**Prelab Assignment:**

* Read the background, the entire procedure (all 4 days), and the data section. For any terms you are not familiar with, create a vocabulary list and research their definitions.
* Make a list of all materials you will need, including the amounts.

|  |  |
| --- | --- |
| Term | Definition |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |

**Materials:**

**Background:**

In this lab you will weigh a sample of copper metal and react it with nitric acid to form a blue solution of copper (II) nitrate. This blue solution will then be reacted with sodium hydroxide to precipitate copper (II) hydroxide. Then, by thermal decomposition, black copper (II) oxide will be formed. The addition of sulfuric acid to the copper (II) oxide will produce copper (II) sulfate. The final step will be to add zinc to precipitate copper metal by single displacement. From the initial weight and the final weight of the copper before and after the reactions you will be able to determine a quantitative relationship between the reactants and the products.

**Procedure:**

NOTE: You must wear goggles throughout this experiment! Follow all directions carefully!

**DAY 1**

1. Obtain a clean and dry 400 ml beaker and label it with you names (write with Sharpie on the glass). **Do all steps in this beaker**.
2. Carefully weigh approximately 0.50 grams of copper filings in the 400 ml beaker. Record the exact weight, using correct SigFigs.
3. Place your beaker in the **fume hood** and then add 4.0 ml concentrated HNO3. **Caution: Nitric acid is extremely dangerous. Handle with care!!** The **reddish brown fumes that are produced in this step (NO2) are toxic.** Keep the beaker in the hood until the gas is no longer evolved. (It helps to swirl the liquid to drive the gas out.) When the reaction is complete, add about 125 mL distilled water and then carry the beaker to your lab station. Observe and record the characteristic color of the copper (II) solution. Record all observations of changes throughout this lab.
4. Add 30 mL of 3.0 M NaOH. **Caution: NaOH is very corrosive. Handle with care!!** The precipitate that forms is copper (II) hydroxide.
5. When the reaction has gone to completion, place your labeled beaker on the back bench.

**\*After completing all of the lab work for Day 1, update all information you are recording- diagrams, equations, and observations/data.\***

**DAY 2**

1. Retrieve your beaker from the back bench.
2. **Add a boiling chip to your solution.**
3. Set up Bunsen burner and ring stand.

Attach Bunsen burner to gas valve via a hose.

Attach iron ring to ring stand approximately a foot off the table. Place wire gauze on top of iron ring.

Turn on gas so that valve points down the hose and light the Bunsen burner.

**If you need assistance, ask Ms. Kovach.**

Adjust flame as needed so that there is a small blue cone.

1. Place 400 mL beaker on wire gauze using tongs. Heat, **while stirring** to prevent spattering, until the solution boils. The black precipitate formed by thermal decomposition is copper (II) oxide.
2. Turn off the Bunsen burner and gas valve, then let the solution settle until you can see two layers.
3. Decant the supernatant liquid down the sink. To rinse the precipitate, carefully add about 200 mL of boiling water (in large beakers on hot plates). Let the solution settle and decant once more.
4. In the fume hood, add 15 mL of 6.0 M H2SO4 **(caution: this is very corrosive)** to convert the CuO to CuSO4.
5. As soon as it is visible, remove boiling chip with tweezers.
6. In the fume hood, add 2.5 g of zinc granules to precipitate the copper metal. Stir until the supernatant liquid is colorless and no more gas bubbling is observed.
7. **When the reaction is completed**, return to your lab station and decant the solution down the sink.
8. Obtain a small 50 mL beaker. Mark it with your group name and period with a sharpie. Weigh it to the nearest 0.01 gram.
9. Using a stirring rod and a little distilled water, **transfer** the solid to the 50 mL, labeled and massed beaker from step 12. Finish the next step in this beaker.
10. Return to the fume hood. Add 5 mL of water, then 10 mL concentrated HCl (**dangerous!!**) to react with and remove any zinc metal left over. Leave your beaker in the fume hood to fully react.
11. When no more bubbling is apparent, return to your station and decant the acid into the sink, **flushing with lots of distilled water**. Add water to your beaker, stir, let settle, then decant.
12. Repeat washing the product with water twice.
13. Wash your product with 5 mL ethanol. Let settle, and decant the liquid into the sink.
14. Place your product in the bin for the drying oven overnight.
15. Put away your materials; wipe off your station; **wash your hands**

**\*After completing all of the lab work for Day 2, update all information you are recording- diagrams, equations, and observations/data.**

**DAY 3**

1. Obtain your sample from the drying oven bin. CAUTION: Hot glassware looks like cold glassware so use tongs or a hot hand.

2. Once completely cooled, determine the mass of your copper and beaker and record.

3. The copper precipitate can be scraped out and disposed of in the labeled beaker in the fume hood. Clean your small beaker with soap and water. Wipe off your station and wash your hands.

