

Chapter 13, Properties of Solutions

Chem1A, General Chemistry I

Solution: homogeneous mixture of two or more substances

- **solute:** smaller component (being dissolved)
- **solvent:** larger component (doing dissolution)

Solubility: maximum amount of solute that dissolves in a set amount of solvent at a set temperature

- **unsaturated:** less than the maximum amount of solute dissolved
- **saturated:** equal to the maximum amount of solute dissolved
- **supersaturated:** greater than the maximum amount of solute dissolved

Solubility is **dependent** on:

- **solute-solvent interactions:** stronger attractions → more favorable
- **pressure:** for gases only, higher → more favorable
- **temperature:** for gases, higher → less favorable; for solids, higher → more favorable

Concentration: ratio of solute to solvent/total solution

- **dilute:** low ratio of solute
- **concentrated:** high ratio of solute

COMMON UNITS OF CONCENTRATION

$$\text{mass percent} = \frac{\text{g solute}}{\text{total g solution}} \times 100$$

$$\text{parts per million (ppm)} = \frac{\text{g solute}}{\text{total g solution}} \times 10^6$$

$$\text{parts per billion (ppb)} = \frac{\text{g solute}}{\text{total g solution}} \times 10^9$$

$$\text{mole fraction (X)} = \frac{\text{moles component}}{\text{total moles mixture}}$$

$$\text{Molarity (M)} = \frac{\text{moles solute}}{\text{L solution}}$$

$$\text{molality (m)} = \frac{\text{moles solute}}{\text{kg solvent}}$$

Colligative Properties: dependent on quantity, not identity.

- **Vapor pressure reduction:** lowering of vapor pressure over a volatile (liquid with measurable vapor pressure) liquid due to the presence of an impurity.

$$\text{Raoult's Law} = P_A = X_A P_A^O$$

- **Freezing Point Depression/Boiling Point Elevation:** presence of solute lowers the triple point for the solvent, thus changing the phase change line.

$$\Delta T_f = K_f \cdot m \quad \text{OR} \quad \Delta T_b = K_b \cdot m$$

- **Osmosis:** Selective passage of molecules through a semipermeable membrane.