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6. Part D: Transfer the filter paper and solid back to the original beaker. Dissolve the solid copper oxide by adding approximately 10 mL of 3 M H_2SO_4(aq) to the filter paper containing the residue from the previous step. Once the solid has dissolved, remove the filter paper and rinse it with 10 – 20 mL of deionized water. Add the washings to the acid solution, and save the solution for the next step. Note any color change. Also note the reaction that is occurring.

7. Part E: WORK IN THE HOOD! Add about 0.40 g of zinc metal to the acidic copper solution. If any blue color remains after the zinc has dissolved, a bit more zinc may need to be added (record in your report!). Note the reaction that is occurring. Dissolve any excess zinc with a small amount (approximately 5 mL) of 3 M H_2SO_4(aq).

8. Filter the supernatant liquid from the solid and wash the solid 3 times with 20 mL portions of deionized water.

9. Transfer the solid copper onto a large watch glass and place it in the laboratory oven (PS 103 or PS 107) for 15 to 20 minutes at around 100 °C or until dry. Weigh to determine the mass of recovered copper.

Data Analysis and Calculations

Initial color and form of the copper ______________________________

Mass of Cu(s) at the beginning of the experiment ______________________________

Mass Recovered ______________________________

% Recovery ______________________________

Comment and discussion: Do your results support Lavoisier's law of conservation of mass? How does your percent recovery deviate from the expected 100%? Briefly explain.

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Post-lab Questions

1. Write the symbol or formula for the form of copper that is present in the following parts of the experiment:

   A. after adding nitric acid ____________________________

   B. after adding NaOH, litmus paper turns blue ____________________________

   C. after boiling ____________________________

   D. after adding sulfuric acid ____________________________

   E. after adding zinc ____________________________

2. Now give the color of the copper substances in each of the steps above:

   A. ____________________________ D. ____________________________

   B. ____________________________ E. ____________________________

   C. ____________________________

3. A student reports 115% recovery. How could he/she possibly have more copper at the end of the experiment than he/she started with? Explain.

4. If a student used a penny as the source of copper in this experiment, would it matter if a pre-1982 penny (essentially pure copper) versus a post-1982 penny (copper exterior over a zinc core) was used? Would using a post-1982 penny pose any experimental complications? Briefly explain.

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5. Part A in today's experiment is classified as a redox reaction in which electrons are transferred via oxidation of Cu and reduction of the N in HNO_3. The balanced molecular equation is:

$$Cu(s) + 4HNO_3(aq) \rightarrow Cu(NO_3)_2(aq) + 2NO_2(g) + 2H_2O(l)$$

The net ionic equation for this reaction is:

$$Cu(s) + 4H^+(aq) + 2NO_3^-(aq) \rightarrow Cu^{+2}(aq) + 2NO_2(g) + 2H_2O(l)$$

Write balanced molecular, ionic, and net ionic equations for the other four reactions in this inorganic sequence. Classify the types of each reaction in as many possible ways (i.e. redox, synthesis, combustion, decomposition, single replacement, double displacement, precipitation, neutralization).

Part B:

Part C:

Part D:

Part E:

6. Referring to part E, write the reaction for the reduction of copper(II) ion into solid copper using zinc. Calculate the theoretical mass of zinc needed to carry out the reaction based on the initial mass of copper used. Compare this theoretical mass of zinc with the actual amount used in the laboratory. Justify any differences.

Name: ______________________________ Section: ____________________

Pre-lab Questions

Upon reading the procedure in preparation for this experiment, you should also answer the following questions:

1. Use the outlined procedure to describe:

   a) a test for determining whether a solution is basic enough.

   b) a test to decide whether enough zinc has been added.

2. Write out and classify the molecular, ionic, and net ionic equations that take place when H_2SO_4 is added to the excess zinc in part E.

3. Does observing a color change always indicate that a chemical change has occurred? Explain why or why not.

4. What should the student do if the solution in step E is still blue?