Solutions

SOLUTIONS

Exercise-I (Conceptual Questions)

1. Ans. (3)

$$M = \frac{n}{V_{(L)}} = \frac{w}{M_w \times V_{(L)}} = \frac{8}{40\times1} = 0.2\ M$$

2. Ans. (4)

Molality is defined as no. of moles of solute dissolved in 1000 g of solvent

$$M = \frac{n_B}{w_A(g)} \times 1000$$

$$\frac{18\times1000}{180\times1000} = 0.1M$$

3. Ans. (4)

$$M = \frac{n}{V_{(ml)}} \times 1000 = \frac{5.85\times1000}{58.5\times500} = 0.2\ M$$

4. Ans. (4)

$$M = \frac{n}{V_{(ml)}} \times 1000$$

$$0.1 = \frac{w\times1000}{M_w \times 1000}$$

$$0.1 = \frac{w\times1000}{98\times1000}$$

w = 9.8 g

5. Ans. (3)

$$X_A = \frac{n_A}{n_A + n_B}$$

$$n_{glycerine} = \frac{w}{M_w} = \frac{46}{92} = 0.5 = n_A$$

$$n_{H_2O} = \frac{w}{M_w} = \frac{36}{18} = 2 = n_B$$

$$X_A = \frac{n_A}{n_A+n_B} = \frac{0.5}{2.5} = 0.2$$

6. Ans. (4)

$$ppm = \frac{\text{wt of solute(g)}}{\text{wt of solution(g)}} \times 10^6$$

$$= \frac{10}{1000} \times 10^6 = 10,000\,ppm$$

7. Ans. (4)

$$N = \frac{w}{E_w \times V_{(L)}} \text{ or } N = n_f \times M$$

n_f of H_3PO_4 = 3

N = n_f × M

Normality of 1M H_3PO_4 is = 3×1 = 3N

8. Ans. (3)

Normality = n_f × M

N = 2 × M

0.2 = 2 × M

M = 0.1 M

n_f of Na_2CO_3 = 2

$Na_2CO_3 = 2Na^+ + CO_3^{2-}$

n_f = total +ive or total -ive charge = 2

9. Ans. (2)

Phosphorous acid (H_3PO_3) ; n_f = 2

N = n_f × M

N = 2 × 0.3 = 0.6N

10. Ans. (2)

Molarity of pure water is 55.5 M

$$M = \frac{n}{V_{(L)}} = \frac{w}{M_w \times V_{(ml)}} \times 1000$$

$$\left(\text{density} = \frac{w}{V_{(ml)}} = 1\right)$$

Density of water is 1 g 1 ml

$$M = \frac{1000}{M_W} = \frac{1000}{18} = 55.5\ M$$

11. Ans. (3)

Molarity of pure water is always 55.5 M

12. Ans. (3)

$w_{NaCl} = w_{KCl}$, but M_w of NaCl < M_w of KCl

$$M = \frac{n}{V_{(L)}} = \frac{w}{M_w \times V_{(L)}}$$

$$M \propto \frac{1}{\text{Mol. wt of solute}}$$

So, $M_{NaCl} > M_{KCl}$

13. Ans. (2)

$$X_A = \frac{n_A}{n_A + n_B}$$

$$n_{O_2} = \frac{w}{M_w} = \frac{8}{32} = \frac{1}{4};\ n_{N_2} = \frac{w}{M_w} = \frac{7}{28} = \frac{1}{4}$$

$$X_{O_2} = \frac{n_{O_2}}{n_{O_2} + n_{N_2}} = \frac{\frac{1}{4}}{\frac{1}{4} + \frac{1}{4}} = 0.5$$

14. Ans. (1)

$$X_A = \frac{n_A}{n_A + n_B}$$

$$n_A = \frac{w}{M_w} = \frac{7.8}{78} = 0.1$$

$$n_B = \frac{w}{M_w} = \frac{46}{92} = 0.5$$

$$X_{Benzene} = \frac{n_{Benzene}}{n_{Benzene} + n_{toluene}} = \frac{0.1}{0.1 + 0.5} = \frac{1}{6}$$

