All India Aakash Test Series for Medical - 2021

TEST - 5 (Code-C)

Test Date : 19/01/2020

ANSWERS

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

HINTS & SOLUTIONS

[PHYSICS]

1. Answer (4)

Hint: For a wire of a given material, breaking stress is constant.

Sol.: $\frac{F_1}{A_1} = \frac{F_2}{A_2} \Rightarrow F_2 = F_1.\frac{A_2}{A_1} = 4F_1$

$\Rightarrow \quad F_2 = 4 \times 30g = 120g$ N

$= 120$ kg

2. Answer (1)

Hint: $\Delta L = \frac{FL}{AY} \Rightarrow A = \frac{FL}{Y\Delta L}$

Sol.: $\frac{A_B}{A_S} = \frac{Y_S}{Y_B} \Rightarrow \left(\frac{R_B}{R_S}\right)^2 = \frac{2}{1} \Rightarrow \frac{R_B}{R_S} = \sqrt{2}$

3. Answer (2)

Hint: Bulk modulus,

$B = \frac{\Delta P}{-\Delta V / V} \Rightarrow \Delta P = -B\frac{\Delta V}{V}$

Sol.: $B = 2000 \times 10^6$ Pa, $V = 100$ litre

and $\frac{\Delta V}{V} = -\frac{0.004}{100}$

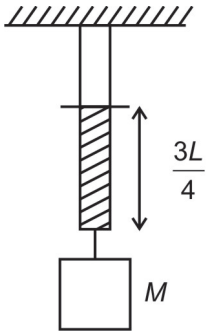
$\therefore \Delta P = -\frac{B \times \Delta V}{V} = \frac{2000 \times 10^6 \times 0.004}{100}$

$= 80{,}000$ Pa $= 80$ kPa

4. Answer (4)

Hint: Stress will be different at different points of wire.

Sol.:



Tension at $\frac{3L}{4}$ from lower end

$T = Mg + \frac{3Mg}{4}$

$= 7\frac{Mg}{4}$

Stress developed at this point

$S = \frac{F}{A} = \frac{7Mg}{4A}$

5. Answer (3)

Hint & Sol.: Angle of contact does not depend on inclination. It depends of nature of solid and liquids in contact.

6. Answer (4)

Hint: $U = S\,4\pi R^2$ (S : Surface tension)

Sol.: Radius of single drop $R' = n^{-1/3}R$

$R' = (1331)^{-1/3} R$

$= \frac{R}{11}$

Hence surface energy of single drop

$U' = U\left(\frac{R'}{R}\right)^2$

$U' = \frac{U}{121}$

7. Answer (1)

Hint: As we moves upwards, atmospheric pressure decreases.

Sol.: $\rho_{air} gh = \rho_{Hg} g\left[75 - 60\right] \times 10^{-2}$

$\Rightarrow h = \frac{\rho_{Hg}}{\rho_{air}} \times 15 \times 10^{-2} = 10^4 \times 15 \times 10^{-2}$

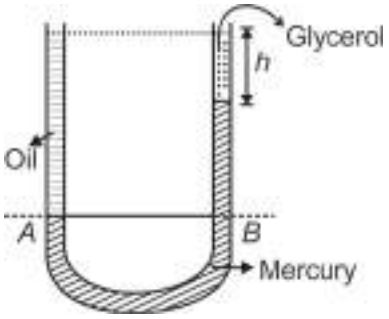
$= 1500$ m $= 1.5$ km

8. Answer (2)

Hint: Gauge pressure due to a liquid column $= \rho gh$.

In a non-accelerated tube, pressure at same level in a liquid is same.

Sol.:



$P_A = P_B$

$\Rightarrow P_0 + \rho_{oil} g\ 20\times10^{-2} = P_0 + \rho_{glycerol} gh\times10^{-2}$

$+\rho_{mercury} g(20-h)\times10^{-2}$

$\Rightarrow \rho_{oil}\times 20 = \rho_{glycerol} h + \rho_{mercury}\, 20 - \rho_{mercury} h$

$\Rightarrow 20\times0.8 = 1.3h + 13.6\times20 - 13.6h$

$\Rightarrow 12.3h = 256$

$h = 20.81$ cm

9. Answer (4)

Hint: Law of floatation

Sol.: Let volume of block is V

In water $\rightarrow V\rho_{block} g = \frac{2}{3}\rho_{water}.g$

$$\rho_{block} = \frac{2}{3}\rho_{water} \quad ...(1)$$

In oil $\rightarrow V\rho_{block} g = \frac{1}{3}V\rho_{oil} g$

$$\rho_{block} = \frac{1}{3}\rho_{oil} \quad ...(2)$$

From (1) and (2)

$\rho_{oil} = 2\ \rho_{water}$

$= 2 \times 1000 = 2000$ kg/m^3

10. Answer (2)

Hint: Terminal speed

$v_0 \propto r^2 \Rightarrow \frac{v_{01}}{v_{02}} = \frac{r_1^2}{r_2^2}$

Sol.: Radius of big drop $R = n^{1/3}r$

$R = (64)^{1/3}.r = 4r$

Now $\frac{v_{01}}{v_{02}} = \frac{r_1^2}{r_2^2} = \frac{r^2}{(4r)^2} = \frac{r^2}{16r^2}$

$\Rightarrow v_{02} = 16\times v_{01}$

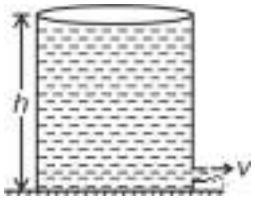
$= 16 \times 2.5$

$= 40$ m/s

11. Answer (4)

Hint: Use $F_{thrust} \le (f_s)_{max}$.

Sol.:



$\rho a v^2 \le \mu A h \rho g$

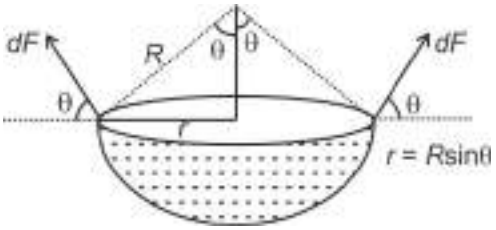
$a(2gh) \le \mu A \rho g h$

$\mu = \frac{2a}{A}$

$\mu \ge 0.02$

12. Answer (4)

Hint: Force due to surface tension $F = \sigma.l$



$F_{net} = \int dF \sin\theta = \sigma.\sin\theta \int dl$

$= \sigma \sin\theta.2\pi r = \sigma 2\pi R \sin^2\theta$

$= 2\pi R\sigma\left(\frac{1}{\sqrt{2}}\right)^2$

$= \pi R\sigma$

13. Answer (2)

Hint & Sol.: Density of water is maximum at 4°C. Volume decreases between 0°C and 4°C on heating, hence coefficient of cubical expansion is negative between 0°C to 4°C.

14. Answer (4)

Hint & Sol.: For anisotropic material

$\Rightarrow \gamma = \alpha_x + \alpha_y + \alpha_z$

$= \alpha_1 + \alpha_2 + \alpha_3$

15. Answer (2)

Hint: Heat capacity $H = mC$ (C : specific heat capacity)

Sol.: $\frac{R_1}{R_2} = \frac{1}{3}$ and $\frac{C_1}{C_2} = \frac{1}{1}$

Hence capacity (H) = mC

$\frac{H_1}{H_2} = \frac{m_1C_1}{m_2C_2} = \frac{\frac{4}{3}\pi R_1^3.C}{\frac{4}{3}\pi R_2^3.C}$

$= \left(\frac{R_1}{R_2}\right)^3 = \frac{1}{27}$

16. Answer (4)

Hint: Heat loss = Heat gain

Sol.: Let m gram of water having temperature θ°(> 20°C) is mixed to 40 gram water at 20°C

Let final temperature of mixture is θ

$\Rightarrow m(1).(\theta_0 - \theta) = 40.(1).(\theta - 20)$

$\Rightarrow m\theta_0 - m\theta = 40\theta - 800$

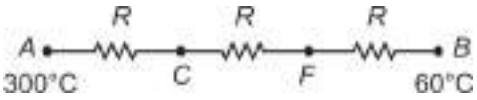
$\Rightarrow \theta = \dfrac{800 + m\theta_0}{40 + m}$

Which is greatest for option (4).

17. Answer (2)

Hint: Law of thermal conduction

Sol.: Equivalent circuit will be as (R : thermal resistance of each rod)



Temperature difference between A and B is 240°C which is equally divided in all resistances.

Hence $T_A - T_C = 80°$

$T_C = T_A - 80 = 300 - 80°$

= 220°C

18. Answer (1)

Hint: Use Wien's law :- $\lambda_m \propto \dfrac{1}{T}$

Sol.: $\lambda_m.T = \text{constant}$

$\Rightarrow \dfrac{(\lambda_m)_1}{(\lambda_m)_2} = \dfrac{T_2}{T_1} = \dfrac{(3227 + 273)}{(2227 + 273)}$

$\Rightarrow \dfrac{4000\text{Å}}{(\lambda_m)_2} = \dfrac{3500}{2500} = \dfrac{7}{5}$

$\Rightarrow (\lambda_m)_2 = 2857\text{Å}$

19. Answer (3)

Hint: $\dfrac{2}{k_e} = \dfrac{1}{k_1} + \dfrac{1}{k_2}$

Sol.: In steady state

$\dfrac{2}{k_e} = \dfrac{1}{K} + \dfrac{1}{\left(\frac{k}{5}\right)}$

$k_e = \dfrac{k}{3}$

20. Answer (4)

Hint: Use Stefan's law

Sol.: Let power radiated by the sun is P and radius of planet is R then in the situation of equilibrium (thermal)

$\Rightarrow \dfrac{P}{4\pi r^2}.\pi R^2 = \sigma.4\pi R^2.T^4$

$\Rightarrow T^4 = \dfrac{P}{\sigma.16\pi r^2} \Rightarrow T^4 \propto \dfrac{1}{r^2}$

$\Rightarrow T \propto r^{-1/2}$

21. Answer (4)

Hint & Sol.: Few greenhouse gases are CO_2, CH_4, N_2O, O_3 and chlorofluorocarbon.

22. Answer (3)

Hint: Ice converts into water and water converts into steam

$Q = mC_i\Delta\theta + mL_f + mC\Delta\theta + mL_v$

Sol.: $Q = \begin{pmatrix} 20 \times \frac{1}{2} \times 20 + 20 \times 80 + 20 \times \\ 1 \times 100 + 20 \times 540 \end{pmatrix}$cal

$= (200 + 1600 + 2000 + 10800)$cal

= 14600 cal

23. Answer (2)

Hint & Sol.: Mean kinetic energy of a molecule per degree of freedom is $\dfrac{1}{2}k_BT$ and gas molecules have three translational degrees of freedom.

24. Answer (2)

Hint & Sol.: For adiabatic process PV^γ = const.

$P\left(\dfrac{nRT}{P}\right)^\gamma = \text{const.} \Rightarrow P^{1-\gamma}T^\gamma = \text{const.}$

$PT^{\left(\frac{\gamma}{1-\gamma}\right)} = \text{const}$

25. Answer (2)

Hint & Sol.: Ideal gas equation

$P = \dfrac{\rho RT}{M}$

$\Rightarrow \dfrac{\rho}{P} = \dfrac{M}{RT} \Rightarrow k \propto \dfrac{1}{T}$

$\Rightarrow \dfrac{k_1}{k_2} = \dfrac{T_2}{T_1} \Rightarrow \dfrac{k}{k_2} = \dfrac{273 + 120}{273 + 20}$

$\Rightarrow k_2 = \dfrac{293}{393}k$

26. Answer (2)

Hint: $C_V = \frac{R}{\gamma - 1}$

Sol.: For an ideal gas $\frac{R}{C_V} = \gamma - 1$

$\Rightarrow \gamma - 1 = 0.4 \Rightarrow \gamma = 1.4$

Hence gas is diatomic.

