14. $m = \frac{M \times 1000}{d \times 1000 - M \times M_w \text{ of solute}}$

$3 = \frac{M \times 1000}{1.110 - M \times 40}$

$3.33 - 120\ M = M \quad 1000$

$3.33 = M(1120)$

$M = 2.97$

16. The concentration of solution (ppm)

$= \frac{\text{wt. of solute}}{\text{wt. of solvent}} \times 10^6 = \frac{5}{10^6} \times 10^6 = 5\,\text{ppm}$

31. $\Delta T_b = m \quad k_b$

$\Delta T_b = 0.69 \quad 0.513\ C$

$\Delta T_b = 0.69 \quad 0.513\ C$

$T_{solution} - T_{solvent} = 0.359\ C$

$T_{solution} - 99.725\ C = 0.359\ C$

$T_{solution} = 100.0789\ C$

32. $\Delta T_f = i \quad m \quad k_f$ $[NaCl = Na^+ + Cl^-]$

$\Delta T_f = 2 \quad 1 \quad 1 \quad 1.86 \quad i = 2$

$\Delta T_f = 3.72$

$T_{solvent} = T_{solution} = 3.72$

$O - T_{solution} = 3.72$

$T_{solution} = -3.72\ C$

33. $\Delta T_b = m \quad k_b$

$0.3 = \frac{10 \times 1000}{100 \times 100} \times k_b$

$k_b = 0.3$

39. $\alpha = \frac{M_T - M_0}{M_0} = \frac{58.50 - 31.80}{31.80} = 0.8396 = 83.96\%$

40. $3A \longrightarrow A_3$

$1-\alpha \qquad \alpha/3$

$i = 1 - \alpha + \alpha/3 \qquad \alpha = 100\ \%$

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

52. 5% solution means 100 mL solution contain 5 g cane sugar

0.877 % means 100 mL solution contain 0.877 g X isotonic solution $C_1 = C_2$

$\frac{5}{342 \times 100} = \frac{0.877}{M_W \times 100}$

$M_W = \frac{0.877}{5} \times 342 = 59.98$

54. Osmotic pressure $\propto$ Colligative properties

OP = iCRT

$AlCl_3$ (i = 4), $BaCl_2$ (i = 3), Urea (i = 1)

1. $\Delta T_b = \frac{1000 K_b w_2}{M_2 w_1} \quad T_b - T_b = \frac{1000 \times 0.52 \times 0.6}{60 \times 100}$

$T_b - 373 = 0.052 \quad T_b = 373.052$

4. $M_2 = \frac{1000 \times K_b \times w_2}{\Delta T_b w_1} \quad M_2 = \frac{1000 \times 2.53 \times 2.5}{1.38 \times 34}$

5. $\Delta T_f = \frac{1000 k_f w_2}{M_2 w_1}$

$M_2 = \frac{1000 \times 6.8 \times 1.2}{2.8 \times 15} \quad M_2 = 194.2\ \text{g/mole}$

6. $\Delta T_b = i \quad \frac{1000 k_b w_2}{M_2 w_1} \quad i = \frac{0.27 \times 122 \times 100}{1000 \times 0.54 \times 12.2}$