15. Ans. (2)

Molality = $\frac{n_B}{w_A} \times 1000$

Mole traction of solute in benzene = 0.2

$$X_B = \frac{n_B = 0.2}{n_A + n_B}$$

$X_A = 1 - X_B = 1 - 0.2 = 0.8 = = \frac{n_A}{n_A + n_B}$

$$\frac{X_B}{X_A} = \frac{n_B}{n_A} = \frac{0.2}{0.8} \qquad n_A = \frac{w_A}{M_A}$$

$$M = \frac{n_B}{w_A} \times 1000 \qquad w_A = n_A \times M_A$$

$$M = \frac{n_B}{78 \times n_A} \times 1000 \qquad = n_A \times 78$$

$$= \frac{0.2}{0.8 \times 78} \times 1000 \qquad M_A = M_w \text{ of benzene}$$

$$= \frac{1000}{78 \times 4} = 3.2 \qquad = 78$$

$$\boxed{X = 3.2}$$

16. Ans. (2)

$$ppm = \frac{\text{wt of solute(g)}}{\text{wt of sol}^n\text{(g)}} \times 10^6$$

$$= \frac{0.02}{500} \times 10^6$$

= 40 ppm

17. Ans. (2)

$$N = \frac{X}{5.6} = \frac{20}{5.6} = 3.58$$

18. Ans. (2)

$$M = \frac{n}{V_{(ml)}} \times 1000 = \frac{5 \times 1000}{34 \times 100} = 1.5M$$

19. Ans. (4)

$10\%\left(\frac{w}{V}\right)$ H_2SO_4 solution means 10g H_2SO_4 in 100 ml solution

$$N = \frac{w \times 1000}{E_w \times V_{ml}} \qquad \because E_w \text{ of } H_2SO_4 = 49g$$

$$= \frac{10 \times 1000}{49 \times 100} = 2$$

20. Ans. (1)

$$N = \frac{w \times 1000}{E_w \times V_{(ml)}}$$

$$0.1 = \frac{6.3 \times 1000}{63 \times V_{(ml)}}$$

$V_{(ml)}$ = 1000 ml = 1 L

21. Ans. (1)

As per definition, molality is defined as no. of moles of a solute in 1kg solvent.

22. Ans. (4)

As per theory

23. Ans. (1)

$$M = \frac{n_1}{V_{solution}} \qquad m = \frac{n_2}{w_{solution}}$$

$$1 = \frac{n_2}{V} \qquad 1 = \frac{n_2}{w}$$

$w_{solvent} < V_{solution}$ $\quad$ (d_{water} = 1g/ml)

$n_1 > n_2$

A is more concentrated than B.

24. Ans. (4)

$M = \dfrac{n}{V_{solution}}$ $\qquad$ $m = \dfrac{n}{w_{solution}}$

$w_{solvent} < V_{solution}$ $\qquad$ (d_{water} = 1g/ml)

Hence m > M

25. Ans. (2)

98% (w/W) H_2SO_4 means 98g H_2SO_4 in 100 g solution.

$d_{solution}$ = 1.8 g/ml

$$\text{density} = \frac{\text{wt. of solution}}{\text{Vol. of solution}}$$

$$1.8 = \frac{100}{\text{Vol. of Solution}}$$

$$\text{Vol. of solution} = \frac{100}{1.8}$$

$$M = \frac{n \times 1000}{V_{(ml)}} = \frac{98 \times 1.8 \times 1000}{98 \times 100} = 18\text{ M}$$

26. Ans. (2)

$P = K_H X$

$760 = 2\times10^5 X_g$

$$X_g = \frac{760}{2\times10^5} = 3.8\times10^{-3}$$

27. Ans. (1)

NH_3 reacts with water

28. Ans. (3)

$P_S = P_A^0 X_A + P_B^0 X_B$

$$X_A = \frac{1}{1+4} = \frac{1}{5}$$

$$X_B = \frac{4}{1+4} = \frac{4}{5}$$

$$P_S = 92 \times \frac{1}{5} + 31 \times \frac{4}{5}$$

$$= \frac{92+124}{5} = \frac{216}{5} = 43.2\text{ mmHg}$$

29. Ans. (4)

$P_S = P_A^0 X_A + P_B^0 X_B$ $\quad \because P_S$ = 1atm or 760 torr

$760 = 900\,X_A + 360\,X_B$

$760 = 900\,X_A + 360(1-X_A)$

$760 = 360 + 540\,X_A$

$400 = 540\,X_A$

$X_A = 0.740$

30. Ans. (2)

$$Y_A = \frac{P_A^0 X_A}{P_A^0 X_A + P_B^0 X_B} \qquad X_A = 0.5 = X_B$$

$$Y_A = \frac{108\times0.5}{108\times0.5+36\times0.5} = \frac{108}{144} = 0.75$$

31. Ans. (4)

$Y_A = \dfrac{P_A^0 X_A}{P_S}$ As per theory

32. Ans. (3)

$\Delta S_{mixing} \neq 0$ $\qquad$ (for ideal solution)

