Level-01

(1) @ $M_1 V_1 + M_2 V_2 = M_f \times (V_1 + V_2)$

$25 \times 3 + 75 \times 4 = M_f (25 + 75)$

$M_f = 3.75 M$

(2) $0.25 = \dfrac{W \times 1000^{4}}{106 \times 250}$

$W = \dfrac{106}{16} = 6.625 gm$

(3) $N_1 V_1 = N_2 V_2$

$2 \times 1 = N_2 \times 6$

$N_2 = 0.33 N$

(4) $\chi_{NaCl} = \dfrac{\dfrac{5.85}{58.5}}{\dfrac{5.85}{58.5} + \dfrac{90}{18}} = \dfrac{0.1}{0.1+5} = 0.0196$

(5) $M = \dfrac{0.006}{100} \times 1000 = 0.06 M$

(6) $M = \dfrac{9.8}{98 \times 2} = 0.05 M$

(7) $M = \dfrac{5}{40 \times 250} \times 1000 = 0.5$

(6) $N = M \times n\,factor$ $n\,factor\,(H_3PO_3) = 2$

$\quad\quad = 0.3 \times 2$

$\quad\quad = 0.6\,N$

(7) $M_1 V_1 = M_2 V_2$

$\quad M_1 \times 20 = 0.01 \times 19.85$

$\quad M_1 = \dfrac{0.1985}{20} = 0.009925\,M$

(8) $\quad 4v_1 + 10v_2 = 6$

$\quad\quad v_1 + v_2 = 1$

$v_1 = \dfrac{2}{3}L \;;\; V_2 = \dfrac{1}{3}L$

$V_1 = 0.67L \;;\; V_2 = 0.33L$

(11) molality is no. of mole of solute per 1000 gm of solvent.

(9) $M = \dfrac{22 \times 1.253 \times \overset{10}{\cancel{1000}}}{342 \times \cancel{100}} = 0.805\,M$

$N = 0.805 \times n\,factor = 0.805 \times 6$

$\quad\quad\quad = 4.830\,N$

$m = \dfrac{22 \times 1000}{342 \times 78} = 0.825\,m$

(10) $\quad N_1 V_1 = N_2 V_2$

$\quad 0.4 \times 20 = N_2 \times 40$

$\quad\quad N_2 = 0.2$

$\quad\quad M_2 = 0.1\,M$

(11) $c = \dfrac{6.02 \times 10^{20} \times 1000}{6.02 \times 10^{23} \times 100} = 0.01 M$

(12) $\chi_{H_2O} = \dfrac{25/18}{25/18 + \frac{25}{46} + \frac{50}{60}} = 0.503$

(13) $\dfrac{n_{solute}}{n_{solute} + n_{solvent}} = 0.2 \quad \Rightarrow \quad n_{solute} \times 0.8 = n_{solvent} \times 0.2$

$$\dfrac{n_{solute}}{w_{solvent}} = \dfrac{1000}{18 \times 4}$$

$$m = 3.2 m$$

(14) $\dfrac{P^0 - P}{P^0} = \dfrac{w_B \times M_A}{M_B \times w_A}$

$$0.00719 = \dfrac{71.5 \times 18}{M_B \times 1000}$$

$$M_B = 180$$

(15) Boiling point will be increased

(16) $P = P^0 N_1$

(17) glucose

(18) $\chi_{solute} = \dfrac{50-45}{50} = 0.1$

(19) $P_{Total} = P_{Pentane} + P_{Hexane} = \frac{1}{5} \times 440 + \frac{4}{5} \times 120 = 184$

$$\chi_{vapour(pentane)} = \dfrac{\frac{1}{5} \times 440}{184} = 0.478$$

(20) $P_B = P_B^° \, X_B$

$$= \frac{75 \times 1}{1 \cdot 5}$$

$$= 50$$

(21) $\dfrac{P^° - P}{23 \cdot 8} = \dfrac{100 \times 18}{342 \times 1000}$

$P^° - P = 0 \cdot 125 \, mmHg.$

(22)   for $BaCl_2$ lowering of vapour pressure is highest because $i^° = 3$

(23) $P = \dfrac{P^° \times 9.9}{10.9} = 0 \cdot 90 \, P_0$

(24)   same as ques.19

(25)   Benzene + methanol.

(26) $CCl_3 + CHCl_3$

(27) $\Delta S_{mix.} > 0$ for ideal solution.

(28)   we cannot obtain HCl or H_2O in their pure states.

(29)   Minimum boiling azeotropic solution shows positive deviation from Raoults law.

(30)   Azeotropic mixture are constant temperature boiling mixture.