27. Answer (1)

Hint: Use ideal gas equation $PV = nRT$

Sol.: On joining both the vessels number of moles of the gases remain constant

Hence $n = n_1 + n_2$

$$\frac{P_0(2V)}{RT_0} = \frac{PV}{R\,2T} + \frac{3PV}{RT}$$

$$\frac{2P_0}{T_0} = \frac{P}{2T} + \frac{3P}{T} = \frac{7P}{2T}$$

$$\frac{P_0}{T_0} = \frac{7P}{4T}$$

28. Answer (4)

Hint: Heat absorbed $\Delta Q =$ work $+ \Delta U$

Sol.: $Q_{PRQ} = \Delta U + W_{PRQ}$

$Q_{PSQ} = \Delta U$

$Q_{PTQ} = \Delta U + W_{PTQ}$

ΔU is same in all three process.

W_{PRQ} is positive while W_{PTQ} is negative

$\therefore Q_{PRQ} > Q_{PSQ} > Q_{PTQ}$

29. Answer (3)

Hint: Work done = Area under P–V curve with volume axis

Sol.: $W_{AB} = -4P_0V_0$

$W_{BC} =$ Zero

$W_{CD} = P_0V_0$

Total work done $= -4P_0V_0 + P_0V_0 = -3P_0V_0$

30. Answer (4)

Hint & Sol.: Given graph is for isobaric process.

Hence C_P for diatomic gas $= \frac{7}{2}R = 3.5R$

31. Answer (2)

Hint: Ideal gas equation $PV = nRT$

Sol.: $PV = nRT$

$$\Rightarrow P = \frac{nR}{V}T \Rightarrow P = KT$$

$$\frac{P}{T} \propto \frac{1}{V}$$

Hence Slope $\propto \frac{1}{\text{Volume}} \Rightarrow V_1 < V_2$

32. Answer (1)

Hint & Sol.: According to Charle's law

$$V_t = \frac{V_0}{273}t + V_0 \Rightarrow t = \left(\frac{273}{V_0}\right)V_t - 273$$

On comparing with $y = mx + c$, we can say that temperature is on y-axis and volume is on x-axis.

33. Answer (4)

Hint: For an adiabatic process

$P^{1-\gamma}.T^{\gamma} =$ constant

Sol.: Given $P \propto T^5$

for adiabatic process $P \propto T^{\gamma/\gamma-1}$

Hence $\frac{\gamma}{\gamma - 1} = 5 \Rightarrow \gamma = 5\gamma - 5$

$$\Rightarrow \gamma = \frac{5}{4}$$

$$\Rightarrow \frac{C_P}{C_V} = \frac{5}{4}$$

34. Answer (2)

Hint: Translational kinetic energy is equal to $\frac{3}{2}RT$

Sol.: $P = \frac{P_0}{\left[1 + \left(\frac{V}{V_0}\right)^2\right]}$

at $V = V_0 \Rightarrow P = \frac{P_0}{2} \Rightarrow T = \frac{P_0V_0}{2R}$

$$\therefore \text{K.E.} = \frac{3}{2}RT = \frac{3}{2}R.\frac{P_0V_0}{2R} = \frac{3P_0V_0}{4}$$

35. Answer (1)

Hint: Pressure on both side of piston P_2 will be same in equilibrium

Sol.: $PV = nRT = \frac{m}{M}RT$

$\Rightarrow \quad MV = \frac{mRT}{P} =$ same on both sides of the piston

In the position of equilibrium

$M_1V_1 = M_2V_2$

$\Rightarrow 32(360 - \theta) = 28\theta$

$\Rightarrow \theta = \frac{360 \times 32}{60} = 192°C$

36. Answer (2)

Hint: Efficiency of Carnot engine is $\eta = 1 - \frac{T_2}{T_1}$

T_1 = Source temperature and

T_2 = Sink temperature

Sol.: Initially $\eta = \frac{1}{3} = 1 - \frac{T_2}{T_1}$

Finally $\eta' = \frac{2}{3} = 1 - \frac{T_2 - 50}{T_1}$

On solving these equations we get

T_1 = 150 K

37. Answer (3)

Hint: Use $PV = nRT$.

Sol.: P-T graph is a straight line passing through origin

Hence $V =$ constant $\Rightarrow W = 0$

$\rho = \frac{M}{V} \propto \frac{1}{V} \Rightarrow$ If V is constant then density is also constant.

$PV = nRT$

$P = \left(\frac{nR}{V}\right)T \Rightarrow$ Slope of line AB $\propto n$

38. Answer (3)

Hint & Sol.: For a cyclic process $\Delta U = 0$

39. Answer (1)

Hint: Apply Newton's law of cooling

Sol.: Let temperature of body after next 7 minutes is θ

$\frac{60 - 40}{7} = K\left(\frac{60 + 40}{2} - 10\right)$ ...(1)

$\frac{40 - \theta}{7} = K\left(\frac{40 + \theta}{2} - 10\right)$ ...(2)

On solving (1) and (2) $\theta = 28°C$

40. Answer (2)

Hint: Efficiency of Carnot engine

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

Sol.: $\eta_1 = \frac{40}{100} = 1 - \frac{T_2}{T_1}$ ...(1)

$\Rightarrow \eta_2 = \frac{50}{100} = 1 - \frac{T_2}{T_1'}$ ...(2)

(T_2 = Remain same)

On solving, equation (1) and (2) $T_2 = \frac{1200}{5}$K and

$T_1' = 480$ K

41. Answer (3)

Hint: $PV^{\gamma} =$ constant

Sol.: $P_1V_1^{\gamma} = P_2V_2^{\gamma}$

$\frac{P_1}{P_2} = \left(\frac{V_2}{V_1}\right)^{\gamma} \Rightarrow \frac{P}{P'} = \left(\frac{V}{2V}\right)^{3/2}$

$\Rightarrow P' = 2\sqrt{2}P$

42. Answer (1)

Hint: Mean free path

$l = \frac{1}{\sqrt{2}\pi nd^2} \Rightarrow l \propto \frac{1}{nd^2}$

Sol.: $\frac{l_1}{l_2} = \frac{n_2 d_2^{\,2}}{n_1 d_1^2} = \left(\frac{n_2}{n_1}\right)\left(\frac{d_2}{d_1}\right)^2$

$\Rightarrow \frac{l_1}{l_2} = \left(\frac{4}{3}\right)\left(\frac{5}{2}\right)^2 = \frac{4}{3}.\frac{25}{4} = \frac{25}{3}$

Hence $\Rightarrow \frac{l_1}{l_2} = \frac{25}{3}$

43. Answer (3)

Hint: Use formula for the $\gamma_{mixture}$

Sol.: $\gamma_{mix} = \frac{\frac{n_1\gamma_1}{\gamma_1 - 1} + \frac{n_2\gamma_2}{\gamma_2 - 1}}{\frac{n_1}{\gamma_1 - 1} + \frac{n_2}{\gamma_2 - 1}}$

Here $n_1 = 2, \gamma_1 = \frac{5}{3}, n_2 = 3, \gamma_2 = \frac{7}{5}$

On solving $\gamma_{mix} = \frac{31}{21}$

44. Answer (1)

Hint & Sol.: Degrees of freedom of monoatomic gas is 3.

45. Answer (4)

Hint: Energy of 1 mole of ideal gas

$U = f\frac{RT}{2}$

Sol.: Energy of 3 mole of nitrogen

$U_{N_2} = n_1\frac{f_1RT}{2} = 3 \times \frac{5}{2}RT$

Energy of 2 mole of Neon

$U_{Ne} = n_2\frac{f_2RT}{2} = 2 \times \frac{3}{2}RT$

$\therefore$ Total internal energy of the system is

$U = U_{N_2} + U_{Ne}$

$= \frac{15}{2}RT + \frac{6}{2}RT$

$= \frac{21}{2}RT$

[CHEMISTRY]

46. Answer (2)

Hint: Chlorine has highest electron affinity in periodic table.

Sol.: Hydrogen has 3 isotopes : $_1H^1$, $_1D^2$ and $_1T^3$, of which tritium($_1T^3$) is radioactive. In Haber's process, H_2 acts as a reducing agent.

47. Answer (3)

Hint: H_2O_2 is an oxidising agent.

Sol.: $PbS + 4H_2O_2 \rightarrow PbSO_4 + 4H_2O$

48. Answer (4)

Hint: Basic nature of oxides of alkaline earth metals increases down the group.

Sol.: Basic nature: BeO < MgO < CaO < SrO.

49. Answer (4)

Hint: All alkaline earth metal carbonates on decomposition releases CO_2

Sol.: Alkali metal carbonates do not decompose on heating except Li_2CO_3

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

$K_2CO_3 \xrightarrow{\Delta}$ No decomposition

50. Answer (4)

Hint: CaH_2 is known as hydrolith

Sol.: $CaSO_4$: Dead burnt plaster

$CaSO_4.2H_2O$: Gypsum

Quick lime : CaO

51. Answer (1)

Hint: On moving down the group, lattice energy of alkaline earth metal sulphates remains almost constant but hydration energy decreases.

Sol.: Solubility order : $BeSO_4 > MgSO_4 > CaSO_4 > SrSO_4 > BaSO_4$

52. Answer (3)

Hint: Inert pair effect

Sol.: Thallium shows +1 and lead shows +2 oxidation state.

53. Answer (4)

Hint: Incomplete octet species are electron deficient species

Sol.: BF_3, B_2H_6 and H_3BO_3 all are electron deficient species

$BF_3 + F^- \longrightarrow BF_4^-$

$B_2H_6 + 2CO \longrightarrow 2BH_3.CO$

$H_3BO_3 + OH^- \longrightarrow [B(OH)_4]^-$

54. Answer (2)

Hint: Atomic radii : B < Ga < Al < In < Tl

55. Answer (4)

Hint: Potassium ions are the most abundant cations within cell fluids

56. Answer (3)

Hint: Lesser the hydration, more will be the ionic mobility of ions in water

Sol.: Hydration : $Li^+ > Na^+ > K^+ > Rb^+ > Cs^+$

Ionic mobility : $Cs^+ > Rb^+ > K^+ > Na^+ > Li^+$

57. Answer (2)

Hint: BeO is amphoteric in nature

Sol.: Due to small size of Be^{2+}, it does not exhibit coordination number more than four.

58. Answer (1)

Hint: Volume strength = 11.2 × M

Sol.: Volume strength = 11.2 × M = 11.2 × 0.6 = 6.72 volume

59. Answer (4)

Hint: Heavy water (D_2O) is used to slow down the speed of neutrons in nuclear reactor.

60. Answer (1)

Hint: Cu can't displace hydrogen from HCl.

Sol.: $Zn + 2NaOH(aq.) \rightarrow Na_2ZnO_2 + H_2$

61. Answer (1)

Hint: $CaC_2 + 2H_2O \longrightarrow Ca(OH)_2 + C_2H_2$

62. Answer (2)

Hint: O_2^{2-} is peroxide ion

Sol.: $KO_2 \Rightarrow K^+ + O_2^-$ (Superoxide ion)

63. Answer (1)

Hint: $Si_2O_7^{6-}$ are pyrosilicates.