$i = 0.5 \quad i = 1 - \alpha + \frac{\alpha}{n}$

$0.5 = 1 - 1 + \frac{1}{n} \quad n = 2$

9. $\Delta T_b = i\ k_b m \quad x_3y_2 \longrightarrow 3x^{+2} + 2y^{+3}$

$i = 1 - \alpha + 3\alpha + 2\alpha \quad i = 0.75 + 1.25$

$i = 2 \quad T_1 - T_0 = 2 \quad 1 \quad 0.52$

$T_1 = 373 + 1.04 \quad T_1 = 374.04$

13. $\Delta T_b = k_b m \quad T_1 - T_0 = 0.573 \quad 0.1$

$T_1 = 373.0573\ K$

16. $\Delta T_b = k_b m \quad 0.15 = 0.512 \quad m$

$m = 0.292 \quad \Delta T_f = K_f m'$

$m' = m/2 \quad T_1 - T_0 = 1.86 \quad \frac{0.292}{2}$

$T_1 = -0.27\ C$

28. Acetone = 10 gm water = 90 gm

mole % of acetone $= \frac{10/58}{12/58 + 90/18} \times 100 = 3.33\%$

29. $\Delta T_f = K_f m \quad m = \frac{0.14}{1.86} = 0.075$ molal

34. $\frac{P^\circ - P_S}{P_S} = \frac{\text{loss in wt. of solvent}}{\text{loss in weight of solution}} \quad \ldots(i)$

$\frac{P^\circ - P_S}{P_S} = \frac{w_1}{M_1} \times \frac{M_2}{w_2} \quad \ldots (ii)$

from eq. (i) and (ii)

$\frac{0.04}{2.5} = \frac{5 \times 18}{180 \times M_1}$

$M_1 = 31.25$

2. Given that,

P = 640 mm, P_s = 600 mm, w = 2.175 g, W = 39.0 g, M = 78

$\because \quad \frac{P^0 - P_s}{P_s} = \frac{w \times M}{m \times W}$

$\therefore \quad \frac{640-600}{600} = \frac{2.175 \times 78}{m \times W}$

$\therefore$ m = 65.25

3. Given

$\Delta T = \frac{1000 \times K_f' \times w}{m \times W}$

W = wt. of benzene = V d = 50 0.879 g

$\therefore \quad 0.48 = \frac{1000 \times 5.12 \times 0.643}{m \times 50 \times 0.879}$

$\Delta T = 5.51 - 5.03 = 0.48$

$\therefore$ m = 156.06

w = 0.643 g, $K_f' = 5.12$ K mol^{-1} kg

5. $\frac{P^0 - 21.85}{21.85} = \frac{30 \times 18}{90 \times m}$ for I case.....I

Now Weight of solvent (विलायक का भार)=90+18=108g

$\frac{P^0 - 22.15}{22.15} = \frac{30 \times 18}{108 \times m}$ for II case.....II

$\therefore$ By eq. (i) P m – 21.85 m = 21.85 6 = 131.1

By eq. (ii) P m– 22.15 m = 22.15 5 = 110.75

– + –

$\therefore \quad 0.30$ m = 20.35

$\therefore \quad m = \frac{20.35}{0.30} = 67.83$

On substituting in Eq. (i),

$\frac{P^0 - 21.85}{21.85} = \frac{30 \times 18}{90 \times 67.83}$

$\therefore \quad P^0 =$ **23.78 mm**

6. $\Delta T_f = \frac{1000 K_f W_2}{M_2 W_1}$

$M_2 = \frac{1000 \times 5.12 \times 2}{0.6 \times 100}$ $M_2 = 170.6$ gm/mol

10. $\Delta T = K_f$ molality (1 + α)

For acetic acid : $CH_3COOH \rightleftharpoons CH_3COO^- + H^+$

1 0 0

1 – α α α

Given, α = 0.23 ; Also, molality (मोललता)

$= \frac{\text{mole of acetic acid (एसीटिक अम्ल के मोल)}}{\text{weight of water in kg (जल का kg में भार)}}$

$= \frac{3 \times 10^{-3} \times 10^3}{60 \times \frac{500 \times 0.997}{10^3}} = 0.10$

$\Delta T = K_f$ molality (1 + α)