Entropy always increases on mixing

33. Ans. (2)

As per theory

34. Ans. (1)

As per definition

35. Ans. (4)

Refractive index is not a colligative property

36. Ans. (1)

$P_S = P_A^0 X_A + P_B^0 X_B$ (P_B^0 =0 for non-volatile solute)

$P_S = P_A^0 \times X_A$

$P_S = P_A^0(1 - X_B)$ $\quad \because X_A = 1 - X_B$

$P_S = P_A^0 - P_A^0 X_B$

$P_A^0 X_B = P_A^0 - P_S = \Delta P$

$\Delta P = P_A^0 X_B$

$\boxed{\Delta P \propto X_B}$

37. Ans. (1)

As per theory

38. Ans. (1)

$P_S = P_A^0 X_A + P_B^0 X_B$

$P_B^0 = 0$; Since solute is solid (non-volatile)

$P_S = P_A^0 X_A$

$\boxed{P_S \propto P_A^0}$

39. Ans. (2)

$P_s = P_0\,N_1 + 0$

$N_1 + N_2 = 1$

$N_1 = 1 - N_2$

$P_s = P_0\,(1-N2)$

$P_s = P_0 - P_0\,N_2$

$P_0 - P_s = P_0\,N_2$

40. Ans. (1)

$P_S = P_A^0 X_A + P_B^0 X_B$ $\qquad X_A = \dfrac{n_A}{n_A + n_B} = \dfrac{2}{1+2} = \dfrac{2}{3}$

$P_S = P_A^0 X_A$ $\qquad X_B = \dfrac{n_B}{n_A + n_B} = \dfrac{1}{3}$

$P_S = P_A^0 \times \dfrac{2}{3}$ $\qquad P_B^0 = 0$

$\dfrac{P_S}{P_A^0} = \dfrac{2}{3}$

41. Ans. (4)

$P_S = P_A^0 X_A + P_B^0 X_B$

At 373K ; $\quad P_A^0$ = 760 mm Hg for aqueous sol.

$750 = 760\ X_A + 0$

$750 = 760(1 - X_B)$

$750 = 760 - 760X_B$

$X_B = \dfrac{10}{760} = \dfrac{1}{76}$

42. Ans. (3)

$P_S = P_A^0 X_A + P_B^0 X_B$ $\qquad X_B = 0.1$

$P_S = 23.8\ (0.9) + 0$ $\qquad X_A = 1 - X_B = 0.9$

$P_S = 21.42$ mm Hg

43. Ans. (2)

$\dfrac{P_A^0 - P_S}{P_S} = \dfrac{n_B}{n_A} = \dfrac{w_B \times M_A}{M_B \times w_A}$

$\dfrac{10-9}{9} = \dfrac{1 \times 200}{M_B \times 20}$

$\dfrac{1}{9} = \dfrac{10}{M_B}$

$M_B = 90$ amu

44. Ans. (2)

CH_3OH will have highest vapour pressure since its Bpt is lowest.

45. Ans. (1)

As per Raoult's law.

Vapour pressure of each component is directly proportional to its mole fraction.

46. Ans. (3)

$P_S = P_A^0 X_A + P_B^0 X_B$

$84 = 70(0.8) + P_B^0(0.2)$

$84 = 56 + 0.2\ P_B^0$

$28 = 0.2\ P_B^0$

$P_B^0 = 140$

47. Ans. (3)

$\Delta T_b = K_b.m \,\&\, \Delta T_f = K_f m$

$(\Delta T_b)_1 = K_b \dfrac{n_B}{w_A}$

$\Delta T_f = K_f \dfrac{n_B}{(2w_A)}$

$\dfrac{\Delta T_b}{\Delta T_f} = \dfrac{K_b(2)}{K_f}$

$\dfrac{0.15}{\Delta T_f} = \dfrac{2(0.512)}{1.86}$

$\Delta T_f = 0.272$

$T_f' = -0.272°C$

48. Ans. (2)

$\Delta T_b = K_b m$

$K_b = \dfrac{\Delta T_b}{m}$

49. Ans. (2)

$\Delta T_b = K_b m$

$0.52 = 0.52 \times \left[\dfrac{6 \times 1000}{M_X .100}\right]$

$M_X = 60$

50. Ans. (4)

$\Delta T_b = K_b m$

For 1 g area

$0.25 = K_b \times \left[\dfrac{1}{60.w_A}\right]$ $\qquad$ ... (1)

