Endothermic and   
Exothermic Reactions

Many chemical reactions give off energy. Chemical reactions that release energy are called *exothermic* reactions. Some chemical reactions absorb energy and are called *endothermic* reactions. You will study one exothermic and one endothermic reaction in this experiment.

In Part I, you will study the reaction between citric acid solution and baking soda. An equation for the reaction is:

H3C6H5O7(aq) + 3 NaHCO3(s)  3 CO2(g) + 3 H2O(aq) + Na3C6H5O7(aq)

In Part II, you will study the reaction between magnesium metal and hydrochloric acid. An equation for this reaction is:

Mg(s) + 2 HCl(aq)  H2(g) + MgCl2(aq)

MATERIALS

|  |
| --- |
| Temperature Probe or thermometer |
| 50-mL graduated cylinder |
| balance |
| baking soda, NaHCO3 |
| hydrochloric acid, HCl, solution |
| magnesium, Mg |
| Styrofoam cup |
| 250-mL baker |
| citric acid, H3C6H5O7, solution |

Pre-Lab

1. DEFINE eNDOTHERMIC AND eXothERMIC

eNDOTHERMIC \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

eXOTHERMIC \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

2. wHAT WILL BE THE REACTANTS IN PART i?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

3. If a reaction is endothermic, the temperature of the surroundings should \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, but if a reaction is exothermic, the temperature of the surroundings should \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

4. hOW WILL YOU TELL IF A REACTION IS ENDOTHERMIC OR EXOTHERMIC? (ANSWER WITH COMPLETE SENTENCES).

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

PROCEDURE

1. Obtain and wear goggles.

Part I Citric Acid plus Baking Soda

2. Place a Styrofoam cup into a 250-mL beaker as shown in Figure 1. Measure out 30 mL of citric acid solution into the Styrofoam cup. Place the Temperature Probe into the citric acid solution.

3. Weigh out 10.0 g of solid baking soda on a piece of weighing paper.

4. You are now ready to begin collecting data.

1. Record the initial temperature in your data table.
2. Add the baking soda to the citric acid solution. Gently stir the solution with the Temperature Probe to ensure good mixing.
3. Record the temperature in your data table every 30 seconds for 5 minutes.

5. Dispose of the reaction products as directed by your instructor.

Part II Hydrochloric Acid Plus Magnesium

6. Measure out 30 mL of HCl solution into the Styrofoam cup. Place the Temperature Probe into the HCl solution.

7. Obtain a piece of magnesium metal from your instructor.

8. Record the initial temperature in your data table.

b. Add the magnesium to the hydrochloric acid solution. Gently stir the solution with the Temperature Probe to ensure good mixing.

c. Record the temperature in your data table every 30 seconds for 5 minutes.

9. Dispose of the reaction products as directed by your instructor. Rinse the Temperature Probe.

DATA TABLE

|  |  |  |
| --- | --- | --- |
| Time | Part I | Part II |
| 0 seconds (initial) | °C | °C |
| 30 seconds | °C | °C |
| 1 min | °C | °C |
| 1 min 30 seconds | °C | °C |
| 2 min | °C | °C |
| 2 min 30 seconds | °C | °C |
| 3 min | °C | °C |
| 3 min 30 seconds | °C | °C |
| 4 min | °C | °C |
| 4 min 30 seconds | °C | °C |
| 5 min | °C | °C |

Processing the data

1. Graph the temperature change for each reaction using the graph paper on page 4.

2. Determine the change in temperature for each reaction by subtracting the highest temperature value from the lowest temperature value in each set.

Part I: \_\_\_\_\_\_\_\_\_\_\_\_\_°C Part II: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_°C

2. Tell which reaction is exothermic. Explain.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

3. Tell which reaction is endothermic. Explain.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

4. For each reaction, describe three ways you could tell a chemical reaction was taking place.

Part I

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

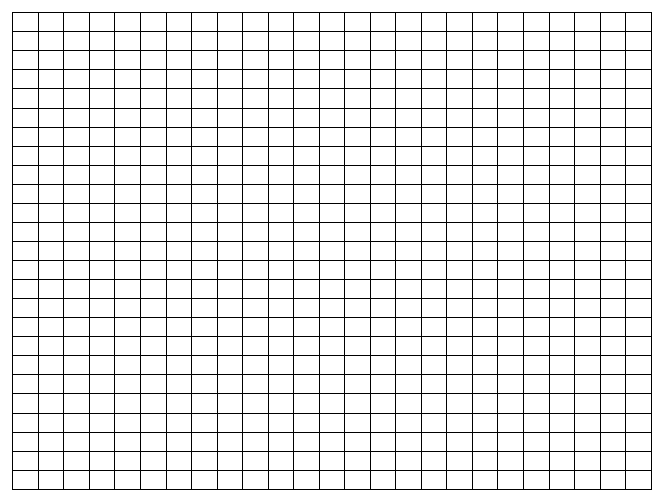
\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Part II

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Graph

Title \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_