

Name: _____

Percentage of Hydration

Background: When ionic compounds crystallize from aqueous solutions, water frequently becomes a part of the crystal structure. The water is called water of hydration and occurs in a fixed ratio with ionic components of the crystal. Examples of hydrated crystals include $\text{BaCl}_2 \cdot 2\text{H}_2\text{O}$, $\text{CaCl}_2 \cdot \text{H}_2\text{O}$, and $\text{MgCl}_2 \cdot 6\text{H}_2\text{O}$. The water of hydration can be removed by the applying heat. In this experiment the percentage of hydration of the hydrated form of magnesium sulfate or copper(II) sulfate will be determined.

Objective: To determine the percentage of hydration for a hydrate.

Safety: Wear chemical splash goggles, gloves, and an apron. Tie back long hair. Use caution in handling the crucible and cover. Transport the crucible and cover on a dry ceramic tile.

Disposal: The dehydrated product may be placed in the non-hazardous waste container.

Materials

• Bunsen burner	• ceramic tile
• crucible and cover	• iron ring
• triangle pipe stem	• crucible tongs
• ring stand	• electronic or centigram balance
• 4 g hydrated magnesium sulfate or copper(II) sulfate	

Procedure

1. Place the crucible in the triangle pipe stem. Put the cover on, slightly ajar. Heat the crucible and cover. Begin with the crucible above a gentle gas flame. Later, as the crucible becomes hotter, increase the temperature of the flame by increasing the gas flow and air flow. Heat for a total of five minutes.
2. Shut off the gas flow to the burner. Allow the crucible to cool slightly on the pipe stem. Gently set the lid squarely on the crucible and carefully lift the crucible with lid from the pipe stem with the tongs and set it on the ceramic plate. To avoid transfer of mass from your fingers, always handle the crucible and cover with crucible tongs.
3. When the crucible and cover have cooled, carry them to the balance on the tile. Determine the mass of the crucible and cover and record it in the Data Table.
4. Add approximately 4 g of hydrated magnesium sulfate or copper(II) sulfate to the crucible. Accurately determine the mass of the crucible, cover, and contents, and record it in the Data Table.
5. Return the crucible to the triangle pipe stem. Leave the cover slightly ajar. Heat the crucible assembly gently for five minutes. If it makes a crackling sound, turn off the gas flow to the Bunsen burner and then restart after the crackling ceases. After five minutes of gentle heating, increase the heat gradually until maximum heat is applied.
6. Continue to heat the crucible assembly for seven to eight more minutes.
7. Shut off the gas flow to the Bunsen burner. Cool the crucible assembly and measure

its mass as before. Record the mass in the Data Table.

- Reheat the crucible for another ten minutes (Steps 5–7). This time, you don't need to spend five minutes warming up the assembly, unless it somehow got wet.
- If the difference between mass measurements is greater than 0.01 g, repeat Step 8 until the successive mass measurements differ by 0.01 g or less. Record this mass in the Data Table as the constant mass. Dispose of the product as directed by your teacher.

Analysis

- Calculate the mass of the **hydrated** material. Record in the Calculations Table.
- Calculate the mass of the **anhydrous** material. Record in the Calculations Table.
- Determine the mass of water lost from the hydrate and record it.
- Determine the percentage of water in the hydrate from the mass of water lost and the mass of the hydrate. Record this percentage.
- Your instructor will provide you with the accepted value. Using that value, calculate the absolute error and percentage error.

Report

On a separate piece of paper, identify possible sources of error in your measurements, whether they are systematic or random, and how those errors would affect your final results.

Data Table

substance to be dehydrated	
mass of crucible and cover	
mass of crucible, cover, and hydrated contents	
mass of crucible, cover, and contents after first heating	
mass of crucible, cover, and contents after second heating	
mass of crucible, cover, and contents heated to constant mass	

Calculations Table

mass of hydrated starting material	
mass of anhydrous product	
mass of water lost	
percentage of water: experimental	
percentage of water: accepted	
Absolute error	
Percent relative error	