

Experiment 1. Some Typical Chemical Reactions

Most often when substances are mixed nothing happens other than physical mixing. That is, no new substances are produced. Sometimes, however, when substances are mixed, different substances are produced. For example, if vinegar is mixed with baking soda, a great deal of effervescence (bubbling) is observed as a gas is rapidly evolved. The gas is carbon dioxide, a substance which is very different from baking soda and the substances in vinegar. Such a process is termed a **chemical reaction**. In all chemical reactions one or more substances are converted into one or more different substances. The substances undergoing the chemical reaction are called **reactants**, and the substances produced are called **products**. In the above example, baking soda and a substance in the vinegar known as acetic acid are the reactants, and carbon dioxide is one of the products. Two other products are also produced in this chemical reaction, water and a substance known as sodium acetate. These latter two products are present in the solution after the reaction.

Much of chemistry is concerned with the study of chemical reactions. In fact, chemistry's significance in our technological society is due primarily to the importance of chemical reactions. Chemical reactions sustain life, for example. Most materials from which consumer products are made are produced via chemical reactions, and chemical reactions are used to produce most of the energy used to heat and light our buildings, and move our cars, trucks, locomotives and airplanes. These examples are only representative of the multitude of important reactions.

PURPOSE: In this experiment you will examine several examples of chemical reactions. From these, you will build observational skills, discover the properties of acids and different gases, express reactions and substances symbolically and extend laboratory experiences to the real world.

A. Reactions of acids with metallic elements. Place a small amount of aluminum shot (or pellets) in a small test tube (enough to cover the bottom of the test tube). Add about 2 mL of water and the same amount of dilute hydrochloric acid (6M). (Hydrochloric acid is hydrogen chloride gas, HCl, dissolved in water.) Observe the contents over a period of 10 minutes. What is the evidence that a reaction is occurring?

When the reaction is going on vigorously bring the flame of an ignited wood splint to the mouth of the test tube. Record the results.

From the list of properties of gases given at the end of the experiment select the one/s which describes the gas produced in the reaction.

From the list of chemical equations at the end of the experiment, choose the one which describes the reaction you observed.

What is the name of the gas produced in the reaction?

The reaction you have seen is typical of the reactions of most of the metallic elements with nearly all acids. In each case hydrogen gas is evolved and an ionic compound of the metallic element called a salt is produced.

How are the following substances represented symbolically (write their symbols)? (Get these from the reaction you chose above. Ignore any numbers in front of the species in the reaction but include all subscripted numbers.)

aluminum shot _____

hydrochloric acid _____

hydrogen gas _____

the salt in this reaction _____

B. Reactions of acids with metallic carbonates.

B.1 Marble is a naturally occurring ionic compound, calcium carbonate, CaCO_3 . Place several chips of marble in your 100 mL beaker and add 10 mL of water to the beaker. Do the marble chips dissolve in the water to form a solution?

Add 20 mL of dilute hydrochloric acid, HCl (6M). Note evidence for any chemical reaction.

Light a wooden splint and insert the burning end into the beaker being careful not to touch the liquid. What do you observe?

From the list of properties of gases given at the end of the experiment select the one's which describes the gas produced in the reaction.

From the list of chemical equations listed at the end of the experiment choose the one corresponding to the reaction.

What is the name of the gas produced in the reaction?

What else is produced?

Where are these other products located?

How are the following substances represented symbolically?

calcium carbonate _____

water _____

calcium chloride _____

hydrochloric acid _____

There are many other naturally occurring materials composed primarily of calcium carbonate, among which are limestone, oyster shells and pearls. Predict what would happen if you were to swallow a pearl. (Hint: your stomach contains a fairly strong solution of hydrochloric acid).

B.2 Other metallic carbonates react with acids as well. Place a small amount of sodium carbonate in one test tube (enough to cover the bottom of the test tube) and a similar amount copper(II) carbonate in another test tube. Add several drops of dilute hydrochloric acid to each test tube and agitate each mixture. Record your results **and** write the chemical equations for the reactions.

Repeat the procedure using dilute sulfuric acid, H_2SO_4 , instead of hydrochloric acid. Record results ***and*** write the chemical equations for the reactions.

What do these reactions of acids with carbonates have in common?

The reactions you have observed in parts A and B are typical of acids. From the list of properties of acids given at the end of the experiment select the ones you observed in this experiment.

How are the following substances represented symbolically?

sodium carbonate _____

copper(II) carbonate _____

sulfuric acid _____

From your all your answers in B, what symbol do you think is carbonate? _____

C. Reactions of metallic elements with compounds of other metallic elements. Place two or three mL of copper sulfate solution in a test tube, add a few drops of sulfuric acid, and drop in an iron nail. Let stand a minute or two and pour off the copper sulfate solution. Rinse the nail and examine it. The deposit on it is not rust but another metal. What does it appear to be?

Where does it come from?

Write the equation for the reaction. (The sulfuric acid does not take part in the reaction but serves the purpose of cleaning the surface of the nail).

In general, metallic elements will react with compounds of less active metallic elements to produce the less active metallic element and a compound containing the more active metallic element. Metallic elements will not react with compounds of more active metallic elements. From the above reaction, indicate which is more active, iron or copper.

Predict what will happen if iron sulfate solution is allowed to come in contact with a small piece of copper wire.

Test your prediction. Record your results.

Relate to real world:

1. Name three important uses of chemical reactions (as given in introduction).

2. Of the gases you observed in lab today, which could be used as an alternative fuel? _____
What observation leads you to this conclusion?

Combustion is a reaction where the fuel reacts with oxygen gas, O_2 . The products of the reaction are compounds containing oxygen and one of the elements in the fuel. Regular fuel is a hydrocarbon—a compound containing carbon and hydrogen. There are, therefore, 2 products as the result of the combustion of regular fuel—a compound containing oxygen and carbon and a compound containing oxygen and hydrogen. What are these products?

What would the product(s) of the combustion of the alternative fuel be?

What advantage would using the alternative fuel have over using regular fuel?

3. Marble statues in industrial areas are often observed to physically change, depending greatly on weather conditions. Explain these changes **in complete sentences** below based upon your observations in the lab. Answers to the following questions may be helpful in helping you think through the explanation. **Every essay below needs to be individually written. Copying your partner's answers is plagiarism and you will receive a zero for the entire lab.**

Does calcium carbonate dissolve in water?

What substance studied in lab today will react with marble?

How can this substance be present in the weather in industrial areas?

Explanation:

PROPERTIES OF GASES:

colorless gas

colored gas

flammable gas which forms an explosive mixture with air

nonflammable gas which extinguishes fires

nonflammable gas in which combustible materials burn more brightly

PROPERTIES OF ACIDS:

Acids react with metallic hydroxides to form ionic compounds and water.

Acids react with many metallic elements to form hydrogen gas and an ionic compound of the metallic element.

Acids form solutions having a sour taste.

Acids turn litmus, an acid-base indicator, red in color.

Acids react with metallic carbonates to form carbon dioxide, water and ionic compound of the ionic element.

CHEMICAL REACTIONS:

