Units of Concentration

There are many different units of concentration, but if you understand the basic definition of each unit, common principles will apply.

First a solution is composed of two basic components: a *solvent* and a *solute*.
Solvent = the component that does the dissolving
Solute = the component that is being dissolved
Therefore

solution = solute + solvent

This also means that if we added the mass of the solute and the mass of the solvent it would equal the mass of the whole solution.

$$\text{Mass}_{\text{solution}} = \text{Mass}_{\text{solute}} + \text{Mass}_{\text{solvent}}$$

$$\text{Molarity} = \text{M} = \frac{\text{mols of solute}}{\text{Liters of solution}}$$

$$\text{Molality} = m = \frac{\text{mols of solute}}{\text{kg of solvent}}$$

$$\text{Wt.}\%_{\text{A}} = (\text{w/w}\%) = \frac{\text{Mass of A}}{\text{Total Mass}} \times 100$$

$$\text{Mol Fraction} = \chi_{\text{A}} = \frac{\text{mols of A}}{\text{Total mols}}$$

$$\text{Weight / Volume}\% = (\text{w/v}\%) = \frac{\text{mass of solute (g)}}{\text{total vol. of soln (mL)}} \times 100$$

$$\text{Parts per X} = \text{ppX} = \frac{\text{mass of solute (g)}}{\text{Total X Mass(g)}}$$

X = "m" = million
X = "b" = billion
X = "t" = trillion

$$\text{Normality} = \text{N} = \frac{\text{mols of "active" } \text{H}^+ \text{or } \text{OH}^- \text{ions}}{\text{L of Soln.}}$$

Molarity is one of the only units of concentration (from the ones above) that is NOT some ratio of solvent to solute. Therefore if we try to convert to or from molarity to one of the other units of concentration given, we need to use **density**.

When converting units of concentration, look at the denominator of the given concentration and make an assumption that would make your life easy. Then get the components that are need for the other unit of concentration.

Unit of concentration given	Denominator	Assumption to be made	Outcome
Molarity	L of solution	1 L of solution	Molarity becomes mols of solute
Molality	kg of solvent	1 kg of solvent	Molality becomes mols of solute
Wt. $\%_{\text{A}}$	Total mass	100 g total	Wt. $\%_{\text{A}}$ becomes mass of A
Mol. $\text{Fraction}_{\text{A}}$	Total mols	1 mol total	Mol. $\text{Fraction}_{\text{A}}$ becomes the mols of A
w/v%	Total vol. (mL)	100 mL total soln.	w/v% becomes mass of solute in grams
ppX	Total X mass	X total mass	ppX becomes mass of solute in grams
Normality	L of solution	1 L of solution	Normality becomes mols of "active" H^+ or OH^- ion in soln