(31) $\underset{C_1}{\overset{\text{Canesugar}}{}} = \underset{C_2}{\overset{\text{Urea}}{}}$

$$\frac{x}{342} = \frac{6}{60 \times 1}$$

$$x = 34.2$$

(32) $\pi = CRT$

$$C = \frac{\pi}{RT} = \frac{0.0821}{0.0821 \times 300} = 0.33 \times 10^{-2}$$

(33) $\pi = CRT$

$$= \frac{5}{342} \times 0.0821 \times 423 \times 10$$

$$= 5.078 \, atm$$

(34) $P \propto \dfrac{1}{\text{Molarmass}}$

$$P_2 > P_1 > P_3.$$

(35) Osmosis is the movement of solvent molecules from lower to higher concentration.

(36) same as Q35.

(37) $C_1 = C_2$

$$\frac{5}{342} = \frac{1}{x}$$

$$x = 68.4$$

(38) same as ques 33

(39) Blood is isotonic with 0.16M Nacl

(40) copper ferrocyanide

(41) $\pi v = \dfrac{m}{M} RT$

$6 \times 10^{-4} \times 1 = \dfrac{4}{M} \times 0.082 \times 300$

$M = 1.6 \times 10^5$

(42) Boiling point will be increased.

(43) $\Delta T_b = k_b \times m$

$0.52 = \dfrac{0.52 \times 6 \times 1000}{M \times 100}$

$M = 60$

(44). $\Delta T_b = K_b \times m$

$$= \frac{0.513 \times 0.1 \times 1000}{200}$$

$\Delta T_b = 0.2565$

$T_1 - T_0 = 0.2565$

$T_1 = 100.2565 \,^\circ\text{C}$

(45) $\Delta T_b = i K_b m$

$$= \frac{3 \times 0.52 \times 13.44}{134.4 \times 1}$$

$$= 1.56 \times 0.1$$

$$= 0.156 \sim 0.16$$

(1) $\Delta T_b = K_b m$

$1 = \dfrac{2.53 \times 10 \times 1000}{M \times 100}$

$M = 253$

(2) $\Delta T_b = K_b m$

$0.25 = \dfrac{0.25}{\Delta T_b} = \dfrac{1 \times 180}{60 \times 3} = 1$

$\Delta T_b = 0.25$

$T_1 = 100.25°C$

(3) $\Delta T_b = i K_b m$

$= 1 \times 1.86 \times 0.05$

$= \dfrac{1.86 \times 5}{10000}$

$= 0.093$

$T_1 = -0.093°C$

(4) $\dfrac{\Delta T_b}{0.186} = \dfrac{0.521}{1.86}$

$\Delta T_b = 0.0521$

(5) on adding non volatile solute freezing point decreases.

(6) Same as ques 1.

(7) $\Delta T_f \propto i K_f m$

for urea. $i = 1$

(8) same as ques. 7

(9) $\Delta T_f = \dfrac{1.86 \times 17 \times 1000}{46 \times 1000}$

$\Delta T_f = 0.69°c$

$T_1 = -0.69°c$

(10)   Kcl solution > phenol solution > glucose solution

(11) for 0.1 M $Al_2(SO_4)_3$ $i = 5$

(12) same as ques 11

(13) $\Delta T_f \propto i$

Urea	common salt (Nacl)	Na_2SO_4
i 1	2	3

1 : 2 : 3

(14) same as ques. 8

(15) same as ques 8.

(16) same as ques. 8

(17) same as ques. 8

(18) same as ques 8.

(19) same as ques. 8
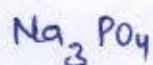
(20) same as ques 19

(21) same as ques. 19.

(22)   for 0.1M $K_4[Fe(CN)_6]$
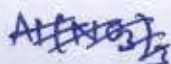
$$i = 5$$

(23)   for sodium phosphate

$$Na_3 PO_4$$
$$i = 4.$$

(24) for $K_3[Fe(CN)_6]$; for $Al_2(SO_4)_3$
$$\quad\quad i = 5 \quad\quad\quad\quad\quad i = 5$$

~~$Al(NO_3)_3$~~
~~$i = 4$~~

(25) $Ca(NO_3)_2$
$$i = 3$$

(26) for urea (non electrolyte)
$$i = 1$$

(27) $\Delta T_f = i\, K_f\, m$

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

$$0.2 = \frac{i-1}{1}$$

$$i = 1.2$$

$\Delta T_f = 1.2 \times 1.86 \times 0.2$
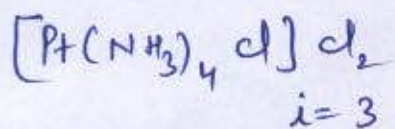
$= 0.24 \times 1.86$

$= 0.45$

$T_1 = -0.45°C$

(28) $\Delta T_f = i \, K_f \, m$

$\quad\quad 0.0054 = i \times 1.8 \times 0.001$

$\quad\quad\quad\quad i = 3$

$\quad\quad [Pt(NH_3)_4 \, Cl] \, Cl_2$

$\quad\quad\quad\quad\quad i = 3$

(29) same as ques 28.

