

Sol.: Aquatic amphibians are ammonotelic in nature.

Ammonia is readily soluble in water. It is the most toxic form and requires large amount of water for its elimination.

Cartilaginous fishes (*Carcharodon*) and mammals are ureotelic. Ammonia produced by metabolism is converted into urea in the liver of these animals.

Urea is 100,000 times less toxic than ammonia.

170. Answer (1)

Hint: ANS transmits impulses from the CNS to the involuntary organs.

Sol.: ANS is further classified into sympathetic and parasympathetic neural system.

Visceral nervous system comprises the whole complex of nerves, fibres, ganglia and plexuses by which impulses travel from the CNS to the viscera and from the viscera to the CNS.

171. Answer (2)

Hint: Mouth contains radula

Sol.: The space between the hump and the mantle is called the mantle cavity in which feather like gills are present. They have respiratory and excretory functions.

The anterior head region has sensory tentacles.

The mouth contains a file-like rasping organ for feeding called radula.

172. Answer (3)

Hint: All are chordates

Sol.: In all chordates there is ventral heart.

Pristis (cartilaginous fish) is viviparous and poikilothermic animal.

Crocodilus (reptile) and *Aptenodytes* (bird) are oviparous.

Aptenodytes (bird) and *Pteropus* (mammal) are homoiothermous animals.

All chordates have notochord and dorsal, hollow single CNS.

173. Answer (3)

Hint: Middle layer

Sol.: Inside the skull, brain is covered by cranial meninges consisting of an outer layer called dura mater, a very thin middle layer called arachnoid and an inner layer (which is in contact with the brain tissue) called pia mater.

174. Answer (2)

Hint: Identify the feature present in some flatworms.

Sol.: Members of the phylum Platyhelminthes are mostly endoparasites found in animals including human beings. They are bilaterally symmetrical, triploblastic and acoelomate animals with organ level of organisation.

Hooks and suckers are present in tapeworms but only sucker is present in liver fluke.

175. Answer (4)

Hint: Identify a feature absent in annelids

Sol.: Multicellularity and division of labour is seen in all animals.

Closed circulatory system is present in annelids except leeches.

Arthropods have open circulatory system.

Both annelids and arthropods have metameric segmentation and organ system level of organisation. Respiratory system is present only in arthropods.

176. Answer (3)

Hint: A mollusc

Sol.:

Exocoetus	–	Flying fish
Pterophyllum	–	Angel fish
Betta	–	Fighting fish
Scoliodon	–	Dog fish
Sepia	–	Cuttle fish

177. Answer (1)

Hint: Sub-mucosa

Sol.: Brunner's glands are present in sub-mucosa of duodenum.

Gastric glands containing chief cells, goblet cells and intestinal glands (crypts of Lieberkuhn) are mucosal modifications.

178. Answer (3)

Hint: J-shaped organ

Sol.: Stomach is located in the upper left portion of the abdominal cavity. Stomach has an oblique muscle layer.

179. Answer (1)

Hint: Hypersecretion

Sol.: Hyperthyroidism – Graves' disease

Hypersecretion of GH in adults – Acromegaly

Hyposecretion of GH – Dwarfism

Hypothyroidism – Cretinism

180. Answer (3)

Hint: Hypothalamus

Sol.: The posterior pituitary (pars nervosa) is under the direct neural regulation of the hypothalamus.

Hypothalamus lies at the base of thalamus which is major coordinating centre for sensory and motor signalling.

Hypothalamus along with limbic system is involved in the regulation of sexual behaviour, expression of emotional reactions and motivation.

181. Answer (2)

Hint: Hypoglycemic hormone

Sol.: Prolonged hyperglycemia leads to diabetes mellitus which is associated with loss of glucose through urine and formation of harmful compounds known as ketone bodies.

Diabetic patients are successfully treated with insulin therapy.

182. Answer (4)

Hint: Thick myofilament

Sol.: During muscle contraction, the thin and thick filaments slide pass over each other but retain their length. Ca^{++} is released from sarcoplasmic reticulum into sarcoplasm.

During shortening of the muscle, i.e., contraction, the 'I' bands get reduced, whereas the 'A' bands retain the length.

183. Answer (3)

Hint: Muscular dystrophy is a genetic disorder.

Sol.: Tetany is rapid spasms in muscle due to low Ca^{++} in body fluids.

Osteoporosis is age-related disorder characterised by decreased bone mass and increased chances of fractures.

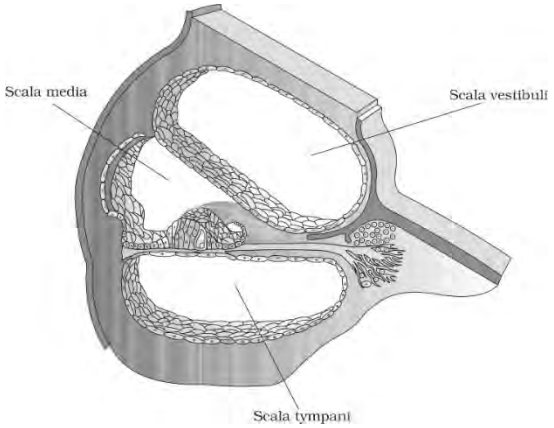
184. Answer (4)

Hint: A ends at the oval window

Sol.: A – Scala vestibuli

B – Scala media

C – Scala tympani



185. Answer (1)

Hint: Also has vomit centre

Sol.: Hindbrain comprises pons, cerebellum and medulla oblongata.

Midbrain, pons and medulla oblongata make up the brain stem.

Medulla contains centres which control respiration, cardiovascular reflexes and gastric secretions.

SECTION - B

186. Answer (3)

Hint: Voluntary muscles.

Sol.: Skeletal muscle fibres are present in biceps.

The features present in skeletal muscle fibres are peripheral nuclei, multinucleated and voluntary.

Both cardiac and skeletal muscle fibres are striated and cylindrical in shape.

Both cardiac and smooth muscle fibres are uninucleated and involuntary. They have central nucleus and fibres are connected by cell junctions.

187. Answer (1)

Hint: A pair of spermatheca is present in the 6^{th} segment.

Sol.: Testis : 4^{th} – 6^{th} abdominal segment

Ovaries : 2^{nd} – 6^{th} abdominal segment

Spermatheca : 6^{th} abdominal segment

Mushroom gland : 6^{th} – 7^{th} abdominal segment

188. Answer (2)

Hint: Hydrolysis of ester bond

Sol.: The bond between phosphate and hydroxyl group of a sugar is an ester bond.

Enzymes belonging to class III-Hydrolases catalyse hydrolysis of ester, ether, peptide or glycosidic bonds.

Class II – Transferases

Class IV – Lyases

Class VI – Ligases

189. Answer (2)

Hint: G ≡ C

Sol.: GC content is higher than AT content in DNA given to 'Y'. GC rich DNA melts at high temperature due to greater stability as 'G' interacts with 'C' through 3 hydrogen bonds. So, it will take more time to denature than DNA given to 'X'.

190. Answer (3)

Hint: Tunica media is comparatively thinner in veins

Sol.: Lumen diameter:

Vein > Artery > Capillary

191. Answer (2)

Hint: Carry deoxygenated blood

Sol.: Vena cava collects blood from whole body and opens into right atrium of the heart.

192. Answer (2)

Hint: Conditions at tissue level

Sol.: In tissues, low pO_2, high pCO_2, high H^+ concentration or low pH and higher temperature exist. All these conditions are favourable for dissociation of oxygen from the oxyhaemoglobin and shifts the oxygen dissociation curve to the right side.

The opposite conditions exist in the alveoli.

193. Answer (3)

Hint: Radial symmetry

Sol.: When any plane passing through the central axis of the body divides the organism into two identical halves, it is called radial symmetry. It is seen in members of phylum Cnidaria (*e.g.,* – *Adamsia*) and Ctenophora (*e.g., – Pleurobrachia*).

Spongilla (sponge) is asymmetrical.

Members of phylum Platyhelminthes to Chordata have bilateral symmetry with few exceptions.

194. Answer (4)

Hint: Succus entericus

Sol.: Starch is converted into maltose by ptyalin (salivary amylase) at pH 6.8.

Proteins under the action of pepsin is broken down into proteoses and peptones at pH 1.8.

$$\text{Lactose} \xrightarrow[\text{pH 7.8}]{\text{Lactase}} \text{Glucose + Galactose}$$

195. Answer (4)

Hint: Identify the feature of hormone secreted by adenohypophysis.

Sol.: Juxtaglomerular cells of kidney secrete erythropoietin which stimulates erythropoiesis (formation of RBCs).

Testosterone secreted by Leydig cells or interstitial cells also stimulate erythropoiesis.

Cortisol produces anti-inflammatory reactions and suppresses immune response.

FSH stimulates growth and development of ovarian follicles in females and have no role in RBC formation.

196. Answer (3)

Hint: Excess secretion of GH in adults results in severe disfigurement of face.

Sol.: Hypersecretion of growth hormone in adults does not cause further increase in height because epiphyseal plates close after a certain age.

