Concentration

Concentration

Percent concentration by mass *%(m/m)*

$$\%\text{conc.} = \frac{\text{mass solute}}{\text{mass solution}} \times 100$$

Percent concentration *%(m/v)*

$$\%\text{conc.} = \frac{\text{grams solute}}{\text{mL solution}} \times 100$$

Parts per million by mass

$$\text{ppm} = \frac{\text{mass solute}}{\text{mass solution}} \times 10^6$$

Percent concentration by volume *%(v/v)*

$$\%\text{conc.} = \frac{\text{volume solute}}{\text{volume solution}} \times 100$$

For the concentration equations, mass and volume can be in any units as long as the numerator and denominator match.

Molarity (M)

$$M = \frac{\text{moles solute}}{\text{liters solution}}$$

Molality (m)

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

Dilution

$$M_1V_1 = M_2V_2$$

Gas Solubility and Pressure (Henry's Law)

$$\frac{\text{solubility}_1}{\text{pressure}_1} = \frac{\text{solubility}_2}{\text{pressure}_2}$$

Colligative Properties

Freezing Point Depression

$$\Delta T_F = i \cdot K_F \cdot m$$

ΔT_F - *Freezing point depression;* **i** - *# ion particles per solute molecule;* **m** - *molality;* **K_B** - *Cryoscopic constant of the solvent*

Boiling Point Elevation

$$\Delta T_B = i \cdot K_B \cdot m$$

ΔT_B - *Boiling point elevation;* **i** - *# ion particles per solute molecule;* **m** - *molality;* **K_B** - *Ebullioscopic constant of the solvent*

Osmotic Pressure

Note that osmotic pressure uses **molarity,** not molality.

$$\Pi = iMRT$$

Π - *osmotic pressure, atm;* **i** - *# ion particles per solute molecule;* **M** - *molarity;* **T** - *temperature, °K;* **R** - *ideal gas constant, 0.08206*

K_F & K_B for water

K_F = 1.86 °c kg/mol K_B = 0.512 °c kg/mol