(30) $i_{KNO_3} > i_{CH_3COOH}$

$P \alpha \, i$

$\quad\quad P_1 > P_2$

(31) same as ques. 20

(32) $\alpha = \dfrac{i-1}{x+y-1}$

(33) $\quad Y_A = \dfrac{P_A^o \, X_A}{P_{total}}$

$\quad\quad$ graph of Y_A Vs $\dfrac{1}{P_{Total}}$ is linear.

(34) same as ques . 28

(35)
$$Y_6 = \frac{408 \times \cdot 3}{408 \times 3 + 141 \times \cdot 7}$$

$$Y_6 = 0.554$$

$$Y_7 = 0.446$$

(36) same as 35

(37) $\Delta T_b = i K_b m$

$$1 \cdot 6 = \frac{i \times 2 \cdot 34 \times 28 \times 7^6}{M \times 315}$$

(38) $i = \frac{5}{7} = 0 \cdot 71$

(39) $i = \frac{5 \cdot 85}{3 \cdot 2} = 1 \cdot 82$

$$\alpha = \frac{i - 1}{n - 1} = \frac{1 \cdot 82 - 1}{2 - 1} = 0 \cdot 82$$

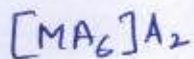(40) weight (Benzene) $= v \times d = 5 \times 0.879 = 43.95 \, gm$

$$\Delta T_f = k_f \times m \implies 0.48 = \frac{5.12 \times 0.643 \times 1000}{M \times 43.95}$$

$$M = 156.05$$

(41) $\Delta T_f = i \, k_f \, m$

$0.00558 = i \times 1.86 \times 0.001$

$i = 3$

$[MA_6]A_2$

(42) for NaCl, $i = 2$

$\Delta T_f = i \, k_f \, m$

$\frac{\Delta T_f}{k_f} = 2 \times k_f \, m$

$m = \frac{1}{1000} \sim 0.0585 \, gm \, NaCl$

(43) Non ideal solution with positive deviation -

(44) Osmosis is the movement of solvent from low concentration to high concentration.

(45) $P = \left(P^{\circ}_A - P^{\circ}_B \right) X_A + P^{\circ}_B$

$$P^{\circ}_B = 140$$

Assertion & Reasoning type Questions

(1) Molality is the no. of moles of solute dissolved in 1kg of solvent.

(2) final Normality = $\dfrac{0.1 \times 100 + 0.2 \times 100}{200} = \dfrac{30}{200} = 0.15$

(3) Both will form the vapours.

(4) The composition of vapour phase is same as that of liquid phase.

(5) Molecular mass of polymers cannot be calculated.

(6) because water is polar and benzene is nonpolar.

(7) Solutions having same osmotic pressure are called isotonic solutions.

(8) Reverse osmosis is used in desalination of sea water.

(9) Camphor is used as solvent in determination of Molecular mass of naphthalene.

(10) Both are colligative properties.

(11) increase in surface area increases the rate of evaporation

(12) Due to strong intermolecular hydrogen bonding.

(13) same as Ques.10

~~(14) due to the addition of non volatile solute vapour pressure~~

(14) same as Ques.3

(15) Molar heat of vaporisation is the amount of heat required to vaporise one mole of liquid.

(16) same as Ques 14.

(17) same as Ques.6

(18) use of pressure cooker reduces cookingtime.

(19) CCl_4 and H_2O are immiscible.

(20) same as Ques.7.

(21) same as Ques 13.

Questions

(1) $P_A = (P_A^o - P_B^o) x_A + P_B^o$

(2) $P = P_A x_A + P_B^o x_B$

$= \dfrac{200 \times \dfrac{25.5}{119.5}}{\dfrac{25.5}{119.5} + \dfrac{40}{85}} + \dfrac{41.5 \times \dfrac{40}{85}}{\dfrac{25.5}{119.5} + \dfrac{40}{85}}$

$= 90.63 \, mmHg$

(3) $\Delta T_b = i K_b m \qquad \Delta T_b \propto i$

Nacl will show higher elevation of b.p.

(4) Acetone + chloroform shows a negative deviation from Raoult's law.

(5) $\dfrac{P^o - P}{P^o} = x_b$

$\dfrac{20 \cancel{P}}{\dfrac{100 \cancel{P}}{5}} = \dfrac{w/40}{\dfrac{w}{40} + 1}$

$\dfrac{5w}{40} = \dfrac{w}{40} + 1$

$\dfrac{4w}{40} = 1$

$w = 10 gm$

(6) Hypertonic

(7) $\dfrac{P^{\circ} - P}{P^{\circ}} = \dfrac{w_B \times M_A}{M_B \times w_A}$

$\dfrac{P^{\circ} - P}{23.8} = \dfrac{100 \times 18}{342 \times 1000}$

$P^{\circ} - P = 0.125 \, mmHg$

(8) $N = M \times n$
$\quad = 3 \times 3$
$\quad = 9$

(9) $\dfrac{X_{Alcohol}}{X_{H_2O}} = \dfrac{n_{Alcohol}}{n_{H_2O}} = \dfrac{138/46}{72/18} = \dfrac{3}{4}$

(10) $1\,M\,NaCl$ because $i = 2$

(11) $\Delta T_f = i k_f m$

$\quad = 2 \times 1.86 \times 1$

$\quad = 3.72 \, ^{\circ}C$

$T_1 = -3.72 \, ^{\circ}C$

Topic 1

Expressions of concentrations

(1) $X_A = \dfrac{m}{55.5+m} = \dfrac{1}{56.5} = 0.017$

↓

Mole fraction of solute

(2) Solubility increases K_H decreases. CO_2 is the most soluble gas in water.

