When we express the concentration of a solute in percent mass per volume, we report the mass of a specific solute for every 100 mL of the total solution as a standard.

The formula for percent mass per volume is:

$$\frac{\text{Mass of solute (in grams)}}{\text{Volume of solution (in mL)}} \times 100\%$$

For example, a 4% solution of NaCl in water is made by dissolving 4 g NaCl in enough water to give a total final volume of 100 mL.

$$\frac{4 \text{ g NaCl}}{100 \text{ mL}} \times 100\% = 0.04 \times 100\% = 4\% \text{ NaCl solution}$$

The total final volume of solution is measured after completely mixing the solute and the solvent. If a solute is mixed with a solvent in different amounts, it will not always equal a 100 mL solution. Since it is impossible to predict the volume after mixing, enough solvent is added to first dissolve the solute. More solvent is later added to bring the solution to a final desired total volume. Thus, to make a 4% NaCl solution, we add enough water to dissolve 4 grams of NaCl to bring the final volume of the solution to 100 mL.

Ratios can be used to calculate solutions that are greater or less than 100 mL.

Example of calculating concentration of percent mass/volume

1. What is the concentration of a solution in percent mass per volume made by dissolving 5.7 g NaCl in enough water to have a total solution volume of 125 mL?

$$\frac{5.7 \text{ g NaCl}}{125 \text{ mL of solution}} = \frac{?}{100 \text{ mL of solution}} \quad \textit{(cross multiply)}$$

$$\frac{5.7 \text{ g NaCl} \times 100 \text{ mL solution}}{125 \text{ mL of solution}}$$

4.56 grams per 100 mL solution or 4.56%

Example of Calculating Molarity

The **molarity (M)** of a substance in solution is defined as the number of moles of solute per liter of solution.

$$\frac{\text{moles of solute}}{\text{liters of solution}} = \text{molarity (M)}$$

In the simulations, the solution is given in mL. You will need to convert milliliters to liters: 1 L = 1,000 mL.

$$\frac{\text{moles of solute}}{\text{liters of solution}} = \text{molarity (M)}$$

Example:

$$\frac{\text{3 moles of CaCl}}{\text{1.75 L of } H_2O} = \text{1.7 moles/L or M}$$