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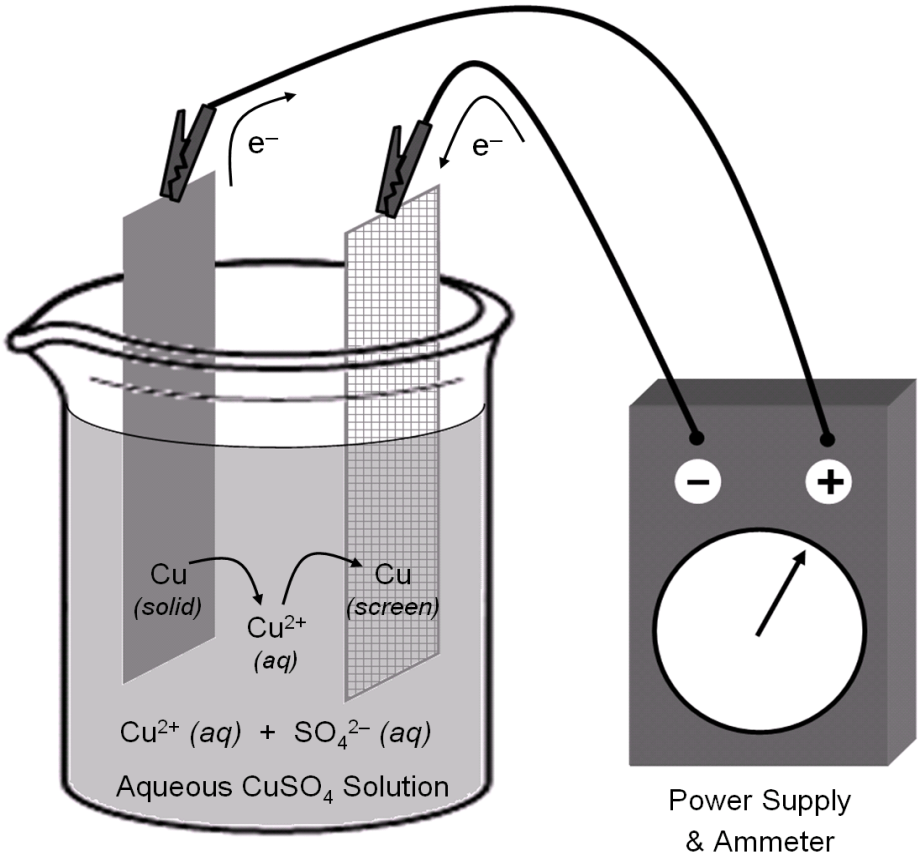
Experiment #5: Determination of Avogadro's Number from Electrodeposition of Copper

There are many ways of finding Avogadro's number; regardless of the method used, they all begin with an arbitrary amount of one compound or element. Currently, the mole is defined by the weight of 12.0000 grams of carbon-12 atoms. In today's lab, we will measure Avogadro's number using electroplating techniques.

You will use an apparatus (depicted below) to plate out a small amount of copper. Because you will be able to measure the current delivered using an ammeter, you can determine the number of electrons that passed through the wire. Using the equation that relates the number of electrons to the number of copper atoms, you can find the number of atoms in the freshly plated sample. Finally, you must assume that the atomic weight of copper is 63.54 grams/mole, similar to the way that the atomic weight of 12.00 grams/mole was chosen for carbon. Consider the following useful pieces of information:

1. Gram atomic weight of copper: 63.54 grams of Cu = 1 mole of Cu atoms
2. Charge on an e^-: 1.60×10^{-19} coulombs = 1 electron
3. Amps × seconds = coulombs OR 1 amp = 1 coulomb/sec
4. The balanced half-reaction for copper is represented by $Cu \rightarrow Cu^{+2} + 2e^-$



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Procedure

1. Set up the apparatus as indicated in the picture.

2. Clean the solid Cu strip with steel wool; wash BOTH Cu strips with dilute NaOH, followed by dilute HNO_3, and finally rinse with DI H_2O. At this point, make certain to handle both Cu strips with forceps.

3. Rinse strips with acetone and when dry, weigh and record the mass of the Cu strips.

4. Place the strips in a 250 mL beaker containing about 200 mL of 1M $CuSO_4$. DO NOT ALLOW THE STRIPS TO TOUCH.

5. Adjust the current to approximately 0.175 Amp (175 mA) and run the system for 30 minutes. If you cannot maintain a constant amp reading, take readings at 5 minute intervals and average the current.

6. Carefully rinse both Cu strips under a slow stream of DI water, then rinse with acetone, and allow to dry. Weigh and record the mass of each dry Cu strip.

Data and Calculations

1. Current _____ amps
2. Time _____ seconds
3. Initial Mass of Copper A (solid) _____
4. Final Mass of Copper A (solid) _____
5. Change in mass of Copper A (solid) _____
6. Initial Mass of Copper B (screen) _____
7. Final Mass of Copper B (screen) _____
8. Change in mass of Copper B (screen) _____
9. Average change in mass of the Copper Strips _____

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Post-lab Questions

1. Was the change in mass by the screen the same as the solid mass? Briefly explain your results.

2. Calculate the value of Avogadro's number starting with the amount of current you used. SHOW ALL YOUR WORK.

3. Calculate the percent error in your experimental value of Avogadro's number.