For 3g glucose

$\Delta T_b = K_b \times \dfrac{3}{180 \times w_A}$ $\qquad$ ... (2)

$\dfrac{eq.(1)}{eq.(2)} \Rightarrow \dfrac{0.25}{\Delta T_b} = 1$ $\qquad \Rightarrow \Delta T_b = 0.25$

$T'_b = 100.25°\ C$

51. Ans. (1)

$\Delta T_f = K_f m$

$(5.45 - 3.55) = K_f \times 0.374$

$1.90 = K_f \times 0.374$

$K_f = 5.08$ K kg mol^{-1}

52. Ans. (4)

$\Delta T_f = 0.186$

$$\frac{\Delta T_f}{\Delta T_b} = \frac{K_f m}{K_b m}$$

$$\frac{0.186}{\Delta T_b} = \frac{1.86}{0.512}$$

$\Delta T_b = 0.0512$

53. Ans. (4)

As per theory

Only solvent molecules

Solidify at freezing point

54. Ans. (2)

$\Delta T_f = K_f M$

$$= 1.86 \times \left(\frac{0.02}{100} \times 1000\right)$$

$= 0.372°C$

55. Ans. (1)

$\Delta T_f = K_f m$

$$= 1.86 \times \left(\frac{18}{180} \times \frac{1000}{1000}\right) = 0.186$$

$T_f' = -0.186°C$

56. Ans. (4)

$\Delta T_f = 273.15 - 271.94$

$= 1.21$

$\Delta T_f = K_f m$

$$1.21 = 1.86 \times \left[\frac{1.25}{M_w} \times \frac{1000}{20}\right]$$

$M_W = 96.01$ g/mol

57. Ans. (1)

As per definition of osmosis

58. Ans. (2)

As per definition of osmosis

59. Ans. (1)

$\pi \propto C$

$\pi = CRT$

60. Ans. (4)

Silicates of cobalt & nickel & copper ferrocyanide are inorganic compounds which act as semipermeable membrane.

61. Ans. (1)

If $C_1 = C_2$

No movement across membrane.

62. Ans. (3)

Mole Fraction of solute will increase & hence osmotic pressure will increase.

63. Ans. (3)

$$\pi = \frac{n}{v} RT$$

Osmotic pressure of solution will increase if no. of solute molecule is increases.

64. Ans. (2)

$\pi_1 = C_1 RT$

$$= \frac{3.42}{342 \times 1} RT$$

$= 0.01$ RT

$\pi_2 = C_2 RT$

$$= \frac{0.18}{180 \times 0.1} \times RT$$

$= 0.01$ RT

65. Ans. (3)

2 molal sucrose solution means 2 mole sucrose in 1kg solvent

wt of sol. = wt of solute + wt of solvent

= (2 × 342) + 1000

= 1684 g

$$d_{sol.} = \frac{W}{V_{sol}}$$

$$1.4 = \frac{1684}{V_{(ml)}}$$

$$V_{(ml)} = \frac{1684}{1.4}$$

$\pi = CRT$

$$= \left(\frac{n}{V_{(ml)}} \times 1000\right) \times 0.0821 \times 298$$

$$= \frac{2}{1684} \times 1.4 \times 1000 \times 0.082 \times 298$$

$= 40.7$ atm

66. Ans. (1)

$\pi = CRT$

$= 0.3 \times (0.0821 \times 298)$

$= 7.34$ atm

67. Ans. (2)

$n_1 = M_1V_1$ $(V_1=V_2=V)$

$n_2 = M_2V_2$ $M_1 = M_2 = 0.1M$

$n_1 = 0.1$ V

$n_2 = 0.1$ V

when equal volume of both are mixed, then

$\pi = \left(\frac{n_1+n_2}{2V}\right)RT$

$= \left(\frac{0.1V+0.1V}{2V}\right)RT$

$= (0.1)$ RT

68. Ans. (3)

wt of solution = 3+60

= 63 g

$d = \frac{w}{V_{(ml)}} = 1g/ml$

$\frac{63}{V_{(ml)}} = 1$

$V_{ml} = 63$ ml

$\because$ π = CRT

$\pi = \left(\frac{n}{V_{ml}}\times 1000\right)\times 288\times 0.0821$

$= \left(\frac{3\times 1000}{180\times 63}\right)\times 288\times 0.0821 = 6.25$ atm.

