

# Experiment 1: An Inquiry into Chemical Reactions

## Introduction

The main types of reactions that occur in aqueous solution are: precipitation, acid/base (neutralization), gas forming, and oxidation-reduction. In this experiment, you will be asked to conduct several reactions that fall into these categories and answer questions about them.

## Pre-lab

1. Name the following compounds:  $\text{Cu}(\text{NO}_3)_2$  and  $\text{Na}_2\text{CO}_3$ .
2. Write a balanced, net ionic equation for the reaction between these two compounds in solution.
3. Write the balanced net ionic equation for the reaction between the product of the reaction in Question 2 with  $\text{HCl}(\text{aq})$ .
4. Write the balanced net ionic equation for the reaction between  $\text{Cu}(\text{NO}_3)_2(\text{aq})$  and  $\text{NaOH}(\text{aq})$ .
5. Write a balanced net ionic equation for the reaction between the product of Question 4 and sulfuric acid.
6. Balance the following redox reaction and identify the reactant oxidized and the oxidizing agent.  
 $\text{Cu}^{2+} + \text{I}^- \rightarrow \text{CuI} + \text{I}_2$
7. Write a balanced net ionic equation for the reaction between  $\text{Cu}^{2+}$  and  $\text{Na}_2\text{S}(\text{aq})$ .

## Procedure

1. Obtain a clean test tube. Place ten drops of 0.1 M  $\text{Cu}(\text{NO}_3)_2$  in a test tube. What color is the solution?
2. Add 10 drops of 0.1 M  $\text{Na}_2\text{CO}_3$  to the test tube. What do you observe?
3. Add 12 drops of 1 M  $\text{HCl}$  to the test tube and stir. What do you observe?
4. Add 10 drops of 1.0 M  $\text{NaOH}$  to the test tube and stir. What do you observe?
5. Add 18 drops of 0.1 M  $\text{H}_2\text{SO}_4$  to the test tube and stir.
6. Add 5 drops of 1.0 M  $\text{KI}$  to the test tube and stir. The following redox reaction occurs:  
 $\text{Cu}^{2+} + \text{I}^- \rightarrow \text{CuI} + \text{I}_2$ . What is the color of the mixture in the test tube?
7. Thiosulfate ion,  $\text{S}_2\text{O}_3^{2-}$ , will react with iodine according to the following unbalanced equation:  
 $\text{S}_2\text{O}_3^{2-} + \text{I}_2 \rightarrow \text{S}_2\text{O}_6^{2-} + 2\text{I}^-$
8. Slowly add 3 drops of 1.0 M  $\text{Na}_2\text{S}_2\text{O}_3$  and stir. What do you observe?
9.  $\text{Cu}^+$  forms the complex ion  $\text{Cu}(\text{NH}_3)_2^+$  when reacted with ammonia. Add 9 drops of 3 M  $\text{NH}_3$  to the test tube, observe then stir. What do you observe?
10. Add 1 drop of 3% hydrogen peroxide to the test tube and stir. What do you observe?
11. Add 5 drops of 0.5 M  $\text{Na}_2\text{S}$  to the test tube and stir. What do you observe?
12. Using the proper technique, smell the contents of the test tube. What do you observe?

### Post-lab Questions

1. Identify the type of reaction in Step 2.
2. Identify the type of reaction in Step 3.
3. When a solution turns cloudy, what has been formed?
4. Which reactant is oxidized in Step 7?
5. Based on your observations of Steps 6-8, what is the color of iodine and what is the color of CuI?
6.  $\text{Cu}^+$  will react with hydrogen peroxide to form  $\text{Cu}^{2+}$ . Is hydrogen peroxide acting as an oxidizing agent or reducing agent when this reaction occurs?
7. What is causing the smell in Step 12?