LAB: TYPES OF CHEMICAL REACTIONS

When elements combine to form molecules and compounds, they undergo chemical reactions, which involve a transfer and/or sharing of electrons. The changes that occur during a chemical reaction are represented by a **chemical equation**. An equation uses chemical symbols to represent the substances that react.

There are four types of chemical reactions. In a **synthesis reaction**, two or more substances combine to form a new substance. For example, water and oxygen combine to form hydrogen peroxide. A **decomposition reaction** produces several products from the breakdown of a single compound. For example, water will break down into molecules of hydrogen and oxygen. Lastly, displacement reactions involve two or more reactants combining to form two or more different products. In a **single replacement** reaction, one element replaces another in a compound. In a **double replacement** reaction, two elements from two different compounds switch places.

Reactions can also be classified on the basis of energy use. Reactions that give off heat when chemicals combine are said to be **exothermic**, or heat releasing. Heat is usually released when stable bonds are formed. Reactions that become cold are said to be **endothermic**, or heat absorbing. Heat is usually consumed to break stable bonds.

In this lab you will be identifying the types of chemical reaction you observe, recognize the reactants and products of the reaction, and compose a balanced chemical equation for the observed reaction using appropriate chemical symbols.

PRE-LAB

The pre-lab must be completed before the lab can be started in class.

1. Read and understand the entire lab.

2. What safety considerations are important in this lab?

3. For all three parts of this lab, rewrite the procedures in your own words and create data tables for each part (design separate data tables for Parts I and II, copy the data table provided for Part III). Leave sufficient space in your notebooks for analysis and conclusions.

SAFETY

- Wear safety goggles at all times.
- Long hair should be tied back at all times.
- Do not get any chemicals on skin or clothing. Alert your teacher immediately if this happens.
- Alert the teacher to any chemical spills or glass breakage.

CHEMICAL SYMBOLS

$NaHCO_3$	Sodium bicarbonate (baking soda)
$CuSO_4$	Copper II sulfate solution
CO_2	Carbon dioxide
Na_2CO_3	Sodium carbonate
H_2O	Water
Cu	Copper
S	Sulfur
CuS	Copper sulfide
Zn	Zinc
$ZnSO_4$	Zinc sulfate
H_2	Hydrogen

PART I. MAKING COPPER

Materials: Zinc strip, Sand paper, Copper II sulfate solution, Small beaker (as a test tube holder), Small test tube, Paper towel

Procedures:

1. Use a piece of sand paper to clean and polish the zinc strip.

2. Add copper II sulfate solution to the test tube until the test tube is about half full. Use the small beaker as a test tube holder for the copper II sulfate solution.

3. In a data table, record observations of the physical properties of both the zinc and the copper II sulfate solution.

4. How do you think the copper II sulfate solution will affect the appearance of the zinc? Record your predictions in a data table.

5. Add the zinc strip to the solution. Leave the zinc in the solution while you perform the other investigations. Periodically check the zinc strip by pulling it out of the solution and making observations.

6. After waiting 20-30 minutes, record the description of the product formed in a data table.

Analysis & Conclusions:

1. When zinc reacts with copper II sulfate it forms copper and zinc sulfate. Write a balanced chemical equation for this reaction and identify the reactants and products.

2. What type of reaction (synthesis, decomposition, single or double replacement) is the formation of copper and zinc sulfate? How do you know?

PART II. HEATING BAKING SODA

Materials: Matches, Test tube, Spoon, Wood splint, Test tube holder, Baking soda

Procedures:

1. Place a spoonful of baking soda in a test tube.
2. What do you think will happen if you heat the baking soda? Record your prediction in a data table.
3. Using a test tube holder, heat the test tube in the flame of the Bunsen burner. Do not point the test tube at anyone or at your face.
4. Record the description of the products formed inside the test tube in the data table.
5. Test for the presence of carbon dioxide by lighting a wooden splint and holding the flame over the opening of the test tube. If the flame on the wooden splint is extinguished, carbon dioxide is present. Record your observation in your data table.

Analysis & Conclusions:

1. When baking soda (sodium bicarbonate) is heated, it is broken down into sodium carbonate, carbon dioxide gas, and water. Write a balanced chemical equation for this reaction and identify the reactant and products.
2. What type of reaction (synthesis, decomposition, single or double replacement) is the heating of baking soda? How do you know?

PART III. MAKING COPPER SULFIDE

Materials: Large test tube, Test tube clamp, Vial of copper, Vial of sulfur, Rubber band, Rubber dam, Bunson burner, Matches/flint striker, Wood splint, Electronic balance, 1 small piece of weighing paper

Procedures:

1. Using an electric balance, mass the amount of sulfur in the vial**. Record this amount in your data table.** Remove the sulfur from the scale and use a wooden splint to mash up the large chunks of sulfur. Be careful not lose any sulfur in the process.

Items	Mass (kg)		Physical Characteristics
Mass of Cu			
Mass of S			
Total mass of test tube, dam, Cu, & S	Before ignition	After ignition	After ignition

2. In your data table indicate your initial physical observations of sulfur.
3. Pour the sulfur into your test tube.
4. Using the same scale and weigh paper, mass the amount of copper in the vial. **Record this amount in your data table.**
5. **In your data table** indicate your initial observations of the copper.
6. Pour the copper into the same test tube with the sulfur.
7. Obtain a rubber dam and place it loosely over the opening of the test tube using a rubber band to secure it in place.
8. Shake the test tube to ensure that the copper and sulfur are evenly mixed in the test tube.
9. Mass the whole test tube with all its contents and **record the amount in your data table.**
10. Hold the test tube on its side so that the contents are evenly spread out. Heat the closed end of the test tube using a Bunsen burner until a reaction happens. Be sure to aim the opened end of the test tube away from yourself and others. **Record observations in your table.**
11. Once the reaction is complete, allow the test tube to cool in the test tube rack. When cool, mass the test tube and **record in your data table**.
12. Dump the contents onto a piece of paper and observe the product. **Record observations in your table.**

Clean-up: Wrap the product in the paper and throw away in the trash can. DO NOT throw away the rubber sheath. Rinse the test tube out as best as possible using a test tube brush, then place in bucket of soapy water to let soak.

Analysis & Conclusions:

1. When copper reacts with sulfur, copper sulfide is created. Write a balanced equation for this reaction and identify the reactant and products.
2. What type of reaction (synthesis, decomposition, single or double replacement) is the reaction of copper and sulfur?
3. How did the physical characteristics of both copper and sulfur change during the chemical reaction?
4. What was the importance of massing all the items before the reaction as well as after the reaction?
5. If the reaction of copper and sulfur happens in a 1 to 1 ratio (one atom of copper reacts with one atom of sulfur), why did we use 1 gram of copper and only 0.5 grams of sulfur?