Solution units

Molarity (M) - moles of solute/L of solution

Molality (m) - moles of solute/kg of solvent

Mole Fraction (χ) - moles of ?/total moles in solution

χ

also: mass percent, volume percent, volume-mass percent

NaF in toothpaste g/ounce

A Problem:
Concentrated sulfuric acid is a 16.8 M aqueous solution with a density of 1.94 g/mL. What are the molality and mole fraction of the solution?

1 L (b/c have M)

↳ 16.8 mols H_2SO_4

1940 g

$16.8 \text{ mols} \times \frac{98 \text{ g}}{1 \text{ mol}} = 1646.4 \text{ g } H_2SO_4$

1646.4 g / 293.6 g H_2O

$m = \frac{\text{mols solute}}{\text{kg solvent}} = \frac{16.8 \text{ mol } H_2SO_4}{.2936 \text{ kg } H_2O} = 57.2 \text{ m}$

$\chi = \frac{\text{mols } H_2SO_4}{(\text{mols } H_2SO_4 + \text{mols } H_2O)} = \frac{16.8}{(16.8 + 16.30)} = .508$

$293.6 \text{ g } H_2O \times \frac{1 \text{ mol}}{18.015 \text{ g}} = 16.30 \text{ mols}$

Colligative Properties

prop's that depend on the presence of dissolved stuff

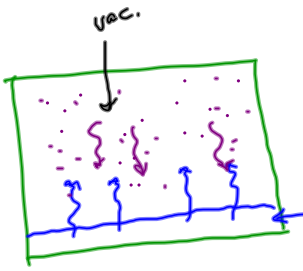
freezing pt dep.

boiling pt elev.

osmotic pressure

depression of vapor P

Vapor Pressure - what it is



P ↓) eventually

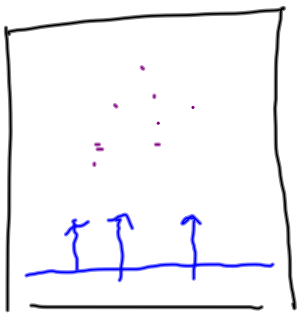
P ↑

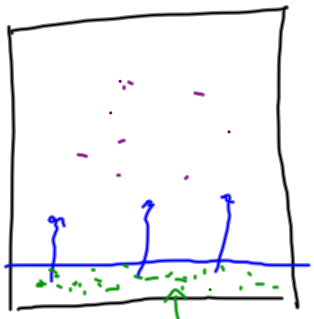
rate evap = rate cond

so . . . P = const

vapor P

Decreasing Vapor pressure - the theory





dissolved stuff

more attraction in liquid phase

less evaporation

So... less in gas phase

P is lower

Vapor pressure - the math and graph

$P = P^{\circ} \chi$ ← mol fraction of solvent

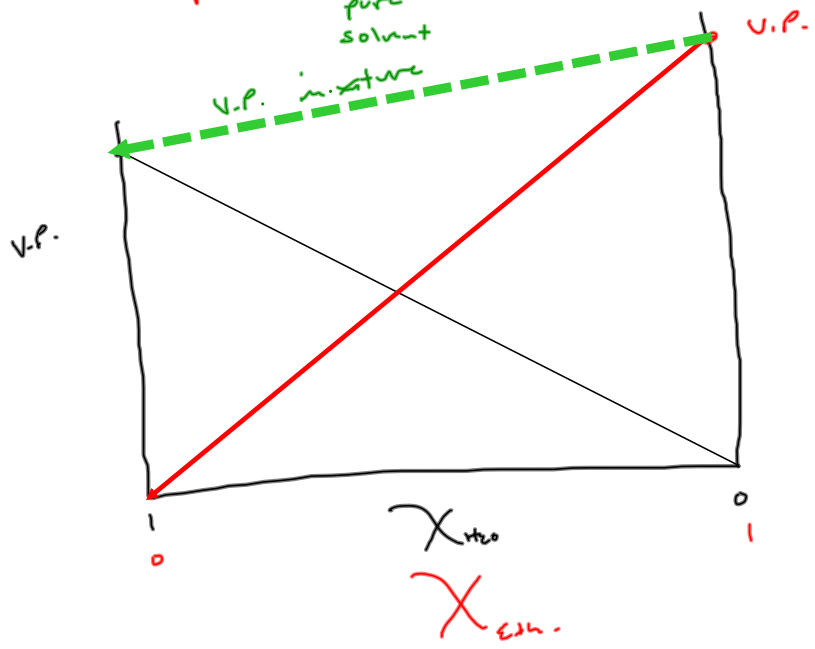
P: solution vapor P

P°: VP of pure solvent

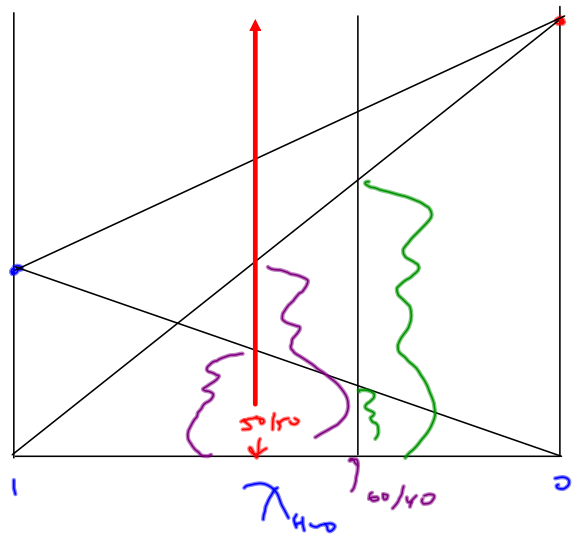
V.P. mixture

V.P.

V.P.



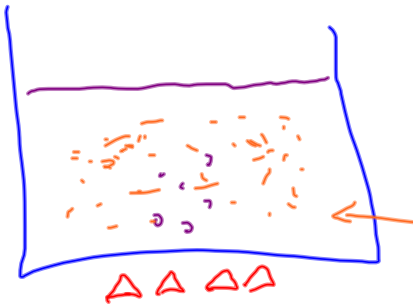
distillation



vapor = 60 Eth
40 H_2O

vapor 75 Eth
25 H_2O

Boiling Point Elevation - the theory



to boil ... need to break away from att. to neighbors

still

→ more att. need more NRG to break away (higher T)

b.p. = T @ which v.p. = Patm

Boiling Point Elevation - the math

$\Delta T = k_b \cdot m \cdot i$ ← van't Hoff factor

# of particles / formula