Name _____ Class _____ Date _____

Laboratory Investigation

Chapter 8 Chemical Reactions **20**

Single-Replacement Reactions

Background Information

In nature, elements can occur either free, meaning uncombined with other elements, or chemically combined in a compound. The tendency of a particular element to combine with other substances is a measure of the activity of that element. The more active an element is, the more likely it is to combine. In a single-replacement reaction, an uncombined element replaces a less active element that is combined in a chemical compound. The less active element is then freed from the compound.

For example, in the reaction

$$\text{Zinc} + \text{Copper sulfate} \rightarrow \text{Zinc sulfate} + \text{Copper}$$

zinc replaces the less active copper, combines with sulfate, and frees the copper from the compound.

In this investigation you will observe how various metals undergo single-replacement reactions when placed in acid. If the metal is more active than the hydrogen in the acid, it will replace the hydrogen and hydrogen gas will be released.

Problem

How does a single replacement reaction occur?

Materials *(per group)*

safety goggles
5 test tubes
test-tube rack
1 M hydrochloric acid
graduated cylinder
zinc
copper
aluminum
iron
magnesium

Procedure

1. Label each test tube with the name of one of the metals listed in the materials.
2. Put on your safety goggles. Carefully pour 5 mL of hydrochloric acid into each test tube.
3. One at a time, place the appropriate metal in each test tube. Observe what happens to the metal in each test tube and feel each test tube as the reaction proceeds. Record your data in Observations.
4. When you have completed the investigation, carefully pour off the acid, rinse the metal several times with water, and put it into a container provided by your teacher. Do not put any unused metal in the sink.

Observations

1. Magnesium _____

2. Aluminum _____

3. Iron _____

4. Copper _____

5. Zinc _____

Analysis and Conclusions

1. Write the single-replacement reaction that occurred between the acid and each metal.
   a. Magnesium _____
   b. Aluminum _____
   c. Iron _____

d. Copper _____

_____

e. Zinc _____

_____

2. Were these reactions endothermic or exothermic? _____

Explain. _____

_____

Critical Thinking and Application

1. Which of the metals are more active than hydrogen? _____

_____

2. Which of the metals are less active than hydrogen? _____

_____

3. What could you do to prove that hydrogen gas was produced as a result of these reactions? _____

_____

_____

4. The rate at which hydrogen gas is produced as a result of these single-replacement reactions is an indication of the relative activity of the metals. List the metals in order of their activity from most active to least active _____

_____

5. Nonmetals can also be involved in single-replacement reactions. If chlorine is more active than bromine, write the equation for the reaction between chlorine and potassium bromide. _____

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