69. Ans. (4)

π = CRT

$2.5 = C(0.0821 \times 297)$

C = 0.1025

70. Ans. (2)

$\pi_1 = \pi_2$

$C_1RT = C_2RT$

$C_1 = C_2$

$\frac{8.6}{60\times 1} = \frac{0.5\times 1000}{M_W\times 100}$

$M_W = 34.89$ g

71. Ans. (2)

$\pi_1 = \pi_2$

$C_1RT = C_2RT$

$C_1 = C_2$

$\frac{n_1}{V_1} = \frac{n_2}{V_2}$

$\frac{6.84\times 1000}{342\times 100} = \frac{1.52\times 1000}{M_2\times 100}$

$M_2 = 76$

72. Ans. (4)

$\pi_1 = \pi_2$

$C_1RT = C_2RT$

$C_1 = C_2$

$\frac{n_1}{V_1} = \frac{n_2}{V_2}$

$\frac{500}{M_w\times 1} = \frac{3.42}{342\times 1}$

$M_2 = 50000$

73. Ans. (1)

Intravenous injection are dissolved in water containing salts at particular ionic concentration that matches plasma concentration.

74. Ans. (2)

$\frac{(\Delta T_f)_A}{(\Delta T_f)_B} = \frac{(iK_fm)_A}{(iK_fm)_B} = \frac{2}{1}$

$i_A = 1$ (given)

$\frac{i_A}{i_B} = \frac{2}{1}$

$\frac{1}{i_B} = \frac{2}{1}$

$i_B = \frac{1}{2}$

$i_B < 1$ (Case of Association)

75. Ans. (4)

$i < 1$ (case of Association)

76. Ans. (2)

$K_3[Fe(CN)_6] \rightarrow 3K^+ + [Fe(CN)_6]^{-3}$

Total no. of ions = 4

(After dissociation)

77. Ans. (2)

If $i > 1$, experimental molecular weight of an electrolyte will always be less than its calculated value.

78. Ans. (2)

For non-electrolyte Vant Hoff factor is 1

79. Ans. (2)

$\pi = i$CRT

($i = 2$ for NaCl)

$\pi = \left(\frac{2\times0.585\times1000}{58.5\times100}\right)RT = 4.92$ atm

80. Ans. (4)

$i = 1 - \alpha + \frac{\alpha}{n}$

$(n = 3)$ $(\alpha = 100\% = 1)$

$3A \rightarrow A_3$

$i = 1 - 1 + \frac{1}{3} = \frac{1}{3}$

81. Ans. (3)

$i = 2$ (for KCl)

$i = 1$ (for sugar)

So, ratio of value of any colligative property will be 2

82. Ans. (2)

$i_{NaCl} : i_{CuSO_4} : i_{K_2SO_4}$

= 2 : 2 : 3

= 1 : 1 : 1.5

83. Ans. (2)

$\Delta T_f = iK_fm$

= 2×1.86×1

= 3.72

$T_f^1 = -3.72°C$

84. Ans. (2)

$\Delta T_b = iK_bm$

(i = 2 for NaCl)

$\Delta T_b = 2\times0.51\times0.1$

= 0.102

$T_b^1 = 100 + 0.1$

= 100.1°C

85. Ans. (2)

$i = 1 - \alpha + \frac{\alpha}{n}$

$\alpha = 0.4$, $n = 2$

$i = 0.8$

86. Ans. (3)

$i = \frac{\text{calculated } M_w}{\text{observed } M_w}$

$i = \frac{164}{65.6} = 2.5$

$i = 1 - \alpha + n\alpha$

for $Ca(NO_3)_2$; n is 3

$i = 1 - \alpha + 3\alpha = 1 + 2\alpha = 2.5$

$\alpha = 0.75$

degree of dissociation is 75%

87. Ans. (3)

$\pi_{Na_2SO_4} = \pi_{glucose}$

$(iCRT) = (iCRT)$

$i \times 0.004 = 1\times0.010$

$i = 2.5$

for Na_2SO_4

$i = 1+2\alpha = 2.5$

$\alpha = 0.75$

Degree of dissociation is 75%

88. Ans. (3)

$\pi = iCRT$ (i = 2 for NaCl)

$= \left(\frac{2\times5.85\times1000\times RT}{58.5\times100}\right)$

= 2RT

Which is isotonic with 2M sucrose solution.