$\Delta T = 1.86 \quad 0.1 \quad 1.23 = 0.229$

11. $\Delta T_f = i K_f m$ $0.062 = i \quad 1.86 \quad 0.01$

i = 3.33 $\alpha = \frac{i-1}{n-1}$

$\alpha \Rightarrow \frac{3.33-1}{4-1}$ $\alpha \Rightarrow 0.777$

14. $\Delta T_b = i K_b m$ $0.46 = i \quad 0.52 \quad \frac{0.011 \times 10^3}{0.1 \times 261}$

i = 2.098 $\alpha = \frac{i-1}{n-1}$

$\Rightarrow \frac{2.098-1}{3-1}$ $\alpha \Rightarrow 0.55$

25. For 0.01 M solution,

$\pi_1 V_1 = n_1 S_1 T_1$ $n_1 / V_1 = 0.01$

$\therefore \quad \pi_1 = 0.01 \quad 0.0821 \quad 300$ T = 300 K

= 0.2463 atm

For 0.001 M solution,

$\pi_2 V_2 = n_2 S T_2$ $n_2 / V_2 = 0.001$

$\therefore \quad \pi_2 = 0.001 \quad 0.0821 \quad 300$ T = 300 K

= 0.02463 atm

The movement of solvent particles occurs from dilute to concentrate solution, i.e., 0.001 M to 0.01M solution. Thus, pressure should be applied on concentrated solution, i.e., **on 0.01 M solution** to prevent osmosis.

(विलायक के कणों की गति तनु से सान्द्र विलयन अर्थात्, 0.001 M से 0.01 M विलयन तक होती है। अत: परासरण को रोकने के लिए सान्द्र विलयन अर्थात्, **0.01 M विलयन** पर दाब लगाना चाहिए।)

Also, magnitude of external pressure (और बाह्य दाब का परिमाण)

= 0.2463 – 0.0246 = 0.2217 atm pressure on 0.01 M solution.

26. For initial solution,

$\because$ $\pi = \frac{500}{760}$atm , T = 283 K

$\frac{500}{760} \times V_1 = n \times S \times 283$ ... (i)

After dilution, let volume becomes V_2 and temperature is raised to 25 C, i.e, 298 K

(तनुता के पश्चात्, माना आयतन V_2 हो जाता है तथा ताप 25 C अर्थात् 298 K तक बढ़ जाता है)

$\pi = \frac{105.3}{760}$atm

$\frac{105.3}{760} \times V_2 = n \times S \times 298$ ... (ii)

$\therefore$ By Eqs. (i) and (ii), we get

$\frac{V_1}{V_2} = \frac{283}{298} \times \frac{105.3}{500}$ $\frac{V_1}{V_2} = \frac{1}{5}$

$\therefore$ $V_2 = 5\ V_1$

i.e., solution was diluted to 5 times. (अर्थात् विलयन 5 गुना तक तनु हो गया)

28. $\pi = i\ cST$ $\alpha = \frac{i-1}{n-1}$

$0.46 = \frac{i-1}{5-1}$ $i = 2.84$

$\pi = 2.84 \quad 0.1 \quad 0.082 \quad 291$

$\pi = 6.785$ atm

LIQUID SOLUTION — EXERCISE # 4[B]

1. $\Delta T_b = iK_b m$

$0.15 = 3 \quad 0.5 \quad m \Rightarrow m = 0.1$

Now, $Pb(NO_3)_2 + 2NaCl \longrightarrow PbCl_2 + 2NaNO_3$

0.1 0.2

\- - 0.1 0.2

Now, this solution contains two salts

(अब, इस विलयन में दो लवण हैं)

$\Delta T_f = K_f \quad m \quad 0.83 = 1.86\ [2 \quad 0.2 + 3s]$

where s is molar solubility of $PbCl_2$.

(जहाँ s, $PbCl_2$ की मोलर विलेयता है।)

$s = 1.54 \quad 10^{-3} \quad K_{sp} = 4s^3 =$ **$1.46 \quad 10^{-5}$**

2. $\Delta T_b = i \quad K_b \quad m$

$5.93 \quad 10^{-3} = \frac{(x+1) \times 0.52 \times 0.25 \times 1000}{M \times 10}$

$\frac{(x+1)}{M} = 4.56 \quad 10^{-4}$ ... (i)

$\frac{M}{100} = 23x$ ... (ii)

From equation (i) and (ii)

(समीकरण (i) व (ii) से) $x = 20.34 \simeq 20$

Formula of protein (प्रोटीन का आण्विक सूत्र) = $H_{20}P$

$M = 2300 \quad 20 - 20 \quad 23 + 23 =$ **45563 amu**

3. $A + B \longrightarrow A_n + B$

$P_M = P_A\ X_A + P_B\ X_B$

Let a mole of A are left due to polymerization after 100 min. (माना बहुलीकरण के कारण 100 min. पश्चात् A के a मोल शेष रहे।.)

