***Chemical Changes (Hot Plate)***

**Introduction:**

Substances may be created by chemical change and may also undergo chemical change. If a substance is produced as a result of a chemical change, or reaction, it is called a product. If a substance is the subject of a chemical change, it is a reactant. Any substance can be either a reactant or product, depending on the chemical reaction.

There are several types of chemical reactions. If two substances combine to form one product, a synthesis reaction has occurred. If one reactant breaks down into several products, then a decomposition reaction has occurred. When an element replaces another one in a compound, a single displacement reaction has occurred. If ions in two compounds swap places to produce two new compounds, then a double displacement reaction has occurred.

One way of knowing that a chemical change has occurred is by observing that the properties of the product are different from those of the beginning reactant. This new product can then become one of the reactants in another reaction. In this experiment you will observe the sequence of changes that occur when a solution that begins as copper (II) nitrate is treated with a series of different reactants. All of the reactions will take place in the same test tube. Look for evidence that a new substance is formed from each chemical change. Also observe how heat and chemical reactions are related.

**Purpose:**

To observe the types of evidence that indicate a chemical change has taken place.

To infer from the observation of chemical change that a new substance has been formed.

To identify the type of reaction that has taken place.

To identify and record data that shows how heat is involved in chemical changes.

To explain how a substance can be either a reactant or a product in chemical reactions, and why this is necessary for recycling.

**Materials/Equipment:**

**Equipment: Chemicals:**

Test tube 1.0 M Copper (II) nitrate

2 beakers (100 mL) 1.0 M sodium hydroxide

Hot plate 1.0 M hydrochloric acid

Ruler 12 cm piece of aluminum wire

Wax pencil

Stirring rod

**Safety**:

* Always wear safety glasses in the chemistry lab
* Never eat or drink in the chemistry lab
* Handle all chemicals with care
* Hydrochloric acid and sodium hydroxide solutions are corrosive to eyes and skin.
* Avoid contact of all chemicals with eyes and all body tissues. If any solutions are spilled on you, flush the area immediately with water and notify your teacher.
* Report spills to your teacher immediately.

**Procedure:**

1. Pour 50 mL of water into a 100 mL beaker.
2. Place the beaker on the hot plate and start heating the water to boiling.
3. While the water bath is heating, make 4 marks that are 1 cm apart on the test tube with the wax pencil starting at the bottom of the test tube.
4. Add copper (II) nitrate to the first mark on the test tube.
5. Add sodium hydroxide to the third mark on the test tube. Mix carefully with the stirring rod. Rinse the stirring rod.
6. Touch the bottom of the test tube to see if heat is being released. Record your observations in the data table.
7. The copper containing product is copper (II) hydroxide. The other product is sodium nitrate. Record this information in the “products” column of the data table. If a precipitate is formed, record its color in the precipitate column. In the supernate column, record the color of the liquid in your test tube.
8. In this reaction, two compounds react to form two new compounds. Enter the type of reaction in your data table.
9. Put the test tube in the water bath begun in step 1. Heat it until a change occurs. In this reaction, copper (II) hydroxide breaks down. The products of this reaction are copper (II) oxide and water.
10. Record your observations in the proper columns of the data table for this reaction. Identify the type of reaction.
11. Remove the test tube from the water bath. Turn off the hot plate and allow it to cool with the beaker in place. Do **not** attempt to remove the beaker at this time.
12. Place the test tube in a second beaker of room temperature water. Allow it to cool for approximately 2 minutes.
13. Add hydrochloric acid to the fourth mark on the test tube. Mix well with the stirring rod. The products of this reaction are copper (II) chloride and water.
14. Record your observations in the proper columns of the data table. Identify the type of reaction.
15. Place the piece of aluminum wire in the test tube. Leave it until no more reaction is observed. Touch the bottom of the test tube to check for temperature changes. Two reactions take place. In one reaction, the compound copper (II) chloride and the element aluminum react to produce the element copper and the compound aluminum chloride. Record your observations for this first reaction in the data table and identify the type of reaction.
16. The aluminum also reacts with the excess hydrochloric acid in the test tube to produce hydrogen and aluminum chloride. Record you observations for this second reaction in the data table and identify the type of reaction.
17. When the reaction has slowed, carefully decant the liquid from the test tube and remove the wire. Place the wire on a piece of paper towel. Scrape the wire with the stirring rod and press some of the product firmly on the paper towel. Record your observations.
18. Dispose of solids in the waste container. Clean your test tube and return materials as directed by your teacher.

Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Partner’s Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

***Chemical Changes***

**Pre-lab questions**:

1. In order to complete this lab, you will need to be familiar with some common chemistry terms. Define the following:
   1. Reactant
   2. Product
   3. Synthesis reaction
   4. Decomposition reaction
   5. Single displacement reaction
   6. Double displacement reaction
   7. Precipitate
   8. Supernate
2. What are some common signs of chemical change?

**Data Table**:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Reactants** | **Products** | **Observations of Products** | | | **Was heat a reactant or product?** | **Type of reaction?** |
| **Precipitate**  **(solid)** | **Supernate**  **(liquid)** | **Were gases formed?** |
| **copper (II) nitrate**  (blue solution)  and  **sodium hydroxide** (clear solution) | and |  |  |  |  |  |
| **Copper (II) hydroxide**  and  **heat** | and |  |  |  |  |  |
| **Copper (II) oxide**  and  **hydrochloric acid** | and |  |  |  |  |  |
| **Copper (II) chloride**  and  **aluminum** | and |  |  |  |  |  |
| **Hydrochloric acid**  and  **aluminum** | and |  |  |  |  |  |

**Questions:**

1. What are some causes of chemical change?
2. List four types of observations that indicate when a chemical change has occurred.
3. In what two ways may heat be involved in chemical changes?
4. On the data table, determine the identity of each product. For example, the products of reaction 2 are copper (II) oxide and water. In the observations columns, you should have written that the precipitate was black and the supernate was clear. Which substance is the copper (II) oxide? Which substance is the water? Write the names of the substances under your descriptions in the proper column.
5. Write an equation for each reaction by referring to the data table for the reactants and products. Use state symbols for each substance (aq for aqueous solution, s for solid, g for gas, l for liquid).
   1. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   2. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   3. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   4. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   5. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
6. What are the usual colors of solutions of copper compounds? (look at your data table)
7. In the last step of the experiment, where is the aluminum chloride? How could you recover it?

**Extensions:**

The chemical conversion of one product into another useful product is what we speak of as recycling. The copper (II) nitrate solution used in the experiment is prepared originally from the element copper and nitric acid. After a number of steps the copper is recovered.

Chemical changes are required to make these conversions. For example, the metals that are changed into alloys and shaped into soft-drink cans are themselves converted by chemical changes into other products.

Describe the advantages and disadvantages of recycling metals as was done in this experiment.