COPPER CHEMISTRY

Name: _____

Date _____ Lab Partner _____

Copper is a shiny, red-brown metal that is an excellent conductor of heat and electricity. Copper is one of the few metals that can be found uncombined with other elements in nature. It is also present in the minerals, chalcopyrite ($CuFeS_2$) and chalcocite (Cu_2S).

In this laboratory, you will start with a piece of pure copper wire. You will then prepare a variety of copper compounds by taking the copper through a series of chemical reactions. Finally, in the last reaction, copper metal will be regenerated. With good technique and care you should have an acceptable quantitative recovery of starting material.

PROCEDURE

Close observation will help with the questions that follow your experimental work. Be sure to record all observations. Be specific.

Weigh about 100 mg (to 3 significant figures) of copper wire and put it into a 50 mL beaker.

Weigh a second sample, also about 100 mg (to 3 significant figures), of copper wire and put it into another 50 mL beaker. The mass of the second sample should not be the same as the mass of the first sample.

Apply the following steps to the contents of **each** beaker. You will be doing duplicate experiments concurrently.

REACTION 1:

IN THE HOOD, add 20 drops of concentrated (16 M) nitric acid. **WHILE STILL IN THE HOOD** and after the reaction is complete (the copper wire is gone), add 20 mL of water.

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

Observations:

REACTION 2:

Put the beaker on ice. While stirring, slowly add 6 mL of 3 M NaOH.

$$Cu(NO_3)_2(aq) + NaOH(aq) \rightarrow Cu(OH)_2(s) + NaNO_3(aq)$$

Observations:

REACTION 3:

Put the beaker on a hot plate (low heat setting). If "bumping" occurs, remove from the hot plate.

$$Cu(OH)_2(s) + \text{heat} \rightarrow CuO(s) + H_2O(l)$$

Allow the solid product of Reaction 3 to settle, then decant the supernatant liquid. Decanting is a simple separation of liquid from solid and it is illustrated on the corkboard in your lab. Any losses of solid in decantation will reduce your yield of product.

Add about 40 mL of very hot DI water to wash the solid. Decant the wash liquid.

Observations:

REACTION 4:

Add 3 mL of 6 M H_2SO_4 to the washed solid. If necessary, a little heat and a few more drops of acid will speed dissolution of the solid.

$$CuO(s) + H_2SO_4(aq) \rightarrow CuSO_4(aq) + H_2O(l)$$

Observations:

REACTION 5:

WORKING IN THE HOOD, add a **small piece** (about 1 cm^2) of aluminum foil to the products of Reaction 4. Add two drops of concentrated HCl. Add more small pieces of aluminum foil, only if needed, until the reaction is complete (the blue color of the solution just disappears).

$$CuSO_4(aq) + Al(s) \rightarrow Al_2(SO_4)_3(aq) + Cu(s)$$

Observations:

REACTION 6 (if necessary):

There should be no aluminum in your beaker at this point. If there is, add one drop of concentrated HCl to your beaker.

$$Al(s) + HCl(aq) \rightarrow H_2(g) + AlCl_3(aq)$$

Observations (if made):

RECOVERY OF COPPER:

Decant the liquid from reaction 5 (or 6). Save all of the solid product.

Add a few mL of DI water to wash the product in the beaker. Decant the liquid and repeat the water wash.

WORKING IN THE HOOD, wash with 3 mL of methanol. Decant the liquid after each wash.

Dry the product in the beaker on a hot plate at a low setting.

Obtain the mass of the dry product on tared weighing paper.

DATA

	Sample 1	Sample 2
Initial mass of Cu		
Final mass of Cu		
Percent recovery of Cu		

Explain/justify the percent recovery of Cu result.