$P_M = 300\left(\frac{a}{12+a}\right) + 500\left(\frac{12}{12+a}\right)$ ... (i)

$k = \frac{2.303}{100}\log\frac{10}{a}$ ... (ii)

after 100 minute solute is added & final vapour pressure is 400 mm Hg i.e. $P_s = 400$

(100 मिनट पश्चात् विलेय को मिलाया जाता है व अन्तिम वाष्प दाब 400 mm Hg है। अर्थात् $P_s = 400$)

$\frac{P_M - 400}{400} = \frac{0.525}{(a+12)}$ ... (iii)

from equation (i) and (iii) $a = 9.9$

putting this in eq. (ii) k (इसे समीकरण (ii) में रखने पर

$k) = \frac{2.303}{100}\log\frac{10}{9.9} =$ **$1.0 \quad 10^{-4}$**

4. Beaker A (बीकर) :-

Mole fraction of urea (यूरिया की मोल भिन्न)

$= \frac{\frac{12}{60}}{\frac{12}{60} + \frac{140.4}{18}} = \frac{0.2}{0.2 + 7.8} = 0.025$

Beaker B (बीकर) :-

Mole fraction of glucose (ग्लूकोस की मोल भिन्न)

$= \frac{\frac{18}{180}}{\frac{18}{180} + \frac{178.2}{18}} \Rightarrow 0.01$

Mole fraction of glucose is less so vapour pressure above the glucose solution will be higher than the pressure above urea solution, so some H_2O molecules will transfer from glucose to urea side in order to make the solutions of equal mole fraction to attain equilibrium. Let x mole of H_2O transfered

(ग्लूकोस की मोल भिन्न कम है अत: ग्लूकोस विलयन की सतह पर वाष्प दाब यूरिया विलयन की सतह पर दाब से अधिक होगा, अत: साम्य प्राप्त करने के लिए समान मोल भिन्न के विलयनों को बनाने के लिए कुछ H_2O अणु ग्लूकोस से यूरिया की ओर स्थानान्तरित होगें। मानाकि x मोल H_2O में स्थानान्तरित हुए।)

$$\frac{0.2}{0.2+7.8+x} = \frac{0.1}{0.1+9.9-x} \Rightarrow x = 4$$

now mass of glucose solution (अब ग्लूकोस विलयन का द्रव्यमान) = 196.2 – 18 4 = 124.2

wt. % of glucose (ग्लूकोस का भार %) $= \frac{18}{124.2} \times 100$

$\Rightarrow$ **14.49 %**

5. Let n_B mole of B present in 1 mole of mixture that has been vaporized.

(माना 1 मोल मिश्रण में B के n_B मोल उपस्थित है जो कि वाष्पीकृत होते हैं इस प्रकार)

Thus, $Y_B = n_B$

$X_B = 1 - n_B$

$P = P_A X_A + P_B X_B = P_A + X_B (P_B - P_A)$

$$X_B = \frac{P - P_A^\circ}{P_B^\circ - P_A^\circ} = 1 - n_B \qquad \ldots(i)$$

$$Y_B = \frac{P_B^\circ X_B}{P} \Rightarrow n_B = \frac{P_B^\circ (1 - n_B)}{P}$$

$n_B P = P_B - n_B P_B$

$$n_B = \frac{P_B^\circ}{P_B^\circ + P} \qquad \ldots(ii)$$

from equation (i) and (ii)

$$1 - \frac{P_B^\circ}{P_B^\circ + P} = \frac{P - P_A^\circ}{P_B^\circ - P_A^\circ} \Rightarrow \frac{P}{P_B^\circ + P} = \frac{P - P_A^\circ}{P_B^\circ - P_A^\circ}$$

on solving

$P = \sqrt{P_A^\circ P_B^\circ} = \sqrt{100 \times 900} \Rightarrow$ **300 mm Hg**

