Chemistry Lab: Determination of the Empirical Formula for a Compound

On paper you have determined the empirical formula of a compound. In this experiment you will determine the simplest formula of a compound by collecting experimental data.

In this experiment, a measured mass of a copper chloride compound of unknown formula [Cu_xCl_y] that has been dissolved in water will be reacted with NaOH to make a new copper compound. This data will be used to calculate the empirical formula for the form of copper chloride dissolved in water you started with.

Materials:

250mL beaker	0.60g $\pm$ 0.10g NaOH
Vacuum filtration funnel / flask	100 mL dissolved copper compound
Filter paper(s)	glass stirring rod
100 mL graduated cylinder	metal spatula

1. Place a weighing paper onto the balance. Zero out the mass of the paper, and obtain 0.60g $\pm$ 0.10g of the solid NaOH. Record the exact mass of the solid. Add the solid to a clean 250mL beaker.

2. Using a graduated cylinder, obtain about 50 mL of deionized water. Add the water to the beaker with the solid sodium hydroxide and stir with a glass stirring rod to dissolve all of the solid. Record your observations.

3. Using a graduated cylinder, obtain 100mL of the solution of the copper compound. Add it to the beaker with the dissolved sodium hydroxide and stir with a glass stirring rod to completely mix the contents. Record your observations.

4. Place the beaker on the wire gauze with ring stand assembly. Light your burner and gently heat the mixture until a black solid is formed, stirring occasionally. As soon as the blue solid is completely replaced by the black solid, discontinue heating and begin to cool the beaker.

5. Obtain a piece of filter paper for the vacuum filtration funnel, and record its exact mass.

6. Place the filter paper in the vacuum funnel, and add a few milliliters of deionized water from the squirt bottle to moisten the filter paper.

7. Hook up the rubber tubing to the vacuum flask, and ensure the drain tube is securely down the drain of the sink. Turn on the cold water half-way.

8. Carefully pour the contents of the beaker, a little at a time, into the filter funnel, until all the contents are in the funnel. Rinse the beaker into the funnel with small amounts of deionized water. (If the collected solution in the flask under the funnel is cloudy, pour the contents of the flask back into the original flask, and pass it through the same filter again.)

9. Carefully rinse the collected solid with small amounts of deionized water. Avoid using too much rinse water.

10. Allow the contents to continue to vacuum drain for several minutes.

11. Using a spatula, carefully remove the filter paper and place it on a sheet of paper with the names of all group members and the hour.

12. Let the black solid dry overnight on the filter paper, and weigh it the next class period.

Observations:

Data

Day one	Day two
Volume of dissolved copper compound = mL	Mass of filter paper plus new copper solid = g
Mass of NaOH used = g	
Mass of filter paper(s) = g	Mass of new copper solid = g

1. Your original dissolved copper chloride compound actually had a concentration of 6.72g/L of the dissolved compound. Calculate the mass of the dissolved copper chloride compound in the volume of the solution you used. SHOW YOUR WORK.

Mass of copper compound in the original solution sample =_____

2. The new copper solid collected and dried on the filter paper has been shown to be CuO. Calculate the percent composition of this compound. SHOW YOUR WORK

%Cu = _____

%O = _____

3. Using the results of question 2 above and the mass of the solid collected on the filter paper, calculate the mass of Cu in your CuO solid sample. (This is the same as the mass of Cu in your original dissolved solid – why?). SHOW YOUR WORK

Mass of copper in solid =_____

4. Using your answers to questions 1 and 3 above, calculate the mass of chlorine in your original dissolved copper compound. SHOW YOUR WORK.

Mass of chlorine in the original solution =_____

5. Using the answers to questions 3 and 4 above, calculate the empirical formula of the dissolved copper chloride compound you started with. SHOW YOUR WORK

Empirical formula =_____