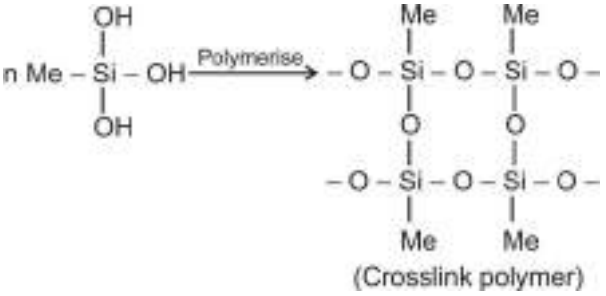
64. Answer (2)

Hint: PbO_2 is amphoteric oxide

65. Answer (3)

Hint: $MeSiCl_3$ on hydrolysis forms $MeSi(OH)_3$

Sol.:



(Crosslink polymer)

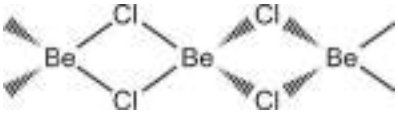
66. Answer (3)

Hint: $Li \xrightarrow{Air} Li_2O + Li_3N$

67. Answer (4)

Hint: $BeCl_2$ forms a chloro-bridge dimer in vapour phase

Sol.: $BeCl_2$ has chain structure in the solid state as shown.



68. Answer (2)

Hint: $\Delta_f H°$ value of diamond is 1.9 kJ mol^{-1}

Sol.: $\Delta_f H°$ value of fullerene is 38.1 kJ mol^{-1}

69. Answer (1)

Hint: On small scale pure CO is prepared by dehydration of formic acid

Sol.: $HCOOH \xrightarrow[Conc.H_2SO_4]{373K} H_2O + CO$

70. Answer (1)

Hint: Carbon does not have any vacant *d*-orbital in CCl_4 so it is not hydrolysed.

71. Answer (3)

Hint: $Mg(NO_3)_2$ crystallises with six molecules of water whereas $Ba(NO_3)_2$ crystallises as anhydrous salt.

Sol.: Tendency of alkaline earth metal nitrates to form hydrates decreases down the group.

72. Answer (4)

Hint: Due to small size, $Li^{\oplus}$ has highest hydration enthalpy which accounts for its high negative E° value.

Sol.: Li is most powerful and Na is least powerful reducing agent among alkali metals.

73. Answer (2)

Hint: Melting point : MF > MCl > MBr > MI

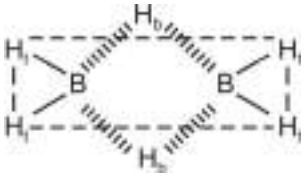
74. Answer (2)

Hint: Li give crimson red colour in flame test

Sol.: Mg does not give flame test

75. Answer (3)

Hint:



H_b : bridge H

H_t : terminal H

Sol.: Terminal B-H bonds are 2C-2e bonds. Bridge B-H bonds are 3C-2e bonds (banana bonds). Boron atom is sp^3 hybridised.

76. Answer (3)

Hint: Bleaching powder is formed by the reaction of Cl_2 with $Ca(OH)_2$

Sol.: $2Ca(OH)_2 + 2Cl_2 \rightarrow CaCl_2 + Ca(OCl)_2 + 2H_2O$

(Bleaching powder)

77. Answer (4)

Hint: Average percentage of silica in portland cement is 20-25%

78. Answer (1)

Hint: Smaller cation is more stabilized by smaller anion.

Sol.: Thermal stability order : LiH > NaH > KH > RbH > CsH

79. Answer (4)

Hint: On moving down the group, metallic nature of alkali metal increases

80. Answer (2)

Hint: Suspension of slaked lime in water is known as milk of lime

81. Answer (2)

Hint: Blue bead contains metaborates

Sol.:

$$Na_2B_4O_7.10H_2O \xrightarrow[\text{Strong heat}]{\text{Pt loop.}} \underset{\text{(Glassy bead)}}{B_2O_3} + NaBO_2$$

$$\xrightarrow{CuO} \underset{\text{Metaborates}}{Cu(BO_2)_2}$$

82. Answer (1)

Hint: $B_3N_3H_6$ is known as inorganic benzene

83. Answer (3)

Hint: Due to absence of *d*-orbital, boron cannot show six coordination number.

Sol.: $AlF_3 + 3F^- \rightarrow [AlF_6]^{3-}$

84. Answer (4)

Hint: Solid CO_2 is known as dry ice

Sol.: ZSM-5 is used to convert alcohol directly into gasoline.

85. Answer (1)

Hint: Syngas : $CO + H_2$

Sol.: Producer gas : $CO + N_2$

86. Answer (3)

Hint: Down the group catenation tendency decreases

Sol.: In 14^{th} group, Pb does not show catenation.

87. Answer (2)

Hint: Silica is resistant to Halogens and dihydrogen

Sol.: Silica is attacked by HF.

$SiO_2 + 4HF \rightarrow SiF_4 + 2H_2O$

88. Answer (1)

Hint: Al can show coordination number six.

Sol.: $AlCl_3 + H_2O \rightarrow \underset{\substack{(sp^3d^2)\\\text{(Octahedral)}}}{[Al(H_2O)_6]^{3+}} + 3Cl^-$

89. Answer (4)

Hint:

	Li	Na	K	H_2O
	↓	↓	↓	↓
Density(g/cm^3)	0.53	0.97	0.86	1

90. Answer (2)

Hint: TEL (tetral ethyl lead : $PbEt_4$) was used as anti-knocking compound.

[BIOLOGY]

91. Answer (4)

Sol.: Hydroponics avoids the problem of weeding.

92. Answer (3)

Hint: Micronutrients are toxic in slight excess.

Sol.: Zn, Fe, Mn, Cu and B are micronutrients.

93. Answer (2)

Hint: Nitrogen is an essential element.

Sol.: Nitrogen is a mineral which is required by plants in the greatest amount.

Calcium activates ATPase while boron is associated with the pollen germination.

94. Answer (3)

Hint: Disorders caused by the deficiency of an element can be corrected by the availability of only that element.

Sol.: Requirement of any essential element cannot be replaced by other element. Plant cannot complete its life cycle or set seed in the absence of an essential element.

An essential element should be a component of either structural or functional molecule.

95. Answer (2)

Sol.: Deficiency of Cu is not associated with delayed flowering.

96. Answer (4)

Hint: Ni is the activator of urease and hydroxylases.

Sol.: Zn is the activator of carboxylases.

97. Answer (1)

Hint: Both potassium and chlorine maintain turgidity of the cells.

Sol.: Potassium and chlorine both maintain the cation-anion balance of cells hence regulate the osmotic potential of cells.

98. Answer (3)

Sol.: Best defined function of manganese is its involvement in photolysis/splitting of water during photosynthesis.

99. Answer (3)

Hint: Hunger signs/deficiency symptoms appear in young tissue for immobile elements.

Sol.: Calcium is an immobile element.

100. Answer (4)

Hint: Metabolic phase of the absorption of ions is an energy dependent process.

Sol.: In metabolic phase of ion absorption, movement of ions is an active process.

101. Answer (4)

Hint: N_2-fixing bacteria of soil help in converting atmospheric N_2 into its compounds which can be used/absorbed by plants and microbes.

Sol.: Decomposer microorganisms of soil decompose organic matter to release minerals bound in organic matter.

102. Answer (1)

Hint: Nitrite reductase does not require molybdenum.

Sol.: Nitrite reductase enzyme contains copper and iron.

103. Answer (3)

Hint: Sulphur is used in the synthesis of some vitamins, coenzyme A and ferredoxin.

Sol.: Mg is involved in the synthesis of DNA and RNA.

104. Answer (2)

Sol.: Grey spots in oats are due to the deficiency of Mn.

105. Answer (2)

Sol.: *Frankia* is a symbiotic filamentous bacterium present in various non-legume plants.

106. Answer (4)

Hint: Leghaemoglobin is red-pink coloured pigment present in the cells of root nodules.

Sol.: Leghaemoglobin is an oxygen scavenger which ensures the functioning of nitrogenase under anaerobic conditions.

107. Answer (3)

Hint: Nod factor is released by symbiotic bacteria when they collect over the root hairs before infection.

Sol.: Nod factor causes curling of root hairs followed by formation of infection thread, containing the bacteria.

108. Answer (2)

Sol.: The overall reaction involved in N_2-fixation is

$$N_2 + 8H^+ + 8e^- + 16\ ATP \xrightarrow{Nitrogenase} 2NH_3 + H_2 + 16\ ADP + 16\ Pi$$

so for per molecule of ammonia (NH_3) formation, 8 ATP and $4H^+$ are required.

109. Answer (4)

Hint: Reductive amination is catalysed by glutamate dehydrogenase enzyme.

Sol.: In reductive amination of α-ketoglutaric acid, glutamic acid is produced in the presence of NH_4^+, reduced coenzyme (NADPH) and glutamate dehydrogenase.

110. Answer (1)

Sol.: Division and growth of cortical and pericycle cells leads to formation of root nodules.

111. Answer (3)

Hint: C_4 plants have dimorphic chloroplasts in their leaves.

Sol.: Maize, *Sorghum* and sugarcane are C_4 plants among the given plants.

112. Answer (4)

Hint: Non-cyclic photophosphorylation is called Z-scheme.

Sol.: Non-cyclic photophosphorylation occurs in granal thylakoids, operates at high light intensity, involves both PS I and PS II and requires external source of electrons which is water.

113. Answer (2)

Hint: T.W. Engelmann described the first action spectrum of photosynthesis using a green alga and aerobic bacteria.

Sol.: Green alga *Cladophora* was used to describe the first action spectrum of photosynthesis.

114. Answer (3)

Hint: During photosynthesis, proton gradient is generated across the thylakoid membrane due to accumulation of H^+ ion in lumen of thylakoids.

Sol.: Transfer of H^+ from stroma to lumen, photolysis of H_2O and reduction of $NADP^+$ towards stroma, contribute in formation of proton gradient across thylakoid membrane. Movement of H^+ from lumen to stroma through CF_0 of ATP synthase enzyme leads to breaking of proton gradient.

115. Answer (1)

Hint: *Amaranthus* is a C_4 plant.

Sol.: *Amaranthus*, being a C_4 plant has Kranz anatomy in their leaves.

116. Answer (3)

Hint: Calvin cycle occurs only in chloroplasts.

Sol.: Transamination is an intermediate step of photorespiration in peroxisome. It is not a step of Calvin cycle.

117. Answer (4)

Hint: PS II is involved in non-cyclic photophosphorylation.

Sol.: PS II is associated with liberation of O_2 as their is splitting of water, however its reaction centre (P_{680}) has absorption maxima at 680 nm.

Reaction centre of PS I shows absorption maxima at 700 nm (P_{700}).

118. Answer (3)

Hint: Chlorophyll a is blue green or bright green in the chromatogram.

Sol.: Chlorophyll b absorbs blue and red wavelengths and accounts for ¼ of the total chlorophyll. Chlorophyll a is the reaction centre of PS II which shows absorption maxima at 680 nm.

119. Answer (4)

Hint: Photorespiration is a wasteful process as it does not produce ATP or NADPH.

Sol.: Photorespiration occurs in the presence of sunlight only. It is initiated in chloroplast where O_2 is first utilised.

