

TYPES OF CHEMICAL REACTIONS

EXPERIMENT 10

PURPOSE

To identify and classify chemical reactions.

DEFINITIONS

1. Describe the five types of chemical reactions.
2. Of the five reaction types, which type of reaction(s) are characterized by:
 - a. two products
 - b. a single reactant
 - c. two reactants
 - d. a single product

BACKGROUND

Although countless chemical reactions exist, nearly all of them can be classified into a few specific categories. In this experiment, you will learn to differentiate five general types of chemical reactions. Some of the reaction you will perform; others will be demonstrated by your teacher. From observations, you will identify the products of each reaction and determine the type of reaction that has taken place. You will consider the following reaction types: *combination reactions*, *decomposition reactions*, *single-replacement reactions*, *double-replacement reactions*, and *combustion reactions*. The majority of common chemical reactions can be classified as belonging to one of these categories.

MATERIALS

iron filings
magnesium turnings
calcium carbonate powder
0.5M copper(II) sulfate
0.1 M lead(II) nitrate
0.1 M potassium iodide
2 M hydrochloric acid

SAFETY

- Wear your safety goggles.
- Hydrochloric acid is corrosive and can cause severe burns.
- Lead and copper compounds are toxic. Use as little of these compounds as practical.
- Exercise care when working with an open flame. Tie back hair and loose clothing. Do not use the burner near flammable materials.
- Return or dispose of all materials according to the instructions of your teacher.

PROCEDURE

As you perform the experiment, record your observations in Data Table 1.

Part A. Student Experiments

1. **Iron metal and copper(II) sulfate solution.** Half-fill a small test tube with copper(II) sulfate solution. Add about one-half small spatula of iron filings to the solution. After 5 minutes, record your observations.
2. **Lead(II) nitrate and potassium iodide solutions.** Put 2 mL of lead(II) nitrate solution into a small test tube. Add 5 drops of potassium iodide solution. Record your observations.
3. **Magnesium metal and hydrochloric acid.** *Caution: Hydrochloric acid is corrosive.* Half-fill a medium-sized test tube with 2 M hydrochloric acid. Place the test tube in a test-tube rack and add several magnesium turnings. Record your observations.

TYPES OF CHEMICAL REACTIONS
EXPERIMENT 10

4. **Calcium carbonate and hydrochloric acid.** Calcium carbonate occurs naturally as limestone and marble and in clam shells. It is also the main component in chalk, and it is found in your medicine cabinet in antacids used to neutralize excess acid in your stomach. This reaction explains why acid rain is so destructive to marble building and statues. It is a two step reaction involving two different reaction types that happen in rapid succession. Place a small spatula-full of calcium carbonate powder in a small test tube and carefully add 7 drops of hydrochloric acid. Record your observations.

Part B. Teacher Demonstration

5. **Action of electricity on water (electrolysis).** Water can be broken down into its component elements by passing electricity through it. This process is called *electrolysis*. Make observations of the reaction as performed by your teacher. Your teacher will test the two gases formed.

ANALYSIS

1. State the most important safety concern in this lab and the required precaution you took.
2. Write an equation for each reaction in this experiment. Indicate the state (*s*, *l*, *g*, *aq*) for each reactant and product, then balance each equation. Remember that the reaction of calcium carbonate and hydrochloric acid involves two reaction types happening in rapid succession. Write both reactions.
3. State the reaction class for each reaction.
4. Although no combustion reactions were run in the course of this experiment, in prior experiments you burned natural gas using the Bunsen burner. The primary gas in natural gas is methane, CH₄. Write a balanced equation for the combustion of methane.
5. In the electrolysis of water, what was the meaning of the ratio of hydrogen gas volume to oxygen gas volume in the collection tubes?
6. **Honors:** What was the most probable source of error that would lead to incorrect observations?

OBSERVATIONS

DATA TABLE 1: OBSERVATIONS	
Reaction	Observations
Iron + copper(II) sulfate	
Lead(II) nitrate + potassium iodide	
Magnesium + hydrochloric acid	
Calcium carbonate + hydrochloric acid	
Electrolysis of H ₂ O	