Evidence of Chemical Change Lab

Name\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Objectives:**

* To observe the types of evidence that indicate that a chemical change has occurred
* To infer from the observation of chemical change that a new substance has been formed

**Introduction:**

Substances include elements and compounds. New substances may be created by chemical changes and may undergo further chemical changes to form another new substance. Multi-step synthetic processes are commonly used to prepare complex substances. The substance that undergoes chemical change is called the reactant. The substance that is formed by the chemical change is called the product. The same substance can be either a reactant or a product, depending on the chemical reaction.

One way to know that a chemical change has occurred is by observing that the properties of the product are different than those of the reactant. For example if two aqueous solutions are mixed, and a solid forms, one can infer that two water soluble substances have reacted to produce a substance that is not water soluble. Similarly, if two liquids or a liquid and solid are mixed and gas bubbles are observed, one can infer that a new product has been formed that is in the gas phase. A change in color or odor may also indicate that a chemical reaction has taken place. Other indications that a chemical change may have occurred include changes in temperature or appearance of light or flame. However, both physical and chemical changes produce changes in energy, so temperature change does not always confirm a chemical change has occurred. Similarly, solubility of a substance often depends on temperature of the solution (see Reference Table G), so cooling a solution may cause a dissolved substance to precipitate (crystallize, become solid) from solution.

In this experiment you will observe a sequence of changes that occur when an aqueous solution of copper(II) nitrate, Cu(NO3)2(aq), 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 has formed from each chemical change. In addition, observe how heat energy and chemical changes are related. Remember that reactions that require an overall input of energy are termed endothermic, while those that release energy overall are termed exothermic.

The chemical conversion of one product into another useful product is a type of chemical recycling. The copper (II) nitrate solution used in this experiment is originally prepared from the element copper, and nitric acid, HNO3(aq). After a number of steps, the copper is recovered.

Chemical changes are required to make these conversions. For example, the metals that are used to make soft-drink cans are themselves converted by chemical changes into other products or recycled to produce new cans. Recycling enables us to reuse scarce natural resources or value added products like aluminum metal, usually at lower cost than mining and purifying them.

**Equipment:**

Pyrex test tube 13 x 100 mm (or slightly larger), test tube holder

150 or 250 mL beaker, beaker tongs, glass stirring rod

Test tube rack, Bunsen burner, ringstand, iron ring, wire gauze

**Chemicals:**

1. M copper (II) nitrate 1.5 M hydrochloric acid
2. 1.5 M Sodium hydroxide small piece of aluminum foil

**Procedure:**

Where instructed in the procedure, record your observations in the data table on the next page.

1. Using the 150 or 250 mL beaker, prepare a hot water bath by filling the beaker approximately 2/3 full of water and heating it over the Bunsen burner. Control the heat so that the water does not boil over.
2. While the water is warming, one lab partner should obtain the marked test tube. The test tube should have three marks that are one centimeter apart, starting at the bottom of the test tube. Marks can be made using a ruler and a wax pencil or a permanent ink sharpie.
3. Use a disposable pipette to add 1.0 M copper (II) nitrate to the first mark on the test tube.
4. Add 1.5 M sodium hydroxide to the second mark on the test tube. Mix the solutions with the stirring rod**. The copper containing product is copper (II) hydroxide, Cu(OH)2. The other product is sodium nitrate, NaNO3 (aq)**

**Observation**:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Use a test tube holder to put the test tube in the hot water bath prepared in step one. Heat it until no more change occurs. **The products are Copper (II) oxide, CuO, and water.**

**Observation**:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Turn off the gas to the Bunsen burner. Remove the test tube from the hot water bath. Cool the test tube and its contents in your test tube rack. Add 1.5 M hydrochloric acid, HCl (aq), to the third mark on the test tube. Mix with the stirring rod. Rinse the stirring rod.  **The products are copper (II) chloride , CuCl2(aq) and water.**

**Observation:**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Place a small piece of aluminum foil in the test tube. Leave it until no more reaction is observed. Touch the bottom of the test tube to check for temperature change. **The products of the reaction are elemental copper, Cu, and aluminum chloride.**

**Observation:**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Dispose of the solids and liquids in the experiment as directed by your teacher. Empty the water from the hot water bath. Clean and dry all equipment used. Remember to wash your hands at the conclusion of your lab work.

Enter the information below from your procedures and observations. The precipitate column will be where you list solid products, and the supernate column is where you will list liquid and/or dissolved products.

Data Table

|  |  |  |  |
| --- | --- | --- | --- |
| Reactants | Products | Precipitate (solid) | Supernate (liquid) |
| Step 4 |  |  |  |
| Step 5 |  |  |  |
| Step 6 |  |  |  |
| Step 7 |  |  |  |

**Questions:**

1. What are two causes of chemical change?

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1. Heat is either released or absorbed in a chemical reaction. Cite an example of both an exothermic and an endothermic chemical reaction that you observed in this lab.

Endothermic:(energy absorbed)

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Exothermic:(energy released)

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1. What is the difference between an element and a compound? Give an example of each that was involved in this lab.\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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1. What color are solutions that contain copper compounds? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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1. In the last reaction of the experiment you produce aluminum chloride and copper.
2. Using your data table, which of the products of this reaction is water soluble? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. Describe a separation procedure that would allow you to recover the aluminum choride.

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1. How could you recover the copper?

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1. The symbol (aq) is used for some solutions. What does (aq) mean?

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1. List four types of observations that could indicate that a chemical change has occurred.

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1. Write a balanced chemical equation for each of the reactions you performed and indicate whether the type of chemical reaction was single replacement, double replacement, or elimination (dehydration).

Step 4 reaction equation: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Step 4 type of reaction:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Step 5 reaction equation: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Step 5 type of reaction:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Step 6 reaction equation: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Step 6 type of reaction:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Step 7 reaction equation: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Step 7 type of reaction:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_