Chemistry **Name _____**
Lab **Date_____Block___**

Stoichiometry and Limiting Reagent Copper (II) Sulfate Lab

In this lab activity, you will work with metallic iron and ionized copper. The metallic iron is in the form of steel wool. The ionized copper is in the compound copper (II) sulfate. In the course of the chemical reaction, the iron is ionized as copper metal is produced. In this experiment, you will measure the amounts of reactants and products and will be able to determine the quantitative relationships between the moles of metallic iron (a reactant) and moles of metallic copper (a product). Both qualitative and quantitative data tables appear on the following page. All items must be filled in and it is IMPORTANT to SHOW WORK ON ALL CALCULATIONS. Not showing work will result in the loss of points.

Procedure:

1. Using the electronic balances, determine the **mass** of a clean, dry **250 mL beaker** to the nearest 0.01 grams.

2. Add approximately **13.00-15.00 grams of copper (II) sulfate** to the beaker. Record the total **mass of the flask and compound** to the nearest 0.01 grams.

3. Add 100.0 mL of distilled water to the beaker to dissolve the salt. It will be necessary to stir the beaker contents to accelerate the dissolving process.

4. Record the **mass** of approximately **3.00 g of a tuft of steel wool** to the nearest 0.01 grams.

5. Add the steel wool to the beaker in small pieces. Stir the contents of the beaker intermittently for 5-10 minutes or until all of the steel wool appears to have disappeared. Record your **observations**.

6. Write you name on a piece of **filter paper** (in pencil) and record the **mass** to the nearest 0.01 grams.

7. When all of the steel wool has reacted, clean and collect the remaining mixture according to the following procedure:

   Let the solid copper particles settle in the beaker. Carefully pour off, or decant, the liquid into a 400 mL beaker. A solid glass rod is used in the technique. Wash the residue in the original beaker with 50 mL of distilled water, and decant again. Repeat the washing procedure at least two times. It is safe to pour the solution in the 400-mL beaker down the drain.

   Prepare a filtering setup. Fold the piece of filter paper. Fit it into a funnel and moisten the paper with distilled water. Use a water bottle to carefully transfer the copper residue into the filter paper from the beaker. Rotate the beaker as you flush the residue from it. Do not overfill the filter paper. After the water has run through the filter paper, carefully remove the filter paper from the funned and place it on the tray to dry in the oven overnight.

Qualitative Data Table – Observations you can make using your five senses

	Observations
$CuSO_4$ (aq)	
Addition of Fe to $CuSO_4$	
Solution after reaction	
Product in solution	
Filtered product	
Product after drying	

Quantitative Data Table – Measured Data

	Data	**Calculations**
Mass of dry beaker		
Mass of beaker and $CuSO_4$		
Mass of $CuSO_4$		
Mass of Fe		
Mass of filter paper		
Mass of dry product + filter paper		
Mass of product		

Data Analysis – upon completion of the lab, answer the following questions.

1. Write a chemical equation for this reaction. Include the states of each reactant and product and balance the equation.

2. Write the total ionic and the net ionic equation for this reaction. (**Honors only**)

3. What is the solid residue created in the reaction?

4. Determine the number of moles of iron that reacted.

5. Using the mass of the dry copper product, determine the number of moles of copper produced.

6. Determine the experimental mole ratio of moles of Fe to moles of Cu. Divide the moles of Fe by the moles of Cu to obtain a decimal number.

7. What is the theoretical mole ratio of moles of Fe/moles of Cu? Explain how you determined this.

8. Which reactant was the limiting reagent? Which is the excess reagent? Show both fence posts to support your response to the limiting/excess reagent. ***Remember solid copper was your product!***

9. How much excess reagent is left over?

10. What evidence did you observe that would suggest some ionized copper remained dissolved in the water? How could you remove all the dissolved copper from the solution

11. What mass of copper did you calculate you would produce (**theoretical yield)**?

12. What mass of copper did you actually produce (**actual yield)**?

13. What is the **percent yield** of copper?