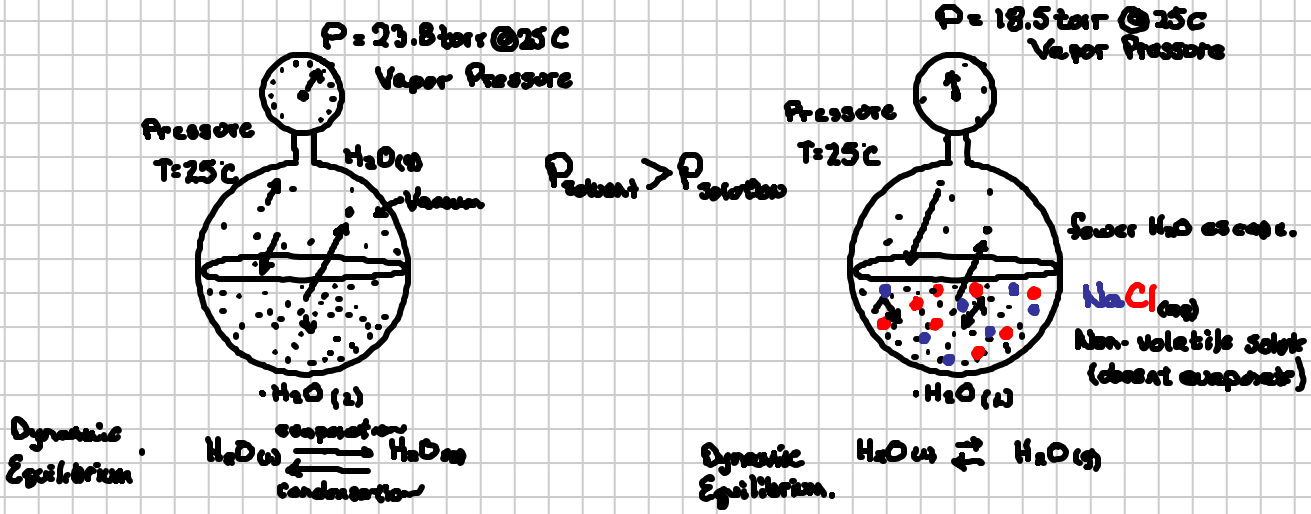
Lecture 33 Colligative Properties: Raoult's Law
Note Title

Vapor Pressures of Solutions



Raoult's Law Dissolved solutes decrease the vapor pressure of the solvent.

$$\Delta P = i (X_{solute})(P_{solvent})$$

- ΔP: change in vapor pressure
- i: Van't Hoff factor
- X_{solute}: mole fraction solute
- $P_{solvent}$: vapor pressure pure solvent

Example 8.75 g of NaCl is dissolved in 250. mL of distilled H_2O at 100.°C

What is the vapor pressure of the solution?

$\Delta P = i (X_{NaCl})(P_{H_2O})$

$\Delta P = (1.9)(0.01067376)(760 \text{ torr})$

$\Delta P = 15.4_{129} \text{ torr}$ (3 S.F.)

$P_{solution} = P_{solvent} - \Delta P = 760.^{\text{zero dec.}} \text{ torr} - 15.4_{129}^{\text{1 dec.}} \text{ torr}$

$= 744_{587}$

$= 745 \text{ torr}$

Vapor pressure of solution

$i_{NaCl} = 2$ . . realistic $i = 1.9$

$P_{H_2O}^{100C} = 760. \text{ torr}$

$\text{mol}_{NaCl} = \frac{8.75 \text{ g}}{58.442477 \text{ g/mol}} = 0.149719 \text{ mol}_{NaCl}$

$\text{mol}_{H_2O} = \frac{250. \text{ mL}}{1} \cdot \frac{1.00 \text{ g}}{1 \text{ mL}} \cdot \frac{1 \text{ mol}}{18.01528 \text{ g}} = 13.8771 \text{ mol}_{H_2O}$

$X_{NaCl} = \frac{0.149719 \text{ mol}_{NaCl}}{(0.149719 + 13.8771)} = 0.01067376$

Note: Requirement for boiling: $P_{soln} = P_{atm}$

$745 \text{ torr} \neq 760 \text{ torr}$

... Soln won't boil at 100°C!

To re-achieve boiling .. must incr. the T > 100°C Boiling Pt elevation.