89. Ans. (3)

i = 4 for $(NH_3)_4PO_4$ & $\pi = iCRT$,

hence, $(NH_3)_4PO_4$ will exert maximum osmotic pressure.

90. Ans. (3)

1M Alum will exert highest osmotic pressure because Vant Hoff factor is maximum.

91. Ans. (2)

$\pi_{NaCl} = iCRT$ $(i = 2)$

$\pi_{Na_2SO_4} = iCRT$ $(i = 3)$

$i_{Na_2SO_4} > i_{NaCl}$

Hence osmotic pressure of Na_2SO_4 is more than NaCl solution.

92. Ans. (1)

i = 5 for $Al_2(SO_4)_3$ will have highest osmotic pressure.

93. Ans. (2)

i = 2 for $AgNO_3$

i = 3 for $BaCl_2$

i = 3 for Na_2SO_4

i = 4 for $(NH_4)_3PO_4$

Vant Hoff factor for $AgNO_3$ is minimum.

So it will exert minimum osmotic pressure.

94. Ans. (2)

i = 1 [Glucose]

i = 2 [NaCl]

$i = 3$ [$BaCl_2$]

Glucose < NaCl < $BaCl_2$

95. Ans. (4)

$\pi_{Ca(NO_3)_2} = iCRT$

$= 3 \times (0.1)RT$

$= 0.3RT$

$\pi_{Na_2SO_4} = iCRT$

$= 3\times0.1(RT)$

$= (0.3RT)$

96. Ans. (3)

$i_{KNO_3} = 2$

$i_{CH_3COOH} = \frac{1}{2}$

$\pi_{KNO_3} > \pi_{CH_3COOH}$

$P_1 > P_2$

97. Ans. (2)

$\Delta T_{b(AlCl_3)} = iK_b m$

$\Delta T_{b(CaCl_2)} = iK_b m$

$i_{AlCl_3} > i_{CaCl_2}$

98. Ans. (1)

$\Delta T_f = iK_f m$

$i_{K_2SO_4} = 3$ (maximum)

Hence K_2SO_4 will have lowest Freezing point.

99. Ans. (1)

$\Delta T_f = iK_f m$

$\Delta T_f \propto im$

For 0.01 M NaCl, ΔT_f will be maximum & hence minimum freezing point.

100. Ans. (4)

$i = \frac{M_{normal}}{M_{abnormal}}$

For $K_4[Fe(CN)_6]$

$i = 1 + 4\alpha$

$M_{Abnormal} = \frac{M_{Normal}}{i}$

$= M_{Normal}(1+4\alpha)^{-1}$

101. Ans. (4)

0.1 M Na_3PO_4 will have maximum solute particle & hence will have least vapour pressure.

102. Ans. (4)

$\Delta T_f = iK_f m$

$\Delta T_f = im$

For 1 M area sol. depression in fpt will be least & hence maximum fpt.

103. Ans. (4)

On Adding non volatile solute, fpt of solution is less than pure solvent.

104. Ans. (3)

$\text{fpt} \propto \frac{1}{\Delta T_f} \propto \frac{1}{im}$

105. Ans. (2)

$\Delta T_b = iK_b m \Rightarrow \Delta T_b \propto im$

for glucose : (i=1)

$\Delta T_b = 1 \times K_b \times \left(\frac{1\times1000}{180\times100}\right)$

For 1% $\left(\frac{w}{w}\right)$ NaCl (i=2)

$\Delta T_b = 2 \times K_b \times \left(\frac{1\times1000}{55.5\times100}\right)$

For 1% $\left(\frac{w}{w}\right)$ $Ca_3(PO_4)_2$

(i=5)

$\Delta T_b = 5 \times K_b \times \left(\frac{1}{310}\right) \times 1000 \times 100$

For 1% $\left(\frac{w}{w}\right)$ urea (i=1)

$\Delta T_b = \left(\frac{1\times1\times1000}{60\times100}\right)K_b$

For (NaCl), ΔT_b is maximum & hence maximum boiling point.

