WLHS / Chem / Monson

Name_____ Date_____ Per____

LAB: *Copper (II) Chloride and Aluminum – Limiting Reactant and % Yield*

Introduction / Background:

The purpose of this lab is to experimentally produce copper metal through the reaction shown below. Stoichiometry will be used to calculate the limiting reactant, and the percent yield of copper metal produced.

Copper (II) chloride$_{(aq)}$ + Aluminum$_{(s)}$ → copper$_{(s)}$ + aluminum chloride$_{(aq)}$

Pre-laboratory Assignment

1) Write out the **balanced** equation for the reaction:

_____

2) When you mix an aqueous solution of copper (II) chloride with a solid piece of aluminum metal, what is an easy, **VISUAL** observation you could make to determine which reactant is in EXCESS vs. which reactant is the LIMITING REACTANT?

3) **IF** 0.4 g of Al reacts with 5.00 copper (II) chloride, which is the limiting reactant? How much of the excess reactant will be left over? SHOW WORK.

4) In the above reaction, what mass of copper metal is expected to form? SHOW WORK.

5) IF, in the above reaction, you actually produce 1.07 g of copper metal in the lab, what is your PERCENT YIELD?

Materials

safety goggles	stirring rod	2 beakers (150 & 250 mL)	large weigh boat
aluminum foil	copper(II) chloride	water	

Safety

The copper chloride used in this lab is poisonous if ingested and is also a skin/eye irritant. **Goggles must be worn at all times**. Avoid contact with skin. Seek medical attention if copper chloride is ingested.

Procedure

1) Obtain and label a 150 mL beaker. **Dry and measure the mass** of the empty 150 mL beaker.
2) Place about **6.00 g** of ***copper (II) chloride*** in the 150 mL beaker. **RECORD THE EXACT MASS OF THE COPPER CHLORIDE AND BEAKER IN YOUR DATA TABLE.**
3) Add about 50 mL of water to the beaker.
4) Stir until all of the copper (II) chloride has dissolved entirely.
5) Obtain a piece of Aluminum foil and determine its mass. **RECORD THE EXACT MASS IN YOUR DATA TABLE.** Add the ***aluminum foil*** to the solution. Tear the aluminum foil into small pieces (this increases the surface area of the aluminum). **DO NOT WAD IT UP INTO A BALL!**
6) Let the reaction run to completion. Stir if necessary.
7) Wait until all of the copper settles. Do not disturb.
8) Slowly pour off the solution into a 250 mL beaker. Use a stirring rod to keep copper pieces from leaving the beaker. Try not to disturb the copper in the beaker. You can discard the decanted solution in the sink. **KEEP THE COPPER!**
9) "Wash" the copper with additional water, and again let it settle.
10) Decant again into the 250 mL beaker. Repeat steps 9 and 10 as many times as possible.
11) Obtain a large weigh boat and label it with your group's initials and period. **Measure and record the mass in your data table.**
12) Scrape out ALL of the copper into the large weigh boat.
****Put your weigh boat with copper on the side counter and let it dry overnight. Answer the questions / do the calculations for Day 1.**

Data Table:

Mass of Beaker:	g
Mass of Copper (II) Chloride & Beaker:	g
Mass of Aluminum foil:	g
Mass of empty weigh boat:	g
Mass of weigh boat and Copper **AFTER DRYING**: (day 2)	g

Calculations:

Mass of Copper (II) Chloride:

_____

Show work

Mass of Copper formed:_____

(day 2; show work!)

Questions Day 1:

1) a) Which reactant was the **limiting** reactant?_____

b) Show **mathematically** which one is the limiting reactant.

c) **What VISUAL observations support this?**

2) a) Which reactant was the **excess** reactant?_____

b) Calculate HOW MUCH of the excess reactant will remain after the reaction is complete.

c) **What VISUAL observations support that this is the excess reactant?**

3) What kind of reaction was this (of the five types we've learned)?_____

4) What would happen in the lab if the **other** reactant were limiting? ***What would you observe?***

Questions Day 2:

1) Using the mass of the limiting reactant from day 1, calculate the theoretical mass of copper that should have formed. **Show work.**

2) Using the theoretical mass of copper that should have formed, and the mass of copper that was actually obtained in the experiment (actual yield), **calculate the percent yield of the experiment. Show work.**

For each scenario below, *predict* the effect on the calculated percent yield of copper. (Hint: will the % yield be greater than or less than 100%?)

3) Copper was lost during the process of transferring it to the weigh boat.

4) Not all of the water was removed from the copper.

5) Copper chloride (which is green/blue by the way) is still present in the final copper sample collected.

6) Based on the percent yield calculated, brainstorm reasons that would explain why **your** yield was NOT exactly 100%.

7) Using the previous questions and your results and observations from lab, what changes would you make in the lab to improve upon the percent yield?

CLAIM – EVIDENCE – REASONING

- **Claim**: Provide an IMPROVEMENT for the PROCESS or PROCEDURE that would improve the percent yield.
- **Evidence:** Provide data to support your claim.
- **Reasoning**: Logical explanation of how your evidence supports your claim.