Name _____ Date _____ Period _____ Lab 21

Analysis of Copper Sulfate Lab*

[VIDEO LAB]

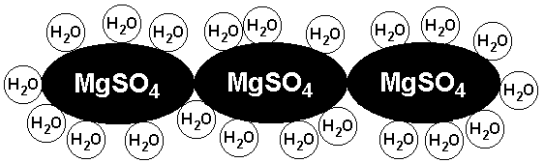
Learning goals:

1. Quantify the conservation of mass through experimentation.
2. Model the nature of the proportions (coefficients) of substances in chemical reactions.

Materials: copper sulfate pentahydrate, pyrex test tubes, test tube holders, bunsen burners, water bottles, & centigram balances.

Background:

In hydrates, the water molecules are tucked in between "host" molecules of another substance. For example, the Epsom salt that people often bathe in is a hydrate of magnesium sulfate, $MgSO_4$. H_2O molecules can cluster around and fit in between the $MgSO_4$ molecules that make up a salt crystal in a ratio of seven water molecules to each magnesium sulfate molecule.



Hydrate formulas indicate this ratio and are written in the following way:

$$MgSO_4 \cdot 7H_2O$$

In this lab you are going to remove the water from copper sulfate hydrate by heating so you can experimentally determine the value of X as a ratio of the mass.

$$CuSO_4 \cdot X\ H_2O$$

Safety:

1. Safety glasses must be worn at ALL times.
2. Long hair must be tied back and sleeves rolled up while using the burners.
3. Follow all instructions and dispose of materials according to teacher instructions.

Part 1 - Dehydration of copper sulfate pentahydrate

1. Obtain a "Pyrex" brand test tube and record its mass.
2. Obtain 0.5 to 2 grams of the copper sulfate hydrate (blue); weigh it directly in the test tube. The exact mass should vary between each group so that we can graph the results; however, record the mass of your sample as accurately as possible.
3. Using a test tube holder, hold the copper sulfate test tube in the Bunsen burner flame until it all changes color. Hold the test tube at an angle so the copper sulfate spreads through most of the tube.
4. Move the test tube gently to evenly distribute the heat and agitate the copper sulfate. Heat the top of the test tube as well to completely dry any water droplets that appear.
5. Once the copper sulfate has all changed color, allow it to cool, and then record the mass with it in the test tube. Keep the copper sulfate for part 2.

Data (construct a table here): Submit data HERE (once per group).

Part 2 - Testing the copper sulfate:
Did the mass of the copper sulfate change before and after the experiment? Develop a hypothesis (**claim**) to explain where it went:

Write a simple procedure to test your **hypothesis (claim) [CER sentence frames]**:

Data (evidence): Record any data from your test.

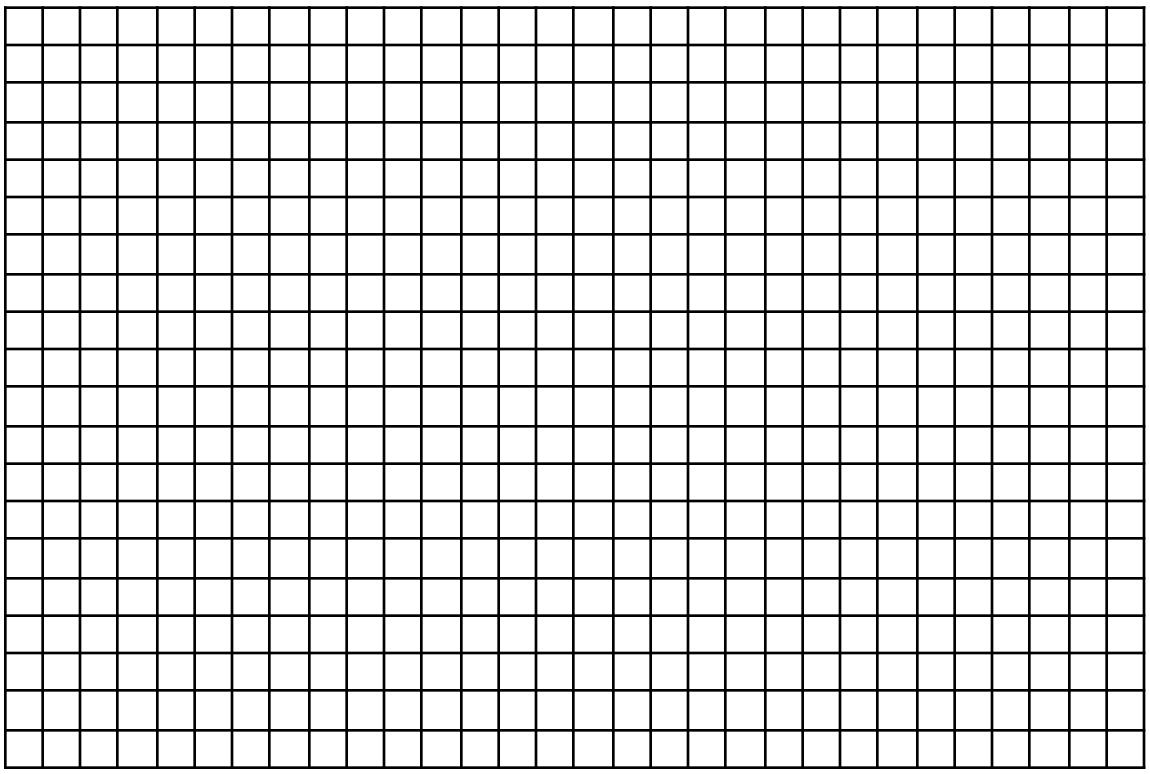
Reasoning: Explain how your data (evidence) supports or denies your hypothesis (claim). [CER Frames]

Part 3 - Analysis of class data

Record the class data from columns U-W and complete the remainder of the table as follows. *Tip: use a spreadsheet to make the analysis much easier* [VIDEO].

	Column U	Column V	Column W	Column X	Column Y	Column Z
Group	Mass of test tube (g)	Mass of copper sulfate before heating (g)	Mass of copper sulfate after heating (including test tube mass) (g)	Mass of copper sulfate after heating (subtract test tube mass) (g)	Mass change (column V-X)	Ratio of water to copper sulfate by mass (g) (column Y/X)
A						
2						
3						
4						
5						
6						
7						
8						
K						

Make a graph of the mass change (column y) vs. the mass of copper sulfate after heating (column x). The graph should be labeled with appropriate increments. The graph should have an appropriate title, and the graph should have axis labels with the units included. Create a best fit line and calculate the slope. [Graphing guide pdf OR VIDEO]



Analysis Questions

1. Describe the ratio (column Z). Is it similar or different for each group? Calculate the average ratio of column Z. Explain & show calculations.

2. What is the X value of the copper sulfate hydrate ($CuSO_4 \cdot X\ H_2O$)? What does this number mean?

3. Describe the graph. Is the best fit line very close to the data? Does the line go in a consistent direction? If so which way?

4. Use the best fit line (or the equation) to predict the mass of water expected to absorb into 20 grams of pure copper sulfate. (See this VIDEO for help).

5. Why did water vaporize and the copper sulfate did not? Use the concepts of intermolecular forces to explain.

*Adapted from the University of University of Manitoba:
https://www.umanitoba.ca/outreach/crystal/resources%20for%20teachers/Emperical%20and%20Molecular%20Formulae%20C30S-3-11.doc