ABLES® KOTA

Case II — Liquid-Solid Soln (Volatile - Non volatile)

A/c to Dalton's V.P. of Soln.

$$P_S = P_A + P_B$$

A/c to Raoult's law

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

$$\boxed{P_S = P_A^o X_A + 0} \Rightarrow \boxed{P_S = P_A^o X_A} \quad -(1)$$

$$\boxed{P_S \propto X_A}$$

Water (volatile) P_A^o, X_A

glucose (Non-vol.) $(P_B^o = 0, X_B)$

From eq. (1)

$$P_S = P_A^\circ X_A$$

$$\left\{ \because X_A + X_B = 1 \quad X_A = 1 - X_B \right\}$$

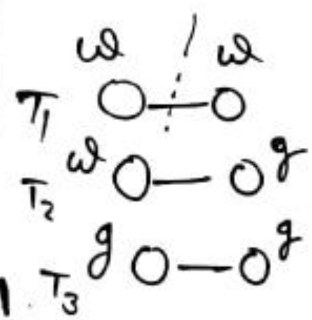
$$P_S = P_A^\circ (1 - X_B)$$

$$P_S = P_A^\circ - P_A^\circ \cdot X_B$$

$$P_A^\circ X_B = P_A^\circ - P_S$$

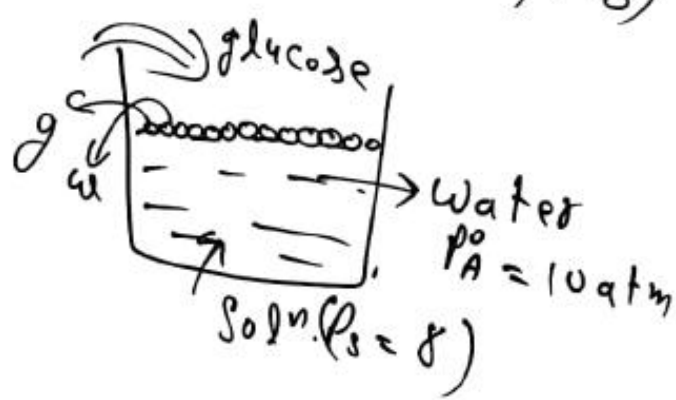
$$\Rightarrow \boxed{P_A^\circ - P_S = P_A^\circ \cdot X_B}$$

lowering in V.P. (l.V.P.) $= P_A^\circ - P_S = P_A^\circ X_B$



Water (volatile) P_A°, X_A

glucose (Non-vol.) $(P_B^\circ = 0, X_B)$



##

$$\frac{P_A^o - P_s}{P_A^o} = X_B$$

For Dilute Solution.

$$\frac{P_A^o - P_s}{P_A^o} = X_B$$

$$\frac{P_A^o - P_s}{P_A^o} = \frac{n_B}{n_A + n_B}$$

$n_A >>> n_B \Rightarrow n_A + n_B \simeq n_A$

$$\boxed{\frac{P_A^o - P_s}{P_A^o} = \frac{n_B}{n_A}}$$ * For dilute Soln.

For All Soln

$$\frac{P_A^o - P_s}{P_A^o} = \frac{n_B}{n_A + n_B}$$

$$\Rightarrow \frac{P_A^o}{P_A^o - P_s} = \frac{n_A + n_B}{n_B}$$

$$\Rightarrow \frac{P_A^o}{P_A^o - P_s} - 1 = \frac{n_A + n_B}{n_B} - 1$$

$$\frac{P_A^o - (P_A^o - P_s)}{P_A^o - P_s} = \frac{n_A + n_B - n_B}{n_B}$$

$$\boxed{\frac{P_s}{P_A^o - P_s} = \frac{n_A}{n_B}} \Rightarrow \boxed{\frac{P_A^o - P_s}{P_s} = \frac{n_B}{n_A}}$$

##

$$\frac{P_A^o - P_s}{P_A^o} = X_B$$

For Dilute Solution.

$$\frac{P_A^o - P_s}{P_A^o} = X_B$$

$$\frac{P_A^o - P_s}{P_A^o} = \frac{n_B}{n_A + n_B}$$

$$n_A >>> n_B \Rightarrow n_A + n_B \approxeq n_A$$

$$\boxed{\frac{P_A^o - P_s}{P_A^o} = \frac{n_B}{n_A}}$$

* For dilute Soln.

