Concentration

Concentration

Percent concentration by mass

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

Parts per million by mass

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

Percent concentration by volume

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

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

Molarity (M)

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

Molality (m)

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

Dilution

$$M_1V_1 = M_2V_2$$

Density

$$\text{Density} = \frac{\text{mass}}{\text{volume}}$$

Density of water = 1 g/ml

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

For water...

K_F = 1.86 °c kg/mol

K_B = 0.512 °c kg/mol

Osmotic Pressure

$$\Pi = iMRT$$

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