

LAB [20 pts]
Evidence of an Interaction
CuCl₂ + Aluminum

Name _____
Period _____ Date _____
Lab Partners _____

Introduction:

This experiment provides you with an opportunity to carefully observe a simple reaction. Try to think of conditions that matter. Be alert to questions that come to mind as you observe. Afterwards, we will try to answer some of your “why” questions. It is important that you make your observations as specific and complete as you can.

Purpose:

To make observations and draw conclusions about physical and chemical changes on the addition of CuCl₂ crystals to water and the subsequent addition of Al foil.

Prelab Consideration

- As you may know, US pennies are made of copper (although since 1982 they have consisted of a thin copper coating on a zinc core), just like the Statue of Liberty. However, pennies generally look considerably different from the Statue. Describe the difference in the physical appearances of each (you can look up the Statue, but do not investigate the chemistry yet).
- Thus, something must have happened to the Statue. This can happen to pennies as well, and a search of pennies in your house may turn up some samples that resemble the Statue. If you cannot find any, then you can find images online. Are the pennies with this characteristic generally new or old? What general type of chemical change is at work?
- Watch the video, *Why is the Statue of Liberty Green?* (https://youtu.be/_ZSLrXtg1-o).

Procedure and Observations: [3 pts]

Please carry out the procedural steps below and fill in the observations requested. Your observations do not need to be written in complete sentences. For your observations:

- Specify colors, general temperature (hot or cold) and states of substances (*solid, liquid, gas, aq solution*)
 - Please use the following terms correctly: *cloudy vs. clear; colored vs. colorless;*
 - Try not to make inferences in this section. Thus, do not say words such as: *rusting, evaporating, reacting, burning, or dissolving.* Just describe color changes and appearance/disappearance of materials.
1. Fill a 100 mL beaker about half full with water. Ask me to add about one teaspoon of blue crystals (CuCl₂) to the 100 ml beaker. Allow the water/crystal mixture to stand undisturbed for a short time.
Observations when added CuCl₂ crystals to water (no stirring):

2. Stir the water until all the crystals dissolve.

Observations after stirring the CuCl_2 crystals and water:

3. After I have checked your observations, place a piece of **loosely** rolled aluminum foil into the liquid. Record your observations until the reaction is completed. Write down any questions that have occurred to you during this experiment.

Observations after adding aluminum foil:

Questions which have occurred to you while watching this reaction:

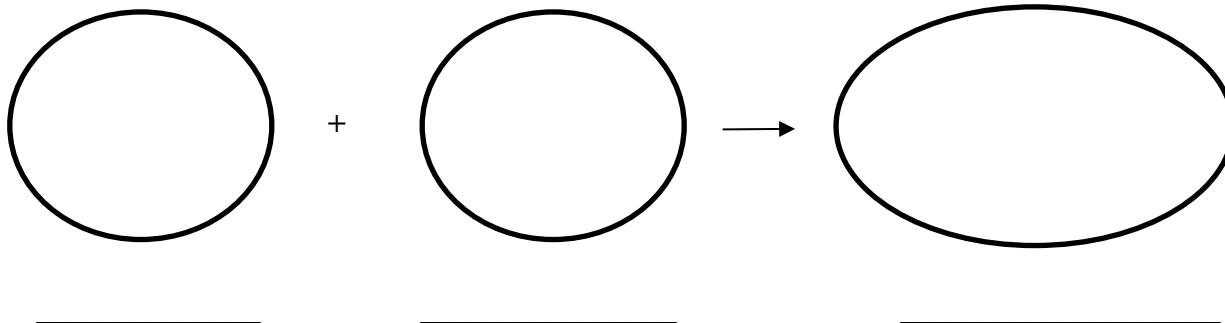
(You must come up with at least 3 good questions.)

4. When your reaction is complete, pour the contents of your beaker into the waste beaker. (Do not throw the mixture down the sink). Clean your beaker and stirring rod (with soap!!), and place them back in your lab cabinet. Make sure your lab area is clean and lab cabinet is in proper order. Wash hands. Dry w/ towel.



