Chemical Reactions of Copper and Iron

In this lab you will learn to observe a chemical reaction, deduce what is happening in the reaction, and write a chemical equation that describes the reaction.

Pre-lab Assignment. To prepare for this lab, review the handout on reactions that you received during last week's lab and the work you completed during that lab. Complete the worksheet on the backside of this page before you come to lab; we will review this worksheet before you begin the experiment.

Procedure. Included with this handout is the first set of questions that will guide you as you explore the chemistry of copper. After a group discussion of the questions on this sheet, you will receive the first of several additional pages of questions on the chemistry of copper. Work with your assigned partner to complete each page of questions, checking your work with the instructor as you finish each page. When you finish the reactions of copper, obtain a set of questions on iron. You will complete these questions and turn in your answers when you are done. ***Be sure to record your observations in your lab notebook as well as on the worksheets!***

Hints and Suggestions. The following will help you organize and complete your work:

- For each metal ion, the reactions are completed by adding a new reagent to the result of the previous reaction. Do not discard the contents of a test-tube unless the procedure so directs you.
- It is easy to contaminate a solution by failing to clean your test-tubes or stirring rods after using them, or by using the same pipet to sample different solutions. Keep your equipment clean, your solution's labeled, and your lab bench organized and neat!
- After you add a reagent to a test-tube, be sure to mix the contents by stirring the solution with a stirring rod or by gently agitating the test-tube.
- Measuring reagents by counting drops is not particularly precise, so treat the directions as a general guide. If you don't see a change after you add the specified drops of reagent, add a few additional drops and then mix and observe.
- You can determine if a solution is acidic or basic by using litmus paper: solutions that are acidic turn blue litmus paper red, and solutions that are basic turn red litmus paper blue.
- Potential hazards in the lab include solutions of the strong acids HCl and H_2SO_4, and solutions of the strong base KOH. Strong acids and bases are caustic and can cause burns; use these solutions carefully. In the presence of acid, solutions of Na_2S produce H_2S, a toxic and smelly gas; when so directed, ***complete reactions that use Na_2S in a hood and dispose of the reaction mixture and clean out your test-tube while working in the hood***.

Waste Disposal. Place all waste in the appropriate container provided in the hood.

Lab Report. Each partner will turn in a complete set of worksheets for iron.

References. This lab is based on the following article: Wilcox, C. J. *J. Chem Ed. 78*(1), **2001**, 62-63.

Copper Series (page 1); complete before coming to lab

What is the name of the compound whose formula is $Cu(NO_3)_2$?

What is the name of the compound whose formula is Na_2CO_3?

When dissolved in water, solid Na_2CO_3 makes the solution basic due to a reaction between the carbonate ion, CO_3^{2-}, and water, which forms OH^- as a product? Write a chemical equation that shows the chemistry of this acid–base reaction. For this, and all other reactions, be sure to identify the physical state of each species using *(aq)* for a reactant or produced dissolved in water, *(s)* for a solid reactant or a precipitate that forms as a product, *(g)* for a gaseous reactant or product, and *(l)* for a liquid, typically water. Recall that for any reaction that takes place in water, to obtain a balanced chemical reaction you may include H_2O as either a reactant or a product.

If you mix a solution of aqueous $Cu(NO_3)_2$ with a solution of aqueous Na_2CO_3, two precipitates form: $CuCO_3$ and $Cu(OH)_2$. Write a separate chemical equation for each precipitation reaction, one that shows the formation of $CuCO_3$ and one that shows the formation of $Cu(OH)_2$.