

Colligative Properties

↳ properties that depend on the # of particles in solution and not on the nature of the solute particles

Vapor Pressure Lowering

I when solute is nonvolatile (immeasurable vapor pressure), Raoult's Law:

$$P_1 = X_1 P_1^*$$

$$X_1 = \frac{\text{mol solute}}{\text{total mol}}$$

P_1 = vapor pressure of solution

P_1^* = vapor pressure of pure solvent

$$\Delta P = X_2 P_1^*$$

$$X_2 = \frac{\text{mol solute}}{\text{total mol}}$$

- surface area of solvent decreased % of solute molecules \therefore rate of vaporization lowered \therefore vapor pressure lowered

II when both solute + solvent are volatile (measurable vapor pressure), use Raoult's Law twice

note: if e.g.:

$$P_1 = X_1 P_1^*$$

$$+ P_2 = X_2 P_2^*$$

} true for ideal solutions

Boiling Point Elevation

↳ BP = the temp at which the vapor pressure is equal to external atmospheric pressure

$$\Delta T_b = T_b - T_b^* = K_b i m$$

K_b = bp elevation constant

m = molality

Freezing Point Depression

↳ freezing point = melting point

$$\Delta T_f = T_f^* - T_f = K_f i m$$

K_f = fp depression constant

m = molality

Osmotic Pressure

↳ osmosis: selective passage of solvent molecules through a porous membrane from a dilute solution to a more concentrated one

- hypotonic: $[out] < [in]$; 

- isotonic: $[out] = [in]$; 

- hypertonic: $[out] > [in]$; 

$$\Pi = iMRT$$

M = molarity

$R = 0.08206 \frac{L \cdot atm}{mol \cdot K}$



Electrolytes: break apart into ions in solution

- ionic compounds (ex: $AgNO_3$, NH_4Cl , $MgCl_2$)
- acids + bases (ex: HCl , H_3PO_4 , $Ba(OH)_2$, NH_3)
- concentration of solute \neq concentration of particles

Nonelectrolytes: do not break apart into ions

- covalent compounds (ex: $C_6H_{12}O_6$, PCl_5)
- concentration of solute = concentration of particles

Vant Hoff Factor (i)

$$i = \frac{\text{actual \# of particles in soln. after dissociation}}{\text{\# of formula units initially dissolved in soln.}}$$

$$i = \# \text{ of ions in any strong electrolyte}$$

- nonelectrolyte: $i = 1$

- weak acids + bases: $1 < i < 2$

Example Calculations

Chemistry Study Guide Calculations Involving Colligative Properties

Leo J. Malone, Theodore O. Dolter



Chemistry Study Guide Calculations Involving Colligative Properties:

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