Types of Chemical Reactions

Have you ever thought about the fact that aluminum, unlike iron, doesn't seem to rust? Actually, aluminum does react with the oxygen in the air to form the white, powdery compound aluminum oxide, Al_2O_3. The aluminum oxide remains on the aluminum as a protective coating, and no further reaction occurs.

The chemical equation for this reaction is

$$4Al + 3O_2 \rightarrow 2Al_2O_3$$

Have you ever wondered why hydrogen peroxide (H_2O_2) is sold in brown bottles? Hydrogen peroxide decomposes gradually into water and oxygen, but light hastens the reaction.

$$2H_2O_2 \rightarrow 2H_2O + O_2$$

In 1776, Henry Cavendish reacted hydrochloric acid with zinc to produce hydrogen gas. Zinc chloride (ZnCl2) remained behind in the vessel he used.

$$Zn + 2HCl \rightarrow H_2 + ZnCl_2$$

Yet hydrochloric acid reacts with sodium hydroxide (NaOH) to produce table salt (NaCl) and water.

$$HCl + NaOH \rightarrow NaCl + H_2O$$

Look again at the balanced equation for each of these reactions. You are looking at equations that represent, in order, each of four basic reactions: synthesis, decomposition, single displacement, and double displacement.

Once you have learned to write a balanced equation – with the correct reactants, products, formulas, and coefficients – you have crossed one of the major hurdles of chemistry.

In this laboratory activity, you will carry out six different reactions and then identify each type of reaction and write a balanced equation for it.

Objectives

- **Carry out** six different chemical reactions as one of four basic types of chemical reaction.
- **Identify** if a reaction is endothermic or exothermic
- **Balance** the chemical equation for each reaction observed.

Question/Hypothesis

What are the visual indicators of specific chemical reactions?

Materials:

- Right- angle glass bend
- Crucible with cover
- Laboratory burner
- Beaker
- Large test tubes (3)
- Small test tubes (2)
- Ring stand
- Large iron ring
- Clay triangle
- Length of 6-mm rubber tubing
- One-hole stopper
- Glycerol
- Forceps
- Test-tube holder
- Test-tube rack
- Wood splints
- Apron
- Goggles
- Utility clamp
- 10-mL graduates cylinder

Procedure

Reaction A: Synthesis

1. Obtain a piece of magnesium ribbon.
2. Use forceps to fold or coil the magnesium so that it fits the crucible. Put the magnesium into the crucible, and place the crucible on a clay triangle on a ring and ring stand as shown in figure A. Partially cover the crucible - the cover should be skewed slightly to the side so that the magnesium can be seen.
3. Begin to heat the crucible with a low flame. *When the magnesium begins to slow, stop the heating.*
4. After the crucible has cooled to the touch, remove the cover and examine the contents of the crucible for a change in physical traits.
5. Record your observation in Table 1.
6. Discard the solid as directed by your teacher.