197. Answer (2)

Hint: 14 in number

Sol.: Facial bones = Phalanges of right hand = 14

Thoracic vertebrae = 12

Ribs = 12 pairs

Wrist bones = 8

Ankle bones = 7

Pelvic girdle = 2 bones

Pectoral girdle = 4 bones

198. Answer (4)

Hint: Type of skeletal muscles

Sol.: In red muscle fibres, myoglobin content is high which gives reddish appearance. They contain plenty of mitochondria but the amount of sarcoplasmic reticulum is low. So, they have slow rate of contraction for long periods.

White muscle fibres possess very less quantity of myoglobin. Number of mitochondria are also few in them but the amount of sarcoplasmic reticulum is high. So, they show fast rate of contraction for short periods.

199. Answer (2)

Hint: Inner layer is retina

Sol.: A – Fovea, where cones are densely packed

B – Iris

C – Vitreous chamber, filled with a transparent gel

D – Choroid, middle layer

Retina contains three layers of neural cells from inside to outside – ganglion cells, bipolar cells and photoreceptor cells.

200. Answer (4)

Hint: Catecholamines are released from adrenal medulla.

Sol.: Epinephrine and norepinephrine are released from adrenal medulla.

Meissner's corpuscles are tangoreceptors, stimulated by touch and pressure.

❑ ❑ ❑

All India Aakash Test Series for NEET-2024

TEST - 7 (Code-D)

Test Date : 26/03/2023

ANSWERS

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

HINTS & SOLUTIONS

[PHYSICS]

SECTION - A

1. Answer (3)

Hint and Sol.: Pressure change is minimum at both ends in case of vibration of air column in open organ pipe.

∴ In case of vibration of air column in closed organ pipe, odd harmonics of fundamental frequency are generated.

∴ Pressure antinode exists at the place of displacement nodes.

2. Answer (3)

Hint: $f_{\text{apparent}} = \left(\frac{v}{v - v_s}\right) f_{\text{original}}$

Sol.: $5000 = \left(\frac{350}{350 - v}\right) 4500$

$\Rightarrow$ v = 35 m/s

3. Answer (2)

Hint and Sol.: $E = \frac{1}{2}KA^2$ (independent of x)

4. Answer (2)

Hint: Maximum value of $A\sin\omega t + B\cos\omega t$ is $\sqrt{A^2 + B^2}$

Sol.: $x_{\max} = \sqrt{3^2 + 4^2}$

$x_{\max} = 5\ \text{m}$

5. Answer (4)

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

Sol.: $\because v = \omega\sqrt{A^2 - x^2} \Rightarrow v^2 = \omega^2A^2 - \omega^2x^2$

$\Rightarrow \frac{v^2}{\omega^2A^2} + \frac{x^2}{A^2} = 1$

$\Rightarrow$ Graph of v vs x will be circle if ω = 1 rad/s

$\Rightarrow$ $T = 2\pi$ s

6. Answer (1)

Hint: $g_h = g\left(1 - \frac{2h}{R}\right)$ $g_d = g\left(1 - \frac{d}{R}\right)$

Sol.: $\because g_h = g_d$

$\Rightarrow 1 - \frac{2h}{R_e} = 1 - \frac{d}{R_e}$

$\Rightarrow$ $2h = d$

7. Answer (4)

Hint: Buoyant force balances weight of sphere

Sol.: $F_b = \frac{V_S}{2} \times \rho_{\text{water}} \times g + \frac{V_S}{2} \times \rho_{\text{oil}} \times g$

$\rho_s \times V_s \times g = \rho_{\text{oil}} \times \frac{V_s}{2} \times g + \rho_{\text{water}} \times \frac{V_S}{2} \times g$

$\Rightarrow \rho_s = \frac{\rho_{\text{oil}} + \rho_{\text{water}}}{2} = 0.8\ \text{g cm}^{-3} = 800\ \text{kg m}^{-3}$

8. Answer (1)

Hint: Surface tension acts on both surfaces of film

Sol.: $F = 2sl$

$F = 2 \times 0.125 \times \frac{4}{100} = 0.01\ \text{N}$

9. Answer (3)

Hint and Sol.: $V = \sqrt{2gh} \Rightarrow V^2 = 2gh$, variation will be parabolic symmetric about single power

10. Answer (1)

Hint: $B = \frac{\Delta P}{-\frac{\Delta V}{V}}$

Sol.: $2000 \times 10^6 = \frac{\Delta P}{5 \times 10^{-5}}$

$\Rightarrow$ ΔP = 100 kPa

11. Answer (1)

Hint: $\frac{\Delta V}{V} = \frac{2\Delta R}{R} + \frac{\Delta L}{L}$ (for cylinder)

Sol.: $\because \frac{\Delta V}{V} = 0$

$\Rightarrow -2\frac{\Delta R}{R} = \frac{\Delta L}{L}$

$\Rightarrow \mu = \frac{-\Delta R / R}{\Delta L / L} = \frac{1}{2}$

12. Answer (4)

Hint: $L = I\omega$ and $\omega_f^2 = \omega_i^2 + 2\alpha\theta$

Sol.: $\omega = \frac{L}{I} = 10$ rad/s

$\because \quad \omega_f = \omega_i + \alpha t$

$\Rightarrow \alpha = \frac{10}{5} = 2 \text{ rad/s}^2$

$\omega_f^2 = \omega_i^2 + 2\alpha\theta$

$\Rightarrow \quad 100 = 2.2.\theta$

$\Rightarrow \quad \theta = 25 \text{ rad}$

13. Answer (3)

Hint: $KE_{\text{Total}} = \frac{1}{2}I\omega^2 + \frac{1}{2}mv_{cm}^2$

Sol.: $(\text{K.E})_{\text{Total}} = \frac{1}{2} \times \left(mR^2\right)\left(\frac{v^2}{R^2}\right) + \frac{1}{2}mv^2$

$(\text{K.E})_{\text{Rotation}} = \frac{1}{2} \times mR^2 \times \frac{v^2}{R^2} = \frac{mv^2}{2}$

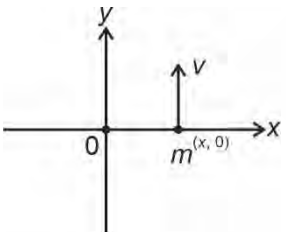
$\Rightarrow \frac{(K \cdot E)_R}{(K \cdot E)_T} = \frac{1}{2}$

14. Answer (2)

Hint and Sol.: $\vec{p} = mu\hat{j}$

$\vec{r} = x\hat{i} + ut\hat{j}$

$\left|\vec{r} \times \vec{p}\right| = \left|\vec{p} \times \vec{r}\right| = mux$



therefore constant

15. Answer (3)

Hint and Sol.: In elastic collision kinetic energy before and after collision remains same but during collision it converts into elastic potential energy.

16. Answer (2)

Hint: $\vec{F} = m\vec{a}$

Sol.: $Mg - T = M \times a$

$500 - T = 50 \times 5$

$T = 500 - 250$

$= 250 \text{ N}$

17. Answer (4)

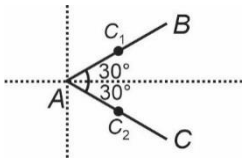
Hint and Sol.: $\because \vec{F}_{ext} = m\vec{a}_{CM}$

Thus if $\left|\vec{F}_{ext}\right| = 0 \Rightarrow \left|\vec{a}_{CM}\right| = 0$

18. Answer (2)

Hint: $x_{CM} = \frac{M_1x_1 + M_2x_2}{M_1 + M_2}$

Sol.:



$x_1 = \frac{l}{2}\cos 30^\circ$

$x_2 = \frac{l}{2}\cos 30^\circ$

$\Rightarrow x_{CM} = \frac{\frac{M}{2} \times \frac{l}{2}\frac{\sqrt{3}}{2} \times 2}{M} = \frac{l\sqrt{3}}{4}$

$y_{CM} = 0$ (by symmetry)

19. Answer (4)

Hint: $W = \int F_x dx$

Sol.: $W = \int_2^4 \frac{-4}{x^2} dx = 4\left[\frac{1}{x}\right]_2^4 = 4\left[\frac{1}{4} - \frac{1}{2}\right] = -1 \text{ J}$

20. Answer (2)

Hint: Use work energy theorem

Sol.: The work done by force in moving from $x = 0$ to $x = 2$ is zero.

$W = \Delta K \cdot E \Rightarrow$ since

There is zero work

$\Rightarrow K \cdot E_i = K \cdot E_F = \frac{1}{2} \times 1 \times 4 = 2 \text{ J}$

21. Answer (3)

Hint and Sol.: $y = A\cos\omega t + B\sin\omega t$

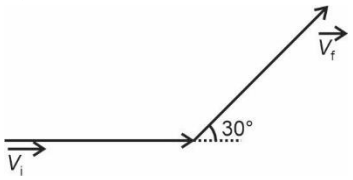
$\Rightarrow \quad \frac{y}{\sqrt{A^2 + B^2}} = \frac{A}{\sqrt{A^2 + B^2}}\cos\omega t + \frac{B}{\sqrt{A^2 + B^2}}\sin\omega t$

$\Rightarrow \quad y = \sqrt{A^2 + B^2}\sin(\omega t + \phi)$

22. Answer (3)

Hint: Velocity is a vector and speed is a scalar quantity.

