What Is This Gas?

SKILLS MENU

- Questioning
- Hypothesizing
- Predicting
- Planning
- Controlling Variables
- Performing
- Observing
- Analyzing
- Evaluating
- Communicating

Air is a mixture of many gases, including nitrogen, oxygen, and carbon dioxide. Most of the gases in air are colourless and odourless. Although these and other gases are indistinguishable in appearance, they exhibit different chemical properties. These properties can be used to identify the following gases that are often encountered in chemical reactions.

- Oxygen is essential for burning. Things burn more vigorously when they are in pure oxygen than when they are in air, which contains only about 20 % oxygen.
- When hydrogen is ignited in air, the hydrogen atoms combine with oxygen atoms to form molecules of H_2O (water vapour). This rapid reaction is accompanied by a characteristic explosive "pop" sound.
- Carbon dioxide does not burn and does not support combustion. Carbon dioxide will extinguish a flame, making it useful as a fire extinguisher. Carbon dioxide produces a white solid when it reacts with a substance called limewater. A white cloudiness appears in the limewater when this powdery solid is produced. The white solid is calcium carbonate—the main component in chalk and limestone.

Purpose

To produce different gases and identify each gas using a chemical test.

Equipment and Materials

- eye protection
- lab apron
- 5 test tubes
- test-tube rack
- metal tongs
- stopper for test tube
- measuring spoon
- 10 mL graduated cylinder
- Bunsen burner
- toothpick
- wooden splints
- candle
- limewater (saturated calcium hydroxide solution)
- manganese dioxide
- hydrogen peroxide (3 % solution)
- hydrochloric acid (5 % solution)
- magnesium ribbon
- sodium hydrogen carbonate (baking soda)



Hydrochloric acid is corrosive and poisonous. Any spills on the skin, in the eyes, or on clothing should be washed immediately with cold water. Report any spills to your teacher.


Secure the Bunsen burner to a utility stand using a clamp and light it using a spark lighter. Tie back long hair and loose clothing.

Procedure

1. Copy Table 1 into your notebook.

Table 1 Observations

Reactants	Burning splint test	Glowing splint test	Limewater test	Candle flame test	Identity of the gas
manganese dioxide and hydrogen peroxide					
hydrochloric acid and baking soda					
hydrochloric acid and magnesium ribbon					

2. Put on your eye protection and lab apron.
3. Set up four test tubes in the test-tube rack and label them A, B, C, and D. Fill a fifth test tube about one-third full of limewater.
4. *Manganese dioxide and hydrogen peroxide*: To each of test tubes A, B, C, and D, add a tiny amount of manganese dioxide powder (enough to cover the broad end of a toothpick) and about one-tenth of a test tube of hydrogen peroxide. Allow the reaction to proceed for about 15 s.
5. Ignite a wooden splint with the Bunsen burner and bring the burning splint to the mouth of test tube A. Record your observations in your data table. Safely discard the used splint in this and each of the following steps.
6. Ignite another wooden splint, then blow out its flame. Insert the glowing splint halfway into test tube B. Record your observations in your data table.
7. Carefully pour the gas produced in test tube C into the test tube of limewater (Figure 1). Be careful not to pour any of the hydrogen peroxide and manganese dioxide. Stopper the limewater test tube and shake to mix the gas and liquid. Record your observations in your data table.

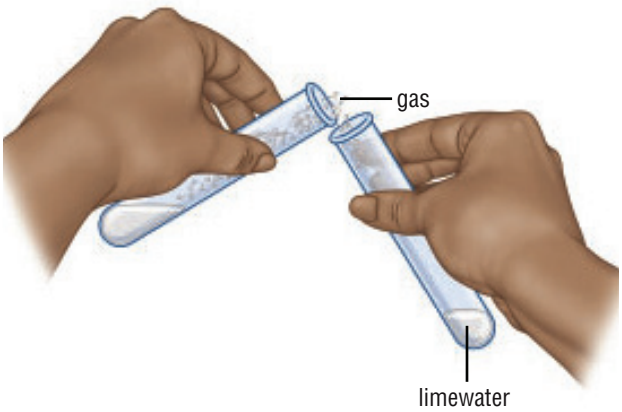

Figure 1 Pouring gas into limewater

8. Light the candle and carefully pour the gas produced in test tube D onto the flame. Record your observations in your data table.
9. Dispose of the contents of your test tubes as directed by your teacher. Clean the test tubes in preparation for the next series of tests.
10. *Hydrochloric acid and baking soda*: Repeat steps 3 to 9, using about 1 mL of baking soda and 4 mL of hydrochloric acid.
11. *Hydrochloric acid and magnesium*: Repeat steps 3 to 9, using 3–5 cm of magnesium ribbon and hydrochloric acid to about one-third of the test tube height.

Analyze and Evaluate

SKILLS HANDBOOK 3.B.7., 3.B.8.

(a) Compare your observations with the description of chemical properties of carbon dioxide, hydrogen, and oxygen given at the beginning of this activity. T/I

(b) Complete the last column of Table 1 by identifying each gas produced in the reactions. T/I

(c) What gas is produced when manganese dioxide and hydrogen peroxide are mixed? Provide evidence to support your answer. T/I

(d) What gas is produced when hydrochloric acid and baking soda are mixed? Provide evidence to support your answer. T/I

(e) What gas is produced when hydrochloric acid and magnesium are mixed? Provide evidence to support your answer. T/I

(f) In each part of the activity, were the changes physical changes or chemical changes? Give reasons for your answer. T/I

(g) What problems, if any, did you encounter in carrying out each of these tests? T/I

(h) What improvements, if any, would you make to the procedure in future tests? T/I

Apply and Extend

(i) From your observations in this activity, suggest reasons why

- birthday balloons are filled with helium, not hydrogen
- during surgery using oxygen cylinders, medical staff wear coverings over their shoes to eliminate sparks produced by static electricity A

(j) Design a simple fire extinguisher that produces carbon dioxide gas quickly when needed. Write a paragraph describing your design and how it will work. A C