LAD J1 (pg 1 of 3) Stoichiometry of a Single Replacement Reaction

"Stoy-key-aw-met-tree" **% Yield of a Product** Name_____Per____

Introduction:

In this lab, mole-mole relationships in chemical reactions will be inspected in an attempt to verify that the theoretical stoichiometry of balanced equations actually occurs in the laboratory. A single replacement reaction will occur when a piece of copper is placed in aqueous silver nitrate. Since copper can form either a +1 or +2 charge, there are two possible equations that could describe this reaction. Further, the mass of one of the products will be measured and a % yield will be calculated.

Prelab: Must be done BEFORE class

1. Since copper can combine as two possible charges (as mentioned in the introduction) write out the two possible balanced equations that could describe the reaction that occurs in this lab as explained in the introduction.

2. In your Google Lab Sheet, set up a data/results table in a new tab, and by make a vertical list of everything that should be measured and calculated. Your entire data/results table must fit on one page, though it does not need to fill the page. Put in the formulas for the calculations, you have the skills to set up the calculations.

Procedure Day 1 Goggles must be worn. Only five students per lab bench please.

A. Label (initials and per #) a small 50 ml beaker, then determine the beaker's mass.

B. Tare the beaker and measure the mass of all the silver nitrate and then dissolve completely in about 15 ml of DEIONIZED water.

C. Measure the mass of the copper wire. Coil the wire as shown by the instructor (leaving a section to be above the surface of the solution that can be used as a handle on the second day), and place the coil in the beaker with the aqueous silver nitrate.
   - **OBSERVE** the silver crystals forming.
   - **OBSERVE** the color of the water solution. Comment in the space below: What is causing this color change?

D. Set the beaker on the class tray on the cart to complete the reaction overnight.

Day 2

E. Shake the silver crystals from the left-over copper wire, and rinse the wire with water using a squirt bottle (the rinse water must go into the beaker).

F. Dip the left-over copper wire in acetone to help the copper dry, then determine the mass of the dried wire.

G. Carefully decant the blue solution into a second beaker (no need to mass this beaker) Try to avoid losing too many floating silver crystals into the second beaker.

H. Wash the silver crystals several times, using the squirt bottle, carefully decanting the wash water each time into the second beaker. Repeat the washing process until there is no longer any hint of blue in the beaker with the silver crystals when the beaker is held over a white piece of paper.

I. Set the silver crystals and the back on the class tray on the cart to dry overnight.

Day 3

J. Measure the mass of the dried silver (metal) crystals in the 50 ml beaker.
   - **OBSERVE**: Is there any blue substance dried in the beaker with the silver crystals. What would a hint of blue mean?

(Don't forget all of the Process the Data items on the next page also should be line items in your data table.)

Disposal:

- The remaining copper wire should be put on the tray on the cart.
- The beakers with the dried silver crystals and the dried blue crystals should be left on the tray on the cart.

Processing the data *(All of these items should be line items in your data table.)*

Part 1 − Stoichiometry mole ratios

a. Calculate the number of moles of silver nitrate that reacted. Assume that all of the silver nitrate reacted.
b. Calculate the mass of copper that *actually reacted*.
Remember that not all the copper reacted – you took some of it out and returned it to the tray.
c. Convert the mass of copper *reacted* into moles of copper reacted.
d. Calculate the mole ratio of silver nitrate reacted to moles copper reacted.

Part 2 – Percent yield of the silver crystals product

e. Calculate the experimental mass of silver crystals that formed.
f. Calculate the theoretical mass of silver that should form by using the starting mass of silver nitrate.
g. Determine the % yield of silver formed by using the experimental mass of silver collected in the lab and the theoretical mass of silver formed from calculation (a).

Post LAD Questions

Part 1 − Stoichiometry

1. Google the word the term decant. What does it mean in context of this lab. What are you decanting in this lab?

2. How can you tell (while you are washing) when you have washed the silver crystals enough? What evidence was there after the crystals were dried if they had not been washed enough?

3. Why must all the wash water get into the beaker? What are you washing off the silver crystals, and where do you want it to go?

4. From looking at your data, what is the *experimental* ratio of moles silver nitrate reacted to moles copper reacted, and explain how this dictates which balanced equation represents the most dominant reaction that occurs in this experiment? Go back to #1 in the preLAD and us a red pen or a highlighter to put a box around the correct equation.

5. Having selected one of the two reactions as the most dominant, What is the charge on the copper ion that was produced during this reaction? What is the roman numeral of the copper(?) nitrate.
   Go back and properly name this salt in your data table.

Part 2 – Percent Yield of the silver product

6. In theory, what should be the value of the % yield?

7. Some students silver crystals may have had some blue color on them. Would the presence of this blue color cause the percent yield to be larger, smaller or no change? Be sure and comment on any change in measurements and follow those changes completely through to the percent yield.

8. It's possible that the surface of the silver crystals oxidized while in the oven. What does this mean? What substance would the silver be oxidizing with?

9. If your crystals did oxidize in the oven, would this cause the percent yield to be larger, smaller or no change? Be sure and comment on any change in measurements and follow those changes completely through to the percent yield.

10. **Explain** why the starting mass of silver nitrate (and not the starting mass of copper wire or the calculated mass of copper reacted) should used to calculate the theoretical mass of the silver product formed?