(3) $M = \dfrac{w \times 1000}{M \times v}$

$0.5 = \dfrac{w \times 1000}{98 \times 200}$

$w = 9.8 \, gm$

(4) $M = \dfrac{25.3 \times 1000}{106 \times 250} = 0.955 \, M$

$Na_2CO_3 \rightarrow 2Na^+ + CO_3^{2-}$

$= 2 \times 0.955 + 0.955$

$= 1.910 \, M + 0.955 \, M$

(5) no of moles in 1 kg water $= \dfrac{1000}{18} = 55.56 \, mole$

When 1 mole of water freeze, energy change $= -6 \, KJ$

" 55.56 mole " " " " " " $= -6 \times 55.56 \, kJ$

$= -333.4 \, KJ/kg.$

(6) $m = \dfrac{450 \times 10^{-3} \times 1000}{180 \times 100} = 0.025\,m$

(7) $N_1 V_1 = N_2 V_2$

$\underset{\times 10^{-3}}{0.4 \times 2.5} = N_2 \times 0.5$

$N_2 = 0.002\,N$

(8)   When $0.1\,N$ NaOH is used

$$N_1 V_1 = N_2 V_2$$
$$\text{(HCl)} \quad \text{(NaOH)}$$

$0.2 \times V_1 = 50 \times 0.1$

$V_1 = 25\,cm^3$

When $0.5\,N$ KOH is used

$$N_1 V_1 = N_2 V_2$$
$$\underset{\text{HCl)}}{\text{(remaining}} \qquad \text{(KOH)}$$

$0.2 \times 25 = 0.5 \times V_2$

$V_2 = 10\,cm^3$

(9) $N = M \times \text{nfactor}$

$N = \dfrac{4 \times 1000}{40 \times 100} = 1\,N$

(10) $N = M \times \text{nfactor}$

$0.2 = M \times 2$

$M = 0.1\,M$

(11) $0.25 = \dfrac{W}{60 \times 2.5}$

$W = 37.5\,gm$

(12) $x_{C_6H_6} = \dfrac{n_{C_6H_6}}{n_{C_6H_6} + n_{CCl_4}} = \dfrac{\cdot\,^{30}/_{78}}{^{30}/_{78} + ^{70}/_{154}} = 0.459$

(13) $M = \dfrac{\overset{4}{\cancel{5}}5 \times 1000}{40 \times 250} = 0.5M$

(14) $N = \dfrac{1.575 \times 1000}{63 \times 250} = 0.1\,N.$

$H_2C_2O_4 \cdot 2H_2O$ is an organic acid which contains 2 molecules of water of crystallisation.

(15) $M_1V_1 + M_2V_2 = M_3V_3$

$M_3 = \dfrac{0.5 \times 800 + 1 \times 200}{1000}$

$M_3 = 0.6M$

(16) $W = \dfrac{E \times N \times V}{1000}$

$E = \dfrac{0.126 \times 1000}{0.1 \times 20} = 63$

(17) $N = \dfrac{N_1V_1 + N_2V_2 + N_3V_3}{V_1 + V_2 + V_3} = \dfrac{60 \times \dfrac{N}{5} + 10 \times \dfrac{N}{2} + 30 \times \dfrac{N}{10}}{60 + 10 + 30} = 0.2N$

(18) Total no. of molecules $= \frac{95}{100} \times \frac{6 \cdot 023 \times 10^{23}}{58 \cdot 5} \times 10 = 0 \cdot 98 \times 10^{23} \sim 10^{23}$

(19) Molality and mole fraction depends only upon weight but not on volume.

(20) % weight of $NaOH = \frac{W_{NaOH}}{W_{solution}} \times 100$

$= \frac{50}{1050} \times 100 = 4 \cdot 76 \%$.

