CHEMISTRY MATTERS
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Unit 6E Lab Investigation – Calculating The Theoretical Yield and Percent Yield of Copper

Name:

Date:

Purpose:

In this investigation, you will measure the reactants and the products of the reaction between iron and copper sulfate. Using stoichiometry, you will then determine the theoretical yield and actual percent yield of copper.

In this lab, solid iron filings and a solution of aqueous copper (II) sulphate will react according to this balanced equation:

$$Fe_{(s)} + CuSO_{4(aq)} \rightarrow Cu_{(s)} + FeSO_{4(aq)}$$

When metallic iron comes in contact with a solution of copper sulphate, the iron displaces the copper. In the activity series, iron is more active than copper. The solid copper can then be seen precipitating as a fine red powder. (What type of reaction is this?)

Safety:

Wear eye protection goggles and a lab apron at all times when conducting this investigation. Use hot pads to handle any hot glassware. Wash hands carefully after each lab session before leaving the room.

Materials:

- balance
- iron filings
- funnel
- Erlenmeyer flask
- stirring rod
- clean, dry beaker (100 or 250 mL)
- copper (II) sulphate crystals
- filter paper
- wooden applicator stick

Procedure:

DAY 1

1. Use a clean, dry beaker.
2. Weigh about 2.5 grams of iron filings and add them to the beaker.
3. Weigh about 12.5 grams of copper (II) sulphate and add to an Erlenmeyer flask. Add 100 mL of water and heat gently to dissolve the crystals in water. DO NOT BOIL.
4. Slowly add the copper sulphate solution to the beaker containing iron filings. Placing a wooden applicator stick into the beaker will help avoid frothing in the mixture.
5. Swirl the beaker to make sure the reaction proceeds to completion. Reddish-brown copper metal should precipitate to the bottom of the beaker.
5. Find the mass of a single piece of filter paper. Place a funnel in the empty Erlenmeyer flask and add the filter paper.
7. After 10 minutes, record any color change in the liquid, and swirl the beaker again. Immediately begin decanting (pouring) liquid into the funnel. Continue swirling the liquid and pouring so that any solid copper from the reaction is poured out onto the filter paper.
8. If any copper remains in the beaker, swirl a little water and decant the entire solution onto the filter paper in the funnel.
9. Label the flask and filter paper with your name and allow the filter to dry overnight.

questions continued on next page

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DAY 2

10. Find the mass of the filter paper with the copper metal. Subtract the known mass of the filter paper to determine the mass of copper produced by the reaction. Record all measurements in the data table below.

Data Table:

Mass of copper (II) sulphate	
Mass of iron filings	
Mass of dry filter paper	
Mass of filter paper with copper	
Mass of copper produced	

Color of the liquid at the end of the reaction is _____.

Data Analysis: (Show your work in each calculation.)

1. Calculate the number of moles of baking soda used in the lab.

2. Calculate the number of moles of copper (II) sulphate used in the reaction.

questions continued on next page

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Data Analysis: (Show your work in each calculation.)

3. Using your answer to question 1 and your knowledge of the balanced equation for this reaction, calculate the theoretical yield of copper produced.

4. Using your answer to question 2 and your knowledge of the balanced equation for this reaction, calculate the theoretical yield of copper produced.

5. Based on your answers to questions 3 and 4,

   Circle which reactant is the limiting reactant. (iron or copper sulphate?)

   Circle which reactant is the excess reactant. (iron or copper sulphate?)

   What is the theoretical yield of copper produced in this reaction? _____.

   What is the actual mass of copper produced in this reaction? _____.

6. Use your answer to question 5 and the actual mass of copper produced to calculate the percent yield of copper in the experiment.