Chemistry CP

Name:

Lab: Precipitation in Double Displacement Reactions

Section:

In chemistry, the term precipitation does not refer to meteorological phenomena such as rain or snow. Rather, *precipitation* occurs in solution when two chemicals react to form a product that is insoluble in water and falls out of solution like rain or snow. A *precipitate* is a solid substance that separates from solution during a chemical reaction. A precipitate can be identified by the cloudy, milky, gelatinous, or grainy appearance it gives to the mixture. The solid might 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 as follows:

$$BaCl_2\,(aq) + Na_2SO_4(aq) \rightarrow 2\,NaCl(aq) + BaSO_4(s)$$

Barium sulfate, $BaSO_4$, 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 or she is X-rayed. The precipitate coats the stomach and intestines, so the organs show up on the X-ray film in vivid contrast.

Notice that the reaction that forms $BaSO_4$ is a double-displacement reaction in which the cations and the anions of the reactants trade partners to form the products. You should also take note that the ratios in which the cations and anions combine to form reactants are different from the ratios for the products. For example, Na^+ combines with SO_4^{2-} in a ratio of 2:1 in sodium sulfate, whereas Na^+ combines in a 1:1 ratio in sodium chloride, NaCl. According to the rules of formula writing, formulas for ionic compounds must be written so that the net charge of the formula is zero.

In this lab, you will carry out a number of double displacement reactions using microscale techniques to mix various solutions. You will observe and describe the precipitates that are formed, using a solubility table to determine the identity of the precipitate. Finally, you will write and balance complete chemical equations to describe the precipitation reactions.

Objectives

- Observe precipitation reactions by mixing aqueous solutions of cations and anions.
- Write and balance complete chemical equations to describe precipitation reactions.

Safety

- Wear your safety glasses.
- Use full microscale pipettes only for the carefully controlled delivery of solutions.
- Silver nitrate can stain the skin, so avoid contact with this solution.

Materials

Small scale reaction surface

Micropipettes of the following solutions: (You will choose 7 of these solutions for this lab)

Lead (II) nitrate
Potassium iodide
Sodium hydroxide
Sodium sulfate
Sodium carbonate
Calcium chloride
Silver nitrate
Sodium chloride
Iron (III) chloride
Sodium phosphate
Copper (II) sulfate

Procedure:

1. On your recording sheet, list the formulas for each solution down the left hand column. Then, in reverse order, list the same formulas across the top of the sheet. On the lines below your formulas, indicate the ions present in each formula.
2. Tape a piece of saran wrap on top of one copy of the experimental sheet.
3. Going down, add 1 drop of the solution at the top of each column.
4. Going across, add 1 drop of the solution at the left of each row. Please be careful not to touch the dropper to the solutions on the sheet, to avoid contamination of the solutions.
5. Record your observations on your second data sheet. If no reaction is visible, record "NR." If a precipitate forms, describe it thoroughly.
6. Dispose of your small-scale reaction surface according to your teacher's instructions.

Analyze and Apply Questions

1. What is a precipitate? How can you tell if a precipitate forms when you mix two solutions?

2. What is a double-displacement reaction?

3. Which of the mixtures gave no visible reaction? (List the reactants; after the arrow, write "NR" for "no reaction.")

4. On a separate sheet of paper, write complete, balanced chemical equations for each of the reactions that formed a precipitate