

### Prepare Your Own Summary

In this chapter, you learned to classify reactions as one of six different types as well as predict the identity of the products of the reaction. You investigated the factors that affect the rate of chemical reaction and examined the role of catalysts in reaction rate. Create your own summary of the key ideas from this chapter. You may include graphic organizers or illustrations with your notes. (See Science Skill 11 for help with graphic organizers.) Use the following headings to organize your notes:

1. Six Types of Chemical Reactions
2. Classifying and Predicting Products of Reactions Based on the Reactants Only
3. Examples of Reactions Occurring at Different Rates
4. Four Factors Affecting the Rates of Reactions.

### Checking Concepts

1. Identify each of the following reactions as synthesis, decomposition, single replacement, double replacement, neutralization (acid-base), or combustion.
  - (a)  $\text{H}_3\text{PO}_4 + 3\text{NaOH} \rightarrow \text{Na}_3\text{PO}_4 + 3\text{H}_2\text{O}$
  - (b)  $\text{P}_4 + 5\text{O}_2 \rightarrow \text{P}_4\text{O}_{10}$
  - (c)  $2\text{Al} + \text{N}_2 \rightarrow 2\text{AlN}$
  - (d)  $2\text{HBr} \rightarrow \text{H}_2 + \text{Br}_2$
  - (e)  $\text{HF} + \text{KOH} \rightarrow \text{KF} + \text{H}_2\text{O}$
  - (f)  $\text{Au}(\text{NO}_3)_3 + 3\text{KI} \rightarrow \text{AuI}_3 + 3\text{KNO}_3$
  - (g)  $\text{Mg} + 2\text{HCl} \rightarrow \text{MgCl}_2 + \text{H}_2$
  - (h)  $2\text{Ti}(\text{NO}_3)_3 + 3\text{Cu} \rightarrow 2\text{Ti} + 3\text{Cu}(\text{NO}_3)_2$
  - (i)  $(\text{NH}_4)_2\text{CO}_3 + \text{Mn}(\text{NO}_3)_2 \rightarrow 2\text{NH}_4\text{NO}_3 + \text{MnCO}_3$
  - (j)  $\text{C}_3\text{H}_8 + 5\text{O}_2 \rightarrow 3\text{CO}_2 + 4\text{H}_2\text{O}$
2. Each reaction below has been identified by type. Use this information to help predict products. Copy and then complete each equation by writing the products of the reactions. **Hint:** Use the charges shown on the periodic table in Figure 4.3 on page 172. Remember to include subscripts and parentheses when required.
  - (a)  $\text{Al} + \text{F}_2 \rightarrow$  synthesis
  - (b)  $\text{K} + \text{O}_2 \rightarrow$  synthesis
  - (c)  $\text{C}_2\text{H}_6 + \text{O}_2 \rightarrow$  combustion
  - (d)  $\text{C}_6\text{H}_{12}\text{O}_4 + \text{O}_2 \rightarrow$  combustion
  - (e)  $\text{Rb}_2\text{O} \rightarrow$  decomposition
  - (f)  $\text{SrF}_2 \rightarrow$  decomposition
  - (g)  $\text{BaCl}_2 + \text{Pb}(\text{NO}_3)_2 \rightarrow$  double replacement
  - (h)  $\text{AgNO}_3 + \text{K}_2\text{Cr}_2\text{O}_7 \rightarrow$  double replacement
  - (i)  $\text{Br}_2 + \text{NiI}_3 \rightarrow$  single replacement, element is a non-metal
  - (j)  $\text{Cl}_2 + \text{Mg}_3\text{N}_2 \rightarrow$  single replacement, element is a non-metal
  - (k)  $\text{HCl} + \text{Mo}(\text{OH})_2 \rightarrow$  neutralization (acid-base)
  - (l)  $\text{Sn}(\text{OH})_2 + \text{HClO}_3 \rightarrow$  neutralization (acid-base)
  - (m)  $\text{Al} + \text{CuI}_2 \rightarrow$  single replacement, element is a metal
  - (n)  $\text{Mg} + \text{FeF}_2 \rightarrow$  single replacement, element is a metal
3. Which type(s) of reactions match the following descriptions?
  - (a) There is only one reactant.
  - (b) There is only one product.
  - (c) The reactants are an acid and a base.
  - (d) The products are an element and a compound.
  - (e) The products are carbon dioxide and water.
  - (f) Both reactants are compounds.
  - (g) One reactant is an element. The other is a compound.

4. Which of the four factors affecting reaction rate is most important in each example below? Choose from among concentration, temperature, surface area, and catalyst.

- (a) Extra dish soap is added to help cut the grease when washing a frying pan.
- (b) Firewood is chopped up into kindling (small pieces) to help start a fire.
- (c) A lighted match is brought near a candlewick in order to light the candle.
- (d) Lemon juice is rubbed on an iron sink to help remove rust.
- (e) The accelerator pedal in a car is pressed, resulting in a faster consumption of fuel in the engine.
- (f) The reaction of oxygen with sucrose in human cells takes place in the presence of an enzyme.
- (g) In order to release the fragrance of garlic when frying it in oil, the garlic is crushed and ground.
- (h) A mild skin disinfectant containing hydrogen peroxide is prepared in a 1 percent solution, while a stronger formulation is prepared in a 3 percent solution.

### Understanding Key Ideas

5. Classify each of the following reactions, and write a balanced formula equation for each.
- (a) lithium + oxygen  $\rightarrow$  lithium oxide
  - (b) magnesium + aluminum chloride  $\rightarrow$  magnesium chloride + aluminum
  - (c) butane ( $C_4H_{10}$ ) + oxygen  $\rightarrow$  carbon dioxide + water
  - (d) hydrochloric acid + lithium hydroxide  $\rightarrow$  lithium chloride + water
  - (e) aluminum oxide  $\rightarrow$  aluminum + oxygen
  - (f) tin + gold(III) nitrate  $\rightarrow$  tin(IV) nitrate + gold

(g) barium hydroxide + lead(IV) bromide  $\rightarrow$  barium bromide + lead(IV) hydroxide

(h) glycerine ( $C_3H_8O_3$ ) + oxygen  $\rightarrow$  carbon dioxide + water

(i) nitrogen + oxygen  $\rightarrow$  nitrogen dioxide

6. Some chemical reactions are affected by surface area, whereas others are not. Explain why this is so.

### Applying Your Understanding

7. Suppose a chemist performed an experiment dissolving equal masses of marble in hydrochloric acid. The results of the three trials are shown in the table below.

Trial	Hydrochloric Acid	Marble	Temperature
1.	Dilute	Finely ground	20°C
2.	Concentrated	Lump	20°C
3.	Dilute	Lump	40°C

The marble dissolved fastest in Trial 1. and slowest in Trial 2. List concentration, surface area, and temperature in decreasing order of their importance in increasing the rate of this reaction.

### Pause and Reflect

Many chemical reactions happen in your daily life. When might it be important for you to use your knowledge of speeding up or slowing down chemical reactions? How could you use your knowledge?