

Chapter Fourteen: Mixtures and Solutions

Section 2: Solution Concentration

Concentration: a measure, in a solution, of how much solute is dissolved in a specific amount of solvent or solution

- Describe qualitatively as concentrated or dilute

Percent by mass: the ratio of the solute's mass to the solutions mass expressed as a percent.

$$\% \text{ by mass} = \frac{\text{mass of solute}}{\text{mass of solution}} \times 100$$

Example: You have 3.6 grams of sodium chloride and dissolve it in 100. grams of water. What is the percent by mass of the salt water?

$$3.6 \text{ grams NaCl} / 100. \text{ grams H}_2\text{O} \times 100 = 3.5 \% \text{ NaCl}$$

Percent by volume: the ratio of the volume of solute to the volume of solution expressed as a percent.

$$\% \text{ by volume} = \frac{\text{volume of solute}}{\text{volume of solution}} \times 100$$

Molarity: the number of moles of solute in one liter of solution

$$\text{Molarity (M)} = \frac{\text{amount of solute (mol)}}{\text{Volume of solution (L)}}$$

Example: A student dissolves 2.75 grams of sodium hydroxide in water to make a 250. mL solution. What is the molarity of the solution?

$$\text{NaOH} = 40.00 \text{ g/mol}$$

$$\text{Molarity} = \frac{(2.75 \text{ g NaOH})(1 \text{ mol}/40.00 \text{ g})}{(250. \text{ mL Soln.})(1 \text{ L}/1000\text{mL})} = \frac{0.06875 \text{ mol NaOH}}{0.250 \text{ L}}$$

$$\text{Molarity} = 0.275 \text{ M NaOH}$$

Dilution: decrease the number of solute particles by adding solvent to the solution

- *Stock solution:* in the lab, a concentrated solution of standard molarity
- $M_1V_1 = M_2V_2$
 - M is the molarity of the solution
 - V is the volume (in similar labels)
 - 1 and 2 represent initial and final, respectively
- Example: If a student used 75 mL of a concentrated hydrochloric acid stock solution to make a 1.5 L of a 0.50 M HCl solution, what was the original concentration of the stock solution?

$$M_1V_1 = M_2V_2$$

$$(M_1)(0.075\text{L}) = (0.50\text{ M HCl})(1.5\text{ L})$$

$$M_1 = 10.\text{ M HCl}$$

Molality: the concentration of a solution expressed in moles of solute per kilogram of solvent

$$\text{Molality } (m) = \frac{\text{moles of solute (mol)}}{\text{Mass of solvent (kg)}}$$