Solutions

① **Henry's law:**

$S = K_H P$

$S = \frac{mol}{dm^3}$

where : S = solubility

K_H = Henry's constant

$P \rightarrow$ partial pressure of gas

② **Mole fraction**

A	B
n_A	n_B

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

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

$$\boxed{X_A + X_B = 1}$$

③ **Molarity** : $\frac{\text{no. of moles}}{\text{volume of solution (in L)}}$

④ **Molality:**

$m = \frac{\text{no. of moles of solute}}{\text{mass of solvent (in kg)}}$

⑤ 1 molal ⇒ 1 mole of solute in 1000g of solvent.

⑥ **Raoult's law:**

① Two volatile solution

$P_A = P_A^o X_A$

$P_B = P_B^o X_B$

$P_T = P_A + P_B$

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

Mole fraction in vapour phase

$Y_A = \frac{P_A}{P_T}$ $\quad Y_B = \frac{P_B}{P_T}$

② **Non-volatile solution**

$P_A = P_A^o X_A$

$P_A = P_A^o (1 - X_B)$

$P_A = P_A^o - P_A^o X_B$

$P_A^o X_B = (P_A^o - P_A) \rightarrow$ lowering in V.P

$X_B = \frac{P_A^o - P_A}{P_A^o} \rightarrow$ Relative lowering in V.P

Colligative properties:

① Osmotic pressure

② Relative lowering in V.P

③ Depression in freezing point

④ Elevation in Boiling point.

Ideal solutions

A-A solvent-solvent + B-B solute-solute $\approx$ A-B solvent-solute

Condⁿ. safity: ① Obey Raoult's law

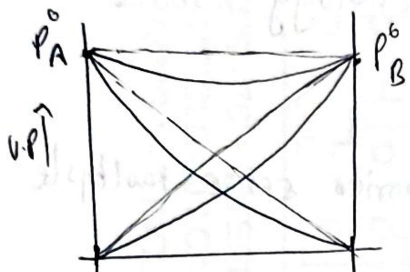
② $\Delta H_{mix} = 0$ (No energy evolved or absorbed)

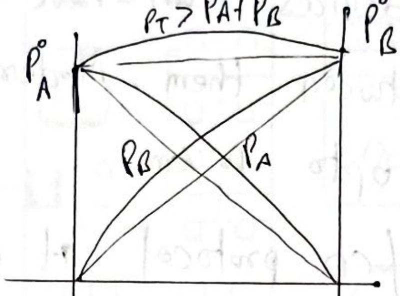
③ $\Delta V_{mix} = 0$ (No expansion or contraction)

e.g
- benzene + toluene
- chlorobenzene + bromobenzene
- n-hexane + n-heptane
- ethyl iodide + ethyl bromide

Non-ideal

+ve deviation	+ve deviation
A – A + B – B < A – B Interaactions.	A – A + B – B > A – B



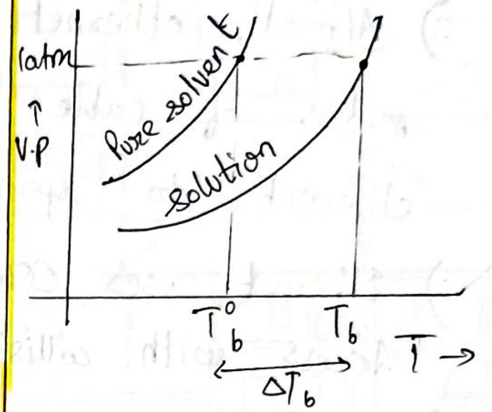


Eg ① $CHCl_3$ + acetone
② $CHCl_3 + CH_3COOH$
③ $CHCl_3 + C_6H_6$
④ $H_2O + HCl$
⑤ $H_2O + HNO_3$
⑥ $CH_3OH + CH_3COOH$
⑦ phenol + aniline

Eg ① Ethanol + water,
② CS_2 + acetone
③ $CCl_4 + C_6H_6$
④ $CCl_4 + C_6H_5CH_3$
⑤ $CCl_4 + CHCl_3$
⑥ ethanol + acetone
⑦ Ethanol + cyclohexane

Elevation in B.P

B.P → pe → V.P of solution = atm pressure



$$\boxed{\Delta T_b = T_b - T^o_b}$$

$$\boxed{\Delta T_b = k_b m}$$

m = molality.