120. Answer (2)

Hint: Chemiosmosis is associated with ATP synthesis in light reaction.

Sol.: Light reaction of photosynthesis does not utilise CO_2, hence CO_2 acceptor molecule is associated with dark reaction or biosynthetic phase of photosynthesis, not with chemiosmosis.

121. Answer (1)

Sol.: Synthesis of glucose and its storage in the form of starch in green parts of plants was explained by Julius Von Sachs.

122. Answer (3)

Hint: Plants which are adapted for dry tropical regions are C_4 plants.

Sol.: Cold sensitive enzyme of C_4 plants is PEP synthetase which forms PEP from pyruvate.

123. Answer (1)

Hint: For fixation of each molecule of CO_2 into glucose, C_4 plants require 2 additional ATP molecules than C_3 plants.

Sol.: For one molecule of sucrose formation, C_4 plants require 60 ATP in comparison to C_3 plants which require 36 ATP so they require 24 additional ATP molecules.

124. Answer (1)

Hint: Antenna pigments absorb different light wavelengths and transfer the energy to the chlorophyll pigment.

Sol.: PEP – Primary CO_2 acceptor molecule of Hatch and Slack pathway.

RuBP – Primary CO_2 acceptor molecule of Calvin cycle.

Shield pigments – Prevent photo-oxidative damage/destruction of chlorophyll pigments by light.

125. Answer (3)

Hint: In stroma, a series of enzymatic reactions synthesise sugar through Calvin cycle.

Sol.: Calvin cycle or dark reaction is not directly dependent on light but depends on the products of light reaction.

126. Answer (4)

Sol.: Primary carboxylation in both C_3 and C_4 plants occur in mesophyll cells by RuBisCO and PEPcase enzymes respectively.

127. Answer (2)

Sol.: Pyruvic acid is a C_3 acid.

128. Answer (3)

Hint: Dark reaction is an enzymatic process which is affected by temperature to a great extent.

Sol.: Light reaction is affected by temperature at a much lesser extent than dark reaction.

129. Answer (3)

Hint: NADH is a coenzyme produced in different steps of cellular respiration.

Sol.: O_2, ATP, glucose, NADPH etc. are photosynthetic products or intermediates but not NADH.

130. Answer (4)

Sol.: Duration of sunlight affects the overall production of photosynthetic products but not the rate of photosynthesis.

131. Answer (4)

Hint: CAM plants have scotoactive stomata.

Sol.: *Bryophyllum* is a CAM plant.

132. Answer (4)

Hint: At low light intensity, neither C_3 nor C_4 plants show higher rate of photosynthesis.

Sol.: C_3 plants show higher rate of photosynthesis at high light intensity and higher concentration of CO_2.

133. Answer (3)

Sol.: Orientation of leaves is an internal/plant factor which affects the rate of photosynthesis.

134. Answer (3)

Hint: C_4 plants have higher concentration of organic acids produced in their leaves.

Sol.: Due to production of various organic acids in their leaves, C_4 plants are tolerant to soil saline conditions.

135. Answer (1)

Sol.: Chemiosmotic hypothesis was explained by P. Mitchell.

136. Answer (2)

Hint: It is produced from tyrosine and iodine.

Sol.: Thyroxine is derivative of amino acid tyrosine and is bound covalently to iodine.

137. Answer (2)

Hint: Identify the milk forming hormone.

Sol.: Hormones secreted by human placenta are hCG, estrogen, progesterone and relaxin.

138. Answer (1)

Hint: ADH is also called vasopressin.

Sol.: Stored ADH released by the posterior pituitary gland stimulates reabsorption of water by kidneys and thus prevents dehydration.

139. Answer (1)

Hint: These structures are related to a lymphoid organ.

Sol.: Hassall's corpuscles are also called thymic corpuscles. They are structures found in the medulla of thymus.

140. Answer (3)

Hint: It is also known as epinephrine.

Sol.: Epinephrine has both endocrine and neural roles. It is secreted by medulla of adrenal gland and at the ends of sympathetic nerve fibres.

141. Answer (2)

Hint: It is produced in the cell bodies of neurosecretory cells of hypothalamus.

Sol.: Vasopressin or ADH moves by axonal transport to axon terminals in posterior pituitary where it is stored.

142. Answer (2)

Hint: Hypoparathyroidism leads to reduced blood calcium levels.

Sol.: Parathormone increases blood calcium level by stimulating resorption from bone, and its absorption from kidney and intestine.

143. Answer (2)

Hint: These glands are ductless glands.

Sol.: Ovaries, testes and pancreas perform both endocrine and exocrine functions.

144. Answer (4)

Hint: Increase in thyroxine levels results in high BMR.

Sol.: Myxedema and cretinism are caused by hypothyroidism in adults and children respectively.

145. Answer (3)

Hint: Wild contractions of skeletal muscles.

Sol.: Reduced levels of PTH results in hypocalcemic tetany. Hyperthyroidism results into exophthalmic goitre.

146 Answer (2)

Hint: Iodopsin is similar to visual violet.

Sol.: Three types of iodopsin are present in cone cells which are responsive to red, green and blue light.

147. Answer (3)

Hint: It is present in inner ear.

Sol.: The vestibular apparatus is a sensory system that helps in balancing, spatial orientation and also in coordinating movement with balance.

148. Answer (2)

Hint: This spot appears yellow.

Sol.: Fovea centralis is a small depression in the centre of macula lutea which contains only cones.

149. Answer (1)

Hint: Cornea is a transparent avascular layer of eye.

Sol.: The cornea refracts light and helps focus it onto retina.

150. Answer (3)

Hint: Deficiency of this can result in night blindness.

Sol.: Retinal is a derivative of vitamin A (retinol).

151. Answer (2)

Hint: Lipid soluble hormones can pass through the cell membrane.

Sol.: Cortisol and testosterone are steroid hormones and being lipid soluble can pass through the cell membrane. They bind to their intracellular receptors.

152. Answer (3)

Hint: Emergency hormones are released in response to stress

Sol.: The sympathetic nerves stimulate the adrenal medulla to secrete emergency hormones.

153. Answer (2)

Hint: Reduced immunity is seen due to atrophy of this gland.

Sol.: The functional portion of thymus is reduced considerably by the time a person reaches maturity. In old age, the functional portion weighs only 3 gms resulting in weakened immune responses.

154. Answer (2)

Hint: Parturition.

Sol.: Stretching of the cervix of the uterus stimulates release of oxytocin which enhances the contraction of smooth muscle cells in the wall of the uterus.

155. Answer (1)

Hint: GnRH is a releasing hormone

Sol.: GnRH is a releasing hormone responsible for the release of gonadotropin FSH and LH from the anterior pituitary.

156. Answer (3)

Hint: An infundibulum is a funnel-shaped cavity or structure.

Sol.: The two wings or lobes of thyroid gland on either side of the windpipe are joined together by a bridge of tissue called isthmus.

157. Answer (3)

Hint: The biological clock is responsible for maintaining circadian rhythm.

Sol.: The secretion of melatonin is regulated by a rhythm generating system located in the suprachiasmatic nucleus of the hypothalamus. Melatonin in turn is secreted by pineal gland.

158. Answer (3)

Hint: A hormone which increases bone density

Sol.: Parathormone is secreted in response to low blood calcium (Ca^{2+}) levels. It increases blood calcium levels and thyrocalcitonin decreases blood calcium.

159. Answer (1)

Hint: A catecholamine responsible for fight and flight reaction.

Sol.: Adrenaline triggers some blood vessels to contract which redirects blood towards skeletal and cardiac muscles.

160. Answer (4)

Hint: β-cells of pancreas secrete insulin.

Sol.: Insulin lowers blood glucose levels, therefore deficiency of insulin will result in hyperglycemia.

161. Answer (2)

Hint: Primary aldosteronism.

Sol.: Conn's syndrome is an endocrine disorder characterized by excessive secretion of the hormone aldosterone from adrenal glands. It leads to retention of sodium and loss of potassium.

162. Answer (1)

Hint: Sella turcica is latin for turkish seat and is a saddle-shaped depression.

Sol.: The pituitary is situated in the sella turcica of sphenoid bone.

163. Answer (2)

Hint: Melanocyte stimulating hormone.

Sol.:

Hormone	Nature of hormone	Source gland	Function
Melanocyte stimulating hormone (MSH)	Peptide	Pars intermedia	Stimulates synthesis of melanin pigment

164. Answer (2)

Hint: This is the first discovered hormone.

Sol.: Secretin is released in response to acid in the small intestine and stimulates pancreas to release bicarbonate ions.

165. Answer (3)

Hint: Generation of glucose from non-carbohydrate substrates.

Sol.: Lack of insulin causes the body cells to starve due to lack of cellular uptake of glucose. As the cells can't use the glucose they begin to break down fat for energy.

166. Answer (3)

Hint: Early onset of puberty is precocious puberty

Sol.: Higher than required levels of estrogen may lead to enlargement of breasts in males called gynaecomastia.

167. Answer (3)

Hint: Overgrowth of bones leading to very tall individuals.

Sol.: An abnormal increase in length of long bones results from hypersecretion of GH during childhood.

168. Answer (1)

Hint: An enzyme which converts ATP to cAMP.

Sol.: cAMP, Ca^{2+}, cGMP, inositol and diacylglycerol are second messengers.

169. Answer (2)

Hint: It is secreted during pregnancy and labor

Sol.: Relaxin is secreted by placenta and softens pubic symphysis during labor.

170. Answer (2)

Hint: Hormone released from zona fasciculata.

Sol.: Glucocorticoids inhibit white blood cells and are also effective in treating chronic inflammatory disorders.

171. Answer (3)

Hint: It determines eye color.

Sol.: Iris is attached at its outer margin to the ciliary processes and regulates the amount of light entering the eyeball through pupil.

172. Answer (3)

Hint: Malleus, incus and stapes are the three ear ossicles.

Sol.: The portion of the membranous labyrinth that lies inside the bony semicircular canals are called semicircular ducts which contain crista ampullaris.

173. Answer (2)

Hint: TSH is thyroid stimulating hormone.

Sol.: TSH stimulates the synthesis and secretion of triiodothyronine (T_3) and thyroxine (T_4) by thyroid gland.

174. Answer (2)

Hint: In males, it is also called ICSH.

Sol.: Luteinizing hormone triggers rupture of Graafian follicle and thereby the release of a secondary oocyte by ovary.

175. Answer (1)

Hint: Pars nervosa receives and stores oxytocin.

Sol.: Neuronal cell bodies in paraventricular nucleus in hypothalamus synthesize and secrete oxytocin. It is stored and released by posterior pituitary.

176. Answer (4)

Hint: Prolactin helps in milk production.

Sol.: Oxytocin stimulates milk ejection from the mammary glands in response to mechanical stimulus provided by a suckling infant.

177. Answer (3)

Hint: Identify a mineralocorticoid.

Sol.: Mineralocorticoids do not influence glucose metabolism. They control Na^+-K^+ balance in blood.

178. Answer (2)

Hint: Hyposecretion means reduced secretion.

Sol.: Hypersecretion of thyroxine by thyroid results in Grave's disease.

179. Answer (2)

Hint: Fluid in this chamber is not replenished if lost.

Sol.: Vitreous humor is formed during embryonic life. Aqueous chamber contains aqueous humor which is replenished each day.

180. Answer (2)

Hint: It opens into the nasopharynx.

