**STOICHIOMETRY LAB—Copper Sulfate + Iron**

**RELATING MOLES TO COEFFICIENTS OF AN EQUATION**

\[ Fe + CuSO_4 \rightarrow Cu + FeSO_4 \]

**PURPOSE:**
1. To investigate how coefficients of a balanced chemical equation are used to represent a mole to mole ratio.
2. To understand limiting vs. excess reactants, stoichiometry, and % yield.

**MATERIALS:**
Balance beam, Bunsen burner, 100 mL beaker, 250 mL beaker, 100 mL cylinder, beaker tongs, ring stand, iron ring, wire gauze, glass stirring rod, safety goggles, copper II sulfate , iron filings, 2 pieces of filter paper

**SAFETY:**
Tie back hair and secure loose clothing

**PROCEDURE:**
1. Find the mass of a clean, dry 100 mL beaker and record.
2. Measure out 8.00 grams of Copper II sulfate onto a piece of filter paper (taking the filter paper’s mass into account). Add these to the beaker.
3. Measure 50.0 mL of water in the cylinder and add it to the beaker.
4. Heat the water/copper II sulfate mixture in the beaker to just below boiling. DO NOT allow the liquid to boil. Continue heating and stir the mixture until all crystals are dissolved. Turn off the gas and remove the burner.
5. Using another piece of filter paper, measure out 2.24 grams of iron filings (taking the filter paper’s mass into account). Record this mass.
6. Add the iron filings, small amounts at a time, to the hot solution. **DO NOT STAND DIRECTLY OVER THE REACTION**, AND **DO NOT INHALE THE FUMES**. Stir continuously. After all the iron has been added and the solution stirred, allow the beaker to sit for 10 minutes while the reaction finishes. Record your observations.
7. **Decant** the liquid (slowly pour off the liquid without disturbing the solid in the bottom) that is in the 100 mL beaker into a 250 mL beaker using the glass stirring rod making sure not to disturb any solid precipitate in the bottom of the 100 mL beaker.
8. Add about 10 mL of water to the solid precipitate in the 100 mL beaker. Stir vigorously in order to wash the solid off. Let the solid settle and decant the liquid again. Repeat this washing and decanting.
9. Spread the solid out on the bottom of the 100 mL beaker and place in a drawer or oven to dry overnight. Complete step 10-12 at the beginning of the next lab period.
10. Find the mass of the 100 mL beaker and the dry copper metal. Record in data table.
11. To clean up, scrape the copper into the trash can using a paper towel. Then wash the beaker out with soap, water, and scrub brush.
12. Wash hands well before leaving the lab.

OBSERVATIONS AND DATA:

a. Mass of empty 100 mL beaker = _____________________________g
b. Mass of iron filings = _____________________________g
c. Mass of 100 mL beaker + copper = _______________________
d. Visual observations____________________________________

CALCULATIONS:
1. find the mass of copper produced (c-a) = ____________________g
2. find the # of moles of copper produced = ________________moles
3. find the # of moles of iron reacted (remember 2.24 g were used)=______________moles
4. find the whole # ratio of moles of iron to moles of copper=__________

CONCLUSIONS & QUESTIONS:
1. How does the ratio found in calculation #4 compare with the ratio of the coefficients of the same two metals in the balanced equation for the reaction?
   Fe + CuSO$_4$ yields Cu + FeSO$_4$

2. How many moles of copper II sulfate were used to perform this experiment? Why is this amount said to be “in excess”?

3. Explain why iron would be the limiting factor in this experiment?

4. Give 3 more examples of balanced single replacement equations besides the one given in this lab.

5. Consider this reaction: Cu + 2AgNO$_3$ yields 2Ag + Cu(NO$_3$)$_2$
   If 3 moles of copper reacts, how many moles of silver will be produced?

6. Having used 2.24 grams of iron in this experiment, what would the theoretical yield of copper be?

7. Calculate your % yield of copper.

8. List sources of error for this experiment.