Sol.:



$\Delta\vec{v} = v_f - v_i$

$\left|\Delta\vec{v}\right| = \sqrt{10^2 + 10^2 - 200\cos 30^\circ} = \sqrt{200(1 - \cos 30^\circ)}$

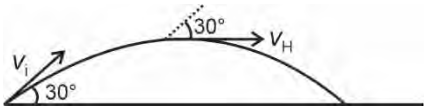
$= \sqrt{2} \times 10 \times \sqrt{2\sin^2 15^\circ} = 20\sin(15^\circ)$

23. Answer (1)

Hint and Sol.:

Time of flight = 2.5 s

∴ The particle will be at highest point of trajectory at t = 1.25 s.

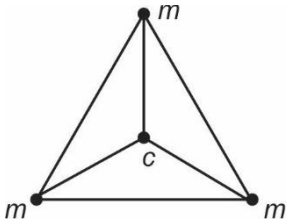


At highest point of trajectory angle will be 30°

24. Answer (4)

Hint: $I = mr^2$

Sol.:



Distance of each particle from centroid $= \frac{2}{3} \times a\sin 60° = \frac{a}{\sqrt{3}}$

$I = 3 \times m\left(\frac{a}{\sqrt{3}}\right)^2$

$= ma^2$

25. Answer (3)

Hint and Sol.: Frequency of potential energy will be 2F

26. Answer (3)

Hint: $PV = nRT$

Sol.: $\because n_1 = \frac{P_1V}{RT}$; $n_2 = \frac{P_2V}{RT}$

$\Rightarrow$ amount leaked $= n_1 - n_2 = \left(\frac{P_1 - P_2}{RT}\right)V$

$= \frac{150 \times 10^3 \times 4 \times 10^{-3}}{8.314 \times 300}$

≈ 0.24 moles

27. Answer (1)

Hint: $\frac{mv_0^2}{r} = \frac{GmM}{r^{3/2}}$

Sol.: $v_0 = \frac{\sqrt{GM}}{r^{1/4}}$

$\Rightarrow v_0 = \sqrt{GM}\, r^{-1/4}$

$ln(v_0) = \frac{-1}{4}\ln(r) + \text{constant}$

28. Answer (1)

Hint: Longitudinal stress $= \frac{F_N}{A}$

Tangential stress $= \frac{F_T}{A}$

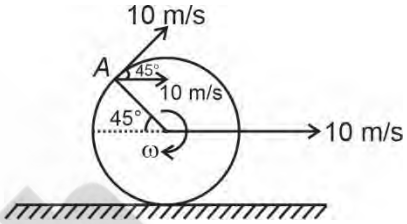
Sol.: $\sigma_N = \frac{F\sin 30°}{A} = \frac{25\text{N}}{4 \times 2.5\ \text{m}^2} = 2.5\ \text{N/m}^2$

$\sigma_T = \frac{F\cos 30°}{A} = \frac{25\sqrt{3}\text{N}}{4 \times 2.5\ \text{m}^2} = 2.5\sqrt{3}\ \text{N/m}^2$

29. Answer (4)

Hint: Use conditions of pure rolling

Sol.:



$V_A = \sqrt{10^2 + 10^2 + 2.10.10\cos(45°)}$

$V_A = \sqrt{200(1 + \cos 45°)}$

$V_A \approx \sqrt{340}$ m/s

30. Answer (2)

Hint: Static friction is a self-adjusting force.

Sol.: $f_{\text{static}} \le f_{s,\,\text{max}}$

$f_{s,\,\text{max}} = \mu \times N = 0.3 \times 5g = 15$ N

$f_{\text{static}} = 10$ N

31. Answer (1)

Hint: $W = \Delta KE$ (Work – energy theorem)

Sol.: $W_{\text{air resistance}} + W_{\text{gravity}} = \Delta\text{KE}$

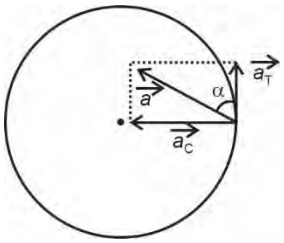
$W_{\text{air resistance}} + 4 \times 10 \times 10 = \frac{1}{2} \times 4 \times 10^2$

$W_{\text{air resistance}} = -200$ J

32. Answer (3)

Hint: $\tan\alpha = \frac{a_c}{a_t}$

Sol.:



$\because \tan\alpha = \frac{a_c}{a_t} = \sqrt{3}$

$\Rightarrow \alpha = 60°$

33. Answer (3)

Hint: $a = \frac{dv}{dt}$

Sol.: $-4v = \frac{dv}{dt}$

$\Rightarrow \int_8^v \frac{dv}{v} = \int_0^t -4dt$

$\ln v\Big|_8^v = -4t\Big|_0^t$

$v = 8e^{-4t}$

34. Answer (3)

Hint: From concept of errors, $\frac{\Delta V}{V} = \frac{3\Delta R}{R}$

Sol.: $\frac{\Delta V}{V}\% = 3 \times 2.5\% = 7.5\%$

35. Answer (3)

Hint and Sol.: From principle of homogeneity

$[bV] = [T]$

$[MLT^{-2}] = [M^xL^yT^z]\ [LT^{-1}]$

$[M^xL^yT^z] = [ML^0T^{-1}]$

Then dimension formula for b is $[ML^0T^{-1}]$

SECTION - B

36. Answer (3)

Hint: $g = \frac{GM}{R^2}$

Sol.: $g = \frac{GM}{R^2}$

$= \frac{G \times \rho \times \frac{4}{3}\pi R^3}{R^2}$

$\Rightarrow g \propto R$

$\Rightarrow \frac{g_A}{g_B} = \frac{R_A}{R_B}$

37. Answer (4)

Hint: $v_{min} = \sqrt{5g\ell}$

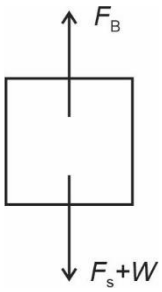
Sol.: Minimum speed which should be given to the object is $\sqrt{5g\ell}$

$v_{min} = \sqrt{5 \times 10 \times \frac{20}{100}} = \sqrt{10}$ m/s

38. Answer (3)

Hint: In equilibrium $\sum F_y = 0$

Sol.:



$F_B = F_s + W$

$10^{-2} \times 600 \times 10 = F_s + 40$

$\Rightarrow F_s = 20$ N

$\Rightarrow Kx = 20$ N

$x = \frac{20}{100} = 20$ cm

State of spring $\rightarrow$ 20 cm stretched

39. Answer (2)

Hint and Sol.: For spring-block system

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

40. Answer (2)

Hint: $P = \vec{F}.\vec{v}$

Sol.: $P = Fv\cos\theta = Fv$ (here $\cos\theta = 1$)

$P = M\frac{dv}{dt}v$

$\frac{P}{M}\int_0^t dt = \int_0^v vdv$

$\frac{Pt}{M} = \frac{v^2}{2}$

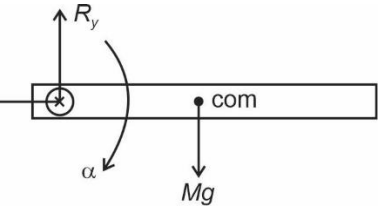
$\Rightarrow v = \sqrt{\frac{2Pt}{M}}$

$\Rightarrow v \propto t^{1/2}$

41. Answer (2)

Hint: Just after cutting, angular velocity of rod is zero

Sol.:



$\because \tau = I\alpha = \frac{ML^2}{3}\alpha$

$\Rightarrow \frac{MgL}{2} = \frac{ML^2}{3}\alpha$

$\Rightarrow \alpha = \frac{3g}{2L}$

$a_{com} = \frac{3g}{2L} \times \frac{L}{2} = \frac{3g}{4}(\text{downwards})$

$\because$ $R_x = M\omega^2 L = 0$ (as ω just after release is zero)

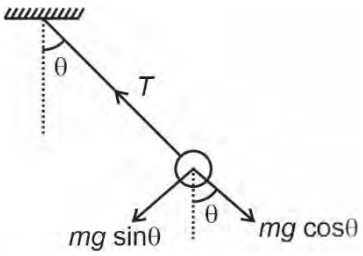
$M_g - R_y = \frac{3Mg}{4}$

$R_y = \frac{Mg}{4} \Rightarrow$ so hinge force $= \sqrt{R_x^2 + R_y^2} = \frac{Mg}{4}$

42. Answer (3)

Hint: $F_{centripetal} = \frac{mv^2}{R}$

Sol.:



