

Group # _____

Name _____

Period __ Date __/__/__

Lab Ch 6 • Percent Composition

Percentage of Water in Hydrates and Sugar in Bubble Gum Lab

Lab Partners: _____

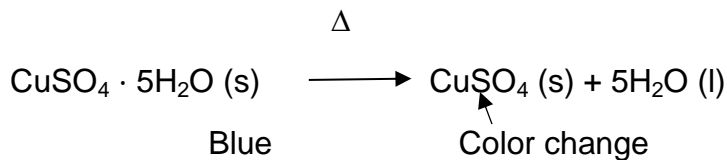
Part 1: Percent Composition of Hydrates

Introduction:

Hydrates are ionic compounds (salts) that have a definite amount of water as part of their structure. This “water of hydration” is released as vapor when the hydrate is heated. The remaining solid (**without water**) is known as the **anhydrous salt**. The general reaction for heating a hydrate is:



The Δ sign means that heat is applied. The percent of water in a hydrate can be found experimentally by accurately determining the mass of the hydrate and the mass of the anhydrous (solid without water) salt. The difference in mass is due to the water lost by the hydrate. In this experiment, a hydrate of copper (II) sulfate ($\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$) will be studied. The change from copper (II) sulfate pentahydrate to anhydrous copper (II) sulfate is accompanied by a **change in color**.



Materials:

Chemical	Equipment
Copper (II) sulfate pentahydrate	Evaporating dish
Distilled Water	Crucible tongs
	Balance
	Ring Stand & iron ring
	2 wire gauze pads
	spatulas
	Stirring Rod
	Bunsen burner

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Safety Precautions:

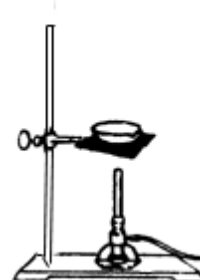
- Always wear safety glasses and a lab apron
- Avoid handling heated materials until they have cooled

Procedure:

1. Clean and dry your evaporating dish.
2. Prepare your ring stand set-up as shown in the diagram at the right.
3. Place your empty evaporating dish on the wire gauze and heat the dish with the hottest flame for couple (~2) minutes. This is done to be sure that the evaporating dish is absolutely dry.

4. Using crucible tongs, remove the dish from the apparatus. Place it on the wire gauze pad and allow it to cool for several minutes.

5. Using a balance, find the mass of the **cooled** evaporating dish. Record this mass in the Data table section. Never weigh an object when it is hot because heat waves tend to be circular and upward (convective), which tends to make objects appear to weigh less.



6. With the evaporating dish on the balance, measure into it exactly 2.000 grams of copper (II) sulfate pentahydrate. **Record observations of the hydrate before heating in data table 1.** Be sure the spatula is very clean to avoid contamination. Record the mass of the dish and the hydrate in the Data section.

7. Place the evaporating dish and the hydrate on the wire gauze. Gently heat the dish by moving the burner back and forth around the base. Increase the heat gradually. Avoid any popping and spattering.

8. **Heat strongly for 5 minutes** or until all of the blue color has disappeared. During the heating, a glass stirring rod may be used to “spread” the solid and break up larger portions of the hydrate. Be sure not to pick up any of the solid on the stirring rod. If the edges of the solid appear to be turning brown, remove the heat momentarily and resume heating with a cooler flame.

9. Allow the evaporating dish to cool for two minutes, **but not too long.** (The longer it sits there cooling the more the water vapor in air will try to re-enter the hydrates). **Record observations of the hydrate after heating in data table 1. Immediately** find the mass of the dish plus the anhydrous salt, and record the mass in the data section. The dish must be weighed before the compound reabsorbs water from the atmosphere.

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10. When you have finished weighing the dish and salt, place the dish back on the counter and squirt some distilled water onto the anhydrous salt. **Record any changes in appearance in data table 1.**

11. When you have finished, the anhydrous salt can be thrown into the trash.

Cleaning and Disposal:

1. Solids go in the trash
2. Clean ALL equipment with LAB Equipment soap & brushes
3. Dry dishes for next lab group and place them on a paper towel.
4. Clean Lab BENCH with small soap bottle and sponge.
5. Wash hands with hand soap.
6. Let me know when you are ready. Do not get unprotected until dismissed.

Data Table 1: Water in hydrate (Observations)

copper (II) sulfate pentahydrate - before heating.	
copper (II) sulfate pentahydrate - after heating.	
copper (II) sulfate pentahydrate - after heating with a squirt of water.	