Sol.: Eustachian tube controls the pressure within the middle ear equalizing it with the air pressure outside the body.

All India Aakash Test Series for Medical - 2021

TEST - 5 (Code-D)

Test Date : 19/01/2020

ANSWERS

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

HINTS & SOLUTIONS

[PHYSICS]

1. Answer (4)

Hint: Energy of 1 mole of ideal gas

$$U = f\frac{RT}{2}$$

Sol.: Energy of 3 mole of nitrogen

$$U_{N_2} = n_1\frac{f_1RT}{2} = 3\times\frac{5}{2}RT$$

Energy of 2 mole of Neon

$$U_{Ne} = n_2\frac{f_2RT}{2} = 2\times\frac{3}{2}RT$$

$\therefore$ Total internal energy of the system is

$$U = U_{N_2} + U_{Ne}$$

$$= \frac{15}{2}RT + \frac{6}{2}RT$$

$$= \frac{21}{2}RT$$

2. Answer (1)

Hint & Sol.: Degrees of freedom of monoatomic gas is 3.

3. Answer (3)

Hint: Use formula for the $\gamma_{mixture}$

Sol.: $\gamma_{mix} = \dfrac{\frac{n_1\gamma_1}{\gamma_1-1}+\frac{n_2\gamma_2}{\gamma_2-1}}{\frac{n_1}{\gamma_1-1}+\frac{n_2}{\gamma_2-1}}$

Here $n_1 = 2, \gamma_1 = \frac{5}{3}, n_2 = 3, \gamma_2 = \frac{7}{5}$

On solving $\gamma_{mix} = \frac{31}{21}$

4. Answer (1)

Hint: Mean free path

$$l = \frac{1}{\sqrt{2}\pi nd^2} \Rightarrow l \propto \frac{1}{nd^2}$$

Sol.: $\frac{l_1}{l_2} = \frac{n_2d_2^{\,2}}{n_1d_1^2} = \left(\frac{n_2}{n_1}\right)\left(\frac{d_2}{d_1}\right)^2$

$$\Rightarrow \frac{l_1}{l_2} = \left(\frac{4}{3}\right)\left(\frac{5}{2}\right)^2 = \frac{4}{3}.\frac{25}{4} = \frac{25}{3}$$

Hence $\Rightarrow \frac{l_1}{l_2} = \frac{25}{3}$

5. Answer (3)

Hint: PV^γ = constant

Sol.: $P_1V_1^\gamma = P_2V_2^\gamma$

$$\frac{P_1}{P_2} = \left(\frac{V_2}{V_1}\right)^\gamma \Rightarrow \frac{P}{P'} = \left(\frac{V}{2V}\right)^{3/2}$$

$$\Rightarrow P' = 2\sqrt{2}P$$

6. Answer (2)

Hint: Efficiency of Carnot engine

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

Sol.: $\eta_1 = \frac{40}{100} = 1-\frac{T_2}{T_1}$ ...(1)

$$\Rightarrow \eta_2 = \frac{50}{100} = 1-\frac{T_2}{T_1'}$$ ...(2)

(T_2 = Remain same)

On solving, equation (1) and (2) $T_2 = \frac{1200}{5}$K and

$T_1' = 480$ K

7. Answer (1)

Hint: Apply Newton's law of cooling

Sol.: Let temperature of body after next 7 minutes is θ

$$\frac{60-40}{7} = K\left(\frac{60+40}{2}-10\right)$$ ...(1)

$$\frac{40-\theta}{7} = K\left(\frac{40+\theta}{2}-10\right)$$ ...(2)

On solving (1) and (2) $\theta = 28°C$

8. Answer (3)

Hint & Sol.: For a cyclic process $\Delta U = 0$

9. Answer (3)

Hint: Use $PV = nRT$.

Sol.: *P-T* graph is a straight line passing through origin

Hence $V =$ constant $\Rightarrow W = 0$

$\rho = \frac{M}{V} \propto \frac{1}{V} \Rightarrow$ If V is constant then density is also constant.

$PV = nRT$

$P = \left(\frac{nR}{V}\right)T \Rightarrow$ Slope of line AB $\propto n$

10. Answer (2)

Hint: Efficiency of Carnot engine is $\eta = 1 - \frac{T_2}{T_1}$

T_1 = Source temperature and

T_2 = Sink temperature

Sol.: Initially $\eta = \frac{1}{3} = 1 - \frac{T_2}{T_1}$

Finally $\eta' = \frac{2}{3} = 1 - \frac{T_2 - 50}{T_1}$

On solving these equations we get

$T_1 = 150$ K

11. Answer (1)

Hint: Pressure on both side of piston P_2 will be same in equilibrium

Sol.: $PV = nRT = \frac{m}{M}RT$

$\Rightarrow \quad MV = \frac{mRT}{P} =$ same on both sides of the piston

In the position of equilibrium

$M_1V_1 = M_2V_2$

$\Rightarrow 32(360 - \theta) = 28\theta$

$\Rightarrow \theta = \frac{360 \times 32}{60} = 192°C$

12. Answer (2)

Hint: Translational kinetic energy is equal to $\frac{3}{2}RT$

Sol.: $P = \frac{P_0}{\left[1 + \left(\frac{V}{V_0}\right)^2\right]}$

at $V = V_0 \Rightarrow P = \frac{P_0}{2} \Rightarrow T = \frac{P_0V_0}{2R}$

$\therefore$ K.E. $= \frac{3}{2}RT = \frac{3}{2}R.\frac{P_0V_0}{2R} = \frac{3P_0V_0}{4}$

13. Answer (4)

Hint: For an adiabatic process

$P^{1-\gamma}.T^{\gamma} =$ constant

Sol.: Given $P \propto T^5$

for adiabatic process $P \propto T^{\gamma/\gamma-1}$

Hence $\frac{\gamma}{\gamma - 1} = 5 \Rightarrow \gamma = 5\gamma - 5$

$\Rightarrow \gamma = \frac{5}{4}$

$\Rightarrow \frac{C_P}{C_V} = \frac{5}{4}$

14. Answer (1)

Hint & Sol.: According to Charle's law

$V_t = \frac{V_0}{273}t + V_0 \Rightarrow t = \left(\frac{273}{V_0}\right)V_t - 273$

On comparing with $y = mx + c$, we can say that temperature is on y-axis and volume is on x-axis.

15. Answer (2)

Hint: Ideal gas equation $PV = nRT$

Sol.: $PV = nRT$

$\Rightarrow P = \frac{nR}{V}T \Rightarrow P = KT$

$\frac{P}{T} \propto \frac{1}{V}$

Hence Slope $\propto \frac{1}{\text{Volume}} \Rightarrow V_1 < V_2$

16. Answer (4)

Hint & Sol.: Given graph is for isobaric process.

Hence C_P for diatomic gas $= \frac{7}{2}R = 3.5R$

17. Answer (3)

Hint: Work done = Area under *P–V* curve with volume axis

Sol.: $W_{AB} = -4P_0V_0$

$W_{BC} =$ Zero

$W_{CD} = P_0V_0$

Total work done $= -4P_0V_0 + P_0V_0 = -3P_0V_0$

18. Answer (4)

Hint: Heat absorbed $\Delta Q =$ work $+\Delta U$

Sol.: $Q_{PRQ} = \Delta U + W_{PRQ}$

$Q_{PSQ} = \Delta U$

$Q_{PTQ} = \Delta U + W_{PTQ}$

ΔU is same in all three process.

W_{PRQ} is positive while W_{PTQ} is negative

$\therefore Q_{PRQ} > Q_{PSQ} > Q_{PTQ}$

19. Answer (1)

Hint: Use ideal gas equation $PV = nRT$

Sol.: On joining both the vessels number of moles of the gases remain constant

Hence $n = n_1 + n_2$

$$\frac{P_0(2V)}{RT_0} = \frac{PV}{R\,2T} + \frac{3PV}{RT}$$

$$\frac{2P_0}{T_0} = \frac{P}{2T} + \frac{3P}{T} = \frac{7P}{2T}$$

$$\frac{P_0}{T_0} = \frac{7P}{4T}$$

20. Answer (2)

Hint: $C_v = \dfrac{R}{\gamma - 1}$

Sol.: For an ideal gas $\dfrac{R}{C_V} = \gamma - 1$

$\Rightarrow \gamma - 1 = 0.4 \Rightarrow \gamma = 1.4$

Hence gas is diatomic.

21. Answer (2)

Hint & Sol.: Ideal gas equation

$$P = \frac{\rho RT}{M}$$

$$\Rightarrow \frac{\rho}{P} = \frac{M}{RT} \Rightarrow k \propto \frac{1}{T}$$

$$\Rightarrow \frac{k_1}{k_2} = \frac{T_2}{T_1} \Rightarrow \frac{k}{k_2} = \frac{273+120}{273+20}$$

$$\Rightarrow k_2 = \frac{293}{393}k$$

22. Answer (2)

Hint & Sol.: For adiabatic process PV^{γ} = const.

$$P\left(\frac{nRT}{P}\right)^{\gamma} = \text{const.} \Rightarrow P^{1-\gamma}T^{\gamma} = \text{const.}$$

$$PT^{\left(\frac{\gamma}{1-\gamma}\right)} = \text{const}$$

23. Answer (2)

Hint & Sol.: Mean kinetic energy of a molecule per degree of freedom is $\dfrac{1}{2}k_BT$ and gas molecules have three translational degrees of freedom.

24. Answer (3)

Hint: Ice converts into water and water converts into steam

$Q = mC_i\Delta\theta + mL_f + mC\Delta\theta + mL_v$

Sol.: $Q = \left(20\times\frac{1}{2}\times 20 + 20\times 80 + 20\times 1\times 100 + 20\times 540\right)$cal

$= (200 + 1600 + 2000 + 10800)$cal

= 14600 cal

25. Answer (4)

Hint & Sol.: Few greenhouse gases are CO_2, CH_4, N_2O, O_3 and chlorofluorocarbon.

26. Answer (4)

Hint: Use Stefan's law

Sol.: Let power radiated by the sun is P and radius of planet is R then in the situation of equilibrium (thermal)

$$\Rightarrow \frac{P}{4\pi r^2}.\pi R^2 = \sigma.4\pi R^2.T^4$$

$$\Rightarrow T^4 = \frac{P}{\sigma.16\pi r^2} \Rightarrow T^4 \propto \frac{1}{r^2}$$

$$\Rightarrow T \propto r^{-1/2}$$

27. Answer (3)

Hint: $\dfrac{2}{k_e} = \dfrac{1}{k_1} + \dfrac{1}{k_2}$

Sol.: In steady state

$$\frac{2}{k_e} = \frac{1}{K} + \frac{1}{\left(\frac{k}{5}\right)}$$

$$k_e = \frac{k}{3}$$

28. Answer (1)

Hint: Use Wien's law :- $\lambda_m \propto \frac{1}{T}$

Sol.: $\lambda_m.T = \text{constant}$

$\Rightarrow \frac{(\lambda_m)_1}{(\lambda_m)_2} = \frac{T_2}{T_1} = \frac{(3227+273)}{(2227+273)}$

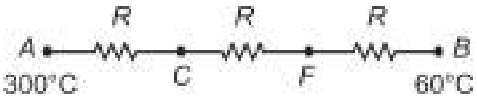
$\Rightarrow \frac{4000\text{Å}}{(\lambda_m)_2} = \frac{3500}{2500} = \frac{7}{5}$

$\Rightarrow (\lambda_m)_2 = 2857\text{Å}$

29. Answer (2)

Hint: Law of thermal conduction

Sol.: Equivalent circuit will be as (R : thermal resistance of each rod)



Temperature difference between *A* and *B* is 240°C which is equally divided in all resistances.

