AP Chemistry Lab
The Copper Cycle

Prelab Questions:

1) Write a balanced reaction for:
   a) The reaction of copper with nitric acid. (note the products of the reaction are copper (II) nitrate ($Cu(NO_3)_2$) and nitrogen dioxide gas(NO_2) and water.

   b) The reaction of $Cu(NO_3)_2$ with sodium hydroxide. (note: the products of the reaction are: copper (II) hydroxide ($Cu(OH)_2$) and sodium nitrate ($NaNO_3$)

   c) The decomposition of copper (II) hydroxide. (note: the products are copper (II) oxide and water)

   d) The reaction of copper (II) oxide with HCl. (note: the products are copper (II) chloride and water)

   e) The reaction of copper (II) ions with Aluminum metal.

Procedure:
Conversion 1: Change the copper metal to copper nitrate, $Cu(NO_3)_2$.

1) Take a sheet of copper and cut a square 3 cm by 3 cm. Clean it up nicely. Get a 250 mL beaker from Morgan. This beaker should have your name on it with "good" labeling tape and water proof ink. Weigh it and then place the copper in it and weigh it again.

2) In the fume hood have Morgan add concentrated nitric acid (HNO_3) to the copper in the beaker. Place the beaker on the hot plate in the fume hood until vigorous bubbling begins. Keep the beaker in the fume hood until you start conversion 2.

Conversion 2: Change the copper nitrate to copper hydroxide, $Cu(OH)_2$

1) Get some 6.0M sodium hydroxide solution.

2) Place a little water and some small ice chips in a 1000 mL beaker to make an ice bath. Carefully place your 250 mL reaction beaker into the larger beaker. Do not spill any of the contents of the reaction beaker into the larger beaker.

3) Slowly, with stirring, add a small portion of the sodium hydroxide (NaOH) into the reaction beaker. With a stirring rod test the resulting solution for pH. Continue to add in small portions of the sodium hydroxide until the pH of the solution is about basic (the same as the sodium hydroxide itself). You have now added NaOH until it was an excess reactant.

Conversion 3: Changing copper hydroxide to copper(II) oxide, CuO.

1) Add 75 mL of distilled water to the reaction beaker.

2) While stirring slowly but constantly, heat the reaction beaker until the contents change to black. Then stop heating but continue to stir until the contents cool.

3) Let the contents settle for 3 to 5 minutes. Decant. Add 75 mL of distilled water. Decant again.

Conversion 4: Changing copper oxide to copper chloride ($CuCl_2$).

1) Carefully add dilute hydrochloric acid (HCl) to the black copper oxide until it turns blue. Do this with small additions with constant stirring. Do not add more then is needed.

Conversion 5: Changing copper chloride to copper metal (Cu).

1) Cut a piece of aluminum wire about 30 cm long. Weight the wire and record the weight. Bend the wire to form a hook shape so that a handle remains above the lip of the beaker. If it doesn't touch the solution in the beaker it can't react can it? Add the wire to the beaker and cover. Let the beaker stand until the reaction is done. Use your eyes!

2) You will find that the copper has settled. Remove the remaining wire from the beaker. With forceps remove any small bits of aluminum wire mixed in with the copper. Decant. Wash the copper in the beaker multiple times with 50 mL portions of distilled water. Try not to lose any copper.

3) Wash the copper once with 0.5 M HCl. Decant. Wash three more times with distilled water.

4) Remove as much water from the beaker as possible without losing any of the copper. Then place beaker with copper in the drying oven. Dry and weigh the aluminum wire. Record the weight.

5) Next day, weigh the beaker with copper. Record the weight.

Data Table:

Mass of reaction beaker = _____g

Mass of Reaction beaker + copper = _____ g

Mass of aluminum wire before reaction (from conversion 5) = _____ g

Mass of aluminum wire after reaction = _____ g

Mass of beaker + copper (from conversion 5) = _____ g

Post lab Questions:

1) Calculate the mass of copper produced in conversion 5.

2) Find the percent recovery (yield) of copper from conversion 1 to conversion 5.

$$\% \text{ recovery} = \frac{\text{mass of Cu (conv. 5)}}{\text{mass of Cu (at start)}} \times 100\%$$

3) Calculate the mass of aluminum used in conversion 5.

4) Calculate the mass of aluminum that should have been used to get this mass of copper.

5) Compare the above two answers. If they don't match explain what you think happened.