Name\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Period\_\_\_\_\_\_Date\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Chemical Reactions of Copper**

**Part A: COPPER (II) NITRATE FROM COPPER METAL**

Weigh a clean, dry beaker. Carefully add approximately 2 grams of copper metal and record the total mass. **In the fume hood,** add 20 ml of concentrated nitric acid (**use caution)**. The NO2 is a dense gas so it will be necessary to hold the flask at an angle. Gently warm the flask for about a minute so that all of the gas dissipates. Do not heat the solution to dryness. **NO2 is very toxic**. Do not remove the flask from the hood until all of the gas is gone. The color of the solution at this point is indicative of a copper (II) nitrate solution.

**PART B: COPPER (II) HYDROXIDE FROM COPPER (II) NITRATE**

Add approximately 30mL of 6 M sodium hydroxide. Continue adding the sodium hydroxide until the solution turns a cloudy dark blue color. If it turns sky blue, add more NaOH.

**PART C: COPPER (II) OXIDE FROM COPPER (II) HYDROXIDE**

Transfer the mixture, in its entirety, to a beaker and begin to warm the solution gently over a burner (DO NOT BOIL) until the black copper (II) oxide forms. Allow the precipitate to settle, and then decant away the liquid into another beaker. Note: when decanting, it is better to leave some liquid in the beaker than it is to lose solid. Wash the copper (II) oxide with about 50 mL of deionized water (use beaker tongs). Again, allow the solid to settle and decant away the liquid. Repeat 2 more times.

**PART D: COPPER (II) SULFATE FROM COPPER (II) OXIDE**

Slowly add 15 mL of 6 M H2SO4 to the beaker and swirl until all of the copper (II) oxide reacts.

**PART E: REGENERATION OF COPPER METAL FROM COPPER (II) SULFATE**

**In the fume hood,** add 3.5 grams of zinc powder a little at a time and swirl the beaker vigorously (caution: the beaker may get hot). After all of the zinc has been added, continue swirling the beaker until the solution is colorless. Once you are certain that all of the copper (II) ions have been converted to elemental copper metal, you will need to react any excess zinc remaining. Remove any large pieces of zinc with tongs, and then add 20 mL of 1M HCl. Stir the mixture often as it reacts to produce hydrogen gas and aqueous zinc chloride (note: the HCl will not react with the copper). Once the bubbling stops, inspect the beaker to see if there is any more zinc visible. If so, add an additional 5 mL of HCl. Carefully decant the liquid from the beaker and wash the copper twice with 20 mL portions of hot deionized water, decanting away the liquid each time. Reweigh the sample once the copper is completely dry.**Data:**

|  |  |  |  |
| --- | --- | --- | --- |
| Mass of empty beaker |   |  |   |
| Mass of beaker and copper |   | Mass of beaker and recovered copper |   |
| Initial mass of copper |   | Final mass of copper |   |

* Percent yield of copper \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Reactions:** Write the equation for the reaction that took place for each part **and** describe the reaction using the observations you made.

Part A: Copper (II) nitrate from copper metal (water is also a product in this part)

Cu + HNO3  🡪 Cu(NO3)2 + NO2 + H2O (I’ll give you this one, just balance it!)

Part B: Copper (II) hydroxide from copper (II) nitrate

Part C: Copper (II) oxide from copper (II) hydroxide

Part D: Copper (II) sulfate from copper (II) oxide

Part E: Regeneration of copper metal from copper (II) sulfate

**Questions:**

1. Hypothetically speaking, if you were to get a percent yield that is less than 100 in this experiment, what are two plausible errors that would account for that?
2. Hypothetically speaking, if you were to get a percent yield that is greater than 100 in this experiment, what are two plausible errors that would account for that?
3. If 1.00g of Zinc is completely reacted according to the reaction in part E of this experiment, how many grams of copper will be produced?
4. Were any copper atoms lost from the system during the steps? If so, how were they lost?
5. Was the Law of Conservation of matter obeyed?
6. Why was Zn used instead of silver at the end of the lab? (Hint: what kind of reaction was it?)
7. Why was it not important to measure exactly how much of each solution we added in each step?
8. Draw particle diagrams for before and after the reaction of the copper and nitric acid.
9. Draw particle diagrams for before and after the copper sulfate reacting with zinc.