$1 \cdot 25$ molal $NaOH$ means $1 \cdot 25$ moles of $NaOH$ in $1000 gm$ of H_2O

$W_{NaOH} = 50 gm$

$W_{solution} = 1000 + 50 = 1050 gm$

(21) $M = \frac{25}{250 \times 100} \times 1000 = 1M$

$m = \frac{25}{250 \times 1 \cdot 25 \times 100} \times 1000 = 0 \cdot 8 m$

(22) $m = \frac{180}{180 \times 1} = 1 \, molal$

(23) $N_1 V_1 = N_2 V_2$

$0 \cdot 1 \times 10 = N_2 \times 15$

$N_2 = \frac{1}{15} = 0 \cdot 066 N$

(24) Total volume of $1m$ solution $> 1000 cc$ due to extra 1 mole H_2SO_4.
$1m$ is less concentrated than $1M$.

(25) Molarity (volume is temperature dependent)

(26)
$$N_1 V_1 = N_2 V_2$$
Acid   Base

$$\frac{6.3 \times 1000}{63 \times 250} \times 10 = 0.1 \times V_2$$

$$V_2 = 40ml.$$

(27) $N_1 V_1 = N_2 V_2$

$$0.5 \times 100 = 0.1 \times V_2$$

$$V_2 = 500cm^3$$

$$V_{H_2O} = 500 - 100 = 400cm^3$$

(28) $N = \dfrac{9.8 \times 1.8 \times 10}{49} = 36 N$

$$N_1 V_1 = N_2 V_2$$

$$36 \times V_1 = 0.2 \times 1000$$

$$V_1 = 5.55 ml$$

(29) 10% strength = $\dfrac{10}{180}$ mole in 100 cc.

1 mole of glucose will be present in = $\dfrac{0.1 \times 180}{10} = 1.8 L$

(30) $N = M \times m\,factor$

$$= 3 \times 3$$

$$= 9 N$$

(31) $N_1V_1 + N_2v_2 = NV$

$10v + 4(1-v) = 7 \times 1$

$V = 0.5 L$

Volume of $10N$ $HCl = 0.5L$

" " $4N$ " $= 1 - 0.5 = 0.5L$

(32) $X_{H_2O} = \dfrac{18/18}{\dfrac{18}{18} + \dfrac{414}{46}} = 0.1$

(33) Volume strength $= \dfrac{22400 \times 25.5}{68}$

$= 8400 ml$

$= 8.4.$

(34) $N_1V_1 = N_2v_2$

$2 \times v = 1 \times 20$

$v = 10 ml$

(35) $ppm = \dfrac{25 \times 10^{-3} \times 10^6}{5000}$

$= 5$

(36) $0.03 = \dfrac{\omega}{60}$

$w = 1.8 gm$

(37) $N \times V = \dfrac{w}{E}$

$0.1 \times v = \dfrac{1}{50}$

$v = \dfrac{1}{5} \times 1000 = 200 \, cm^3$

(38) $0.1 = \dfrac{w \times 1000}{40 \times 250}$

$w = 1 gm$

(39) $M_1 V_1 = M_2 V_2$

$\cancel{12} \times V_1 = 18 \times 24\overset{2}{\cancel{0}}$

$V_1 = 360 \, ml$

$V_1 = 0.36 \, L$

Raoult's law (Ideal and Non ideal solution)

(1) $P = P_A + P_B$

$P = P_A^\circ X_A + P_B^\circ X_B$

$P = P_A^\circ X_A + P_B^\circ - P_B^\circ X_A$

$P = P_B^\circ + X_A (P_A^\circ - P_B^\circ)$

(2) Solution which shows negative deviation from raoults law are called maximum boiling azeotropes.

(3) When concentration of salt solution increases, vapour pressure decreases and Boiling point increases.

(4) with the addition of H_2O, concentration decreases thus vapour pressure increases.

(5) only non ideal solution forms azeotropic mixtures - $(CCl_4 + CHCl_3)$

(6) $\dfrac{\text{loss in weight of solvent}}{\text{gain in weight of } CaCl_2 \text{ tube}} = \dfrac{P^\circ - P}{P^\circ}$

(7) $He + O_2$ mixture is used by deep sea divers because its very low solubility in blood.

(8) $\dfrac{P - P_s}{P} = \dfrac{n}{n + N}$

(9)

$$\frac{P^\circ - P_s}{P^\circ} = X_{solute}$$

$$\frac{0.8 - 0.6}{0.8} = X_{solute}$$

$$X_{solute} = \frac{0.2}{0.8} = 0.25$$

(10) $CH_3CH_2OH + CH_3COCH_3$ is nonideal & shows positive deviation.