6. (a) $\frac{\Delta T_f}{\Delta T_b} = \frac{k_f}{k_b} = \Delta T_f = \frac{0.6 \times 31.8}{5.03} =$ **3.793 C**

(b) Relative lowering of vapour pressure =

$$\frac{n}{n+N} = \frac{\frac{3}{251.5}}{\frac{3}{251.5} + \frac{100}{154}} = \textbf{0.018}$$

(c) $\pi = CRT$

$n = \frac{3}{251.5} = 0.012$

$v = \frac{103}{1.64} = 62.8$ mL

$\pi = \frac{0.012}{0.0628}$ 0.0821 298 = **4.65 atm**

(d) $0.6 = \frac{5.03 \times 3 \times 1000}{M_W \times 100} \Rightarrow M_W =$ **251.5**

7. $C_2H_5OH \longrightarrow V_1 = 20$ mL, $d_1 = 0.7893$ g/mL

$m_1 = 15.786$ g

$H_2O \rightarrow V_2 = 40$ mL, $d_2 = 0.9971$ g/mL

$m_2 = 39.884$ g

Total mass = 55.65 g

$d_{sol.} = 0.9571$ g/mL

$V_{sol.} = 58.14$ mL

% change $= \frac{60 - 58.14}{60}$ 100 = **3.1 %**

$m = \frac{15.766 \times 1000}{46 \times 39.884} =$ **8.6**

8. $P_T = P_A X_A + P_B X_B = P_A X_A + P_B (1 - X_A)$

$P_T = P_B + X_A (P_A - P_B)$

$$Y_A = \frac{P_A^\circ \times A}{P_T} = \frac{P_A^\circ \times A}{P_B^\circ + X_A (P_A^\circ - P_B^\circ)}$$

$0.4 = \frac{0.4 X_A}{1.2 - 0.8 X_A}$

$1.2 = 1.8$ A

$X_A = \frac{2}{3}$

so $X_B = \frac{1}{3}$

$P_T = 0.4 \quad \frac{2}{3} + 1.2 \quad \frac{1}{3} = \frac{2}{3} =$ **0.66 atm**

9. $\frac{0.5}{M} = 3.75 \quad 10^{-3} \Rightarrow M = 133.33$

$0.165 = (1 + \alpha) \quad \frac{1.86 \times 1.5 \times 1000}{133.33 \times 150}$

$1 + \alpha = 1.1827$

$\alpha = 0.1827 =$ **18.27%**

10. $V_B = \frac{78}{0.877}$ 2750 mL = 244.583 L

$V_T = \frac{92}{0.867}$ 7720 mL = 819.192 L

$P_B = \frac{1 \times 0.0821 \times 293 \times 760}{244.583} = 74.74$ torr

$P_T = \frac{1 \times 0.0821 \times 293 \times 760}{819.192} = 22.317$

$46 = 74.74 X_B + 23.317 (1 - X_B)$

$52.423 X_B = 23.683$

$X_B = 0.451$

$Y_B = \frac{P_B^\circ \times X_B}{P_T} = \frac{74.74 \times 0.451}{46} =$ **0.732**

11. $i = 1 - \frac{\alpha}{2} = 1 - \frac{0.84}{2} = 0.48$

$\Delta T_b = \frac{0.48 \times 2.3 \times 0.61 \times 1000}{122 \times 50} = 0.1104$