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Data Table 2: Water in hydrate

Remember to record masses to **two** decimal places

1. Mass of evaporating dish	
2. Mass of dish + hydrate	
3. Mass of hydrate	
4. Mass of dish + anhydrous salt (after heating)	
5. Mass of anhydrous salt	

Calculations - Remember to show all of your work.

1. Calculate the mass of water lost from the hydrate.

Mass of Hydrate (step #3) - Mass of Anhydrous salt (step #5) = **mass of water lost from heating the hydrate**

2. Calculate **Actual Yield**: Find the percent of water lost from the original hydrate.

The percent of water in the original hydrate can be calculated easily:

$$\% \text{ H}_2\text{O} = \frac{\text{Mass of water}}{\text{Mass of hydrate}} \times 100$$

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3. Calculate the **Theoretical yield**: Theoretical yield is the yield you **should have gotten if you had done everything perfect.**

1. Find the molar mass of the five water molecules
2. Find the molar mass of the entire compound, including the five water molecules.
3. Find the theoretical percent of water (mass of water divided by the mass of the whole compound, multiplied by 100”):

$$\% \text{ H}_2\text{O} = \frac{\text{Molar mass of 5 water molecules}}{\text{Molar Mass of entire hydrate}} \times 100$$

Molar Mass of entire hydrate

4. Calculate the **Percent Error**:

$$\frac{[\text{Theoretical yield} - \text{Actual yield}]}{\text{Theoretical yield}} \times 100$$

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Part 2: Percentage of Sugar in Bubble Gum

Introduction: Have you ever looked on a package of bubble gum to see what it is made of? Well, the bubble gum is made of two different types of *saps* collected from trees. The first type of sap, chicle, comes from the sap of the sapodilla or naseberry tree (not raspberry). This tree grows in Mexico, Central America, and tropical sections of South America. The second type of sap, gutta siak is a rubber-like sap obtained from trees that grow in the Netherlands. This sap was found to be fun to chew, and you could probably even blow bubbles with this sap just as it comes from the tree! The sap is later processed into the fun treat we know and love – bubble gum!

Purpose: The purpose of the lab is to calculate the percent of sugar (sucrose: $C_{12}H_{22}O_{11}$) found in bubble gum using percent composition.

Materials:

- Electronic Balance
- Bubble Gum
- Bubble Gum Wrapper

Safety Precautions: *Do NOT throw bubble gum wrappers in the sink or on the floor!*

Wrappers must be saved and used to measure mass of the gum before and after chewing it as gum is NOT to be placed directly on the balance. Gum will be placed on the wrapper before and after chewing it. Finally, chewed gum and the wrapper belong in the trash at the end of the lab – NOT underneath a desk, in the sink or on the floor (or on the bottom of someone's shoe)!

Procedures:

1. Before you start the experiment, make a prediction of what % of sugar do you believe to be in bubble gum? Write your hypothesis in data table (0 – 100%)
2. Obtain a piece of bubble gum.
3. Use a balance to determine the mass of the wrapped bubble gum. Record the mass in the data table.
4. Unwrap the piece of gum and place the wrapper on the balance. Record mass in data table
5. Save your wrapper!!!!
6. Chew a piece of gum for fifteen minutes to dissolve and remove the sugar from the gum.
7. After fifteen minutes of chewing, a gum should have "lost" most of the flavoring. Place your chewed gum on the wrapper that you weighed earlier. Now, place the gum and wrapper on the balance. Record the mass in the data table.

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Disposal :

1. Place the chewed gum and wrapper in the trash.

Data Table 3: Sugar in Gum

Your prediction: % of sugar in gum	
1. Mass of unchewed gum and wrapper	
2. Mass of wrapper	
3. Mass of un-chewed gum	
4. Mass of chewed gum and wrapper	
5. Mass of chewed gum	
6. Mass of sugar in gum	

Calculations: Remember to show all of your work.

1. Calculate the mass of sugar lost in gum.

Mass of un-chewed gum (step #3) - Mass of chewed gum (step #5) = **mass of sugar lost from chewing (step #6)**

2. Calculate **Actual Yield:** Find the percent of sugar lost from the gum.

$$\% \text{ sugar in gum} = \frac{\text{Mass sugar in gum}}{\text{Mass of un-chewed gum}} \times 100$$

