Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_\_\_\_

Lab Section: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**CHEM 131 Lab Experiment: A Penny’s Worth of Chemistry**



**Background**

Copper is an example of one of the coinage metals that are highly resistant to corrosion at room temperature, and are ideal for making jewelry or coins because they do not react with the vast majority of the substances with which they come into daily contact. However, compounds of copper do exist. For example, although copper is not a very reactive metal, it becomes coated when exposed to air, changing from its bright reddish-brown metallic luster to an almost black color, and then develop the familiar green patina. The initial blackening results from the formation of copper oxide and copper sulfide. Metallic copper does react quite vigorously with concentrated nitric acid, undergoing oxidation to the copper (II) ion.

In this experiment a pre-1982 metallic copper penny will undergo a series of chemical transformations, ultimately producing a compound called copper (II) sulfate. This compound can form very large crystals, that you will collect and examine next week.

**Purpose** The Purpose of this lab is for you to be introduced to some basic laboratory techniques and chemical transformations involving copper pennies. You will also synthesize some new compounds of copper, and grow large crystals of your new product.

# PROCEDURE



**CAUTION! Nitric and sulfuric acids are corrosive and will cause burns** to the skin if you spill or splash on you. Where gloves and dispense acidic solutions in the hood. Use caution when working around hotplates, and make sure that your hotplate, and those of your neighbors, is unplugged at the end of the lab.

1. Weigh a copper Penny (pre 1982) to the nearest milligram. Place the coin in a 400mL beaker.
2. Place 450 mL of distilled water in a 600 mL beaker. Place the beaker on a hot plate, and heat until the water boils. Do not wait for the water to boil but proceed with the rest of the experiment. You will use this hot water in step 6.
3. In the **hood** add 24.0 mL of concentrated nitric acid to the penny in the beaker. When the reaction is complete (the penny is gone and no gas bubbles are being produced) add 150 mL of distilled water and stir. You may now take the beaker out of the hood. Be careful. The beaker may be hot! Wait until it cools or handle it with insulated gloves or a beaker tongs.
4. Add 180 mL of 3.0 M sodium hydroxide solution to form blue-white copper (II) hydroxide. Stir well.
5. **Add two or three boiling chips (glass beads)**. Then, **with stirring**, heat the solution just to boiling to convert the copper (II) hydroxide to copper (II) oxide. Be very careful to heat gradually and just until the black copper (II) oxide is formed from the blue-white copper (II) hydroxide. Too much heat will cause the solution to bump and spatter all over you. If you do not add the boiling chips, your solution will "bump" upon heating and spatter out of the beaker. The boiling chips prevent this by giving the vapor bubbles a place to form. Place the beaker on the bench top. Use beaker tongs or insulated gloves to move it as it is hot.
6. Allow the solid to settle and then decant the supernatant liquid into another beaker. To decant means to carefully pour off the liquid making sure that none of the solid goes with it. Add about one-third (150mL) of very hot water you prepared in step 2, stir up the solid for about 15 sec, allow the solid to settle, and decant the hot water. Repeat this with two more portions of very hot water. Handle the beakers with insulated gloves or beaker tongs.
7. Add **carefully** 90 mL of 6.0 M H2SO4 solution to produce aqueous copper (II) sulfate. Stir this mixture to get it to react completely. It also will get somewhat warm and you would be wise to hold the beaker with tongs. Make sure that all the black copper (II) oxide dissolves. You may have to scrape some of this black solid down from the top edges of the beaker with a wet stirring rod. Decant the solution into another beaker. Be sure the solution is clear blue
8. To accelerate the next step, split the blue solution equally into 250-mL or larger beakers. Heat the solutions to reduce the volume to approximately 50 mL each. Scratch the bottom of the beaker to induce boiling and discard the glass beads only when the desired volume is reached. ***Recombine*** the two solutions (the total volume should be about 100 mL or less) and let sit undisturbed for a week to allow crystals of copper (II) sulfate pentahydrate to grow slowly.
9. Next week:

a) Decant as much liquid from over the crystals

 b) Dry the crystals of copper sulfate pentahydrate on paper towel

 c) Scrape the crystals from the paper towel and weigh them on a beaker or vial

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PARTNER: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ SECTION: \_\_\_\_\_\_\_\_\_\_\_

**Penny’s worth**

**Data Sheet / Post-lab Questions**

Complete the following questions during and at the end of the experiment **on a separate sheet of paper.** You may need to use your lecture text or access the internet to answer some of these questions. These questions will be due the week after this laboratory.

(1) Record the mass of penny (to three decimal places).

(2) Record the mass of your copper (II) sulfate pentahydrate crystals (next week). Calculate % recovery for Cu from these crystals.

(3) Record **detailed** observations for each step of the experiment (on an additional sheet of paper).

(4) Look up and write the chemical equation for the reaction of copper with concentrated nitric acid.

(5) Write the formula for copper (II) sulfate pentahydrate.

(6) You are a metallurgy consultant, and a client has presented you with a piece of metal in a jar. You suspect that this metal might be copper. How might you conclusively show whether the metal is copper or not?

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**Penny’s Worth**

**Pre-lab Assignment**

(1) Define element, compound, and mixture.

(2) What are examples of other coinage metals? You can use the Internet in answering this question.

(3) Define “Period” and “Group” as related to the periodic table. Do the coinage metals belong to the same “Period” or “Group”? Are their chemical and physical properties similar or different?