For All Soln

$$\frac{P_A^o - P_s}{P_A^o} = \frac{n_B}{n_A + n_B}$$

$$\Rightarrow \frac{P_A^o}{P_A^o - P_s} = \frac{n_A + n_B}{n_B}$$

$$\Rightarrow \frac{P_A^o}{P_A^o - P_s} - 1 = \frac{n_A + n_B}{n_B} - 1$$

$$\frac{P_A^o - (P_A^o - P_s)}{P_A^o - P_s} = \frac{n_A + n_B - n_B}{n_B}$$

$$\boxed{\frac{P_s}{P_A^o - P_s} = \frac{n_A}{n_B}} \Rightarrow \boxed{\frac{P_A^o - P_s}{P_s} = \frac{n_B}{n_A}}$$

Q.1. Two liq. A & B form an ideal Solⁿ V.P. of liq. A & B in Pure State is 100 & 200 mm of Hg. 2 mole of liq. A & 3 mol of liq. B are mixed to form an ideal Solⁿ. Cal.
(a) Partial V.P. of liq. A & B (b) V.P. of Solⁿ.
(C) Mole Fraction of A & B in Vapour Phase.

Sol. Given :- $P_A^o = 100$ mm of Hg ; $n_A = 2$ mol ; $n_{Total} = 2 + 3 = 5$

$P_B^o = 200$ mm of Hg ; $n_B = 3$ mol ;

$$X_A = \frac{2}{5} ; \; X_B = 3/5$$

(a) $P_A = P_A^o X_A$

$P_A = 100 \times 2/5$

$P_A = 40$ mm of Hg.

$P_B = P_B^o X_B$

$P_B = 200 \times 3/5$

$P_B = 120$ mm of Hg.

(b) $P_S = P_A + P_B \Rightarrow P_S = 40 + 120$

$P_S = 160$ mm of Hg.

(c) $Y_A = \frac{P_A}{P_S} \Rightarrow Y_A = \frac{40}{160} \Rightarrow Y_A = 1/4$

$Y_A + Y_B = 1 \Rightarrow Y_B = 1 - 1/4 = 3/4$

Q. 2. ethanol & methanol form an ideal Soln. v.p. of ethanol (C_2H_5OH) & methanol (CH_3OH) in Pure State 44 & 94 mm of Hg. 92 gm of ethanol & 32 gm of methanol are mixed to form an ideal Soln. Cal.

(a) Partial v.p. of ethanol (A) & methanol (B) (b) Total v.p. of Soln.

(c) mole Fraction in Vapour Phase.

Sol. given: $P_A^0 = 44$; $P_B^0 = 94$

$w_A = 92\,gm$; $w_B = 32\,gm$.

$M_A = 46$; $M_B = 32$

$n_A = \frac{92}{46} = 2$; $n_B = \frac{32}{32} = 1\,mol$; $n_T = 3$

$X_A = 2/3$; $X_B = 1/3$

(i) $P_A = 44 \cdot \frac{2}{3} \Rightarrow P_A = 88/3$

$P_B = 94 \cdot \frac{1}{3} \Rightarrow P_B = 94/3$

(ii) $P_S = P_A + P_B$

$P_S = \frac{88}{3} + \frac{94}{3} = \frac{182}{3}$

$P_S = \frac{182}{3}$

(C) $Y_A = \frac{88/3}{182/3} \Rightarrow \boxed{Y_A = \frac{88}{182}}$; $Y_B = \frac{94/3}{182/3} \Rightarrow \boxed{Y_B = \frac{94}{182}}$

Q.3. Two liq. A & B form an ideal Soln. V.P. of Soln is found to 650 mm of Hg. When mole Fraction of 'A' in liquid phase & vapour phase are 0.25 & 0.75 respectively. Then Cal. P_A^o & P_B^o.

Sol. given ÷ $X_A = 0.25$; $X_B = 1 - 0.25 = 0.75$

$Y_A = 0.75$; $Y_B = 0.25$

$P_S = 650$

$Y_A = \frac{P_A}{P_S} \Rightarrow Y_A = \frac{P_A^o . X_A}{P_S}$

$P_A^o = \frac{Y_A . P_S}{X_A} \Rightarrow P_A^o = \frac{\frac{3}{4} \times 650}{1/4}$

$P_A^o = 3 \times 650$

$\boxed{P_A^o = 1950}$

$Y_B = \frac{P_B^o X_B}{P_S}$

$P_B^o = \frac{Y_B . P_S}{X_B}$

$P_B^o = \frac{1/4 \; 650}{3/4}$

$P_B^o = \frac{650}{3}$