Hence $T_A - T_C = 80°$

$T_C = T_A - 80 = 300 - 80°$

= 220°C

30. Answer (4)

Hint: Heat loss = Heat gain

Sol.: Let *m* gram of water having temperature $\theta°$(> 20°C) is mixed to 40 gram water at 20°C

Let final temperature of mixture is θ

$\Rightarrow m(1).(\theta_0 - \theta) = 40.(1).(\theta - 20)$

$\Rightarrow m\theta_0 - m\theta = 40\theta - 800$

$\Rightarrow \theta = \frac{800 + m\theta_0}{40 + m}$

Which is greatest for option (4).

31. Answer (2)

Hint: Heat capacity $H = mC$ (C : specific heat capacity)

Sol.: $\frac{R_1}{R_2} = \frac{1}{3}$ and $\frac{C_1}{C_2} = \frac{1}{1}$

Hence capacity (H) = mC

$\frac{H_1}{H_2} = \frac{m_1C_1}{m_2C_2} = \frac{\frac{4}{3}\pi R_1^3.C}{\frac{4}{3}\pi R_2^3.C}$

$= \left(\frac{R_1}{R_2}\right)^3 = \frac{1}{27}$

32. Answer (4)

Hint & Sol.: For anisotropic material

$\Rightarrow \gamma = \alpha_x + \alpha_y + \alpha_z$

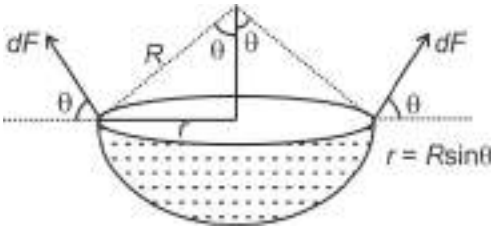
$= \alpha_1 + \alpha_2 + \alpha_3$

33. Answer (2)

Hint & Sol.: Density of water is maximum at 4°C. Volume decreases between 0°C and 4°C on heating, hence coefficient of cubical expansion is negative between 0°C to 4°C.

34. Answer (4)

Hint: Force due to surface tension $F = \sigma.l$



$F_{net} = \int dF \sin\theta = \sigma.\sin\theta \int dl$

$= \sigma \sin\theta.2\pi r = \sigma 2\pi R \sin^2\theta$

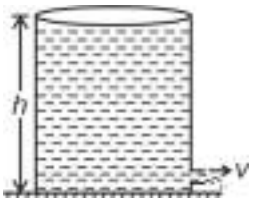
$= 2\pi R\sigma\left(\frac{1}{\sqrt{2}}\right)^2$

$= \pi R\sigma$

35. Answer (4)

Hint: Use $F_{\text{thrust}} \le (f_s)_{\max}$.

Sol.:



$\rho a v^2 \le \mu A h \rho g$

$a(2gh) \le \mu A \rho g h$

$\mu = \frac{2a}{A}$

$\mu \ge 0.02$

36. Answer (2)

Hint: Terminal speed

$v_0 \propto r^2 \Rightarrow \frac{v_{01}}{v_{02}} = \frac{r_1^2}{r_2^2}$

Sol.: Radius of big drop $R = n^{1/3}r$

$R = (64)^{1/3}.r = 4r$

Now $\frac{v_{01}}{v_{02}} = \frac{r_1^2}{r_2^2} = \frac{r^2}{(4r)^2} = \frac{r^2}{16r^2}$

$\Rightarrow v_{02} = 16 \times v_{01}$

$= 16 \times 2.5$

$= 40$ m/s

37. Answer (4)

Hint: Law of floatation

Sol.: Let volume of block is V

In water $\rightarrow V\rho_{block}g = \frac{2}{3}\rho_{water}.g$

$$\rho_{block} = \frac{2}{3}\rho_{water} \quad ...(1)$$

In oil $\rightarrow V\rho_{block}g = \frac{1}{3}V\rho_{oil}g$

$$\rho_{block} = \frac{1}{3}\rho_{oil} \quad ...(2)$$

From (1) and (2)

$\rho_{oil} = 2\ \rho_{water}$

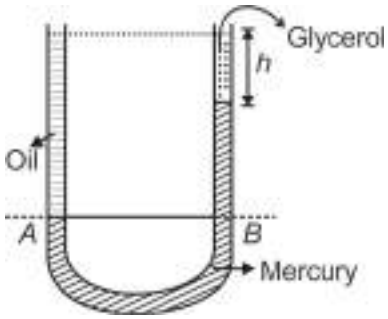
$= 2 \times 1000 = 2000$ kg/m^3

38. Answer (2)

Hint: Gauge pressure due to a liquid column $= \rho gh$.

In a non-accelerated tube, pressure at same level in a liquid is same.

Sol.:



$P_A = P_B$

$\Rightarrow P_0 + \rho_{oil}g\ 20 \times 10^{-2} = P_0 + \rho_{glycerol}gh \times 10^{-2}$

$+\rho_{mercury}g(20 - h) \times 10^{-2}$

$\Rightarrow \rho_{oil} \times 20 = \rho_{glycerol}h + \rho_{mercury}20 - \rho_{mercury}h$

$\Rightarrow 20 \times 0.8 = 1.3h + 13.6 \times 20 - 13.6h$

$\Rightarrow 12.3h = 256$

$h = 20.81$ cm

39. Answer (1)

Hint: As we moves upwards, atmospheric pressure decreases.

Sol.: $\rho_{air}gh = \rho_{Hg}g[75 - 60] \times 10^{-2}$

$\Rightarrow h = \frac{\rho_{Hg}}{\rho_{air}} \times 15 \times 10^{-2} = 10^4 \times 15 \times 10^{-2}$

$= 1500$ m $= 1.5$ km

40. Answer (4)

Hint: $U = S\ 4\pi R^2$ (S : Surface tension)

Sol.: Radius of single drop $R' = n^{-1/3}R$

$R' = (1331)^{-1/3}R$

$= \frac{R}{11}$

Hence surface energy of single drop

$U' = U\left(\frac{R'}{R}\right)^2$

$U' = \frac{U}{121}$

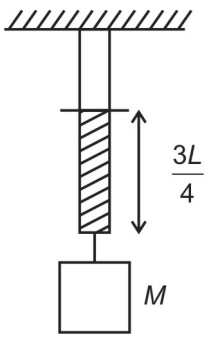
41. Answer (3)

Hint & Sol.: Angle of contact does not depend on inclination. It depends of nature of solid and liquids in contact.

42. Answer (4)

Hint: Stress will be different at different points of wire.

Sol.:



Tension at $\frac{3L}{4}$ from lower end

$T = Mg + \frac{3Mg}{4}$

$= 7\frac{Mg}{4}$

Stress developed at this point

$S = \frac{F}{A} = \frac{7Mg}{4A}$

43. Answer (2)

Hint: Bulk modulus,

$B = \frac{\Delta P}{-\Delta V / V} \Rightarrow \Delta P = -B\frac{\Delta V}{V}$

Sol.: $B = 2000 \times 10^6$ Pa, $V = 100$ litre

And $\frac{\Delta V}{V} = -\frac{0.004}{100}$

$\therefore \Delta P = -\frac{B \times \Delta V}{V} = \frac{2000 \times 10^6 \times 0.004}{100}$

= 80,000 Pa = 80 kPa

44. Answer (1)

Hint: $\Delta L = \frac{FL}{AY} \Rightarrow A = \frac{FL}{Y\Delta L}$

Sol.: $\frac{A_B}{A_S} = \frac{Y_S}{Y_B} \Rightarrow \left(\frac{R_B}{R_S}\right)^2 = \frac{2}{1} \Rightarrow \frac{R_B}{R_S} = \sqrt{2}$

45. Answer (4)

Hint: For a wire of a given material, breaking stress is constant.

Sol.: $\frac{F_1}{A_1} = \frac{F_2}{A_2} \Rightarrow F_2 = F_1.\frac{A_2}{A_1} = 4F_1$

$\Rightarrow \quad F_2 = 4 \times 30g = 120g$ N

= 120 kg

[CHEMISTRY]

46. Answer (2)

Hint: TEL (tetral ethyl lead : $PbEt_4$) was used as anti-knocking compound.

47. Answer (4)

Hint:

	Li	Na	K	H_2O
	↓	↓	↓	↓
Density(g/cm^3)	0.53	0.97	0.86	1

48. Answer (1)

Hint: Al can show coordination number six.

Sol.: $AlCl_3 + H_2O \rightarrow \underset{(sp^3d^2)\text{ (Octahedral)}}{[Al(H_2O)_6]^{3+}} + 3Cl^-$

49. Answer (2)

Hint: Silica is resistant to Halogens and dihydrogen

Sol.: Silica is attacked by HF.

$SiO_2 + 4HF \rightarrow SiF_4 + 2H_2O$

50. Answer (3)

Hint: Down the group catenation tendency decreases

Sol.: In 14th group, Pb does not show catenation.

51. Answer (1)

Hint: Syngas : $CO + H_2$

Sol.: Producer gas : $CO + N_2$

52. Answer (4)

Hint: Solid CO_2 is known as dry ice

Sol.: ZSM-5 is used to convert alcohol directly into gasoline.

53. Answer (3)

Hint: Due to absence of *d*-orbital, boron cannot show six coordination number.

Sol.: $AlF_3 + 3F^- \rightarrow [AlF_6]^{3-}$

54. Answer (1)

Hint: $B_3N_3H_6$ is known as inorganic benzene

55. Answer (2)

Hint: Blue bead contains metaborates

Sol.:

$Na_2B_4O_7.10H_2O \xrightarrow[\text{Strong heat}]{\text{Pt loop.}} \underset{\text{(Glassy bead)}}{B_2O_3} + NaBO_2$

$\xrightarrow{CuO} \underset{\text{Metaborates}}{Cu(BO_2)_2}$

56. Answer (2)

Hint: Suspension of slaked lime in water is known as milk of lime

57. Answer (4)

Hint: On moving down the group, metallic nature of alkali metal increases

58. Answer (1)

Hint: Smaller cation is more stabilized by smaller anion.

Sol.: Thermal stability order : LiH > NaH > KH > RbH > CsH

59. Answer (4)

Hint: Average percentage of silica in portland cement is 20-25%

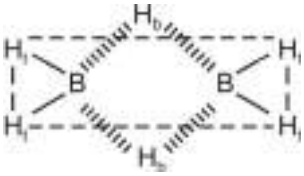
60. Answer (3)

Hint: Bleaching powder is formed by the reaction of Cl_2 with $Ca(OH)_2$

Sol.: $2Ca(OH)_2 + 2Cl_2 \rightarrow CaCl_2 + Ca(OCl)_2 + 2H_2O$
(Bleaching powder)

61. Answer (3)

Hint:



H_b : bridge H

H_t : terminal H

Sol.: Terminal B-H bonds are 2C-2e bonds. Bridge B-H bonds are 3C-2e bonds (banana bonds). Boron atom is sp^3 hybridised.

62. Answer (2)

Hint: Li give crimson red colour in flame test

Sol.: Mg does not give flame test

63. Answer (2)

Hint: Melting point : MF > MCl > MBr > MI

64. Answer (4)

Hint: Due to small size, $Li^{\oplus}$ has highest hydration enthalpy which accounts for its high negative E° value.