$T_b = 46.2 + 0.1104 =$ **46.31 C**

12. $P_A = 100$, $P_B = 300$, $X_A = X_B = \frac{1}{2}$

$P_T = 200$

$Y_A = \frac{100 \times \frac{1}{2}}{200} = \frac{1}{4}$

On condensation $X_A = \frac{1}{4}$, $X_B = \frac{3}{4}$

$P_T = 100 \quad \frac{1}{4} + 300 \quad \frac{3}{4} = 250$

$Y_A = \frac{25}{250} = 0.1$

on further condensation

$X_A =$ **0.1**

13. $CH_3OH \rightarrow V_1 = 30$ mL, $d_1 = 0.798$ g/mL

$m_1 = 23.94$ g

$H_2O \rightarrow V_2 = 70$ mL, $d_2 = 0.9984$ g/mL

$m_2 = 69.888$ g

$m_T = 93.828$ g

$d_{solution} = 0.9575$ g/mL

$V_{solution} = 98$ mL

$\Delta T_f = \frac{1.86 \times 23.94 \times 1000}{32 \times 69.888} =$ **19.91**

$T_f = -19.91$ C

$M = \frac{23.94}{32 \times 0.98} =$ **7.63 M**

14. $P = 179X_B + 92$

$P_B = 271$, $P_T = 92$

$n_B = \frac{936}{78} = 12$, $n_T = \frac{736}{92} = 8$

$X_B = \frac{12}{20} = 0.6 \quad X_T = 0.4$

$P_T = 271 \quad 0.6 + 92 \quad 0.4 = 199.4$

$Y_B = \frac{271 \times 0.6}{199.4} = 0.815$

$Y_T = 0.185$

On further condensation

$X_B = 0.815$, $X_T = 0.185$

$P_T = 271 \quad 0.815 + 92 \quad 0.185 = 237.844$

$Y_B = \frac{271 \times 0.815}{237.844} =$ **0.9286**

15. For two immiscible liquids

$\frac{w_1}{w_2} = \frac{P_1^\circ M_1}{P_2^\circ M_2} = \frac{3.6 \times 123}{97.7 \times 18} = 0.2518$

$\frac{w_2}{w_1} = 3.971$

$\frac{w_2 + w_1}{w_1} = 4.971$

$\frac{w_1}{w_2 + w_1} \quad 100 =$ **20.11%**

16. $\frac{d \ln P}{dT} = \frac{\Delta H}{RT^2}$ ...(i)

$\log P = 3.54595 - \frac{313.7}{T} + 1.40655 \log T$

$\ln P = 3.54595 \quad 2.303 - \frac{313.7}{T} \quad 2.303 + 1.40655 \ln T$

$\frac{d \ln P}{dT} = \frac{313.7 \times 2.303}{T^2} + \frac{1.40655}{T}$ ...(ii)

Compairing equation (i) & (ii)

$\Delta H =$ **R[313.7 2.303 + 1.40655 T]**

at **T = 80 K**

$\Delta H =$ **1659.9 Cal.**

17. $P_s = 20 \quad P = 20.0126$

$\frac{P^\circ - P_s}{P^\circ} = \frac{0.0126}{20} = \frac{n}{n+N} \simeq \frac{n}{N}$

$\frac{\text{moles of solute}}{\text{moles of } H_2O} = 0.0063$

1 mole $H_2O = 18$ g $= 18$ mL

18 mL solution = 0.00063 mole

1L solution $= \frac{0.00063}{18} \times 1000 = 0.35$ mole/L

Let solubility of salt A_3B_4 is s then

$7s = 0.035$

$s = 0.005$ mole/L

$k_{sp} = 3^3 . 4^4 (s)^7 = 27 \quad 256 \quad (0.005)^7$

$k_{sp} =$ **5.4 10^{-13}**

18. At 20 C :

For $C_6H_6 \rightarrow V = \frac{78}{0.877} \times 2750$ mL

$PV = 1 \quad 0.0821 \quad 293$

$P = 74.74$ mm Hg

It vapour pressure of benzene at 27 C is P_1 then

$\ln \frac{P_1}{P} = \frac{\Delta H_V}{R} \left[\frac{1}{T} - \frac{1}{T_1} \right]$

$\ln \frac{P_1}{74.74} = \frac{394.57 \times 78}{8.314} \left[\frac{1}{293} - \frac{1}{300} \right]$

