

## 14

**TYPES OF CHEMICAL REACTIONS****PURPOSE**

To identify and classify chemical reactions based on five general categories.

**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 reactions 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 (PER PAIR)**

(Student Experiment)

safety goggles and apron  
2 small test tubes  
centigram balance  
dropper pipet  
2 medium test tubes  
test-tube rack  
crucible tongs  
gas burner  
ring stand  
utility clamp

0.1M copper(II) sulfate,  $\text{CuSO}_4$   T  
iron filings, Fe  
0.1M lead(II) nitrate,  $\text{Pb}(\text{NO}_3)_2$   T  
0.1M potassium iodide, KI  T  
6M hydrochloric acid, HCl  C  T  
magnesium turnings, Mg  F  
2 wood splints  
book of matches  
3% hydrogen peroxide,  $\text{H}_2\text{O}_2$

## SAFETY FIRST!

In this lab, observe all precautions, especially the ones listed below. If you see a safety icon beside a step in the Procedure, refer to the list below for its meaning.



**Caution:** Wear your safety goggles. (All steps.)



**Caution:** Hydrochloric acid is corrosive and can cause severe burns. (Step 3.)



**Caution:** Lead and copper compounds are toxic. Use as little of these compounds as practical. (Steps 1, 2.)



**Caution:** Exercise care when working with an open flame. Tie back hair and loose clothing. Do not use the burner near flammable materials. (Step 4.)



**Note:** Return or dispose of all materials according to the instructions of your teacher. (Step 7.)



**Note:** Wash your hands thoroughly after completing this experiment.

## 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 2 g 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 5–10 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 6M hydrochloric acid. Place the test tube in a test-tube rack and add several magnesium turnings. Identify any gas that forms by using crucible tongs to hold a *burning* wood splint at the mouth of the test tube. Record your observations.



**4. Action of heat on hydrogen peroxide.** Add 2 mL of 3% hydrogen peroxide solution to a medium-sized test tube. Clamp the test tube to a ring stand, as shown in Figure 14.1. **CAUTION:** *Make sure that the mouth of the tube is pointed away from you and away from everyone else.* Heat the solution *very gently*. Identify any gas that forms by using crucible tongs to insert a *glowing* wood splint into the mouth of the test tube. Record your observations.

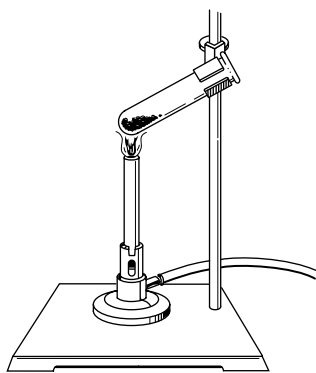


Figure 14.1

**6. Action of heat on sodium hydrogen carbonate.** Solid sodium hydrogen carbonate will be heated strongly in a large test tube for 2 minutes. The gas that is given off will be tested by exposing it to a burning splint and by bubbling it through limewater. Record your observations of these tests.



7. Follow your teacher's instructions for proper disposal of the materials.

**OBSERVATIONS**

DATA TABLE 1: CHEMICAL REACTION TYPES		
Reaction	Observations	Reaction Type
Fe and CuSO <sub>4</sub>		
Pb(NO <sub>3</sub> ) <sub>2</sub> and KI		
Mg and HCl		
H <sub>2</sub> O <sub>2</sub> and heat		
NaHCO <sub>3</sub> and heat		

**ANALYSES AND CONCLUSIONS**

- Classify each of the observed reactions as one of the five reaction types listed in the Background section. Record your answers in Data Table 1.
- Write an equation for each reaction observed. Indicate the state (*s*, *l*, *g*, *aq*) for each reactant and product, then balance each equation.

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- Although no combustion reactions were described in the Procedure section, two combustion reactions did occur in the course of this experiment. The reactants were H<sub>2</sub> and CH<sub>4</sub> (natural gas), respectively. Write a balanced equation for the combustion of each of these substances.

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Name \_\_\_\_\_ Date \_\_\_\_\_ Class \_\_\_\_\_

4. Identify the combustion reaction in question 3 that is also a combination reaction.

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5. Describe in your own words the five types of chemical reactions listed in the Background section. Explain how to distinguish each of these types of reactions.

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6. List the tests that were used to identify the three gases produced in this experiment.

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Name \_\_\_\_\_ Date \_\_\_\_\_ Class \_\_\_\_\_

7. Which type(s) of reactions are characterized by:

a. two products

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b. a single reactant

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c. two reactants

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d. a single product

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