Sol.: Li is most powerful and Na is least powerful reducing agent among alkali metals.

65. Answer (3)

Hint: $Mg(NO_3)_2$ crystallises with six molecules of water whereas $Ba(NO_3)_2$ crystallises as anhydrous salt.

Sol.: Tendency of alkaline earth metal nitrates to form hydrates decreases down the group.

66. Answer (1)

Hint: Carbon does not have any vacant *d*-orbital in CCl_4 so it is not hydrolysed.

67. Answer (1)

Hint: On small scale pure CO is prepared by dehydration of formic acid

Sol.: $HCOOH \xrightarrow[Conc.H_2SO_4]{373K} H_2O + CO$

68. Answer (2)

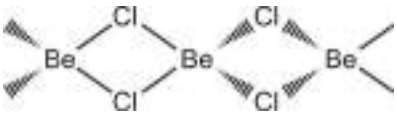
Hint: $\Delta_f H°$ value of diamond is 1.9 kJ mol^{-1}

Sol.: $\Delta_f H°$ value of fullerene is 38.1 kJ mol^{-1}

69. Answer (4)

Hint: $BeCl_2$ forms a chloro-bridge dimer in vapour phase

Sol.: $BeCl_2$ has chain structure in the solid state as shown.



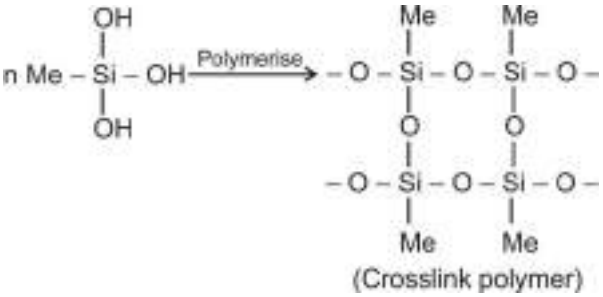
70. Answer (3)

Hint: $Li \xrightarrow{Air} Li_2O + Li_3N$

71. Answer (3)

Hint: $MeSiCl_3$ on hydrolysis forms $MeSi(OH)_3$

Sol.:



(Crosslink polymer)

72. Answer (2)

Hint: PbO_2 is amphoteric oxide

73. Answer (1)

Hint: $Si_2O_7^{6-}$ are pyrosilicates.

74. Answer (2)

Hint: O_2^{2-} is peroxide ion

Sol.: $KO_2 \Rightarrow K^+ + O_2^-$ (Superoxide ion)

75. Answer (1)

Hint: $CaC_2 + 2H_2O \longrightarrow Ca(OH)_2 + C_2H_2$

76. Answer (1)

Hint: Cu can't displace hydrogen from HCl.

Sol.: $Zn + 2NaOH(aq.) \rightarrow Na_2ZnO_2 + H_2$

77. Answer (4)

Hint: Heavy water (D_2O) is used to slow down the speed of neutrons in nuclear reactor.

78. Answer (1)

Hint: Volume strength = 11.2 × M

Sol.: Volume strength = 11.2 × M = 11.2 × 0.6 = 6.72 volume

79. Answer (2)

Hint: BeO is amphoteric in nature

Sol.: Due to small size of Be^{2+}, it does not exhibit coordination number more than four.

80. Answer (3)

Hint: Lesser the hydration, more will be the ionic mobility of ions in water

Sol.: Hydration : $Li^+ > Na^+ > K^+ > Rb^+ > Cs^+$

Ionic mobility : $Cs^+ > Rb^+ > K^+ > Na^+ > Li^+$

81. Answer (4)

Hint: Potassium ions are the most abundant cations within cell fluids

82. Answer (2)

Hint: Atomic radii : B < Ga < Al < In < Tl

83. Answer (4)

Hint: Incomplete octet species are electron deficient species

Sol.: BF_3, B_2H_6 and H_3BO_3 all are electron deficient species

$BF_3 + F^- \longrightarrow BF_4^-$

$B_2H_6 + 2CO \longrightarrow 2BH_3.CO$

$H_3BO_3 + OH^- \longrightarrow [B(OH)_4]^-$

84. Answer (3)

Hint: Inert pair effect

Sol.: Thallium shows +1 and lead shows +2 oxidation state.

85. Answer (1)

Hint: On moving down the group, lattice energy of alkaline earth metal sulphates remains almost constant but hydration energy decreases.

Sol.: Solubility order : $BeSO_4 > MgSO_4 > CaSO_4 > SrSO_4 > BaSO_4$

86. Answer (4)

Hint: CaH_2 is known as hydrolith

Sol.: $CaSO_4$: Dead burnt plaster

$CaSO_4.2H_2O$: Gypsum

Quick lime : CaO

87. Answer (4)

Hint: All alkaline earth metal carbonates on decomposition releases CO_2

Sol.: Alkali metal carbonates do not decompose on heating except Li_2CO_3

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

$K_2CO_3 \xrightarrow{\Delta}$ No decomposition

88. Answer (4)

Hint: Basic nature of oxides of alkaline earth metals increases down the group.

Sol.: Basic nature: BeO < MgO < CaO < SrO.

89. Answer (3)

Hint: H_2O_2 is an oxidising agent.

Sol.: $PbS + 4H_2O_2 \rightarrow PbSO_4 + 4H_2O$

90. Answer (2)

Hint: Chlorine has highest electron affinity in periodic table.

Sol.: Hydrogen has 3 isotopes : $_1H^1$, $_1D^2$ and $_1T^3$, of which tritium($_1T^3$) is radioactive. In Haber's process, H_2 acts as a reducing agent.

[BIOLOGY]

91. Answer (1)

Sol.: Chemiosmotic hypothesis was explained by P. Mitchell.

92. Answer (3)

Hint: C_4 plants have higher concentration of organic acids produced in their leaves.

Sol.: Due to production of various organic acids in their leaves, C_4 plants are tolerant to soil saline conditions.

93. Answer (3)

Sol.: Orientation of leaves is an internal/plant factor which affects the rate of photosynthesis.

94. Answer (4)

Hint: At low light intensity, neither C_3 nor C_4 plants show higher rate of photosynthesis.

Sol.: C_3 plants show higher rate of photosynthesis at high light intensity and higher concentration of CO_2.

95. Answer (4)

Hint: CAM plants have scotoactive stomata.

Sol.: *Bryophyllum* is a CAM plant.

96. Answer (4)

Sol.: Duration of sunlight affects the overall production of photosynthetic products but not the rate of photosynthesis.

97. Answer (3)

Hint: NADH is a coenzyme produced in different steps of cellular respiration.

Sol.: O_2, ATP, glucose, NADPH etc. are photosynthetic products or intermediates but not NADH.

98. Answer (3)

Hint: Dark reaction is an enzymatic process which is affected by temperature to a great extent.

Sol.: Light reaction is affected by temperature at a much lesser extent than dark reaction.

99. Answer (2)

Sol.: Pyruvic acid is a C_3 acid.

100. Answer (4)

Sol.: Primary carboxylation in both C_3 and C_4 plants occur in mesophyll cells by RuBisCO and PEPcase enzymes respectively.

101. Answer (3)

Hint: In stroma, a series of enzymatic reactions synthesise sugar through Calvin cycle.

Sol.: Calvin cycle or dark reaction is not directly dependent on light but depends on the products of light reaction.

102. Answer (1)

Hint: Antenna pigments absorb different light wavelengths and transfer the energy to the chlorophyll pigment.

Sol.: PEP – Primary CO_2 acceptor molecule of Hatch and Slack pathway.

RuBP – Primary CO_2 acceptor molecule of Calvin cycle.

Shield pigments – Prevent photo-oxidative damage/destruction of chlorophyll pigments by light.

103. Answer (1)

Hint: For fixation of each molecule of CO_2 into glucose, C_4 plants require 2 additional ATP molecules than C_3 plants.

Sol.: For one molecule of sucrose formation, C_4 plants require 60 ATP in comparison to C_3 plants which require 36 ATP so they require 24 additional ATP molecules.

104. Answer (3)

Hint: Plants which are adapted for dry tropical regions are C_4 plants.

Sol.: Cold sensitive enzyme of C_4 plants is PEP synthetase which forms PEP from pyruvate.

105. Answer (1)

Sol.: Synthesis of glucose and its storage in the form of starch in green parts of plants was explained by Julius Von Sachs.

106. Answer (2)

Hint: Chemiosmosis is associated with ATP synthesis in light reaction.

Sol.: Light reaction of photosynthesis does not utilise CO_2, hence CO_2 acceptor molecule is associated with dark reaction or biosynthetic phase of photosynthesis, not with chemiosmosis.

107. Answer (4)

Hint: Photorespiration is a wasteful process as it does not produce ATP or NADPH.

Sol.: Photorespiration occurs in the presence of sunlight only. It is initiated in chloroplast where O_2 is first utilised.

108. Answer (3)

Hint: Chlorophyll a is blue green or bright green in the chromatogram.

Sol.: Chlorophyll b absorbs blue and red wavelengths and accounts for ¼ of the total chlorophyll. Chlorophyll a is the reaction centre of PS II which shows absorption maxima at 680 nm.

109. Answer (4)

Hint: PS II is involved in non-cyclic photophosphorylation.

Sol.: PS II is associated with liberation of O_2 as their is splitting of water, however its reaction centre (P_{680}) has absorption maxima at 680 nm.

Reaction centre of PS I shows absorption maxima at 700 nm (P_{700}).

110. Answer (3)

Hint: Calvin cycle occurs only in chloroplasts.

Sol.: Transamination is an intermediate step of photorespiration in peroxisome. It is not a step of Calvin cycle.

111. Answer (1)

Hint: *Amaranthus* is a C_4 plant.

Sol.: *Amaranthus*, being a C_4 plant has Kranz anatomy in their leaves.

112. Answer (3)

Hint: During photosynthesis, proton gradient is generated across the thylakoid membrane due to accumulation of H^+ ion in lumen of thylakoids.

Sol.: Transfer of H^+ from stroma to lumen, photolysis of H_2O and reduction of $NADP^+$ towards stroma, contribute in formation of proton gradient across thylakoid membrane. Movement of H^+ from lumen to stroma through CF_0 of ATP synthase enzyme leads to breaking of proton gradient.

113. Answer (2)

Hint: T.W. Engelmann described the first action spectrum of photosynthesis using a green alga and aerobic bacteria.

Sol.: Green alga *Cladophora* was used to describe the first action spectrum of photosynthesis.

114. Answer (4)

Hint: Non-cyclic photophosphorylation is called Z-scheme.

Sol.: Non-cyclic photophosphorylation occurs in granal thylakoids, operates at high light intensity, involves both PS I and PS II and requires external source of electrons which is water.

115. Answer (3)

Hint: C_4 plants have dimorphic chloroplasts in their leaves.

Sol.: Maize, *Sorghum* and sugarcane are C_4 plants among the given plants.

116. Answer (1)

Sol.: Division and growth of cortical and pericycle cells leads to formation of root nodules.

117. Answer (4)

Hint: Reductive amination is catalysed by glutamate dehydrogenase enzyme.

Sol.: In reductive amination of α-ketoglutaric acid, glutamic acid is produced in the presence of NH_4^+, reduced coenzyme (NADPH) and glutamate dehydrogenase.

