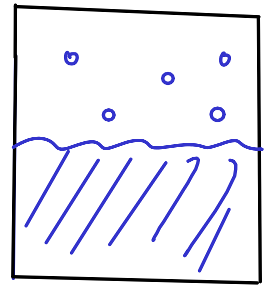
VAPOR PRESSURE LOWERING

- Described by RAOULT'S LAW



P_A = partial pressure of the VAPOR of solvent molecules.

$$P_A = P_A^* \times X_A$$

- X_A: mole fraction of component A
- P_A^*: vapor pressure of pure component A (depends on temperature)
- P_A: partial pressure of component A in a solution

... but component "A" above is actually the SOLVENT. If we want to describe this as a colligative property, we want to express Raolt's law in terms of the SOLUTE! Assuming a two-component mixture, we get...

$$\Delta P = P_A^* \times X_B$$

- X_B: mole fraction of component B (the SOLUTE in a two-component mixture)
- ΔP: Vapor pressure lowering. This is the DECREASE in the vapor pressure of the solvent due to the presence of solute.

BOILING POINT ELEVATION

- Since the vapor pressure is lowered by the presence of a solute, AND since boiling occurs when the vapor pressure of a liquid equals the external pressure - solutes also cause BOILING POINT ELEVATION.

- The equation for boiling point elevation looks almost exactly like the equation for the freezing point depression, and is used in almost the same way.

$$\Delta T_b = K_b \times C_m$$

C_m: concentration of solute (molality)

K_b: Boiling point elevation constant (for SOLVENT)

ΔT_b: Boiling point elevation: The amount the boiling temperature is RAISED by the solute.

What is the boiling point of a solution that contains 2.817 g of molecular sulfur (S_8) dissolved in 100.0 grams of acetic acid?

$T_b = 118.5°C \quad K_b = 3.08 °C/m$

$\Delta T_b = K_b \times C_m$ | $C_m = \frac{\text{moles } S_8}{\text{kg } HC_2H_3O_2}$

$100.0 g = 0.1000 kg$

First, we have to find Cm. How?

Find moles sulfur, since we already know the mass of the solvent!

$$2.817 g\ S_8 \times \frac{mol}{256.56 g} = 0.0109794\ mol\ S_8$$

Find Cm

$$C_m = \frac{0.0109794\ mol\ S_8}{0.1000\ kg\ HC_2H_3O_2} = 0.109794\ m$$

Find deltaTb:

$$\Delta T_b = (3.08 °C/m)(0.109794\ m) = 0.338 °C$$

Calculate the new boiling point by adding deltaTb and the original boiling temperature.

$$T_b = 118.5°C + 0.3°C = \boxed{118.8°C}$$