# DETERMINING THE MASS OF A COPPER ATOM-COMPUTER

LAB ADV COMP 31

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INTRODUCTION

In this experiment, you will confirm the mass of a single atom of Copper by conducting an electrochemical process called *electrolysis*. In electrolysis, an external power supply is used to drive an otherwise non-spontaneous reaction. You will use two copper strips as the electrodes, placed in a beaker of sulfuric acid. By determining the average current used in the reaction, along with the knowledge that all of the copper ions formed are the 2^+ cations, you will calculate the number of atoms in one mole of copper and compare this value with Avogadro's number.
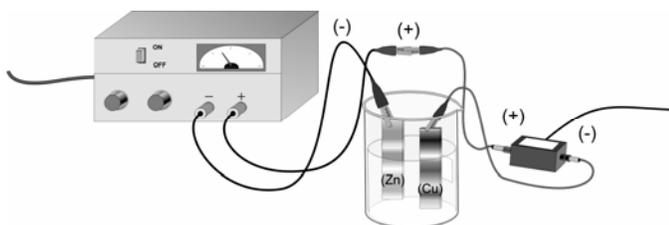
OBJECTIVES

In this experiment, you will

- Prepare an electrochemical cell to oxidize a copper electrode.
- Measure the amount of copper that was deposited in the electroplating process and determine the average current used.
- Calculate a value for the mass of a single atom of Copper and compare it to the accepted value.

MATERIALS

Vernier Lab Pro	1 M H_2SO_4 solution
Laptop with Logger Pro 3.0 or higher	2 copper strips (anode & cathode)
Vernier Current Probe	Balance (+/-0.000g)
1.5 volt DC power source	distilled water
4 connecting wires with alligator clips	two 250 mL beakers
steel wool	

PROCEDURE

1. Obtain and wear goggles.

2. Use steel wool to clean 2 strips of copper, which will be the anode and cathode of the electrochemical cell.

3. Use the balance to measure the mass of both copper strips. Record the mass in your data table.

4. Fill a 250 mL beaker about ¾ full with 1 M H_2SO_4 solution. **CAUTION:** *Handle the sulfuric acid with care. It can cause painful burns if it comes in contact with the skin*.

5. Obtain a DC power supply and a Vernier Current Probe. Use connecting wires, with alligator clips, to connect the DC power supply, Current Probe, and the two metal electrodes to be used in the electrochemical cell (see Figure 1). Copper is the anode and zinc is the cathode in this cell because you do not want the reaction to occur spontaneously. **Note:** Do not place the electrodes in the cell until Step 8.

6. Connect the Current Probe to Channel 1 of the Vernier computer interface. Connect the interface to your computer with the proper cable.

7. Start the Logger *Pro* program on your computer. Open the file "31 Avogadro" from the *Advanced Chemistry with Vernier* folder.

8. Place the electrodes into the 1 M H_2SO_4 solution in the cell. Make sure that the electrodes are immersed in the solution to equal depths and as far apart as possible.

9. Turn on the DC power supply and check the current readings. The initial current should be in the 0.2 – 0.6 A range. If the current is not in this range, adjust the settings on the power supply. Once the initial current is in range, turn off the power supply.

10. Click ▶ Collect to begin the data collection and turn on the power supply. Data will be collected for 3 minutes. Observe the reaction carefully. **Note:** Be ready to turn off the power as soon as the data collection stops.

11. When the data collection is complete, turn off the power supply and carefully remove the first copper electrode (connected to the power supply) from the H_2SO_4 solution. Carefully rinse the copper electrode with distilled water. Dry the copper electrode very carefully

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12. Measure and record the mass of the dry copper electrode, in your data table, for Trial 1.

13. Analyze the graph of your data to determine the average current that was applied during the electrolysis. Click the Statistics button, 📊. Record the mean in your data table as the average current for Trial 1.

14. Repeat Steps 8-13 to conduct a second trial. If time permits, conduct a third trial.

DATA TABLE

	Trial 1	Trial 2	Trial 3
Initial mass of copper electrode (g)			
Final mass of copper electrode (g)			
Difference in mass (g)			
Average current (A)			
Time of current application (s)			

DATA ANALYSIS

1. Calculate the total charge, in coulombs(C), which passed through the electrolytic cell for each trial.

2. Use your answers from 1 above to calculate the number of electrons in the electrolysis for each trial. Recall from the famous Millikan oil-drop experiment that the charge of an electron is 1.602×10^{-19} coulombs per electron.

3. Determine the number of copper atoms lost from the anode in each trial.

4. Calculate the number of copper atoms lost at the anode for each trial. The mass lost at the anode is equal to both the mass of copper atoms lost and the mass of copper ions produced (the mass of the electrons is negligible).

5. Calculate the mass of a single atom of Copper.

6. Determine the percent error.