$P_1 = 100.364$ mmHg

$m = \frac{P^\circ - P_s}{P_s} \quad \frac{1000}{M_{solvent}}$

$m = \frac{100.364 - 98.88}{98.88} \quad \frac{1000}{78} = 0.1924$

$\Delta T_f = k_f \quad m = 5.12 \quad 0.1924 = 0.985$ C

$T_f = 278.5 - 0.985 =$ **277.51 C**

19. Initial moles of H_2O = 0.9

ΔT_f = 6 kJ

$$k_f = \frac{RT_f^2M}{1000\Delta H_f} = \frac{8.314\times(273)^2\times18}{1000\times6000} = 1.86$$

$\Delta T_f = k_f \quad m$

$$m = \frac{2}{1.86} = 1.075$$

so in 1000 g $H_2O \rightarrow$ 1.075 mole solute

in 1 g $H_2O \rightarrow \frac{1.075}{1000}$ mole solute

in 0.9 18 g $H_2O \rightarrow \frac{1.075}{1000}$ 0.9 18 mole solute

mole of solute (n) = 0.0174.15

$$\frac{P^\circ - P_s}{P_s} = \frac{n}{N} = \frac{760-700}{0.0851} = 0.0857$$

moles of H_2O (N) = $\frac{0.017415}{0.0857}$ = 0.2032

moles of Ice separate out = 0.9 – 0.2032 = 0.6968

mass of Ice separate out = 0.6968 18 = **12.54g**

20. $\Delta T_f = (1 + \alpha)\ k_f \quad m$

$0.21 = (1 + \alpha) \quad 1.86 \quad 0.109$

$1 + \alpha = 1.0358$

$\alpha = 0.0358$

$$k_a = \frac{C\alpha^2}{1-\alpha} = \frac{0.109(0.0358)^2}{1-0.0358} = \mathbf{1.44 \quad 10^{-4}}$$

21. $NH_4Cl \longrightarrow NH_4^+ + Cl^-,\ NH_4^+ + H_2O \longrightarrow NH_4OH + H^+$

C Cα

C–Cα Cα Cα Cα–Cαh Cαh Cαh

$$i = \frac{C - C\alpha + C\alpha + C\alpha - C\alpha h + C\alpha h + C\alpha h}{C}$$

= (1 + α + αh)

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

$$0.637 = \frac{(1+\alpha+\alpha h)\times1.86\times10}{53.5}$$

$1 + \alpha + \alpha h = 1.832$ &

since α = 0.75, h **= 0.109**

22. $k_f = \frac{8.314\times(278.4)^2\times78}{1000\times10042} = 5$

$m = \frac{0.02\times1000}{0.98\times78} = 0.2614$

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

$i = 1 - \frac{\alpha}{2} = 0.7643$

$\alpha = 0.4713$

$2A \rightleftharpoons A_2$

C

C–Cα Cα/2

$$k = \frac{C\alpha/2}{(C-C\alpha)^2} = \frac{\alpha}{2C(1-\alpha)^2}$$

$$k = \frac{0.4713}{2\times0.2614(1-0.4713)^2} = \mathbf{3.225}$$

23. $P^T = 1.5 \Rightarrow [T^+] = 0.0316 = C\alpha$ .....(i)

$0.372 = 1.86 \quad C\ (1 + \alpha)$

$C + C\alpha = 0.2$ .....(ii)

from equation (i) & (ii)

C = 0.1684, α = 0.1876

$$k_a = \frac{C\alpha^2}{1-\alpha} = \frac{0.1684(0.1876)^2}{(1-0.1876)} = \mathbf{7.3 \quad 10^{-3}}$$

In 600 mL solution [TF]=C–Cα=0.1368 mole/L

so moles = 0.1368 0.6 = 0.08208

moles left after 24.8 years = $\frac{0.08208}{4}$ = 0.02052

moles disinitegrated

= 0.08208 – 0.02052 = 0.06156

moles of β-particle emittted = 0.06156

No. of β-particle emittted= 0.06156 6.023 10^{23}

= 3.7 10^{22}