Lab: Percent Composition

Purpose: To calculate the percentage of sugar in a piece of chewing gum (part 1) and the percentage of water in a hydrate (part 2)

Pre-Lab:

1.) Find the percent composition formula on Table S and write it below.

2.) Determine the percent composition by mass of nitrogen in NH_3.

3.) Determine the percent composition by mass of carbon in 2,4-dimethyl hexane.

Part 1: A Bubbly Way to Find Percent Composition

When one reads the ingredients label on a package of food, the ingredients are always listed in decreasing order of amounts according to their mass. Sugar is a primary component of gum. When you chew gum, the saliva secreted by your glands dissolves the sugar within the gum. The material left over is just gum arabic, FDA food coloring, and a couple of other chemicals that affect the texture of the gum.

In this experiment, you will design a procedure that will determine the percentage of sugar in a piece of chewing gum.

Procedure: List the 3-4 steps needed to obtain data to calculate the percent of sugar in your gum. (A helpful hint: You will need to save your gum wrapper until you are ***completely done*** collecting data!)

1. _____
2. _____
3. _____
4. _____

Data: Record your data in the space provided below. Make your own data table and include units.

Analysis: Use your data to calculate the following.
Show all of your work with UNITS!

1.) Mass of your original piece of gum

2.) Mass of sugar in your piece of gum

3.) Percent of sugar by mass in your piece of chewing gum

4.) The sugar in gum is sucrose, $C_{12}H_{22}O_{11}$. Calculate the gram formula mass of sucrose. Show work.

5.) Using your answer to #4, convert grams to MOLES of sucrose in your piece of gum. Use dimensional analysis to show your work.

Part 2: Percentage of Water in a Hydrate

Hydrates are ionic compounds (salts) that have a definite amount of water as part of their structure. This water can be released by heating the hydrate. The remaining solid is known as the *anhydrous salt*.

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 salt. The difference in mass is due to the water lost by the hydrate. The percent of water in the original hydrate can easily be calculated:

$$\% \text{ water} = \frac{\text{mass } H_2O}{\text{mass hydrate}} \times 100$$

In this experiment, a *hydrate of copper sulfate* will be used. The change from copper hydrate (blue) to anhydrous salt (white) is accompanied by a change in color.

?? What does the "dot" mean in the hydrate formula??

$$\underset{\text{BLUE}}{CuSO_4 \cdot xH_2O} \rightarrow \underset{\text{WHITE}}{CuSO_4} + H_2O$$

Safety: **Goggles MUST be worn at all times!**
Be careful handling hot equipment- Use tongs!
Burners should NEVER be left unattended!

Procedure:

1. Mass your empty evaporating dish on an electronic balance and record in your data table.
2. Add approximately 2.0 grams of copper sulfate hydrate to the evaporating dish and mass again. Record mass in data table.
3. Using tongs, gently place your evaporating dish on the support over the bunsen burner.
4. Light the burner
5. Heat strongly for 5 minutes or until the blue color has disappeared.
6. During heating, a metal spatula may be used to "spread" the solid and break up any "caked" portions of the hydrate. Be careful NOT to pick up any of the solid on the microspatula! If the edges of the solid appear to be turning brown, remove from the heat momentarily and resume heating at a gentler rate. Do NOT allow your sample to pop like popcorn.
7. Place the evaporating dish on a folded paper towel to cool for about a minute. Then find the mass of the evaporating dish and resulting anhydrous salt.

Data & Analysis:

Measured Data	**mass (g)**
Mass of empty evaporating dish	
Mass of evaporating dish + copper sulfate hydrate	
Mass of evaporating dish + anhydrous salt	

Results you need to calculate	
Mass of copper sulfate hydrate	
Mass of anhydrous salt ($CuSO_4$)	
MOLES of anhydrous salt ($CuSO_4$)	
Mass of water lost during heating	
MOLES of water lost (H_2O)	

1. Use the equation given above to calculate the % of water in your hydrate. Show your work here:

2. Using moles of $CuSO_4$ and moles of H_2O, determine the MOLE RATIO between them: ____:____
(express the ratio in simplest whole numbers)

3. Use your mole ratio, what number do you think "x" would be in the hydrate formula? Insert it in the formula below:

Given formula: $CuSO_4 \cdot xH_2O$ **Actual formula: $CuSO_4 \cdot \_\_\_H_2O$**