106. Ans. (4)

$\Delta T_f = iK_f M$

$\Delta T_f \propto i$

For urea (i=1) which is minimum & hence maximum freezing point.

107. Ans. (2)

$HgI_2 + 2KI \rightarrow [K_2HgI_4]$

On adding mercuric iodide to potassium iodide, No of solute particles decreases as it forms complex.
So freezing point is raised.

108. Ans. (2)
Benzoic acid dimerises in benzene.

109. Ans. (1)
$\pi = iCRT$
$= 2.8 \times 0.1 \times 24.6$
$= 6.89$ atm
For K_2SO_4
$i = 1 + 2\alpha = 1+2(0.9)$
$= 2.8$

110. Ans. (2)
For Hg_2Cl_2 $i = 3$
For Na_2SO_4 $i = 3$
$Hg_2Cl_2 \rightarrow Hg_2^{2+} + 2Cl^-$

Exercise-II (Previous Year Questions)

1. Ans. (3)
$\Delta T_f = iK_f m$
$\Delta T_f \propto i$
For $Al_2(SO_4)_3$ i = 5 (maximum)
Hence $Al_2(SO_4)_3$ will exhibit
Largest freezing point depression

2. Ans. (4)
$(\Delta T_b)_x > (\Delta T_b)_y$
$(iK_b m)_x > (iK_b m)_y$
$(i_x > i_y)$
if $i_y = 1$ then $i_x > 1$
So, X is undergoing dissociation in water while y undergoes no change

3. Ans. (1)
$\Delta S_{mix} > 0$ (always)

4. Ans. (3)
$i_{Al_2(SO_4)_3} = 5$
$i_{K_4[Fe(CN)_6]} = 5$

5. Ans. (2)
1 molal aqueous solution means 1 mole solute in 1000 g water
So
$n_B = 1$
$n_A = \frac{1000}{18} = 55.5$
$X_B = \frac{n_B}{n_A + n_B} = \frac{1}{1+55.5} = 0.0177$

6. Ans. (1)
$Y_A = \frac{P_A^0 X_A}{P_A^0 X_A + P_B^0 X_B}; Y_B = \frac{P_B^0 X_B}{P_A^0 X_A + P_B^0 X_B}$
$X_A = \frac{1}{2}$
$X_B = \frac{1}{2}$
$P_A^0 = 12.8$ KPa (Benzene)
$P_B^0 = 3.85$ KPa (toluene)
$Y_A > Y_B$

7. Ans. (1)
$\frac{P_A^0 - P_S}{P_S} = \frac{n_B}{n_A}$
$\frac{760-732}{73.2} = \frac{n_B \times m_A}{w_A} \times \frac{1000}{1000}$
$\frac{28}{732} = m \times \frac{m_A}{1000}$
$\frac{28}{732} = \frac{m \times 18}{1000}$
m = 2.12
$\Delta T_b = K_b m = 2.12 \times 0.52$
$= 1.1$
$T_b' = 101°C$

8. Ans. (4)
For liq $\rightleftharpoons$ Vapour
$\frac{d(\ln p)}{dT} = \frac{\Delta Hv}{RT^2}$ is correct.

9. Ans. (2)
$Ba(OH)_2 \rightarrow Ba^{+2} + 2OH^-$
$i = 1+(n-1)\alpha$
$n = 3, \alpha = 1$
$i = 1+2\alpha = 3$

10. Ans. (2)

For spontaneous process

ΔG_{mix} is Always less than zero

11. Ans. (3)

K_f does not depend on molality.

12. Ans. (1)

Molarity is dependent on temperature.

13. Ans. (3)

$\Delta H_{mix} = 0$

14. Ans. (1)

Interaction attractive forces between A-A & B-B are stronger than those between A-B.

15. Ans. (3)

2M aq. Solution of NaOH means 2 mole NaOH in 1L.

$$d = \frac{w}{V_{(ml)}}$$

$$1.28 = \frac{w_{Sol}}{1000}$$

$w_{sol.} = 1280$ g

$w_{solvent} = w_{sol} - w_{solute}$

$= 1280 - 80 = 1200$

$$\text{Molality} = \frac{n_B \times 100}{w_A}$$

$$= \frac{2 \times 1000}{1200} = 1.67\,M$$

16. Ans. (4)

$\Delta T_f = K_f m$

$= 5.12 \times 0.078$

$= 0.40$ K

17. Ans. (2)

"Ethanol + Acetone" shows positive deviation from Raoult's law.