(11)

$$P = P_A^\circ X_A + P_B^\circ X_B$$

$$84 = 0.8 \times 70 + 0.2 \times P_B^\circ$$

$$P_B^\circ = 140 mm$$

(12)

$$500 = \frac{1}{3} P_A^\circ + \frac{1}{3} P_B^\circ$$

$$P_A^\circ + 2P_B^\circ = 1500$$

$$500 + 25 = \frac{1}{4} P_A^\circ + \frac{3}{4} P_B^\circ$$

$$P_A^\circ + 3P_B^\circ = 2100$$

$$P_A^\circ = 300 \, mmHg$$

$$P_B^\circ = 600 \, mmHg$$

(12)

$$C = K_H \times P$$

$$= 1.4 \times 10^{-3} \times 0.5 = 7 \times 10^{-4}$$

in $100 ml = 7 \times 10^{-5}$

weight of O_2 in $100 ml = 7 \times 10^{-5} \times 32$
$$= 2.24 \times 10^{-3} gm.$$

(13) $x_B = \dfrac{1}{56.5} \Rightarrow \dfrac{\Delta P}{P} = x_B$.

$$\Delta P = P x_B$$

$$= \dfrac{760 \times 1}{56.5} = 13.45 \text{ torr}$$

(14) In equimolar mixture

$$x_A = 0.5 \ , \ x_B = 0.5$$

$$P = 0.5 \times 150 + 0.5 \times 150$$

$$P = 125$$

$$Y_B = \dfrac{Y_B P_B^{\circ}}{P} = \dfrac{0.5 \times 100}{125} = 0.4$$

(15) chloroform – acetone solution shows negative deviation from Raoults law.

(16) Methanol is a volatile substance, so its aqueous solution in water has more vapour pressure than methanol.

(17) $\dfrac{P^{\circ} - P}{P^{\circ}} = x_B = 0.2$

(18) $184 = 200 \times \dfrac{3}{3+2} + P_B^{\circ} \times \dfrac{2}{3+2}$

$$P_B^{\circ} = 160 \text{ torr}.$$

(19) chloroform + Acetone are shows negative deviation from Raoults law. $\Delta V_{mix} = -ve$.

(20)
$$\gamma_A = \frac{P_A^o X_A}{P_A^o X_A + P_B^o X_B}$$

$$= \frac{1 \times 1}{1 \times 1 + 2 \times 2} = \frac{1}{5} = 0.2$$

(21) An ideal solution have zero volume change and zero heat of mixing.

colligative properties, Abnormal Molecular mass and Distribution law

(1) $\Delta T_f = i \, k_f \, m$

$\Delta T_f = \dfrac{i \times K_f \times W_B \times 1000}{M_B \times W_A}$

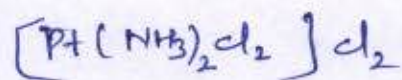$3.82 = \dfrac{i \times 1.86 \times 5 \times 1000}{142 \times 45}$

$i = 2.63$

(2) Dissciation, $i > 1$

Association, $i < 1$

(3) $\Delta T_f = i \, k_f \, m$

$0.0054 = i \times 1.86 \times 0.001$

$i = 3$

$[Pt(NH_3)_2 cl_2] cl_2$

(4) $\pi_1 = \pi_2$

$\dfrac{W_1}{M_1} = \dfrac{W_2}{M_2}$

$\dfrac{3}{M_1} = \dfrac{0.05 \times 180}{180}$

$M_1 = \quad 60$

$n = \dfrac{60}{30} = 2 \quad (CH_2O)_2 = C_2H_4O_2$

(5) Two sucrose solution of same molality will have different depression. of freezing point.

(6) $$\Delta T_f = \frac{1000 \times k_f \times w_2}{M_2 \times w_1} = \frac{1000 \times 1.86 \times 68.5}{342 \times 1000} = 0.372°C$$

$$\Delta T_f = T° - T_1$$
$$= 0 - 0.372 = -0.372°C$$

(7) Concentration of $BaCl_2$ solution is lower, thus solvent moves from $BaCl_2$ to $NaCl$ solution.

(8) $i \propto \dfrac{1}{\text{Concentration}}$

(9) $$\Delta T_f = \frac{5.12 \times 1000 \times 0.223}{136 \times 4.4} = 1.91°C$$
(Theoritical)

(Actual) $\Delta T_f = 5.3 - 4.47$
$$= 0.83°C$$
$$i = \frac{0.83}{1.91} = 0.43$$

$$i < 1$$
Association will take place.

(10) Sucrose $\rightarrow$ no ion

$NaCl \rightarrow Na^+ + Cl^-$

$CaCl_2 \rightarrow Ca^{2+} + 2Cl^-$

glucose $\rightarrow$ no ion.

% $CaCl_2$ has least freezing point.

(11) $\Delta T_f = K_f \times m$

$$0.01 = \frac{K_f \times 1.5 \times 1000}{60 \times 250}$$

$$K_f = 0.1$$

(12) isotonic solution have same osmotic pressure.

(13) $\Delta T_b = \dfrac{0.52 \times 0.6 \times 1000}{60 \times 100} = 0.052°c$

$\Delta T_b = T_1 - T_0$
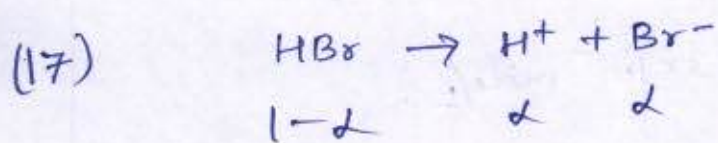
$0.052 = T_1 - 100 \Rightarrow T_1 = 100.052°c$

(14) egg will shrink because osmosis occurs.