$T - mg\cos\theta = \frac{mv^2}{1}$

$T = mv^2 + mg\cos\theta$

$T = m\left(v^2 + g\left(1 - \frac{\theta^2}{2}\right)\right)$

$T = 0.1\left(2.25 + 10\left(1 - \frac{9}{200}\right)\right)$

T = 1.18 N

43. Answer (2)

Hint: $\gamma = 1 + \frac{2}{f}$

Sol.: $\frac{f_{Rot}}{f_{trans}} = \frac{2}{3} \Rightarrow f = 5$

$\Rightarrow \gamma = 1 + \frac{2}{5} = \frac{7}{5}$

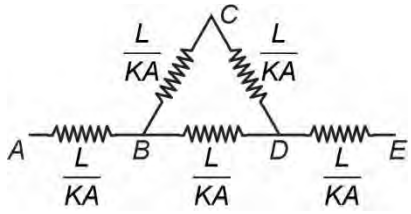
$\Rightarrow$ Gas is diatomic

44. Answer (3)

Hint: $R_s = R_1 + R_2$ and $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2}$

Sol.: Thermal resistance of each rod $= \frac{L}{KA}$

$\Rightarrow$



$R_{th} = \frac{2L}{KA} + \frac{\left(\frac{2L}{KA}\right)\frac{L}{KA}}{\frac{3L}{KA}}$

$R_{th} = \frac{8L}{3KA}$

45. Answer (2)

Hint: $Q = mC\Delta T$

Sol.: $Q = m \times 0.9 \times \Delta T$ ___(I) (Aluminium)

$Q = 5 \times 4.2 \times \Delta T$ ___(II) (Water)

Using (I) and (II)

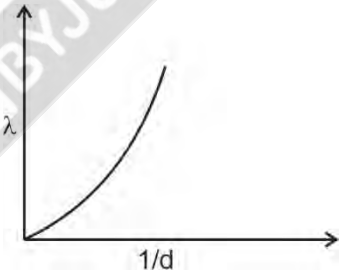
$m = \frac{5 \times 4.2}{0.9} = 23.3$ kg

46. Answer (2)

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

Sol.: $\lambda \propto \frac{1}{d^2}$

$\Rightarrow y = kx^2$



47. Answer (1)

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

Sol.: $\eta_E = 1 - \frac{300}{600} = \frac{1}{2} \Rightarrow 50\%$

$\Rightarrow W = \frac{1}{2} \times 120\text{ J} = 60\text{ J}$

48. Answer (2)

Hint and Sol.: $\because$ PV^n = constant

$\Rightarrow \frac{T_2}{T_1} = \left(\frac{P_2}{P_1}\right)^{\frac{n-1}{n}} = \left(\frac{V_1}{V_2}\right)^{n-1}$

49. Answer (2)
Hint and Sol.: For any polytropic process, PV^n = constant.
Slope of $P - V$ curve $= -\frac{nP}{V}$

50. Answer (4)
Hint: $\Delta Q = nC_p\Delta T$
$\Delta U = nC_V\Delta T$
Sol.: $\frac{\Delta U}{Q} = \frac{C_V}{C_P}$
Diatomic gas $C_V = \frac{5}{2}R,\ C_P = \frac{7}{2}R$
$\Delta U = \frac{5}{7} \times 140$
= 100 J

[CHEMISTRY]

SECTION - A

51. Answer (4)
Hint: Element with minimum standard reduction potential will be strongest reducing agent.
Sol.: Li is strongest reducing agent as it has minimum standard reduction potential.

52. Answer (4)
Hint: On mixing a strong acid with weak acid results into decrease in dissociation of weak acid.
Sol.: Due to very less dissociation of CH_3COOH, total H^+ is approximately equal to (H^+) ion furnished by HCl only.
$\left[H^+\right] = \frac{0.15 \times 200}{400}$
$= 7.5 \times 10^{-2}M$
$pH = -\log (7.5 \times 10^{-2})$
= 1.12

53. Answer (2)
Hint: $W_{rev} = -2.303\ nRT \log \left(\frac{V_2}{V_1}\right)$
Sol.: $W = -2.303 \times 2 \times 2 \times 400 \log \left(\frac{20}{2}\right)$
= –3.68 kcal

54. Answer (4)
Hint: Electronic configuration of F_2 molecule is,
$$\sigma 1s^2 \sigma^* 1s^2 \sigma 2s^2 \sigma^* 2s^2 \sigma 2p_z^2 \left(\begin{matrix}\pi 2px^2 \\ \pi 2p_y^2\end{matrix}\right)\left(\begin{matrix}\pi^* 2p_x^2 \\ \pi^* 2p_y^2\end{matrix}\right)$$
Sol.:

Molecule	Number of electrons in ABMO
C_2	4
O_2	6
N_2	4
F_2	8

55. Answer (3)
Hint: Electronegativity generally increases moving left to right in period. Moving down the group electronegativity decreases.
Sol.: r (atomic radius)
r(Be) = 111 pm
r(B) = 88 pm
- P has greater negative electron gain enthalpy than N due to less electronic repulsion.
- Electronegativities of C and Br are 2.5 and 2.8 respectively.
- Na is more metallic than Mg due to less ionisation energy.

56. Answer (2)
Hint: $E_n = \frac{-IP}{n^2}$
Sol.: $-60 = \frac{-960}{n^2}$
n = 4
number of lines $= \frac{n(n-1)}{2} = \frac{4 \times 3}{2} = 6$

57. Answer (1)
Hint: $CaCO_3 + 2HCl \Rightarrow CaCl_2 + H_2O + CO_2$
Sol.:

	$CaCO_3$	+ 2HCl	$\rightarrow$ $CaCl_2$	+ H_2O	+ CO_2
At initial point	0.1 mol	0.1 mol	–	–	–
Completion of reaction	0.05	–	0.05	0.05	0.05

HCl is limiting reagent
36.5 g HCl gives $\Rightarrow$ 55.5 g $CaCl_2$
Hence 3.65 g HCl will give $\Rightarrow$ 5.55 g $CaCl_2$

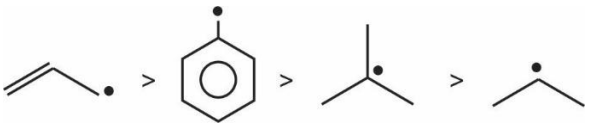
58. Answer (2)
Hint and Sol.:

Ion	Effect of excess concentration
Fluoride	Brown mottling of teeth
Nitrate	Blue baby syndrome
Lead	Damage to kidney
Sulphate	Laxative effect

59. Answer (2)

Hint: More resonance or hyperconjugation results into higher stability of free radical.

Sol.: Order of stability



60. Answer (4)

Hint and Sol.: Fullerene is purest form of carbon

61. Answer (1)

Hint and Sol.: The stability of the peroxide or superoxide increases as the size of the metal ion increases.

- Superoxides $\left(O_2^-\right)$ of alkali metals are paramagnetic in nature.

62. Answer (2)

Hint: Volume strength = molarity × 11.2

Sol.: Volume strength $=\frac{0.34}{34}\times 11.2$

= 0.112 V

63. Answer (2)

Hint: During any redox reaction

$(n_{eq})_{oxidant} = (n_{eq})_{Reductant}$

Sol.: $\left(n_{eq}\right)_{KMnO_4} = \left(n_{eq}\right)_{FeC_2O_4}$

$\text{Mole}\times\left(n-\text{factor}\right)_{KMnO_4} = 3 \times 0.1$

$n \times 5 = 0.3$

n = 0.06 mol

64. Answer (4)

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

Sol.: Reaction for which $\Delta n_g = 0$;

$K_p = K_c$

$H_2 + Cl_2 \rightarrow 2HCl$

$\Delta n_g = 2 - 2 = 0$

65. Answer (2)

Hint: Heat at constant volume $\Rightarrow \Delta U$

Heat at constant pressure $\Rightarrow \Delta H$

Sol.: $CH_4(g)+2O_2(g) \Rightarrow CO_2(g)+2H_2O(g)$

$\Delta H = \Delta U+\Delta n_gRT$

$\because \quad \Delta n_g = 0$

$\Delta H = \Delta U = -40$ kJ

66. Answer (1)

Hint: Rate of diffusion

$r \propto \frac{1}{\sqrt{M}}$

$M \Rightarrow$ molar mass of gas

Sol.: Order of ease of diffusion

$H_2 > He > N_2 > O_2$

67. Answer (2)

Hint and Sol.: $BF_3 \Rightarrow$ Trigonal planar

$NH_3 \Rightarrow$ Pyramidal

$XeF_4 \Rightarrow$ Square planar

$ClF_3 \Rightarrow$ Bent T shaped

68. Answer (4)

Hint: Electron affinity of 3rd period element is more than 2nd period element in same group, due to less electronic repulsion.

Sol.: For oxygen family order of electron affinity is as following

S > Se > Te > O

69. Answer (2)

Hint: For single electron species

$IE = 13.6 \times Z^2$ eV

Sol.: Energy required to remove both electron from He: $E = IE_1 + IE_2$

Where IE_1 **first** ionization energy that is x eV and IE_2 is the ionization energy of removing second e^- from He^+ and it behaves as hydrogen like species.

$E = IE_1 + IE_2$

$= x + 13.6 \times (2)^2$

= (x + 54.4) e.V.

70. Answer (1)

Hint: Combustion of hydrocarbon gives CO_2, and H_2O.

Sol.: $CH_4(g)+2O_2(g)\longrightarrow CO_2(g)+2H_2O(g)$

1 mol *i.e.* 16 g CH_4 will give $\rightarrow$ 1 mol CO_2

$= 1 \times 22.4$ L

= 22.4 L at STP.

