Name _____

How much solid copper can you get from this blue solution?

- How can a balanced chemical equation help determine the relationship between starting amounts and ending amounts?
- What is the relationship between how much you start with and how much you produce?
- Are reactions perfect?

Your Task:

Determine the grams of solid copper that will be produced from your sample in this copper cycle lab.

You will be using two chemical equations to determine the amount of your product.

1. Draw a mass of copper II nitrate. This will be your starting sample of copper for this lab. Record the mass of your copper II nitrate as well as the volume of prepared solution that you will be using. _____
2. In the list to the right, you will find several solutions that are available for this task. Not all of the solutions will produce a result. You must decide which solution to use.

   Available Solutions:
   Hydrochloric acid
   Sodium chloride
   Sodium carbonate
   Calcium nitrate

   a. What kind of reaction will this be? _____
   b. What are the rules/ patterns for this type of reaction?

      _____

      _____

      _____

   c. Which solution will you work with based on those rules? Why?

      _____

      _____
3. Using your chosen solution, write a BALANCED chemical equation.

4. Write the net ionic equation for the reaction above.

5. How many moles of copper II nitrate will you be using?

6. How many moles of sodium carbonate will you need?

7. How many moles of copper II carbonate will you produce?

8. How many moles of sodium nitrate will you produce?

Obtain the Mole Ratio POGIL from your teacher. Follow all the directions and stop signs. Raise your hand when your group reaches a stop sign or needs help.

Using the information learned in Mole Ratio POGIL, you must now perform stoichiometric calculations to proceed with the lab.
For step one in the lab you will need to calculate the volume of sodium carbonate necessary for the reaction and the number of grams of copper II carbonate produced. Some useful information about sodium hydroxide is provided. Remember 1000 mL = 1 L

Sodium carbonate: $\frac{1.00\ moles\ NaOH}{1\ Liter}$

Volume required _____

Copper II carbonate:

Grams produced _____

Check in with your teacher for a " math check". Perform step one in the lab after approval.

Data table/ observations (sight, touch(outside the tube)):

ALL observations and data will be recorded in this space!

A second reaction will begin automatically using **only** the copper II carbonate. Write a balanced chemical equation for this reaction. In part two you will follow directions to make sure this reaction goes to completion.

What type of reaction is this? _____

Calculate the mass of copper II oxide that will be produced in the second reaction. You will need to use previous calculations to help you get started.

Mass of copper II oxide _____

Check in with your teacher for a " math check". Perform step two in the lab after approval.

Answer the following questions after completing part two.

1. Was copper present in the decanted solution (the solution you pipetted off) from part two? How do you know?

   _____

   _____

   _____

2. What does the presence/absence of copper from the decanted solution tell you about your experiment so far?

   _____

   _____

   _____

Part Three

You will now begin the process of isolating your solid copper sample. Your test tube now contains copper I oxide. The copper has changed its charge.

Available Solutions:
Hydrochloric acid
Sodium chloride
Sodium carbonate
Calcium nitrate

Look at the list of available solutions, and choose a solution that will react with copper I oxide. Write a balanced chemical equation.

What type of reaction is this? _____

Calculate the mass of copper I chloride that will be produced in the third reaction. You will need to use previous calculations to help you get started.

Mass of copper I chloride _____

Calculate the amount of hydrochloric acid that you will need to use for this reaction. 1000 mL = 1 L

HCl $\frac{2.95\ moles}{1\ L}$

Volume of HCl_____

Immediately following the production of copper I chloride, you will isolate your solid copper. For this step you will use aluminum wire. What product from the previous equation will the aluminum react with? _____

What type of reaction will this be? _____

Write the balanced chemical equation for the reaction, and calculate the mass of solid copper that you will produce.

Mass of solid copper _____

Questions:

1. What was your theoretical(calculated) yield for solid copper? _____
   What was your actual (lab produced) yield for solid copper? _____
   Calculate your percent yield? _____ $\frac{Actual\ yield}{Theoretical\ yield} \times 100\% = Percent\ yield$

2. Did your theoretical yield match your actual yield? _____ elaborate on your answer using your data and your observations from the lab to explain why or why not.

   _____
   _____
   _____
   _____
   _____
   _____
   _____
   _____
   _____
   _____
   _____

3. Assuming that you filtered out ALL of the solid copper from your solution, what compound remained in the filtered solution? _____

   Was any copper II chloride still in the solution? _____ How do you know?

   _____
   _____
   _____

   Write a balanced chemical equation for the addition of $AgNO_3$ to your filtered solution.

   _____

   The use of silver nitrate in this step allowed you to identify the presence of which ion?

   _____

Safety:

Your goggles must be on your eyes at all times in the lab!

During this lab you will work with strong acids, strong bases, glass ware, Bunsen burners, and hot water. Some of the reactions in this lab will produce considerable heat (exothermic), enough to boil the water. Glassware will be hot and it will look the same as cold glassware. Please use caution and follow all of the directions.