(15) $\Delta T_b = \dfrac{1000 \times K_b \times 10}{100 \times 100} = K_b$

(16) H_2SO_4 gives 3 ions & NaCl gives 2 ions. vapour pressure of solution of NaCl is higher.

(17)

$$HBr \rightarrow H^+ + Br^-$$
$$1-\alpha \qquad \alpha \qquad \alpha$$

total ions $= 1-\alpha + \alpha + \alpha = 1+\alpha.$ $i = 1+\alpha$

$$= 1 + \frac{90}{100} = 1.9$$

$\Delta T_f = i K_f m$

$$= \frac{1.9 \times 1.86 \times 8.1/81}{100/1000}$$

$$= 3.534°c$$

$\Delta T_f = T_0 - T_1$

$3.534 = 0 - T_1 \Rightarrow T_1 = 3.534°c$

(18) freezing point of pure solvent decreases on the addition of solute.

(19) $\Delta T_b = i \cdot K_b \times m$

$\quad\quad = 2 \times 0.52 \times 1$

$\quad\quad = 1.04$

$\quad\quad \Delta T_b = T_1 - T_0$

$\quad\quad 1.04 = T_1 - 100$

$\quad\quad T_1 = 101.04°C$

(20) atm

(21) optical activity

(22) $\Delta T_f = i K_f \, m$

$\quad 0.00732 = i \times 1.86 \times 0.002$

$\quad\quad i = 2.$

(23) $\pi = cRT$

$\quad C = \pi/RT = \dfrac{0.0821}{0.0821 \times 300} = 0.33 \times 10^{-2} \, mole/L$

(24) no. of particles increases, boiling point increases & freezing point decreases.

$\quad\quad\quad D < B > A < C$

(25) $Ca(NO_3)_2$ & Na_2SO_4 both will give equal ions.

(26)

	i	
KNO_3	2	$\Delta T_b = i K_b m$
Na_3PO_4	4	
$BaCl_2$	3	
K_2SO_4	3	

(27) $\pi_{glucose} = \pi_{urea}$

$$\frac{x \times 1000}{180 \times 100} = \frac{6 \times 1000}{60 \times 100}$$

$$x = 18\, gm$$

(28) $CaCl_2$ act as non volatile solute so results In depression in freezing point.

(29) When freezing starts, liquid solvent is in equilibrium with solid solvent.

(30) $\Delta T_f = i\, K_f\, m$

$$= 1.2 \times 1.86 \times 0.2 = 0.45°C$$

$$\Delta T_f = T_0 - T_f$$

$$0.45 = 0 - T_1$$

$$T_1 = -0.45°C$$

(31) $i = \dfrac{40}{25}$

$1 + \alpha = \dfrac{40}{25}$

$\alpha = \dfrac{15}{25} = 0.6$ or 60%.

(32) $\Delta T_f = K_f \times m$

$$1.01 = \frac{1.93 \times 20 \times 1000}{M \times 500}$$

$$M = 76.4$$

(33) $\dfrac{\Delta T_f(KCl)}{\Delta T_f(BaCl_2)} = \dfrac{2}{3}$

$\Delta T_f(BaCl_2) = \dfrac{3}{2} \times 2 = 3°C \quad \sim -3°C$

(34) by this method lowering in vapour pressure, vapour pressure of solvent and relative lowering of vapour pressure all can be measured.

(35) $\pi = \dfrac{WRT}{MV}$

$T = \dfrac{16.4 \times 180 \times 100}{10 \times 1000 \times 0.082} = 360K$

(36) $i > 1$ dissociation.

(37) A & B

A 0.1M glucose $\rightarrow 0.1 \times 1 = 0.1$

B 0.05M NaCl $\rightarrow 0.05 \times 2 = 0.1$

isotonic means same molar concentration.

(38) $\dfrac{P° - P}{P°} = \dfrac{w_x M}{M_x W}$

$\dfrac{640 - 600}{640} = \dfrac{2.175 \times 78}{m \times 39.08}$

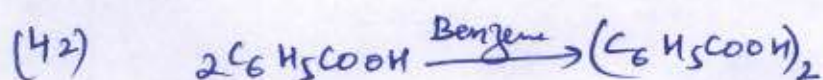$m = 69.60$

(39) $Ca(NO_3)_2 \rightarrow Ca^{2+} + 2NO_3^-$

3 ions.

(40) $\frac{P^° - P}{P^°} = i \chi_B$

i is maximum for $0.1 M\ BaCl_2$

(41) $\pi v = n R T$

$\pi v = \frac{W}{M} R T$

$M = \frac{4 \times 0.0821 \times 300}{4 \times 10^{-4}} = 2.4 \times 10^5$

(42) $2 C_6 H_5 COOH \xrightarrow{Benzene} (C_6 H_5 COOH)_2$

$i = \frac{1}{2} = 0.5$

(43) $\pi v = n R T$

$\pi v = \frac{m_2}{M_2} R T$

$M_2 = \frac{m_2 R T}{\pi v}$

(44) Freezing point will be highest due to lower concentration of NaCl.

