1. SOLUTIONS

Solution

Homogenous mixture of two or more pure substances

Solvent (max.amount)
+
Solute (min.amount)
= Solution

Types of Solutions

Based on physical state

- Gas in Gas (Air)
- Gas in liquid (soda water)
- Gas in solid (Hydrogen in Pd)
- Liquid in gas (Fog)
- Liquid in liquid (Alcohol in H_2O)
- Liquid in solid (Amalgams)
- Solid in gas (Smog)
- Solid in liquid (sugar in water)
- Solid in solid (alloys)

Based on Concentration

- Dilute Solution
- Concertated solution
- Saturated solution
- Super Saturated solution

Concentration terms

Mole fraction (x)

$$\frac{\text{No. of moles of solute}}{\text{Total No. of moles in solution}}$$

Mass Percentage (w/w)

$$\frac{\text{Mass of solute}}{\text{Total mass of solution}} \times 100$$

Molarity (M)

$$\frac{\text{No. of moles of solute}}{\text{Volume of solution(L)}}$$

Parts per million (PPM)

$$\frac{\text{No. of parts of solute}}{\text{Total no. of parts of all components of solution}} \times 10^6$$

Molality (m)

$$\frac{\text{No. of moles of solute}}{\text{weight of the solvent in Kg}}$$

Volume Percentage (V/V)

$$\frac{\text{Volume of solute}}{\text{Total volume of solution}} \times 100$$

Mass by volume %

$$\frac{\text{mass of solute}}{\text{Total volume of solution}} \times 100$$

Solubility

Gas in liquid

Effect of pressure

Solubility increases with increase in pressure.

Henry's Law

Partial pressure of gas in vapour phase. $\propto$ Mole fraction of the gas (x)

$$p = K_H x$$

Solubility of gases increases with decrease of temperature.

Liquid in liquid

Effect of pressure

Partial vapour pressure = vapour pressure of pure component × Mole fraction

$p_t = p^\circ_A x_A + p^\circ_B x_B$

Solid in liquid

Effect of nature of solute and solvent

Like dissolves Like.

Effect of temp.

Exothermic process:-
Solubility decreases with rise in temp.

Endothermic process:-
Solubility increases with rise in temp.

Effect of pressure

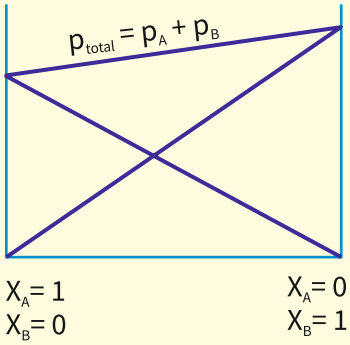
No effect

Ideal and non ideal solution

Ideal

Obey Raoult's Law

$p_s = p_A x_A + p_B x_B$

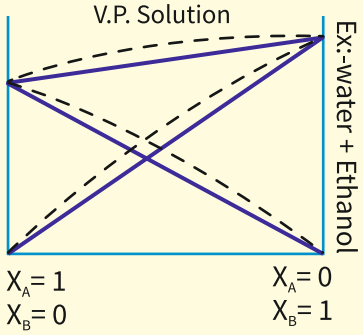


Non Ideal

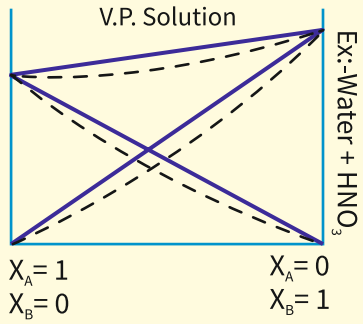
Does not Obey Raoult's Law

$p_s \neq p_A x_A + p_B x_B$

Positive deviation



Negative deviation



Azeotropes

Constant boiling mixtures

Minimum boiling azeotropes

- Positive deviation mixture.
- Ex. 95% Ethanol in water

Maximum boiling azeotropes

- Negative deviation mixture.
- Ex. 68% HNO_3 in water

Colligative property

1. Osmotic pressure

Pressure applied to stop the flow of solvent through semi permeable memberane.

$\pi = CRT$

2. Elevation of Boiling point

$$\Delta T_b = \frac{K_b \times 1000 \times W_2}{M_2 \times W_1}$$

3. Depression in freezing point

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

4. Relative lowering of vapour pressure

$$\frac{W_2 \times M_1}{M_2 \times W_1} = \frac{P_A - P_S}{P_A}$$

Van't hoff factor (i)

Ratio of the normal mass to the observed molecular mass of the solute.

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