Concentration of Solutions

Moles/Litre

$$[x] = \frac{\text{moles of solute}}{\text{volume of solution in L}}$$

Percent Concentrations

Parts per Million/Billion

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

$$\text{ppb} = \frac{\text{mass of solute}}{\text{mass of solution}} \times 10^9$$

Volume % (v/v)

Used when a liquid is dissolved in a liquid e.g. alcohol in water

$$\%\ \text{solute (v/v)} = \frac{\text{volume of solute}}{\text{volume of solution}} \times 100\%$$

*units must match

Mass-Volume % (m/v)

Used for solids dissolved in liquid solvents

$$\%\ \text{solute (m/v)} = \frac{\text{mass of solute in g}}{\text{volume of solution in mL}} \times 100\%$$

Mass % (m/m)

Used for solids dissolved in solids e.g. alloys

$$\%\ \text{solute (m/m)} = \frac{\text{mass of solute}}{\text{mass of solution}} \times 100\%$$

*units must match

Helpful Notes

- for dilute solutions, we assume density is 1 g/mL
- in % concentrations, we find the proportion (fraction) of solute in a solution and change this to be out of 100
  e.g. fraction = 0.02 or 2/100 = 2 parts per hundred or 2%
- for very low concentrations, we change the proportion to be out of 1 million or 1 billion
  e.g. 0.000025 = 25/1000 000 = 25 parts per million