~~on pure state~~:

6. Colligative properties and determination of Molar mass.

The vapour pressure of solution decreases when a non-volatile solute is added to a volatile solvent. All the properties which depend on number of solute particles present in the solution. Such properties are called colligative properties. The proper--ties are →

6.1. Relative lowering of vapour pressure:

i) When a non-volatile solute is added to a solvent, the vapour pressure of the solution becomes less than that of the pure solvent.

ii) Since the non-volatile ~~occupies~~ solute particles occupies the surface leading to lesser surface area for vapours or evaporation

According to Raoult's law,

$$p_1 = x_1 p_1^\circ \quad \cdots \text{(i)}$$

The reduction ~~of~~ in vapour pressure of solvent (Δp_1) is given as:

$$\Delta p_1 = p_1^\circ - p_1 = p_1^\circ - p_1^\circ x_1 = p_1^\circ (1 - x_1) \quad \cdots \text{(ii)}$$

Since, $x_2 = 1 - x_1$, eq (ii) reduces to

$$\Delta p_1 = x_2 p_1^\circ \quad \cdots \text{(iii)}$$

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In a solution containing several non-volatile solutes, the lowering of the vapour pressure depends on the sum of the mole fraction of different solutes.
So, Eq (iii) as-

$$\boxed{\frac{\Delta p_1}{p_1^{\circ}} = \frac{p_1^{\circ} - p_1}{p_1^{\circ}}} = x_2 \text{ - - - - (iv)}$$

So, Relative lowering of vapour pressure = Mole Fraction of solute.

$$\frac{p_1^{\circ} - p_1}{p_1^{\circ}} = \frac{n_2}{n_1 + n_2} \quad \left(\text{since } x_2 = \frac{n_2}{n_1 + n_2}\right) \text{ - - - (v)}$$

n_1 and n_2 = no. of moles of solvent and solute respectively

For dilute solutions,

$n_2 << n_1$

$$\frac{p_1^{\circ} - p_1}{p_1^{\circ}} = \frac{n_2}{n_1} \text{ (vi)} \Rightarrow \frac{p_1^{\circ} - p_1}{p_1^{\circ}} = \frac{W_2 \times M_1}{M_2 \times W_1} \text{ — (vii)}$$

w_1 and w_2 = masses

M_1 and M_2 = Molar masses of solvent solute