Navam's Theory of Miscible Liquids:-

'The Density of liquid solute is equal to the Density of the liquid solvent in a Saturated solution of two Miscible liquids.'

$\Rightarrow \rho_{Solute} = \rho_{Solvent}$ (Only when saturated)

Note:

There is no relationship between the densities of the solute and solvent before mixing them. But after mixing and saturating, the solute interchanges its density to be equivalent with that of the solvent.

Applications:

(i) $\rho_{Solute} = \rho_{Solvent}$

$$\frac{M_{Solute}}{V_{Solute}} = \rho_{Solvent}$$

$$\Rightarrow V_{Solute} = \frac{M_{Solute}}{\rho_{Solvent}}$$

While Distillation, the volume of the desired liquid is pre-known. Then the no. of moles is also known.

$$\frac{V_{Solution}}{V_{Solute}} = x \text{ moles of solute.}$$

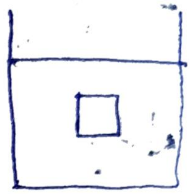
$$\Rightarrow x = \frac{V_{Solution} \times \rho_{Solvent}}{M_{Solute}}$$

(ii) Relationship between Densities and Water Level.

Case-I :

'If the Density of Liquid Ice is greater than that of the Water, then the Water Level rises'

Proof :



Volume of Solvent = V

Density of Solvent = ρ_w

Mass of Solute = M

Volume of Solute (Before melting) = V_s

Volume of Solute (After melting) = V_l

Density of Solute (Before melting) = ρ_s

Density of Solute (After melting) = ρ_l

Given that, $\rho_s > \rho_w$

$$\rho_s > \rho_l \quad [\because \text{NTML}]$$

$$\frac{\cancel{M}}{V_s} > \frac{\cancel{M}}{V_l}$$

$$\Rightarrow V_l > V_s$$

$$V + V_l > V + V_s$$

$$V_f > V_i \Rightarrow \text{Final Volume} > \text{Initial Volume}$$

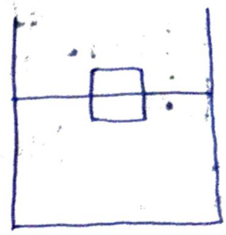
Hence Proved.

Note: Solvent can be other than water.

Case-II:

'If the Density of Liquid Ice is lesser than that of the Water; then the Water Level is undistinguishable.'

Proof:



Volume of Solvent = V

Density of Solvent = ρ_w

Mass of Solute = M

Mass of immersed Solute = M'

Volume of Solute (Before melting) = V_s

Volume of Solute (After melting) = V_l

Density of Solute (Before melting) = ρ_s

Density of Solute (After melting) = ρ_l

Given that, $\rho_s < \rho_w$

$$\rho_s < \rho_l \quad [\because \text{NTML}]$$

$$\frac{M}{V_s} < \frac{M}{V_l}$$

$$\Rightarrow V_l < V_s$$

$$V + V_l < V + V_s$$

Here $V+V_l$ is final Volume but $V+V_s$ isn't Initial Volume since, the ice is not fully immersed. Instead $V + \rho_s M'$ is Initial Volume which can't be related to V_s.