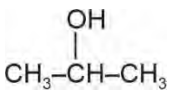
71. Answer (2)

Hint and Sol.: Maximum permissible limit of nitrate in drinking water is 50 ppm.

72. Answer (2)

Hint: Compounds with same molecular formula and different position of either substituent, multiple bond or functional group are known as position isomers.

Sol.: n-propyl alcohol $\Rightarrow CH_3–CH_2–CH_2–OH$

Isopropyl alcohol $\Rightarrow$ 

73. Answer (2)

Hint: Allyl bromide is

$CH_2 = CH – CH_2 – Br$

Sol.: $^1CH_2 = {}^2CH – {}^3CH_2 –Br$

3-Bromoprop-1-ene

74. Answer (4)

Hint and sol.: For oxides of nitrogen N_2O, NO $\Rightarrow$ neutral

N_2O_3, N_2O_4, N_2O_5 $\Rightarrow$ acidic

75. Answer (1)

Hint: Alkali metal carbonates are thermally stable.

Sol.: Only Li_2CO_3 decomposes on heating

$$Li_2CO_3 \xrightarrow{\Delta} Li_2O + CO_2 \uparrow$$

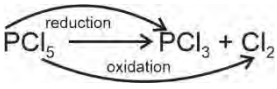
76. Answer (3)

Hint and Sol.: Metal with positive standard electrode potential doesn't given H_2 with dilute mineral acids hence 'Pt' will not give H_2 with dil. HCl.

77. Answer (2)

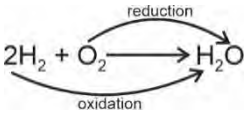
Hint: During a redox change both oxidation and reduction take place simultaneously.

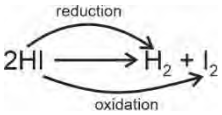
Sol.:

- 

- $CaCO_3 \rightarrow CaO + CO_2$

No change in oxidation state hence it is non-redox

- 

- 

78. Answer (3)

Hint: For adiabatic process q = 0

Sol.: During adiabatic process $\Delta U = W$

Since during expansion

$W < 0$, ΔS = constant

$\therefore$ $\Delta U < 0$ and temperature will decrease

79. Answer (4)

Hint: Precipitation of salt takes place if ionic product exceeds to solubility product

Sol.: Since water is more dense than ice on increasing pressure more melting of ice will take place.

Water expands on freezing because of hydrogen bonding.

80. Answer (3)

Hint: Change in Gibbs free energy is negative for spontaneous processes which can be calculated as.

$\Delta G = \Delta H – T\Delta S$

Sol.: For exothermic reaction with increasing entropy

$\Delta H < 0$ and $\Delta S > 0$

Hence from $\Delta G = \Delta H – T\Delta S$.

ΔG will be negative at any temperature.

81. Answer (3)

Hint and sol.: A gas below the critical temperature can be liquified by applying pressure and is called vapour of the substance. At critical temperature liquid passes into gaseous state continuously.

82. Answer (2)

Hint and Sol.: Odd number of carbon cannot be obtained by Wurtz reaction in product.

83. Answer (1)

Hint: Generally on moving left to right in a period, ionization energy increases.

Sol.:

- Nitrogen has higher ionisation energy than oxygen due to stable half filled p subshell.
- Be, gives higher IP than B due to more penetration power.

Hence order - B < Be < O < N

84. Answer (3)

Hint: Principal quantum number 'n' is always more than azimuthal quantum number 'l' by one in same shell

Sol.: For n = 3; l $\Rightarrow$ 0, 1, 2

hence

$n = 3, l = 3, m = –2, s = +\frac{1}{2}$, is a wrong set

85. Answer (3)

Hint: Mass = moles × molar mass

Sol.:

- 0.1 gram molecule O_2 = 0.1 mol O_2 = 3.2 g O_2
- 6.02×10^{22} molecules of SO_3

$\equiv 0.1$ mol $SO_3 \equiv 8$ g

- 224 ml CO_2 at STP = 0.01 mol = 0.44 g CO_2

SECTION - B

86. Answer (2)

Hint: Alcohols are weaker acid than phenols. Weaker the acid, higher the pK_a value of acid.

Sol.: Order of pK_a values is

$$\underset{(c)}{C_2H_5OH} > \underset{(a)}{CH_3OH} > \underset{(b)}{C_6H_5OH} > \underset{(d)}{HCOOH}$$

87. Answer (3)

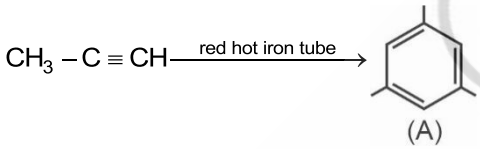
Hint and Sol.:

- Smallest alkane that can show chain isomerism is C_4H_{10} butane

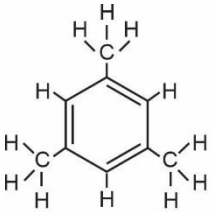
 and are chain isomers

88. Answer (4)

Hint and Sol.:



(A)



(A)

A has 21 σ bonds and 3 pi bonds

89. Answer (1)

Hint: Halogen gets disproportionated in presence of NaOH

Sol.: $3Br_2 + 6NaOH \rightarrow 5NaBr + NaBrO_3 + 3H_2O$

a = 3, b = 6, c = 5, d = 1

90. Answer (2)

Hint: For $B(OH)_2$; $K_{sp} = [B^{2+}]\,[OH^-]^2$

Sol.: $B(OH)_2(s) \rightleftharpoons \underset{S}{B^{2+}}(aq) + \underset{2S+10^{-2}}{2OH^-}(aq)$

$K_{sp} = S\,(2S + 10^{-2})^2$

$\because S << 10^{-2}$

$\therefore S + 10^{-2} \simeq 10^{-2}$

$K_{sp} = S \times 10^{-4}$

$S = 10^{-8}$M

91. Answer (2)

Hint: On adding two chemical reactions, their enthalpies get added to get enthalpy of resultant reaction.

Sol.: $P \rightarrow Q$; $\Delta H_1 = 310.4$ kJ ...(i)

$2Q \rightarrow R+S$; $\Delta H_2 = -570.8$ kJ ...(ii)

Using 2(i) + (ii)

$2P \rightarrow R+S$; ΔH

$\Delta H = 2\Delta H_1 + \Delta H_2$

$= 620.8 - 570.8$

$= 50$ kJ mol^{-1}

92. Answer (2)

Hint and Sol.:

- Splitting of spectral line in electric field is known as Stark effect.
- Splitting of spectral lines in magnetic field is known as Zeeman effect.

93. Answer (2)

Hint: Vapour density $= \dfrac{\text{molar mass}}{2}$

Sol.: Molar mass of hydrocarbon = 2 × 15

= 30

Hence hydrocarbon is C_2H_6.

94. Answer (2)

Hint: Rate of diffusion $\propto \dfrac{1}{\sqrt{M}}$

Sol.: $\dfrac{r_{SO_2}}{r_{He}} = \sqrt{\dfrac{4}{64}}$

$\dfrac{n_{SO_2} \times 2}{5 \times n_{He}} = \sqrt{\dfrac{1}{16}} \quad \left(\because r = \dfrac{v}{t} = \dfrac{n}{t}\right)$

$\dfrac{n_{SO_2} \times 2 \times 4}{5 \times 10} = \dfrac{1}{4}$

$n_{SO_2} = \dfrac{25}{16}$

$W_{SO_2} = \dfrac{25}{16} \times 64 = 100$ g

95. Answer (3)

Hint and Sol.:

Clean water would have BOD value of less than 5 ppm whereas highly polluted water could have a BOD value of 17 ppm or more.

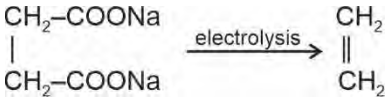
Highly polluted water could have 17 ppm BOD value.

96. Answer (3)

Hint: Wurtz reaction, Kolbe's electrolysis are some of the processes which result into new carbon-carbon bond formation.

Sol.: $CH_3Cl \xrightarrow{Na,\ dry\ ether} CH_3-CH_3+NaCl$

$CH_3COONa \xrightarrow{electrolysis} CH_3-CH_3+CO_2$

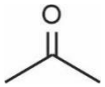
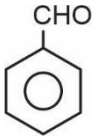
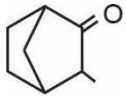
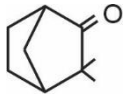


$CH_3COONa \xrightarrow{NaOH+CaO} CH_4$

97. Answer (1)

Hint: Carbonyl compounds with α-hydrogen can show tautomerism.

Sol.:

-  It has 6 enolisable hydrogen
-  It does not have enolisable hydrogen
-  It has one enolisable hydrgoen
-  It has enolisable hydrogen on bridgehead, hence no tautomerism.

98. Answer (2)

Hint: Two oxygen per unit is shared to form straight chain polymer of silicones.

Sol.:

$R_2SiCl_2 \xrightarrow{H^+/H_2O} R_2Si(OH)_2 \xrightarrow{\Delta}$ straight chain silicone polymer.