**Data:**

Make a data table that includes the reaction number, the reactants, the products, and any relevant qualitative and quantitative data for the reactions. Your qualitative data *must* include any experimental errors made throughout the procedure.

**Data Table:**

**Data Table:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Reaction #** | **Reactants** | **Products** | **Quantitative Data** | **Qualitative Observations** |
| 1 |  |  | 400 mL Beaker \_\_\_\_\_\_\_\_\_\_ g  Copper Filings \_\_\_\_\_\_\_\_\_\_\_ g  HNO3 added \_\_\_\_\_\_\_\_\_\_\_\_ mL |  |
| 2 |  |  | NaOH added \_\_\_\_\_\_\_\_\_\_\_\_ mL |  |
| 3 |  |  | N/A |  |
| 4 |  |  | H2SO4 added \_\_\_\_\_\_\_\_\_\_\_mL |  |
| 5 |  |  | 50 mL Beaker \_\_\_\_\_\_\_\_\_\_\_\_ g  Zinc added \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ g  HCl added \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ mL  Ethanol added \_\_\_\_\_\_\_\_\_\_\_mL  50 mL Beaker + dry Cu  \_\_\_\_\_\_\_\_\_\_\_\_\_g |  |

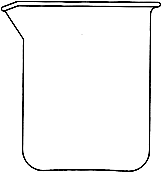
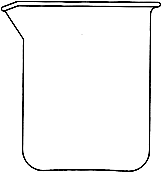
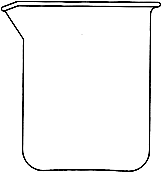
**Chemical Process:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Process:** | **Dissolve** | **Dissociate** | **Ionize** | **Precipitate** |
| What kinds of molecules do this? |  |  |  |  |
| Drawing of what happens in water: |  |  |  |  |

**Reaction Analysis:**

Reaction #1:

1. Verbal description of reaction:   
   Copper solid is mixed with a clear solution of concentrated Nitric Acid. A blue copper (II) nitrate aqueous solution, brown nitrogen dioxide gas, and water are produced as well as energy in the form of heat.
2. Balanced chemical reaction:   
   Cu(s) + 4HNO3(aq) 🡪 Cu(NO3)2(aq) + 2NO2(g) + 2H2O(l) + energy
3. Reaction Type:  
    Decomposition
4. Draw ions/molecules in beaker:



🡪

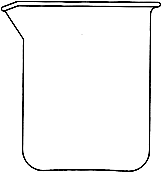
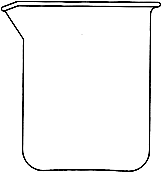
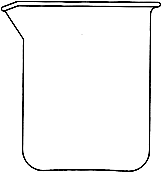
**+**

Reaction #2:

1. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Balanced Reaction:
2. Reaction Type:
3. Draw ions/molecules in beaker:



**+**

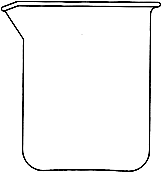
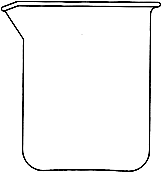
🡪

Reaction #3:

1. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Balanced Reaction:
2. Reaction Type:
3. Draw ions/molecules in beaker:

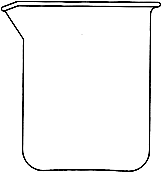
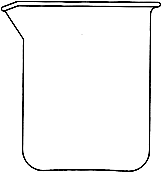
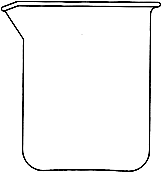


🡪

Reaction #4:

1. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Balanced Reaction:
2. Reaction Type:
3. Draw ions/molecules in beaker:

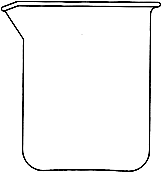
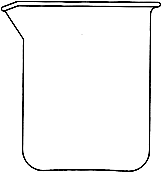
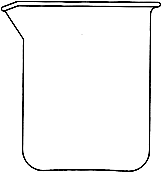
**+**

🡪

Reaction #5:

1. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Balanced Reaction:
2. Reaction Type:
3. Draw ions/molecules in beaker:

🡪

**+**

What is the final product (isolated after all five reactions): \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Data Analysis:**

1. Write a *balanced* equation for the reaction between zinc and hydrochloric acid solution.

What type of reaction is this?

What was the purpose of this reaction?

2. Calculate the percent yield of copper metal

% yield = the amount your experiment produced x 100

the expected (theoretical) yield

3. Error Analysis. Discuss **two** sources of experimental error, and their effects on your final value (increase or decrease). Make sure that these are valid experimental errors, not mistakes you made.

4. This experiment involves copper cycling through solid to aqueous to solid states. Does this lab support the Law of Conservation of Mass? Use evidence from your lab to support your claim.