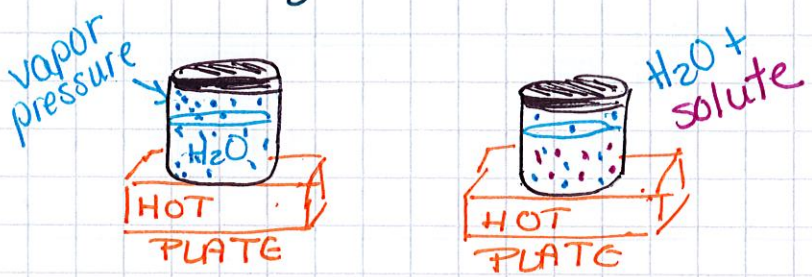
Colligative Properties

- properties that depend ONLY on the # of particles in solution, NOT their identity

(1) Boiling Point Elevation

- adding a solute to a pure solvent raises the boiling point of the resulting solution.

Why? the vapor pressure lowers and a liquid only boils when the vapor pressure equals atmospheric pressure. Therefore you must have higher temperatures for that to happen



$T = 100°C$ $T = 104°C$

- How high the new boiling point gets depends on the # particles of solute in the solution using the van Hoff factor (i)

- for a covalent solute — $i = 1$
- for an ionic solute — i = # ions in the solute compound

examples - what is i?

(1) CO_2 $i = 1$

(2) $NaCl$ ($1+1$) $i = 2$

(3) $AlBr_3$ ($1+3$) $i = 4$

(4) $Cr_3(PO_4)_4$ ($3+1$) $i = 7$

covalent → 2 nonmetals

ionic → metal + nonmetal

- $\Delta T_b = K_b \cdot i \cdot m$
  - ΔT_b: change in the boiling point
  - K_b: boiling point elevation constant
  - i: van Hoff factor
  - m: molality (concentration of the solution)

The higher i is, the higher the change in the boiling pt.

(2) Freezing Point Depression

- adding a solute to a pure solvent will lower the freezing point of the resulting solution

Why? Having a solute inside a solution interferes with the liquid forming a solid, crystalline structure so you must make it colder to force it to freeze.

- $\Delta T_f = K_f \cdot i \cdot m$
  - ΔT_f: change in the freezing point
  - K_f: freezing point depression constant