18. Ans. (1)

$$\frac{P_A^0 - P_S}{P_A^0} = \frac{n_B}{n_A + n_B}$$

For dil soln.

$n_B < n_A$

$$\frac{P_A^0 - P_S}{P_A^0} = \frac{n_B}{n_A}$$

$$\frac{100-80}{100} = \frac{8 \times 114}{M_w \times 114}$$

$M_W = 40$

19. Ans. (3)

Isotonic solutions have same osmotic pressure.

20. Ans. (1)

$$P_1 = \left(\frac{10 \times 1000}{180 \times 250}\right) RT$$

$$P_2 = \left(\frac{10 \times 1000}{60 \times 250}\right) RT$$

$$P_3 = \left(\frac{10 \times 1000}{342 \times 250}\right) RT$$

$P_2 > P_1 > P_3$

21. Ans. (3)

$$\frac{n_{Benzene}}{n_{octane}} = \frac{3}{2}$$

$$X_{Benzene} = \frac{3}{5}$$

$$X_{octane} = \frac{2}{5}$$

$$P_S = P_A^0 X_A + P_B^0 X_B$$

$$= 280 \times \frac{3}{5} + 420 \times \frac{2}{5}$$

$= 336$ mmHg

22. Ans. (1)

$$M = \frac{n_B}{w_A} \times 1000$$

$$1 = \frac{0.5}{w_A} \times 1000$$

$w_A = 500$ g solvent

23. Ans. (1)

$P = K_H X$

$$X \propto \frac{1}{K_H}$$

24. Ans. (2)

Assertion is true because He has low solubility in blood. (NCERT)

25. Ans. (2)

Solubility $\propto \frac{1}{K_H}$

$KH\downarrow \rightarrow$ Solubility$\uparrow$

B > C > A

26. Ans. (1)

$\underset{\text{bar}}{\underset{\downarrow}{\pi}} = \underset{\text{mol L}^{-1}}{\underset{\downarrow}{C}}\ RT$

On comparing with **y = mx**

Slope (m) = RT

25.73 = 0.083 × T

T = 310 K = 37°C

27. Ans. (1)

Amount of glucose required = ?

$n_{glucose} = M \times V_{(\ell)} = \frac{1}{20}\times\frac{250}{1000} = \frac{1}{80}$ mol

$= \frac{1}{80}\times 180$ g

= 2.25 g

28. Ans. (4)

for an isotonic solution

$\pi_1 = \pi_2$

$C_1RT = C_2RT$

$C_1 = C_2$

$\frac{w}{180\times 1} = \frac{15}{60}$

w = 45 g

Exercise-III (Analytical Questions)

1. Ans. (4)

$P = K_Hx$ {x is note Fraction & P is partial

if $K_H = P_1°$ pressure)

$P = P_1°\,X_1$

Hence Raoult's law is special case of Henry's law

2. Ans. (4)

$i = 1 + (n - 1)\alpha$

on decreasing concentration $\alpha\uparrow$ & Hence i increases.

3. Ans. (4)

In pressure cooker, at high pressure cooker, Boiling point of liquid inside the pressure cooker is raised ($\because P \propto T$) which helps in fast cooking

4. Ans. (4)

$\pi_1 = \pi_2$ (for isotonic solution)

Hence there is no net movement of solvent particles.

5. Ans. (2)

For isotonic solution there is no net movement. also osmotic pressure depend on temperature.

6. Ans. (4)

i = 1 (for non electrolyte) for electrolyte

i > 1 (for dissociation) for electrolyte

i < 1 (for association) for electrolyte

7. Ans. (1)

Non ideal solution form azeotropic mixture which are constant boiling azeotropes.

8. Ans. (2)

Colligative properties depend on relative number of solute particles not on the nature of solute particle.

9. Ans. (3)

SPM allows only solvent molecules to pass through it.

10. Ans. (1)

$i = \frac{\text{Normal molar mass}}{\text{Abnormal molar mass}}$

11. Ans. (3)

Total 4 colligative properties

(1) Relative lowering in V.P

(2) Elevation in Bpt

(3) Depression in fpt

(4) Osmotic pressure

12. Ans. (1)

k_f depend on nature of solvent & elevation in boiling point is directly proportional to molality.