Lecture 3.2 Colligative Properties: Osmotic Pressure

Note Title

Colligative properties... depend on the concentration of the solute particles but not their identity

Particle concentration:

1.0M $C_{12}H_{22}O_{11(aq)}$ (non metals) — molecular solute · don't break up

Particle Conc. = 1.0M

Van't Hoff factor: $i = 1$ (ideal)

1.0M $NaCl_{(aq)}$ (metal + non-metal)
- ionic solute
- breaks up 2 pieces
@ Na^+ Cl^-

Particle Conc = $2 \times 1.0M = 2.0M$

$i = 2$ (ideal)

1.0M $K_3PO_{4(aq)}$
- ionic solute
- breaks up into 4 pieces
K^+ K^+ K^+ PO_4^{-3}

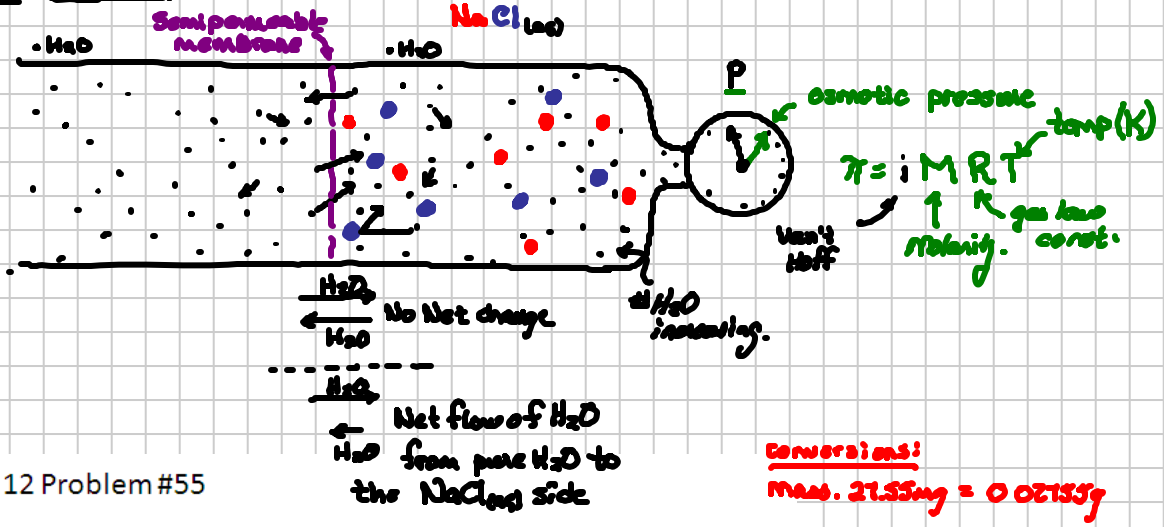
Particle conc = $4 \times 1.0M = 4.0M$

$i = 4$ (ideal)

$i_{ideal} \geq i_{real}$

Why Cl^- → $NaCl_{(aq)}$

Osmotic Pressure:



Chapter 12 Problem #55

A solution containing 27.55 mg of an unknown protein per 25.0 mL solution was found to have an osmotic pressure of 3.22 torr at 25°C. What is the molar mass of the protein?

molecular

conversions:

mass: 27.55mg = 0.02755g

Vol: 25.0mL = 0.0250L

Pressure: $\frac{3.22 \text{ torr}}{760 \frac{\text{torr}}{\text{atm}}} = 0.004236 \text{ atm}$

Temp: 25°C + 273.15 = 298.15 K

1) $\pi = iMRT$ (✓ ?)

$(0.004236 \text{ atm}) = (1)M\left(0.0820578 \frac{L\,atm}{mol\,K}\right)(298.15K)$ ... $M = 1.732631 \times 10^{-4} M$

2) moles = M Liters = $(1.732631 \times 10^{-4} \frac{mol}{L})(0.0250L) = 4.331578 \times 10^{-6}$ mol protein.

3) Molar mass = grams/mol = $\frac{0.02755g}{4.331578 \times 10^{-6} mol} = 6360$ g/mol (3 S.F.)