118. Answer (2)

Sol.: The overall reaction involved in N_2-fixation is

$$N_2 + 8H^+ + 8e^- + 16\ ATP \xrightarrow{\text{Nitrogenase}} 2NH_3 + H_2 + 16\ ADP + 16\ Pi$$

so for per molecule of ammonia (NH_3) formation, 8 ATP and $4H^+$ are required.

119. Answer (3)

Hint: Nod factor is released by symbiotic bacteria when they collect over the root hairs before infection.

Sol.: Nod factor causes curling of root hairs followed by formation of infection thread, containing the bacteria.

120. Answer (4)

Hint: Leghaemoglobin is red-pink coloured pigment present in the cells of root nodules.

Sol.: Leghaemoglobin is an oxygen scavenger which ensures the functioning of nitrogenase under anaerobic conditions.

121. Answer (2)

Sol.: *Frankia* is a symbiotic filamentous bacterium present in various non-legume plants.

122. Answer (2)

Sol.: Grey spots in oats are due to the deficiency of Mn.

123. Answer (3)

Hint: Sulphur is used in the synthesis of some vitamins, coenzyme A and ferredoxin.

Sol.: Mg is involved in the synthesis of DNA and RNA.

124. Answer (1)

Hint: Nitrite reductase does not require molybdenum.

Sol.: Nitrite reductase enzyme contains copper and iron.

125. Answer (4)

Hint: N_2-fixing bacteria of soil help in converting atmospheric N_2 into its compounds which can be used/absorbed by plants and microbes.

Sol.: Decomposer microorganisms of soil decompose organic matter to release minerals bound in organic matter.

126. Answer (4)

Hint: Metabolic phase of the absorption of ions is an energy dependent process.

Sol.: In metabolic phase of ion absorption, movement of ions is an active process.

127. Answer (3)

Hint: Hunger signs/deficiency symptoms appear in young tissue for immobile elements.

Sol.: Calcium is an immobile element.

128. Answer (3)

Sol.: Best defined function of manganese is its involvement in photolysis/splitting of water during photosynthesis.

129. Answer (1)

Hint: Both potassium and chlorine maintain turgidity of the cells.

Sol.: Potassium and chlorine both maintain the cation-anion balance of cells hence regulate the osmotic potential of cells.

130. Answer (4)

Hint: Ni is the activator of urease and hydroxylases.

Sol.: Zn is the activator of carboxylases.

131. Answer (2)

Sol.: Deficiency of Cu is not associated with delayed flowering.

132. Answer (3)

Hint: Disorders caused by the deficiency of an element can be corrected by the availability of only that element.

Sol.: Requirement of any essential element cannot be replaced by other element. Plant cannot complete its life cycle or set seed in the absence of an essential element.

An essential element should be a component of either structural or functional molecule.

133. Answer (2)

Hint: Nitrogen is an essential element.

Sol.: Nitrogen is a mineral which is required by plants in the greatest amount.

Calcium activates ATPase while boron is associated with the pollen germination.

134. Answer (3)

Hint: Micronutrients are toxic in slight excess.

Sol.: Zn, Fe, Mn, Cu and B are micronutrients.

135. Answer (4)

Sol.: Hydroponics avoids the problem of weeding.

136. Answer (2)

Hint: It opens into the nasopharynx.

Sol.: Eustachian tube controls the pressure within the middle ear equalizing it with the air pressure outside the body.

137. Answer (2)

Hint: Fluid in this chamber is not replenished if lost.

Sol.: Vitreous humor is formed during embryonic life. Aqueous chamber contains aqueous humor which is replenished each day.

138. Answer (2)

Hint: Hyposecretion means reduced secretion.

Sol.: Hypersecretion of thyroxine by thyroid results in Grave's disease.

139. Answer (3)

Hint: Identify a mineralocorticoid.

Sol.: Mineralocorticoids do not influence glucose metabolism. They control Na^+-K^+ balance in blood.

140. Answer (4)

Hint: Prolactin helps in milk production.

Sol.: Oxytocin stimulates milk ejection from the mammary glands in response to mechanical stimulus provided by a suckling infant.

141. Answer (1)

Hint: Pars nervosa receives and stores oxytocin.

Sol.: Neuronal cell bodies in paraventricular nucleus in hypothalamus synthesize and secrete oxytocin. It is stored and released by posterior pituitary.

142. Answer (2)

Hint: In males, it is also called ICSH.

Sol.: Luteinizing hormone triggers rupture of Graafian follicle and thereby the release of a secondary oocyte by ovary.

143. Answer (2)

Hint: TSH is thyroid stimulating hormone.

Sol.: TSH stimulates the synthesis and secretion of triiodothyronine (T_3) and thyroxine (T_4) by thyroid gland.

144. Answer (3)

Hint: Malleus, incus and stapes are the three ear ossicles.

Sol.: The portion of the membranous labyrinth that lies inside the bony semicircular canals are called semicircular ducts which contain crista ampullaris.

145. Answer (3)

Hint: It determines eye color.

Sol.: Iris is attached at its outer margin to the ciliary processes and regulates the amount of light entering the eyeball through pupil.

146. Answer (2)

Hint: Hormone released from zona fasciculata.

Sol.: Glucocorticoids inhibit white blood cells and are also effective in treating chronic inflammatory disorders.

147. Answer (2)

Hint: It is secreted during pregnancy and labor

Sol.: Relaxin is secreted by placenta and softens pubic symphysis during labor.

148. Answer (1)

Hint: An enzyme which converts ATP to cAMP.

Sol.: cAMP, Ca^{2+}, cGMP, inositol and diacylglycerol are second messengers.

149. Answer (3)

Hint: Overgrowth of bones leading to very tall individuals.

Sol.: An abnormal increase in length of long bones results from hypersecretion of GH during childhood.

150. Answer (3)

Hint: Early onset of puberty is precocious puberty

Sol.: Higher than required levels of estrogen may lead to enlargement of breasts in males called gynaecomastia.

151. Answer (3)

Hint: Generation of glucose from non-carbohydrate substrates.

Sol.: Lack of insulin causes the body cells to starve due to lack of cellular uptake of glucose. As the cells can't use the glucose they begin to break down fat for energy.

152. Answer (2)

Hint: This is the first discovered hormone.

Sol.: Secretin is released in response to acid in the small intestine and stimulates pancreas to release bicarbonate ions.

153. Answer (2)

Hint: Melanocyte stimulating hormone.

Sol.:

Hormone	Nature of hormone	Source gland	Function
Melanocyte stimulating hormone (MSH)	Peptide	Pars intermedia	Stimulates synthesis of melanin pigment

154. Answer (1)

Hint: Sella turcica is latin for turkish seat and is a saddle-shaped depression.

Sol.: The pituitary is situated in the sella turcica of sphenoid bone.

155. Answer (2)

Hint: Primary aldosteronism.

Sol.: Conn's syndrome is an endocrine disorder characterized by excessive secretion of the hormone aldosterone from adrenal glands. It leads to retention of sodium and loss of potassium.

156. Answer (4)

Hint: β-cells of pancreas secrete insulin.

Sol.: Insulin lowers blood glucose levels, therefore deficiency of insulin will result in hyperglycemia.

157. Answer (1)

Hint: A catecholamine responsible for fight and flight reaction.

Sol.: Adrenaline triggers some blood vessels to contract which redirects blood towards skeletal and cardiac muscles.

158. Answer (3)

Hint: A hormone which increases bone density

Sol.: Parathormone is secreted in response to low blood calcium (Ca^{2+}) levels. It increases blood calcium levels and thyrocalcitonin decreases blood calcium.

159. Answer (3)

Hint: The biological clock is responsible for maintaining circadian rhythm.

Sol.: The secretion of melatonin is regulated by a rhythm generating system located in the suprachiasmatic nucleus of the hypothalamus. Melatonin in turn is secreted by pineal gland.

160. Answer (3)

Hint: An infundibulum is a funnel-shaped cavity or structure.

Sol.: The two wings or lobes of thyroid gland on either side of the windpipe are joined together by a bridge of tissue called isthmus.

161. Answer (1)

Hint: GnRH is a releasing hormone

Sol.: GnRH is a releasing hormone responsible for the release of gonadotropin FSH and LH from the anterior pituitary.

162. Answer (2)

Hint: Parturition.

Sol.: Stretching of the cervix of the uterus stimulates release of oxytocin which enhances the contraction of smooth muscle cells in the wall of the uterus.

163. Answer (2)

Hint: Reduced immunity is seen due to atrophy of this gland.

Sol.: The functional portion of thymus is reduced considerably by the time a person reaches maturity. In old age, the functional portion weighs only 3 gms resulting in weakened immune responses.

164. Answer (3)

Hint: Emergency hormones are released in response to stress

Sol.: The sympathetic nerves stimulate the adrenal medulla to secrete emergency hormones.

165. Answer (2)

Hint: Lipid soluble hormones can pass through the cell membrane.

Sol.: Cortisol and testosterone are steroid hormones and being lipid soluble can pass through the cell membrane. They bind to their intracellular receptors.

166. Answer (3)

Hint: Deficiency of this can result in night blindness.

Sol.: Retinal is a derivative of vitamin A (retinol).

167. Answer (1)

Hint: Cornea is a transparent avascular layer of eye.

Sol.: The cornea refracts light and helps focus it onto retina.

168. Answer (2)

Hint: This spot appears yellow.

Sol.: Fovea centralis is a small depression in the centre of macula lutea which contains only cones.

169. Answer (3)

Hint: It is present in inner ear.

Sol.: The vestibular apparatus is a sensory system that helps in balancing, spatial orientation and also in coordinating movement with balance.

170 Answer (2)

Hint: Iodopsin is similar to visual violet.

Sol.: Three types of iodopsin are present in cone cells which are responsive to red, green and blue light.

171. Answer (3)

Hint: Wild contractions of skeletal muscles.

Sol.: Reduced levels of PTH results in hypocalcemic tetany. Hyperthyroidism results into exophthalmic goitre.

172. Answer (4)

Hint: Increase in thyroxine levels results in high BMR.

Sol.: Myxedema and cretinism are caused by hypothyroidism in adults and children respectively.

173. Answer (2)

Hint: These glands are ductless glands.

Sol.: Ovaries, testes and pancreas perform both endocrine and exocrine functions.

174. Answer (2)

Hint: Hypoparathyroidism leads to reduced blood calcium levels.

Sol.: Parathormone increases blood calcium level by stimulating resorption from bone, and its absorption from kidney and intestine.

175. Answer (2)

Hint: It is produced in the cell bodies of neurosecretory cells of hypothalamus.

Sol.: Vasopressin or ADH moves by axonal transport to axon terminals in posterior pituitary where it is stored.

176. Answer (3)

Hint: It is also known as epinephrine.

Sol.: Epinephrine has both endocrine and neural roles. It is secreted by medulla of adrenal gland and at the ends of sympathetic nerve fibres.

177. Answer (1)

Hint: These structures are related to a lymphoid organ.

Sol.: Hassall's corpuscles are also called thymic corpuscles. They are structures found in the medulla of thymus.

178. Answer (1)

Hint: ADH is also called vasopressin.

Sol.: Stored ADH released by the posterior pituitary gland stimulates reabsorption of water by kidneys and thus prevents dehydration.

179. Answer (2)

Hint: Identify the milk forming hormone.

Sol.: Hormones secreted by human placenta are hCG, estrogen, progesterone and relaxin.

180. Answer (2)

Hint: It is produced from tyrosine and iodine.

Sol.: Thyroxine is derivative of amino acid tyrosine and is bound covalently to iodine.

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