# Pre-Lab Information

Purpose Explore how heating a hydrate allows you to determine its formula in a virtual experiment.

Time Approximately forty-five minutes

Question How can drying a hydrate help you determine its mole ratio of water to salt?

Hypothesis If the initial mass of an unknown hydrate can be determined, then the hydrate can be heated to dehydrate it and the mole ratio can be determined, because the difference in mass is equivalent to the water in the hydrate.

Summary In this lab, you will use heat to dry a hydrate form of CuCl2, measuring the mass before and after drying. Using these numbers, as well as their difference (the water evaporated), you will compute the value of *x* in the formula CuCl2 • *x* H2O.

# Safety

* Always wear safety glasses, a lab apron, and gloves while performing an experiment, particularly while working with materials, such as CuCl2, that are potentially toxic.
* Do not smell or taste any of the chemicals.
* Use the Bunsen burner with caution, as the flame can ignite nearby objects.
* Use tongs when moving hot objects such as the crucible and crucible cover, and do not handle them until you are shown the proper handling techniques. Never touch the crucible; it may not appear hot, but it can cause a severe burn.
* Report all accidents—no matter how big or small—to your teacher.
* Heat the sample and crucible gently to prevent spattering.
* Keep your work area clear of all materials except those needed for the experiment.

# Procedure

1. **Gather Materials**

|  |  |  |
| --- | --- | --- |
| * Bunsen burner * Striker * Ring stand * Ring clamp | * Clay triangle * Crucible with cover * Crucible tongs * Balance | * Timer * Weigh paper * 5-10 g copper (II) chloride |

1. **Prepare a Dry Crucible**
   1. Place the Bunsen burner under the ring stand with the ring clamp attached 1-2 inches above where the flame will be. Place the triangle on the ring clamp.
   2. Place the crucible and cover on the triangle. When heating the crucible, keep the cover slightly tilted in order to allow water vapor to escape.
   3. Light the Bunsen burner with a striker and adjust until its flame burns with control.
   4. Heat the crucible. When the bottom of the crucible becomes red in color, heat for an additional minute to enable the crucible to dry.
   5. Turn off the burner and let the crucible cool for 5-7 minutes.
2. **Measure Initial Masses**
   1. Place a piece of weigh paper on the balance, and tare the balance.
   2. Use the tip of the tongs to place the crucible cover onto the top of the crucible. Use the middle of the tongs to transfer them to the balance. Record the mass to the greatest precision of your balance [e.g., to the nearest mg (0.001 g)].
   3. Remove the cover and place on the balance. While the crucible and cover are still on the balance, add 5-10 grams of copper (II) chloride into the crucible.
   4. Note the color of the copper (II) chloride in the data table.
   5. Record the mass precisely.
3. **Remove Water from the Sample and Remeasure the Mass**
   1. Transfer the crucible, contents, and cover back to the triangle. Keep the cover slightly tilted in order to allow water vapor to escape.
   2. Light the Bunsen burner with a striker and adjust until its flame burns with control. Popping, spatters, and white smoke are signs that you are heating too fast and may be losing material. Therefore, heat **gently** for at least 5 minutes, until the bottom of the crucible is red in color. Then, heat for an additional 1-2 minutes.
   3. Turn off the burner and let the crucible cool for 5-7 minutes.
   4. Place a piece of weigh paper on the balance, and tare the balance.
   5. Using the crucible tongs, place the cover on the top of the crucible and transfer the crucible cover and crucible with copper chloride to the balance. Record the mass precisely.

You likely will not remove all water in just one heating. Repeat Step 4 as many times as needed until the decrease in mass is close to 0. A good threshold is 0.1 g—a change less than that indicates that you have removed essentially all water and can stop heating.

1. **Make Post-Heating Observations**

Note the color of the copper chloride in your data table.

1. **Determine the Formula of the Hydrate**

Fill in the missing values for mass and moles in the second data table. Tips are provided below the table.

1. **Clean Up**
   1. Cool the crucible before trying to remove the salt.
   2. Dispose of copper chloride in a location designated by your teacher.
   3. Clean the crucible and lid when you are finished.

# Data

**Data Collected**

|  |  |
| --- | --- |
| **Color of the CuCl2 hydrate before heating** |  |
| **Mass of crucible and cover (dry and empty)** | g |
| **Mass of crucible, cover, and sample** | g |
| **Mass of crucible, cover, and sample (after each heating, as needed)** |  |
| g g g g  after 1st heating after 2nd heating after 3rd heating after 4th heating | **Final:** g |
| **Color of anhydrous CuCl2 after heating** |  |

**Calculations**

|  |  |  |  |
| --- | --- | --- | --- |
|  | CuCl2 • *x* H2O (s)  CuCl2 (s) + *x* H2O (g) | | |
| **Mass\*** | Not needed | g | g |
| **Molar Mass** | Not needed | 134.45 g/mol | 18.02 g/mol |
| **Moles** | Not needed | **\*\*** | **\*\*** |

**\***Compute by subtracting the correct masses from the data table at the top of the page.

**\*\***Use stoichiometry to convert the masses you already found into moles. (Divide the masses by the molar masses, which are shown in the table for your convenience.)

**Measured Mole Ratio of H2O to CuCl2**   
(Divide the number of moles of H2O by the number of moles of CuCl2. Maintain significant figures!)

**Percent Error of the Mole Ratio:**After you finish the lab, your teacher will provide the actual mole ratio of water to CuCl2. Calculate the percent error using the standard formula below.

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**Formula of the Hydrate:**