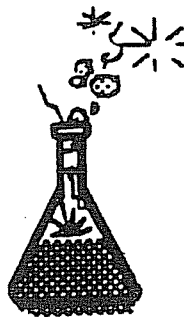


Chemical Reactions



Part I: Single Replacement Reactions

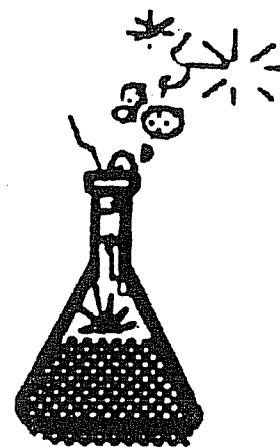
In this activity you will observe and compare some chemical reactions of several metals. The reaction to be studied occurs between the metal and a solution that contains the ions of a different metal (example: CuCl_2). You will carry out the reaction of each of three metals (copper, magnesium, and zinc) with solutions of ionic compounds that contain the metal (copper nitrate, magnesium nitrate, zinc nitrate, and silver nitrate).

Procedure:

1. Clean metals with sand paper before cutting.
2. Cut 4 strips about 1 cm in length of each metal to be tested.
3. Obtain a clean cell well for the reactions.
4. Place 20 drops of copper nitrate in each of the wells in the first column of the well plate. Place 20 drops of the other nitrate solutions in columns two - four as indicated by the data table.
5. Add the metal strips as indicated by the data table.
6. Record observations on data table.
7. Information about the reactions of silver is given as silver is too expensive for this use.
8. Dispose of the metals and solutions as directed by the teacher.

Data:

	$\text{Cu}(\text{NO}_3)_2$	$\text{Mg}(\text{NO}_3)_2$	$\text{Zn}(\text{NO}_3)_2$	AgNO_3		
Zn	<input type="checkbox"/>	<input type="checkbox"/>	—	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Mg	<input type="checkbox"/>	—	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cu	—	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ag	NR	NR	NR	NR	<input type="checkbox"/>	<input type="checkbox"/>



Questions:

1. Which metal reacted with the most solutions?
2. Which metal reacted with the least solutions?
3. List the four metals in order, placing the most reactive metal first (the one that reacted with the most solutions) and proceeding in order to the least reactive metal (the one that reacted with the fewest solutions). Such a ranking of elements in order of chemical reactivity is called an **activity series**.
4. Refer to your metal activity list in Question 3. Based on the list, can you tell why the Statue of Liberty was made with copper instead of zinc?
5. What material that you observed in this activity might have been a better choice of the Statue than copper? Why do you think it wasn't chosen?
6. Given your knowledge of relative chemical activity, which one metal on your list is most likely to be found unreacted or "free" in nature?

Which metal would be least likely to be found unreacted or "free" in nature?

7. Write the balanced single replacement reaction of magnesium with silver nitrate.

Write the balanced single replacement reaction of copper with silver nitrate.

Write the balanced single replacement reaction of zinc with silver nitrate.

8. Could you write an equation for the reaction of silver with copper nitrate? Why or why not?

Part II: Double Replacement Reactions

In this activity you will observe precipitates formed by the chemical reactions between solutions of ionic compounds. A precipitate forms when two chemicals react to form a product that is insoluble in water and falls out of solution like rain or snow. A precipitate can be identified by the cloudy, milky, gelatinous, or grainy appearance it gives to the mixture. The solid may even settle to the bottom of the container.

A barium sulfate precipitate can be produced by the reaction of barium chloride and sodium sulfate. A chemical equation to describe the reaction is written and balanced like this:



Barium sulfate is a common precipitate used as an X-ray contrast medium because it is insoluble in water and opaque to X-rays. Typically a patient drinks an aqueous slurry of barium sulfate just before he is X-rayed. The precipitate coats his stomach and intestines. These organs then show up on the X-ray film in vivid contrast, aiding the doctors diagnosis.

Notice that the reaction that forms BaSO_4 is a double replacement reaction in which the cations and anions of the reactants trade partners to form the products.

Procedure:

1. Put 1 drop of silver nitrate in each well of the top row.
2. Add 1 drop of the solution listed at the top of each column to the silver nitrate.
3. Repeat with lead(II) nitrate on the second row of the plate and calcium chloride on the bottom row.
4. Record your observations in the data table.

Data:

	KI	NaCl	NaOH	FeCl ₃	Na ₂ SO ₄	Na ₃ PO ₄	Na ₄ CO ₃	CuSO ₄
AgNO ₃								
Pb(NO ₃) ₂								
CaCl ₂								

Questions:

1. What is a precipitate?

Which two cations in the lab commonly form precipitates?

2. How can you tell if a precipitate forms when you mix two solutions?

3. Which solutions reacted to form precipitates with calcium chloride?

4. Compare and contrast the double replacement reactions seen in Part II with the single replacement reaction in Part I. Discuss what is happening at an atomic level.

5. Write chemical equations for all the precipitate reactions of silver nitrate seen in the lab.

6. Write chemical equations for all the precipitate reactions of lead(II) nitrate seen in the lab.

7. Write chemical equations for all the precipitate reactions of calcium chloride seen in the lab.