Solution

(B) Solution containing a liquid and non-volatile solute :—

In such case, the vapour pressure of the solution will be equal to vapour pressure of the solvent only because non-volatile solute doesnot form the vapour.

If x_A and x_B is the mole fraction of the solvent and solute respectively then total vapour pressure —

$$P_S = P^\circ_A x_A + P^\circ_B x_B \qquad \text{——①}$$

But non-volatile solute doesnot form vapour.

$$\therefore \quad P^\circ_B = 0$$

eqn — ① becomes

$$P_S = P^\circ_A x_A$$

Thus, vapour pressure of the solution is proportional to the mole fraction of solvent.

Since, $x_A + x_B = 1$

or $x_A = 1 - x_B$

$$\therefore \quad P_S = P^\circ_A (1 - x_B)$$

$$\Rightarrow \quad P_S = P^\circ_A - P^\circ_A x_B$$

$$\Rightarrow \quad P^\circ_A x_B = P^\circ_A - P_S$$

$$\boxed{x_B = \frac{P^\circ_A - P_S}{P^\circ_A}}$$

Where, the term $P^\circ_A - P_S / P^\circ_A$ is called relative lowering of vapour pressure.

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Raoult's law :-

The relative lowering of vapour pressure of solution is equal to the mole fraction of the non-volatile solute.

* Ideal solution and non-ideal solution

A solution which obey's Raoult's law over a wide range of concentration and temperature is called as ideal solution.

In ideal solution -

$\Delta H_{mixing} = 0$ and $\Delta V_{mixing} = 0$.

A dilute solution behaves more closely to ideal solution.

for examples-

1. Methanol & Ethanol
2. Benzene and Toluene
3. Ethyl bromide & Ethyl iodide.

Those solutions which don't obey Raoult's law are called non-ideal solution. Such solutions do not fulfil the conditions of an ideal sol^n.

For such solutions

$\Delta H_{mixing} \neq 0$

$\Delta V_{mixing} \neq 0$.

for examples-

1). CCl_4 and C_6H_6

2). CCl_4 and $CHCl_3$

3). Water and Ethanol

4) H_2O and HCl.

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* Azeotropes or Azeotropic mixture :-

Liquid mixtures which have definite composition, definite boiling point and which distil without change in composition are called Azeotropes or Azeotropic mixture.

for examples—

1). Mixture containing 95% C_2H_5OH and 5% H_2O are an azeotropes. (by volume).

2) Mixture containing 68% HNO_3 and 32% H_2O are an azeotropes. (by mass).

* Colligative Properties :-

The properties of the dilute solution which depends only upon the number of solute particles in a given volume of the solvent are called colligative properties.

These are —

1) Relative lowering of vapour pressure
2) Elevation in boiling point
3) Depression in freezing point
4) Osmotic pressure

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