99. Answer (4)

Hint and Sol.: Only LiCl among alkali metal chlorides get hydrated.

100. Answer (1)

Hint: Central element contains lone pair of electron in case of electron rich hydride

Sol.: d-block elements form interstitial hydride like CrH.

[BOTANY]

SECTION - A

101. Answer (3)

Hint: Growth is slow during early phase of life and when the nutrient supply is limited.

Sol.: Growth is slow during lag phase and just prior to stationary phase.

102. Answer (2)

Hint: Axillary buds are inhibited for growth due to presence of apical buds.

Sol.: Auxins synthesized in apical buds inhibit axillary bud growth.

103. Answer (1)

Hint: Membrane bound organelles are absent in the prokaryotes.

Sol.: Double membrane bound organelles such as mitochondria are not present in bacteria. TCA cycle in bacteria occurs in cytosol.

104. Answer (3)

Hint: Methanogens can live in extreme habitat and decompose organic matter to produce CH_4, CO_2 etc.

Sol.: Methanogens are a type of archaebacteria which are present in marshy areas and gut of ruminants. They produce biogas.

105. Answer (4)

Hint: They cause mad cow disease in cattle.

Sol.: In prions, the protein is abnormally folded.

106. Answer (2)

Hint: In C_4 plants and C_3 plants primary CO_2 acceptors are 3C compound and 5C compound respectively.

Sol.: In C_3 plants, primary CO_2 acceptor is RuBP and in C_4 plants, primary CO_2 acceptor is PEP.

107. Answer (4)

Hint: Crossing over takes place in meiosis.

Sol.: The correct sequence of events in mitosis is:

Condensation of chromosomes $\rightarrow$ disappearance of nuclear membrane $\rightarrow$ arrangement of chromosomes at equator $\rightarrow$ movement of chromosomes to opposite poles $\rightarrow$ cytokinesis.

108. Answer (3)

Hint: Cells enter G_0 phase before DNA replication.

Sol.: Cells that do not divide further exit G_1 phase to enter G_0 stage.

109. Answer (1)

Hint: Crossing over takes place during third sub stage of prophase I.

Sol.: Crossing over takes place between non-sister chromatids of homologous chromosomes in pachytene stage.

110. Answer (4)

Hint: High concentration of CO_2 and photosynthetic products are inversely related to rate of photosynthesis

Sol.: Light intensity beyond a point damages chlorophyll, and thus leads to decrease in photosynthesis.

111. Answer (2)

Hint: The size of bacterial filter is 0.45 μm through which the *Mycoplasma* are passed.

Sol.: *Mycoplasma* – 0.3 μm

Bacteria – 3 to 5 μm

RBC – 7.0 μm

112. Answer (1)

Hint: Cells divide by cell plate formation in plant cells and pairing of homologous chromosomes occur before crossing over.

Sol.: Dissolution of synaptonemal complex occurs in diplotene.

Cell plate is formed during cytokinesis in plant cell.

Formation of tetrad occurs in zygotene.

Separation of homologous chromosomes occurs in anaphase I.

113. Answer (4)

Hint: Acrocentric chromosome has one very long arm and one very short arm. Metacentric chromosome has equal arms.

Sol.: In sub-metacentric chromosome, the centromere is present slightly away from the centre.

114. Answer (1)

Hint: In monocots, the guard cells are dumb-bell shaped.

Sol.: In mango leaves, the guard cells are bean or kidney shaped.

In rice, the guard cells are dumb-bell shaped.

115. Answer (4)

Hint: These cells are large, empty and colourless.

Sol.: The cells of the adaxial epidermis in leaves modify into large, empty and colourless cells which help in rolling of leaves during drought conditions. These cells are called bulliform cells.

116. Answer (3)

Hint: Hexokinase catalyses the addition of phosphate group to a monosaccharide during glycolysis.

Sol.: Hexokinase catalyses the first step of EMP pathway (present in both aerobic and anaerobic organisms) in which glucose is converted to glucose-6-phosphate

117. Answer (2)

Hint: In a dicot stem cambium is present between xylem and phloem and dicot root cells do not perform photosynthesis.

Sol.: The given description matches for a monocot leaf in which the vascular bundles are conjoint and closed and ground tissue is composed of mesophyll cells.

118. Answer (3)

Hint: Root modification is seen in turnip.

Sol.: In turnip, tap root is modified for the storage of food.

119. Answer (1)

Hint: In Guava and *Calotropis*, a pair of leaves arise at each node on opposite side.

Sol.: Mustard – Alternate phyllotaxy.

Guava and *Calotropis* – Opposite phyllotaxy.

Alstonia – Whorled phyllotaxy.

120. Answer (4)

Hint: Axile placentation is found in tomato.

Sol.: Mustard – Parietal placentation

Pea – Marginal placentation

Sunflower – Basal placentation

121. Answer (1)

Hint: Ovary is said to be superior when the gynoecium occupies the highest position on the thalamus.

Sol.: Mustard – Ovary is superior

Ray florets of sunflower and guava – Ovary is inferior.

Plum – Ovary is half inferior.

122. Answer (2)

Hint: One molecule of $NADH_2$ produces 3 ATP molecules in the ETS by donating electrons.

Sol.: The terminal electron acceptor in aerobic respiration is O_2.

123. Answer (1)

Hint: In botanical gardens, plants are grown and labelled for identification and keys are based on similarities and dissimilarities.

Sol.: Botanical gardens – Collection of living plants for reference.

Museums – Collection of preserved plants and animals.

Keys – Based on contrasting characters in a pair called couplet.

Flora – Contains the actual account of habitat and distribution of plants in a given area.

124. Answer (4)

Hint: The morphological characteristics of the plant specimen are not mentioned on the herbarium sheet.

Sol.: The local name of plant specimen is provided in Herbarium.

125. Answer (1)

Hint: Nitrogen is absorbed in the form of nitrites and nitrates and potassium is absorbed as a monovalent cation.

Sol.: The forms in which different elements are absorbed by plants are as follows:

N – NO_3^-, NO_2^- or NH_4^+

K – K^+

P – $H_2PO_4^-$ or HPO_4^{2-}

S – SO_4^{2-}

Mg, Zn, Cu – bivalent cations

126. Answer (3)

Hint: *Rhizobium* and *Frankia* can fix atmospheric nitrogen as symbionts

Sol.: *Rhodospirillum* – anaerobic free-living N_2 fixer.

Azotobacter – aerobic free-living N_2 fixer.

127. Answer (4)

Hint: *Nitrosomonas* and *Nitrobacter* help in conversion of ammonia to nitrate.

Sol.:

N_2 fixation is conversion of atmospheric N_2 into ammonia.

Denitrification is reduction of soil nitrates into N_2.

Ammonification is decomposition of organic nitrogen into ammonia.

128. Answer (3)

Hint: Active transport is an uphill transport.

Sol.: Active transport occurs against the concentration gradient and requires ATP. It is highly selective and is sensitive to protein inhibitors.

129. Answer (3)

Hint: Stomata open in light due to formation of malic acid and influx of K^+ ions into the guard cells.

Sol.: In the dark, the K^+ ions are transported back to the epidermal cells from the guard cells, leading to closing of stomata.

130. Answer (3)

Hint: Water and dissolved minerals are translocated from roots to stem.

Sol.: The movement of water in xylem is unidirectional.

131. Answer (2)

Hint: This type of meristem regenerate the part of grasses removed by herbivores.

Sol.: Intercalary meristem is intercalated between mature tissues.

132. Answer (3)

Hint: This metal ion is an activator of both RuBisCO and PEP carboxylase enzymes.

Sol.: Mg^{2+} is required by pyruvate dehydrogenase for converting pyruvic acid into acetyl CoA.

Pyruvic acid + CoA + NAD^+

$$\xrightarrow[\text{Pyruvate dehydrogenase}]{Mg^{2+}} \text{Acetyl CoA} + CO_2 + NADH + H^+$$

133. Answer (3)

Hint: A wider range of wavelength of incoming light is utilised for photosynthesis due to the presence of accessory photosynthetic pigments.

Sol.: The accessory photosynthetic pigments absorb light of different wavelengths and transfer the energy to chlorophyll molecules, thus they are also called antenna molecules.

134. Answer (3)

Hint: This organelle principally performs the function of packaging.

Sol.: Glycolipids and glycoproteins are formed in golgi apparatus.

135. Answer (4)

Hint: Angiosperms show diplontic life cycle.

Sol.: The dominant phase in the life cycle of angiosperms is the photosynthetic independent diploid sporophytic plant.

SECTION - B

136. Answer (1)

Sol.: *Sorghum* is a C_4 plant whereas *Triticum*, tomato and bell pepper are C_3 plants.

137. Answer (3)

Hint: Neem has pinnately compound leaf and pea has leaf tendrils.

Sol.: *Nepenthes* is an insectivorous plant. Phylloclade is formed by stem modification in *Euphorbia*. In pea, leaves modify to form tendrils.

