

Solution Concentrations

Qualitative expressions: "Dilute and Concentrated"

Quantitative expressions: amount of solute in a given amount of solvent

Mass Percent ... mass of solute in a given mass of solution

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

OR

$$\text{Mass \%} = \frac{\text{grams of solute}}{\text{grams of solute} + \text{grams of solvent}} \times 100$$

Examples:

- (1) Calculate the mass percent of 5.00 g of calcium chloride in 95.0 g of water.

$$\text{Mass \%} = \frac{5.00g}{5.00g + 95.0g} \times 100 = 5.00\%$$

- (2) A 135 g sample of seawater is evaporated to dryness, leaving 4.73 g of solid residue (the salts formerly dissolved in the seawater). Calculate the mass percent of solute present in the original seawater.

$$\text{Mass \%} =$$

- (3) What mass of water must be added to 425 g of formaldehyde to prepare a 40.0% solution of formaldehyde? This solution, called "formalin" is used to preserve biological specimens.

Molarity ... number of moles of solute per liter of solution

(Note: molar mass will be required if grams are needed!)

$$\text{Molarity} = \frac{\text{moles of solute}}{\text{liters of solution}} = \frac{\text{moles}}{\text{liter}} = \mathbf{M}$$

Examples:

- (1) Calculate the molarity of a solution prepared by dissolving 11.5 g of solid NaOH in enough water to make 1.50 L of solution.

$$\text{Molarity} = \frac{\text{moles}}{\text{liter}} \quad \text{so ...}$$

$$(11.5 \text{ g})\left(\frac{1 \text{ mole}}{40.0 \text{ g}}\right) = 0.288 \text{ mole NaOH}$$

$$\text{Molarity} = 0.288 \text{ moles} / 1.50 \text{ L} = 0.192 \text{ M solution}$$

- (2) 24.3 g of NaCl dissolves in 2.45 L of water. What is the molarity of the resulting solution?

- (3) How many moles of NaCl are in 0.125 L of a 4.00 M salt solution?

$$\text{Molarity} \times \text{volume in liters} = \text{moles}$$

- (4) How many grams of NaCl are in 0.125 L of a 4.00 M salt solution?

$$\text{Molarity} \times \text{volume in liters} = \text{moles}$$

- (5) How many grams of NaCl are needed to make 250 mL of a 0.500 M salt solution?