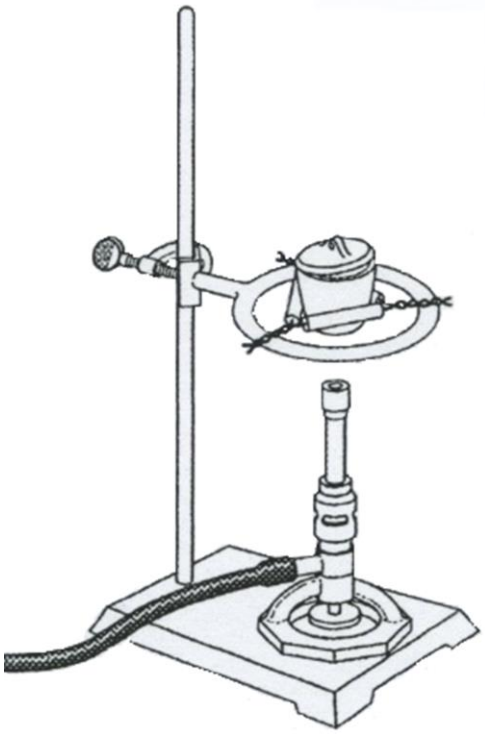


Figure A

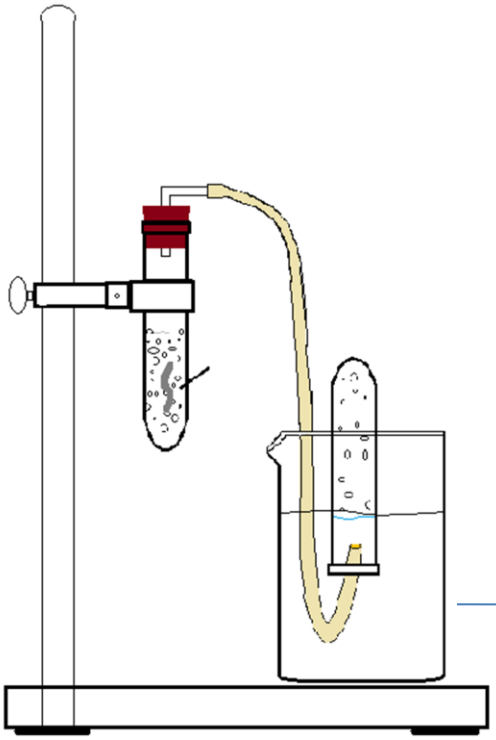


Figure B

Reaction B: Single Displacement

1. Rinse and shake dry the test tubes and delivery tube (glass bend and rubber tubing) you used in Reaction C.
2. Place 10 mL of hydrochloric acid (HCl) in one test tube. Insert the stopper with the glass bend and the attached tubing.
3. Mount the tube in a ring stand with a utility clamp.
4. Fill the second test tube and invert it into a large beaker of tap water as shown in Figure C. Hold the tube in the inverted position, if necessary.
5. Run the rubber tubing to the collection test tube so that the free end of the tubing is just inside the mouth f the tube.
6. Obtain a piece of magnesium ribbon. Open the test tube containing the HCl and carefully drop in the magnesium. Replace the stopper immediately. Record your observation in Table 1.
7. Allow the collection tube to fill with gas.
8. Keep the tube inverted for reaction E.

Reaction C: Synthesis

1. Keeping the tubes inverted, remove the stopper from one of the test tubes from Reaction D and carefully bring a burning splint close to the mouth of the gas-filled tube.
2. If necessary, repeat the previous step with the second test tube of gas. Record your observation in Table 1.

Reaction of D: Double Displacement

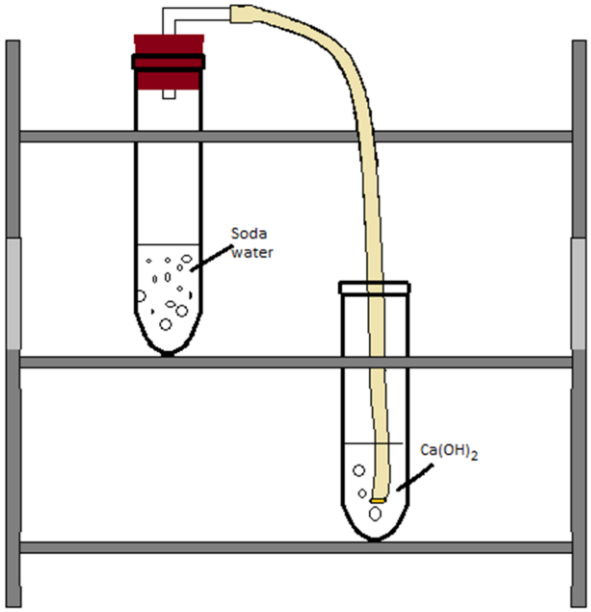
1. Place 5 mL of hydrochloric acid in a small text tube.
2. Place 5mL of silver nitrate (AgNO3) in another small test tube.
3. Pour the contents of one test tube into the other.
4. Record you observation in Table 1.
5. Discard the contents of the test tube as directed by your teacher.

Reaction E: Decomposition

1. Pour 10 mL of clear soda water into a large test tube.
2. Shake the tube gently. Record your observation in Table 1

Reaction F: Double Displacement

1. Stopper the tube of soda water used in Reaction B with a one-hole stopper fitted with a right-angle glass bend and rubber tubing. Be sure to follow the safety rules on page 1. Place the test tube in the upper section of the test-tube rack.
2. Pour about 5 mL of saturated calcium hydroxide, Ca(OH)2, solution into a large test tube placed in the lower section of the test-tube rack. Caution: Handle the Ca(OH)2 solution carefully. It can cause skin irritation.
3. Submerge the free end of the tubing leading from the tube of soda water deep into the tube containing the Ca(OH)2 solution. Your set-up will look like the one in **figure B**.
4. Again shake the tube with the soda water gently. Record your observation in Table 1.
5. Discard the contents of the test tubes as directed by your teacher.



Data and Observations

Table 1

Results of chemical Reactions	
Reaction	Result of Reaction
A	
B	
C	
D	
E	
F	

Analysis

1. Study the observations you recorded in Table 1. Then identify if the reaction that took place endothermic or exothermic and fill the column two of Table 2. Then, in column three, write as a word equation the names of the reactants and the products you think were formed in each reaction and in column four write a balanced equation for each reaction.

Table 2

Word and Balanced Equations for Reactions			
Reaction	Endothermic/ Exothermic	Word Equation	Balanced Equation
A			
B			
C			
D			
E			
F			

2. The claim and evidence statement will be written in paragraph form with NO bullets. Sentences should be written in past tense using NO personal references or names. Each reaction that was performed should have 3 to 5 sentences written to include the below listed information:
    - Explain the visual indicators for each reaction
    - Identify whether it was endothermic or exothermic if possible

When sodium metal is added to water there is a chemical reaction. The reaction between Sodium and water can be recognized by the light energy that is produced. With phenolphthalein present the production of a base NaOH is observed by the indicator turning pink. The light and heat produced show an exothermic reaction.

Reflection and Conclusion

Guidelines for the written conclusion

Reflection

1) Identify and explained sources of error and assumptions made during the experiments?
2) What ideas have changed, what new questions could be posed, or what new approach could be taken if the experiment is repeated?
3) How does this work tie into concepts which were provided in lecture and lessons?
4) Reference specific text, notes, alternative sources, etc.
5) Some reactions involve free elements (elements you did not physically add) as reactants. Recognize which reactions involved a free reactant and identify the reaction and the free element involved**.**