In this lab you will also be working with solutions that contain copper. Copper **CANNOT** go down the sink, into the pipes, and on to the Boise River! Please do not put **any** solutions down the sink during this lab. As chemists, it is important to do our part in protecting the environment. Please use a waste beaker.

Strong bases and strong acids will damage your skin, eyes, and clothing and it may or may not be noticed immediately. If you think you have spilled an acid, pour baking soda over the area(this includes your clothes and skin). If you think you have spilled a base, pour vinegar over the area (this includes your clothes and skin). If ANYTHING gets in your eyes, head to the eye wash station immediately and **MAKE LOTS OF NOISE** on your way!

Failure to adhere to **ANY** of the directions, which includes safety, lab procedures and lab cleanup will result in a week of lunch detention.

Please acknowledge these safety guidelines by signing this paper.

_____

(printed name)

_____date_____

(signature)

Part 1

Materials

Test Tube
150 mL beaker
$Cu(NO_3)_2$ sample
Na_2CO_3

Procedure

1. Obtain your sample of Copper II Nitrate and carefully add to your test tube.
2. Place the test tube in the 150 mL beaker, this will serve as your test tube rack.
3. Measure your calculated volume of sodium carbonate and slowly add to your test tube.
4. Gently tap the bottom of the test tube to mix. Record all observations.
5. Place test tube in 150 mL beaker.
6. Write your name on a piece of masking tape and label your beaker.
7. Place beaker in your class periods' designated location.

Part 2

Materials:

Pippete
Test tube
Flame test stick
Bunsen burner
Copper stick for comparison

Procedure

1. Obtain your sample and record all observations.
2. Place your test tube into the prepared hot water bath. Remove the test tube when you see no further change occurring. Record all observations.
3. Place test tube in the 150 mL beaker and carefully remove the clear liquid (decant) from the top of the solid and place into your second test tube. Be careful to NOT remove any solid.
4. Place the clean flame test stick into the decanted solution in test tube two.
5. Allow the stick to soak in the solution for three minutes.
6. Obtain Bunsen burner and a copper flame test stick.
7. Light burner and observe the copper stick in the flame. Record all observations. Discard the stick into the appropriate waste container.
8. Obtain the flame test stick from your decanted solution and observe the stick in the flame. Record all observations. Discard the stick into the appropriate waste container.
9. Place the decanted solution into the waste beaker and rinse the test tube well with distilled water into the waste beaker.

10. Place beaker with your test tube in your class periods' designated location.

Part 3

Follow all of your instructions! This part will be the most DANGEROUS! HCl is a strong acid and will burn. If you spill alert your teacher immediately.

The second reaction is exothermic. It will produce enough energy to boil the water in your test tube. You should not touch the test tube during the reaction or immediately following the reaction. Please allow time to cool.

Materials:

HCl pipette

Precut aluminum wire

Steel wool

Ice bath

Test tube tongs

Procedure

1. Obtain your sample and record all observations.
2. Carefully measure your calculated volume of HCl using the HCl pipette.
3. Carefully add the HCl to your test tube and return the pipette.
4. Gently tap the test tube to mix. Record your observations.
5. Place the test tube in the 150 ml beaker and allow to sit for three minutes.
6. Make sure there is no solid in the test tube. Gently tap to dissolve any solid that remains.
7. Place your test tube in the prepared ice/cold water bath.
8. Gradually (**very slowly and a little bit at a time**) add the aluminum wire because it may boil over. Record all observations.
9. When the reaction has slowed down, push the aluminum wire to the bottom of the test tube.
10. Using test tube tongs, place the test tube in the 150 mL beaker.
11. Place beaker with your test tube in your class periods' designated location.

Part 4

Materials

Coffee filter

250 ml beaker

Distilled water

Funnel

pH paper

watch glass.

Procedure

1. Obtain your sample and record all observations.
2. Obtain a coffee filter and write your name on it using a pen.
3. Find and record the mass of your coffee filter.
4. Set the funnel in the 250 ml beaker and add the coffee filter.
5. Slowly pour your sample solution into the coffee filter to begin filtering the solid. Make sure all of the solution goes through the filter and not directly into the beaker.
6. Rinse the test tube with distilled water, into the filter, until all of the copper is out of the test tube. Make sure you have rinsed your test tube **VERY WELL**!
7. While the water is leaving the filter, begin your cleanup.
8. Place your test tube on the rack at the back of the room above the sink. Rinse your 150 mL beaker with distilled water; this can go down the sink. Place your beaker on the center tables.
9. After the water has drained from your sample, place the coffee filter on a watch glass to dry.
10. Place the watch glass in your class periods designated location.
11. Obtain the pH paper and find the pH of the waste solution.
12. If your pH is NEUTRAL, pour the contents into the waste beaker and rinse well into the waste beaker. Place this beaker on the center table.
13. If your pH is ACIDIC, alert your teacher, it must be neutralized. Once your solution is neutral, pour the contents into the waste beaker and rinse well into the waste beaker. Place this beaker on the center table.

14. When your sample is dry, find the mass of the copper and coffee filter. Calculate your mass of copper.