138. Answer (3)

Hint: Glycocalyx – bacterial cell envelope

Sol.: Glycogen-granules – inclusion bodies

Cis and *trans* face – golgi apparatus

rRNA synthesis – nucleolus

139. Answer (3)

Hint: Minerals and compounds like nitrates and nitrites translocate through xylem in dissolved state.

Sol.: Sucrose is a disaccharide product of photosynthetates which is transported through phloem.

140. Answer (3)

Hint: It is a phase between G_1 and G_2 phases.

Sol.: DNA replicates in the S-phase of cell cycle.

141. Answer (3)

Hint: In some pteridophytes, the sporophylls may be compactly arranged into strobili or cones.

Sol.: *Marchantia* belongs to Bryophyta and lacks strobili.

142. Answer (3)

Hint: Root pressure leads to guttation and decreases as the day advances.

Sol.: Root pressure can be seen during early morning and at night, when transpiration is low.

143. Answer (2)

Hint: Photolysis of water and photophosphorylation take place during light reaction.

Sol.: ATP, NADPH and O_2 are produced during light reaction of photosynthesis.

144. Answer (4)

Hint: All the organelles included in endomembrane system are membrane bound.

Sol.: Ribosomes are not included in endomembrane system since their function is not co-ordinated with this system.

145. Answer (2)

Hint: The movement of protons across complex V produces ATP.

Sol.: The protons move from mitochondrial matrix to intermembrane space when electrons are donated by NADH + H^+ and $FADH_2$ in the ETS.

146. Answer (1)

Hint: Diatoms are autotrophs and their cell walls are embedded with silica.

Sol.: Diatoms are the chief 'producers' in the ocean.

147. Answer (3)

Hint: Biological names are Latinised and italicised to follow the rules of binomial nomenclature.

Sol.: Generic name, specific epithet and author citation collectively form binomial epithet.

148. Answer (3)

Hint: The secondary vascular tissues are produced by the activity of vascular cambial ring present within the stele.

Sol.: The cork cambium or phellogen gives rise to secondary cortex and cork. It is the extra-stelar cambium.

149. Answer (3)

Hint: For complete oxidation of carbohydrates, number of CO_2 generated is equal to the number of O_2 consumed.

Sol.: For carbohydrates, RQ = 1

For fats, RQ is less than 1

150. Answer (1)

Sol.: The exponential growth can be represented as

$W_1 = W_0 e^{rt}$

Where, W_1 = final size

W_0 = initial size

r = growth rate

t = time of growth

e = base of natural logarithm

[ZOOLOGY]

SECTION - A

151. Answer (1)

Hint: Also has vomit centre

Sol.: Hindbrain comprises pons, cerebellum and medulla oblongata.

Midbrain, pons and medulla oblongata make up the brain stem.

Medulla contains centres which control respiration, cardiovascular reflexes and gastric secretions.

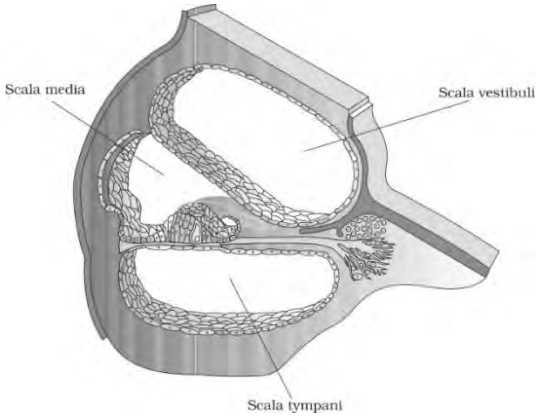
152. Answer (4)

Hint: A ends at the oval window

Sol.: A – Scala vestibuli

B – Scala media

C – Scala tympani



153. Answer (3)

Hint: Muscular dystrophy is a genetic disorder.

Sol.: Tetany is rapid spasms in muscle due to low Ca^{++} in body fluids.

Osteoporosis is age-related disorder characterised by decreased bone mass and increased chances of fractures.

154. Answer (4)

Hint: Thick myofilament

Sol.: During muscle contraction, the thin and thick filaments slide pass over each other but retain their length. Ca^{++} is released from sarcoplasmic reticulum into sarcoplasm.

During shortening of the muscle, i.e., contraction, the 'I' bands get reduced, whereas the 'A' bands retain the length.

155. Answer (2)

Hint: Hypoglycemic hormone

Sol.: Prolonged hyperglycemia leads to diabetes mellitus which is associated with loss of glucose through urine and formation of harmful compounds known as ketone bodies.

Diabetic patients are successfully treated with insulin therapy.

156. Answer (3)

Hint: Hypothalamus

Sol.: The posterior pituitary (pars nervosa) is under the direct neural regulation of the hypothalamus.

Hypothalamus lies at the base of thalamus which is major coordinating centre for sensory and motor signalling.

Hypothalamus along with limbic system is involved in the regulation of sexual behaviour, expression of emotional reactions and motivation.

157. Answer (1)

Hint: Hypersecretion

Sol.: Hyperthyroidism – Graves' disease

Hypersecretion of GH in adults – Acromegaly

Hyposecretion of GH – Dwarfism

Hypothyroidism – Cretinism

158. Answer (3)

Hint: J-shaped organ

Sol.: Stomach is located in the upper left portion of the abdominal cavity. Stomach has an oblique muscle layer.

159. Answer (1)

Hint: Sub-mucosa

Sol.: Brunner's glands are present in sub-mucosa of duodenum.

Gastric glands containing chief cells, goblet cells and intestinal glands (crypts of Lieberkuhn) are mucosal modifications.

160. Answer (3)

Hint: A mollusc

Sol.:

Exocoetus	–	Flying fish
Pterophyllum	–	Angel fish
Betta	–	Fighting fish
Scoliodon	–	Dog fish
Sepia	–	Cuttle fish

161. Answer (4)

Hint: Identify a feature absent in annelids

Sol.: Multicellularity and division of labour is seen in all animals.

Closed circulatory system is present in annelids except leeches.

Arthropods have open circulatory system.

Both annelids and arthropods have metameric segmentation and organ system level of organisation. Respiratory system is present only in arthropods.

162. Answer (2)

Hint: Identify the feature present in some flatworms.

Sol.: Members of the phylum Platyhelminthes are mostly endoparasites found in animals including human beings. They are bilaterally symmetrical, triploblastic and acoelomate animals with organ level of organisation.

Hooks and suckers are present in tapeworms but only sucker is present in liver fluke.

163. Answer (3)

Hint: Middle layer

Sol.: Inside the skull, brain is covered by cranial meninges consisting of an outer layer called dura mater, a very thin middle layer called arachnoid and an inner layer (which is in contact with the brain tissue) called pia mater.

164. Answer (3)

Hint: All are chordates

Sol.: In all chordates there is ventral heart.

Pristis (cartilaginous fish) is viviparous and poikilothermic animal.

Crocodilus (reptile) and *Aptenodytes* (bird) are oviparous.

Aptenodytes (bird) and *Pteropus* (mammal) are homoiothermous animals.

All chordates have notochord and dorsal, hollow single CNS.

165. Answer (2)

Hint: Mouth contains radula

Sol.: The space between the hump and the mantle is called the mantle cavity in which feather like gills are present. They have respiratory and excretory functions.

The anterior head region has sensory tentacles.

The mouth contains a file-like rasping organ for feeding called radula.

166. Answer (1)

Hint: ANS transmits impulses from the CNS to the involuntary organs.

Sol.: ANS is further classified into sympathetic and parasympathetic neural system.

Visceral nervous system comprises the whole complex of nerves, fibres, ganglia and plexuses by which impulses travel from the CNS to the viscera and from the viscera to the CNS.

167. Answer (4)

Hint: Ureotelic organism

Sol.: Aquatic amphibians are ammonotelic in nature.

Ammonia is readily soluble in water. It is the most toxic form and requires large amount of water for its elimination.

Cartilaginous fishes (*Carcharodon*) and mammals are ureotelic. Ammonia produced by metabolism is converted into urea in the liver of these animals.

Urea is 100,000 times less toxic than ammonia.

168. Answer (2)

Hint: Mammals have the ability to produce a concentrated urine.

Sol.: The transport of substances facilitated by the special arrangement of Henle's loop and vasa recta is called the counter current mechanism. This mechanism helps to maintain a concentration gradient in the medullary interstitium. Presence of such interstitial gradient helps in an easy passage of water from the collecting tubule thereby, concentrating the filtrate (urine).

So, if Henle's loop is removed, then there will be production of dilute urine.

169. Answer (1)

Hint: Aorta carries oxygenated blood.

Sol.: Left ventricle is the thickest chamber of heart.

Sino-atrial node is the pacemaker of heart.

Vena cava receives deoxygenated blood.

In aorta, the partial pressure of oxygen is 95 mm Hg.

170. Answer (1)

Hint: TLC = IC + FRC

Sol.:

(a) FRC = TLC – IC
= 2100 – 2300 mL

(b) EC = TV + ERV
TV = EC – ERV
= 500 mL

(c) VC = ERV + IC
IC = VC – ERV
= 3000 – 3500 mL

(d) TLC = RV + ERV + TV + IRV
IRV + ERV + TV = TLC – RV
= 4000 – 4600 mL

171. Answer (2)

Hint: Antigens are present on RBC's surface

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

172. Answer (1)

Hint: Equal to the number of fingers in each hand.

