

## 0.1 Outline

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## 0.2 Terminology

In solution, we need to define the following terms:

- **solvent** – The medium (e.g., water, ethanol, benzene, etc.) in which a solute is dissolved to form a solution.
- **solute** – The substance (e.g. NaCl, glucose, etc.) dissolved in a solvent to form a solution.

## 0.3 Concentration of Solute

The amount of solute in a solution is given by its **concentration**.

$$\text{Molarity(M)} = \frac{\text{moles of solute}}{\text{liters of solution}} \quad (1)$$

$$\begin{aligned} [\text{NaCl}] &= 0.1M \\ &= \frac{0.1 \text{ moles of NaCl}}{1 \text{ L of solution}} \end{aligned}$$

## 0.4 Preparing Solutions

- Weigh out a solid solute and dissolve in a given quantity of solvent.
- **Dilute** a concentrated solution to give one that is less concentrated.

## 0.5 Using Molarity,

What mass of oxalic acid,  $\text{H}_2\text{C}_2\text{O}_4$ , is required to make 250.00 mL of a 0.0500 M solution?

$$\begin{aligned} \text{molar mass} &= (2 * 1.008) + (2 * 12.011) + (4 * 15.999) \\ &= 2.016 + 24.022 + 63.996 \\ &= 90.034 \text{ g mol}^{-1} \end{aligned}$$

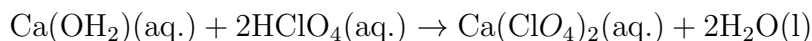
$$250.00 \text{ mL} \times \frac{1 \text{ L}}{1,000 \text{ mL}} \times \frac{0.05 \text{ mol}}{1\text{L}} \times \frac{90.034 \text{ g H}_2\text{C}_2\text{O}_4}{1 \text{ mol H}_2\text{C}_2\text{O}_4} = 1.125425 \text{ g H}_2\text{C}_2\text{O}_4$$

## 0.6 Preparing a Solution by Dilution

You have 50.0 mL of 3.0 M NaOH and you want 0.50 M NaOH. What does one do?

$$\begin{aligned}
 M_1 V_1 &= M_2 V_2 \\
 (3.0)(50.0) &= (0.5) V_2 \\
 V_2 &= \frac{(3.0)(50.0)}{0.5} \\
 V_2 &= (6.0)(50.0) \\
 V_2 &= 300.0 \text{ mL} \\
 &= 3.0 \times 10^2 \text{ mL}
 \end{aligned}$$

In an acid-base titration, it takes 38.55 mL of 0.650 M perchloric acid ( $\text{HClO}_4$ ) to completely neutralize 25.00 mol calcium hydroxide ( $\text{Ca}(\text{OH}_2)$ ) solution.



A) How many moles of  $\text{HClO}_4$  are needed for the complete neutralization?

$$38.55\text{mL perchloric acid} \times \frac{1 \text{ L perchloric acid}}{1,000 \text{ mL perchloric acid}} \times \frac{0.650 \text{ mol}}{1 \text{ L}} = 0.0251 \text{ mol perchloric acid}$$

B) How many moles of  $\text{Ca}(\text{OH}_2)_2$  got consumed during the neutralization?

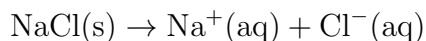
$$0.0251 \text{ mol perchloric acid} \times \frac{1 \text{ mol Ca}(\text{OH}_2)_2}{2 \text{ mol perchloric acid}} = 0.01255 \text{ Ca}(\text{OH}_2)_2$$

C) What is the concentration of  $\text{Ca}(\text{OH}_2)_2$  in the original solution before titration?

$$\frac{25.00 \text{ mol Ca}(\text{OH}_2)_2}{38.55\text{mL}} \times \frac{1,000 \text{ mL}}{1 \text{ mL}} =$$

## 0.7 Dissociation

- When an ionic compound dissolves in water, the solvent pulls the individual ions from the crystal and solvates them.
- This process is called **dissociation**.



- An **electrolyte** is a substance that dissociates into ions when dissolved in water.
- Ionic compounds dissociate in water ( $()$ ).
- Only a few molecular compounds are capable of dissociating in water.
- For example,



## 0.8 Electrolytes

- An **electrolyte** is a substance that dissociates into ions when dissolved in water.
- A **nonelectrolyte** may dissolve in water, but it does not dissociate into ions when it does so.
- There are many examples of molecular compounds (e.g., ) that serve as nonelectrolytes in water.