(45) Camphor is used in molecular mass determination due to its volatile nature.

(46) $\Delta = \frac{P^° - P}{P^°}$

$\frac{30 - P}{30} = 0.1$

$P = 30 - 3 = 27$

(47)

Molar concentration $(M_1) = \dfrac{10}{60} = \dfrac{1}{6}$

$$\dfrac{\frac{\Delta T_{f_1}}{1}}{\frac{\Delta T_{f_2}}{1}} = \dfrac{\frac{M_2}{1}}{\frac{M_1}{1}}$$

Non volatile solute

$$M_2 = \dfrac{50}{m}$$

$$\dfrac{1}{6} = \dfrac{50}{m}$$

$$m = 300 \text{ gm/mol}$$

(48)

$$\dfrac{\Delta T_{f_1}}{\Delta T_{f_2}} = \dfrac{M_2}{M_1}$$

$$\dfrac{2.15}{\Delta T_{f_2}} = \dfrac{180}{342}$$

$$\Delta T_{f_2} = 4.085 K \text{ or } 269.05 K$$

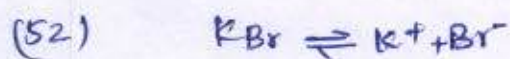**(49)** Osmotic pressure method is especially suitable for determination of molecular masses.

(50)

$$\dfrac{P - P_s}{P} = \dfrac{W_1 \times M_2}{M_1 \times W_2}$$

$$\dfrac{W_{glucose} \times 18}{50 \times 180} = \dfrac{W_{urea} \times 18}{50 \times 60}$$

$$W_{glucose} = 3$$

(51) $\dfrac{P - P_s}{P} \times \dfrac{1000}{M}$ = Molality (m)

$$m = \dfrac{25 - 24.5}{25} \times \dfrac{1000}{18} = 1.11\, m.$$

(52) $KBr \rightleftharpoons K^+ + Br^-$

$$i = \dfrac{1 - 0.8 + 2 \times .8}{1} = 1.8$$

$$\Delta T_f = 1.8 \times 1.86 \times 0.5 = 1.674\, K$$

$$T_f = 271.326\, K$$

(53) Aqueous solution of any substance (non volatile) freezes below $0°c$ because vapour pressure of solution becomes lower than that of pure solvent.

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

$$\dfrac{\Delta T_f}{0.18} = \dfrac{1.86}{0.512}$$

$$\Delta T_f = 0.654$$

$$\Delta T_0 - T_1 = 0.654$$

$$T_1 = -0.654°c$$

(55) $\pi = CRT$

$$C = \dfrac{7.8}{0.0821 \times 310} = 0.31\, mole/L$$

(51)

(56) $K_b = \dfrac{M_1 R T_0^2}{1000 \, \Delta_{vap.} \times H}$

$= \dfrac{18 \times 0.002 \times (373.15)^2}{1000 \times 9.72} = 0.52 \,^oc \, kg/mole$

(57) Distribution law was given by Nernst.

(58) $\Delta T_f = \dfrac{1000 \times K_f \times w}{M \times W}$

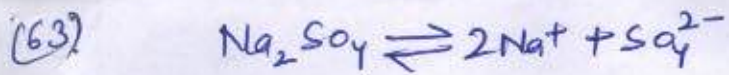$0.74 = \dfrac{1000 \times 1.86 \times 20}{M \times 500}$

$M = 100.$

So, degree of ionisation of electrolyte 0%.

(59) The Molal depression constant (K_f) for camphor is maximum.
So, depression of freezing point will also be maximum.

(60) $\chi_{solute} = \dfrac{760 - 750}{760} = \dfrac{1}{76}$

(61) Naphthalene is a non volatile solid, hence on addition in benzene decreases its vapour pressure.

(62) $\chi_A = \dfrac{0.8 - 0.2}{0.8} = \dfrac{0.6}{0.8} = \dfrac{3}{4} = 0.75$

(63) $Na_2SO_4 \rightleftharpoons 2Na^+ + SO_4^{2-}$

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

$i = 1 + 2\alpha$

(64) At high altitude, the boiling point of water lowers because atmospheric pressure is low.

(65) In Glucose $i = 1$ while others are electrolyte $i > 1$

$$\Delta T_f = i \, k_f \, m$$

ΔT_f is lowest for glucose.

(66)
$$2.74 = \frac{0.1 - \alpha + \alpha + 2\alpha}{0.1}$$

$\alpha = 0.087$ or 87%

degree of dissociation $= \dfrac{0.087}{0.1} \times 100 = 87\%$.