k_b → molal elevation constant
OR
ebullioscopic constant

→ k_b → depends on solvent

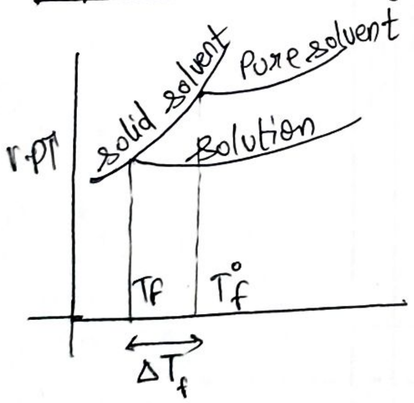
If k_b is NOT given

$$\boxed{k_b = \frac{R(T^o_b)^2 M_{solvent}}{1000\ \Delta H_{vap}}}$$

$$\boxed{\Delta H_{vap} = L_v \times M}$$

L_v → Latent Heat of Vap
M → Molar

Depression in freezing point → pe → V.P of Liquid state ⇓ V.P of solid state



$$\boxed{\Delta T_f = T^o_f - T_f}$$

$$\boxed{\Delta T_f = k_f m}$$

kf = molal depression constant
OR
Cryoscopic constant

kf → depends on solvent
m → molality.

Osmosis :

$$\boxed{\pi = MRT}$$

π → osmotic pressure

M → Molarity

R = Universal Constant = 0.0821 atm L/mol K

T → Temperature (K)

Van't Hoff factor (i)

① $\frac{P_A^\circ - P_A}{P_A^\circ} = X_{solute} \times i$

② $\Delta T_b = k_b \times m \times i$

③ $\Delta T_f = k_f \times m \times i$

④ $\pi = M \times R \times T \times i$

i=1 (glucose, Sucrose, urea)

	Molar Mass
Urea	60 g/mol
glucose	180 "
Sucrose	342 "
Benzene	78
Toluene	92

Isotonic ⇒ Same osmotic pressure.

$\pi_1 = \pi_2$

Hypotonic ⇒ less osmotic pressure.

Hypertonic ⇒ more osmotic pressure

no. of particles $\propto$ colligative properties

Semipermeable membrane is that which permits the passage of Solvent molecules only.

Jiska B.P↓ ⇒ uska V.P↑

Jo Maximum ion produce kare ⇒ uska depression in freezing.P is ↑

Molarity of pure water is 55.6 M

Temp↑ ⇒ Vapour↑ ⇒ V.P↑

no. of particles↑ ⇒ F.P↓

Henry's Law :

i) $\boxed{P = K_H m}$

P = Pressure of the gas

m = mass of the gas

K_H = Henry's Constant

ii) $\boxed{P = K_H \times X}$

P = Partial Pressure of Component

K_H = Henry's Const.

X = mole fraction of Component.

Name	formula		
① Indian salt petre	KNO_3	⑪ Glauber's salt	$Na_2SO_4 \cdot 10H_2O$
② Chile salt petre	$NaNO_3$	⑫ Slaked lime	$Ca(OH)_2$
③ Milk of Magnesia	$Mg(OH)_2$	⑬ Lime stone (Marble)	$CaCO_3$
④ Caustic soda	$NaOH$	⑭ Quick lime	CaO
⑤ Caustic potash	KOH	⑮ Soda ash	Na_2CO_3
⑥ Plaster of Paris	$CaSO_4 \cdot \frac{1}{2}H_2O$	⑯ Washing soda	$Na_2CO_3 \cdot 10H_2O$
⑦ Gypsum	$CaSO_4 \cdot 2H_2O$	⑰ Bleaching powder	$CaOCl_2$
⑧ Dead burnt plaster	$CaSO_4$	⑱ Brine	aq $NaCl$
⑨ Caliche	$NaNO_3 + NaIO_3$	⑲ Nitrolium	$CaC_2 + N_2 \xrightarrow{\Delta} CaCN_2 + C$
⑩ Epsom's salt	$MgSO_4 \cdot 7H_2O$	⑳ Baking soda	$NaHCO_3$

Charge on Dispersed particles.

Positively charged sols	Negatively charged sols
1. Hydrated metallic oxides $Al_2O_3 \cdot xH_2O$, $CrO_3 \cdot xH_2O$, $Fe_2O_3 \cdot xH_2O$	1) Metals, Cu, Ag, Au Sols metallic sulphides As_2S_3, Sb_2S_3, CdS
2) Basic dye stuff, methylene blue sols	2) Acid dye stuff, eosin, congo red sol
3) Haemoglobin (Blood)	3) sols of starch, gum
4) Oxides: TiO_2 sol	4) Gelatin, clay, gum sols