Post Lab questions:

- 1) [3 pts] When the CuCl_2 crystals are stirred into the water, a physical change takes place.
- a) What is the term for the type of physical change that takes place? _____
- b) Describe an observation that gives support that this is only a physical change and not a chemical change. *(Remember: Physical changes are changes that do not affect the identity of a substance. What observations of the original crystals and the resulting solution support that the same substances are still present?)*
- c) Draw particle diagrams of the physical change that takes place. (Before and after the change.) Then, below each drawing, fill in the blanks by writing in the appropriate chemical formulas with states. **Hint:** Compounds consisting of metal atoms and non-metals atoms exist as ionic crystal lattices when solids. Compounds consisting of all non-metal atoms exist as molecules.



- 2) [3 pts] When the aluminum foil was added to the solution, a chemical reaction does take place. Describe **three** observations that suggest that a chemical reaction took place after adding aluminum. (*Make sure you give specific observations. For example, do not just say there was a "color change." Instead, state what specific color change took place.*)
- 3) [2 pts] Many people think that the red solid that forms is rust. Why is it impossible for the red solid to be rust? Explain your reasoning. (*Hint: Look up the chemical formula of rust.*)
- 4) [1 pt] What is the identity of the red solid? _____ Explain how you came to your decision. *Hint: The reactants are CuCl₂ and aluminum (water is not a reactant). Thus, there are only two possible pure elements that the red solid could be (state them and explain reasoning). State what each of these pure elements look like and make best choice.*

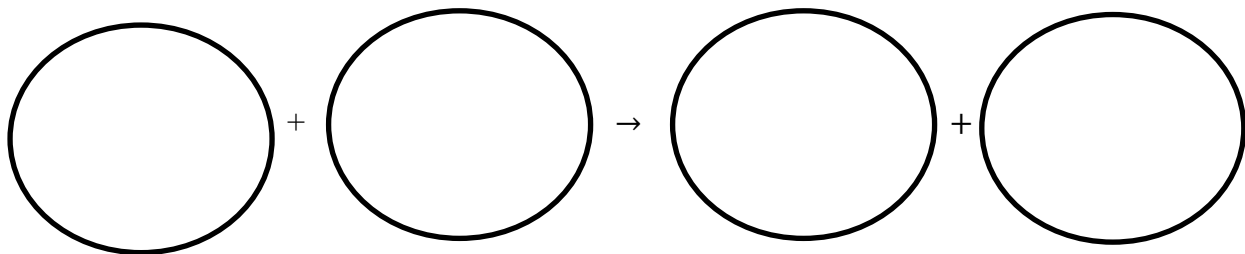


- 5) [2 pts] Once you have decided on the identity of the red solid, call your teacher over to help you write the overall chemical equation for the reaction. Make sure to include states. Then, below each formula give a physical description of each substance (the color and the state). Lastly, draw a particle diagram for each substance or solution.

(Remember: If a substance is ionic (M⁺NM⁻) it consists of ions. If it is molecular (all NM's), it consists of molecules. If a substance is a pure metal, it consists of neutral atoms in a lattice. If it is an aqueous solution, make sure to include water molecules in the diagram.)



Physical
Descriptions:



- 6) [2 pts] When the reaction stopped and no amount of stirring got the reaction going again, everyone's final reaction mixture had the new red solid; however, with respect to the solution and the silvery metal, there were two different possible outcomes for the final reaction mixtures:

Case 1: Observations of final reaction mixture-- *blue/green solution with no silvery metal.*

Case 2: Observations of final reaction mixture- *colorless solution with some silvery metal.*

Explain why the reaction stopped in each case.

(Hint: First, give observational evidence for which reactant is in the final mixture and which reactant is not in the final mixture. Second, state why the reaction stopped.)

a) Case 1: Observations of final reaction mixture-- *blue/green solution with no silvery metal.*

b) Case 2: Observations of final reaction mixture- *colorless solution with some silvery metal*

- 7) [3 pts] Water is not necessary for this chemical reaction to take place.

a) What experimental test could be done to prove that water does not take part in the chemical reaction?

b) Your teacher has done this experimental test. Describe the experimental results (observations).

c) Though water is not necessary for the reaction to occur, it is helpful. How does it help speed up the reaction?

- 8) [1 pt] Think back to the Statue of Liberty. Do you think this would be an effective method to "undo" its green coloration (the patina is similar in composition to CuCl_2). Explain.