Sol.: Trachea is straight tube extending up to the mid-thoracic cavity which divides at the level of 5th thoracic vertebra into right and left primary bronchi.

173. Answer (2)

Hint: P-Scapula

Sol.: The dorsal, flat, triangular body of scapula has a slightly elevated ridge called the spine which projects as a flat, expanded process called the acromion. The clavicle articulates with this. Below the acromion is a depression called the glenoid cavity which articulates with the head of the humerus to form the shoulder joint.

174. Answer (3)

Hint: Part of renal corpuscle

Sol.: The renal tubule begins with a double walled cup-like structure called Bowman's capsule.

The epithelial cells of Bowman's capsule called podocytes are arranged in an intricate manner so as to leave some minute spaces called filtration slits.

Blood is filtered so finely through these slits that almost all the constituents of plasma except proteins pass onto lumen of Bowman's capsule.

70-80% of electrolytes are reabsorbed by PCT.

Conditional reabsorption of Na^+ takes place in DCT.

175. Answer (3)

Hint: Its digestion starts in buccal cavity.

Sol.: Starch is a good storage material in plants.

Glycogen is the storage polysaccharide in animals.

176. Answer (3)

Hint: Substance that produces colour

Sol.: Pigments – Carotenoids, Anthocyanins

Alkaloids – Codeine, Morphine

Terpenoids – Monoterpenes

Drugs – Vinblastine, Curcumin

177. Answer (4)

Hint: X-Glucose

Sol.: Y-Ribose

Cellulose is a homopolymer of glucose and makes up the plant cell wall.

A nucleic acid containing ribose is called ribonucleic acid (RNA).

Glucose is not a component of nucleic acids.

178. Answer (4)

Hint: In marasmus, mother's milk is replaced too early.

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 seen in child more than one year in age.

Both show wasting of muscles, thinning of limbs, failure of growth and brain development.

But unlike marasmus, some fat is still left under the skin, extensive oedema and swelling of body parts are seen in Kwashiorkor.

179. Answer (2)

Hint: Reduce duration of inspiration

Sol.: Pneumotaxic centre is present in the pons region of brain. Strong neural signals from this area result in shallow and fast breathing, that is, increased rate of breathing by shortening duration of inspiration and thereby alter the respiratory rate.

180. Answer (1)

Hint: 6-8%

Sol.: Proteins constitute 6-8% of plasma and monocytes constitute 6-8% of total WBCs.

Neutrophils constitute about 60-65% of total WBCs and lymphocytes form about 20-25% of total WBCs.

181. Answer (4)

Hint: Cartilage is rich in chondroitin salts.

Sol.: Bones have a hard and non-pliable ground substance, are rich in calcium salts and collagen fibres which give bone its strength.

The next to last nymphal stage has wing pads but only adult cockroaches have wings.

182. Answer (3)

Hint: Related to reproductive system.

Sol.: Mosaic vision is present in both male and female cockroach.

Anal/caudal style and urecose glands are absent in females.

In female, 7^{th} sternum along with 8^{th} and 9^{th} sterna forms brood or genital pouch.

In male, 9^{th} and 10^{th} terga along with 9^{th} sternum form genital pouch.

183. Answer (4)

Hint: Cuboidal epithelium is found in tubular parts of functional unit of kidneys.

Sol.:

PCT of nephron	–	Cuboidal epithelium
Stomach	–	Columnar epithelium
Pulmonary artery, alveoli of lungs	–	Squamous epithelium
Fallopian tubes, bronchioles	–	Ciliated epithelium
Moist surface of buccal cavity and pharynx	–	Compound epithelium

184. Answer (2)

Hint: Neurons are excitable cells.

Sol.: Neurons, the unit of neural system are excitable cells. The neuroglial cells constitute the rest of the neural system and protect and support neurons. They have the ability to divide unlike neurons.

185. Answer (4)

Hint: Water-soluble hormone

Sol.: The lipid soluble hormones interact with intracellular receptors and regulate gene expression. It includes steroid hormones (testosterone, cortisol, etc.) and iodothyronines (thyroxine).

Iodothyronines are secreted by thyroid gland which is located on either side of trachea.

Testosterone regulates spermatogenesis.

Cortisol is the main glucocorticoid.

Hypothalamic hormones are proteinaceous and bind to membrane-bound receptors.

SECTION - B

186. Answer (4)

Hint: Catecholamines are released from adrenal medulla.

Sol.: Epinephrine and norepinephrine are released from adrenal medulla.

Meissner's corpuscles are tangoreceptors, stimulated by touch and pressure.

187. Answer (2)

Hint: Inner layer is retina

Sol.: A – Fovea, where cones are densely packed

B – Iris

C – Vitreous chamber, filled with a transparent gel

D – Choroid, middle layer

Retina contains three layers of neural cells from inside to outside – ganglion cells, bipolar cells and photoreceptor cells.

188. Answer (4)

Hint: Type of skeletal muscles

Sol.: In red muscle fibres, myoglobin content is high which gives reddish appearance. They contain plenty of mitochondria but the amount of sarcoplasmic reticulum is low. So, they have slow rate of contraction for long periods.

White muscle fibres possess very less quantity of myoglobin. Number of mitochondria are also few in them but the amount of sarcoplasmic reticulum is high. So, they show fast rate of contraction for short periods.

189. Answer (2)

Hint: 14 in number

Sol.: Facial bones = Phalanges of right hand = 14

Thoracic vertebrae = 12

Ribs = 12 pairs

Wrist bones = 8

Ankle bones = 7

Pelvic girdle = 2 bones

Pectoral girdle = 4 bones

190. Answer (3)

Hint: Excess secretion of GH in adults results in severe disfigurement of face.

Sol.: Hypersecretion of growth hormone in adults does not cause further increase in height because epiphyseal plates close after a certain age.

191. Answer (4)

Hint: Identify the feature of hormone secreted by adenohypophysis.

Sol.: Juxtaglomerular cells of kidney secrete erythropoietin which stimulates erythropoiesis (formation of RBCs).

Testosterone secreted by Leydig cells or interstitial cells also stimulate erythropoiesis.

Cortisol produces anti-inflammatory reactions and suppresses immune response.

FSH stimulates growth and development of ovarian follicles in females and have no role in RBC formation.

192. Answer (4)

Hint: Succus entericus

Sol.: Starch is converted into maltose by ptyalin (salivary amylase) at pH 6.8.

Proteins under the action of pepsin is broken down into proteoses and peptones at pH 1.8.

$$\text{Lactose} \xrightarrow[\text{pH 7.8}]{\text{Lactase}} \text{Glucose + Galactose}$$

193. Answer (3)

Hint: Radial symmetry

Sol.: When any plane passing through the central axis of the body divides the organism into two identical halves, it is called radial symmetry. It is seen in members of phylum Cnidaria (*e.g.,* – *Adamsia*) and Ctenophora (*e.g.,* – *Pleurobrachia*).

Spongilla (sponge) is asymmetrical.

Members of phylum Platyhelminthes to Chordata have bilateral symmetry with few exceptions.

194. Answer (2)

Hint: Conditions at tissue level

Sol.: In tissues, low pO_2, high pCO_2, high H^+ concentration or low pH and higher temperature exist. All these conditions are favourable for dissociation of oxygen from the oxyhaemoglobin

and shifts the oxygen dissociation curve to the right side.

The opposite conditions exist in the alveoli.

195. Answer (2)

Hint: Carry deoxygenated blood

Sol.: Vena cava collects blood from whole body and opens into right atrium of the heart.

196. Answer (3)

Hint: Tunica media is comparatively thinner in veins

Sol.: Lumen diameter:

Vein > Artery > Capillary

197. Answer (2)

Hint: G ≡ C

Sol.: GC content is higher than AT content in DNA given to 'Y'. GC rich DNA melts at high temperature due to greater stability as 'G' interacts with 'C' through 3 hydrogen bonds. So, it will take more time to denature than DNA given to 'X'.

198. Answer (2)

Hint: Hydrolysis of ester bond

Sol.: The bond between phosphate and hydroxyl group of a sugar is an ester bond.

Enzymes belonging to class III-Hydrolases catalyse hydrolysis of ester, ether, peptide or glycosidic bonds.

Class II – Transferases

Class IV – Lyases

Class VI – Ligases

199. Answer (1)

Hint: A pair of spermatheca is present in the 6^{th} segment.

Sol.: Testis : 4^{th} – 6^{th} abdominal segment

Ovaries : 2^{nd} – 6^{th} abdominal segment

Spermatheca : 6^{th} abdominal segment

Mushroom gland : 6^{th} – 7^{th} abdominal segment

200. Answer (3)

Hint: Voluntary muscles.

Sol.: Skeletal muscle fibres are present in biceps.

The features present in skeletal muscle fibres are peripheral nuclei, multinucleated and voluntary.

Both cardiac and skeletal muscle fibres are striated and cylindrical in shape.

Both cardiac and smooth muscle fibres are uninucleated and involuntary. They have central nucleus and fibres are connected by cell junctions.

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