

Assess Your Understanding

Observing Chemical Change

How Can Changes in Matter Be Described?

- 1a. **REVIEW** The freezing point of water is a (physical/chemical) property. The ability of oxygen to react with iron to cause rust is a (physical/chemical) property.
- b. **POSE QUESTIONS** When silver coins are found in ancient shipwrecks, they are coated with a black crust. Ask a question that could help you determine whether the silver underwent a chemical change or a physical change. Explain.

got it?

- I get it! Now I know that two ways changes in matter can be described are _____
- I need extra help with _____

How Do You Identify a Chemical Reaction?

- 2a. **LIST** What changes in physical properties can be used as evidence that a chemical reaction has occurred?

- b. **APPLY CONCEPTS** What evidence of a chemical change is observed when rust forms on iron?

- c. **COMPARE AND CONTRAST** How are endothermic and exothermic reactions the same? How are they different?

got it?

- I get it! Now I know that two kinds of changes you can observe when chemical reactions occur are _____
- I need extra help with _____

Place the outside corner, the corner away from the dotted line, in the corner of your copy machine to copy onto letter-size paper.

Key Concept Summaries

Observing Chemical Change

How Can Changes in Matter Be Described?

Matter is often described by its characteristics, or properties, and how it changes. The two kinds of properties of matter are physical properties and chemical properties.

A physical property is a characteristic of a substance that can be observed without changing the substance into another substance. The temperature for melting a solid metal is a physical property. Color, texture, density, and conductivity are physical properties of matter. A chemical property is a characteristic of a substance that describes its ability to change into another substance. To observe the chemical properties of a substance, it must change or be changed into another substance. A chemical property can be a material's flammability or its ability to rust or tarnish.

Changes in matter can be described in terms of physical changes and chemical changes. A physical change is any change that alters the form or appearance of the substance but does not change it into another substance. A change in matter that produces one or more new substances is a **chemical change** or chemical reaction. In a chemical change, the atoms rearrange to form new substances. When a substance undergoes a chemical change, it results in different physical properties as well. Substances that undergo chemical changes are called **reactants**. The new substances that form are the **products**. Chemical changes occur when existing bonds break and new bonds form. New substances are produced.

How Do You Identify a Chemical Reaction?

Chemical reactions involve changes in properties and changes in energy that you can observe. One way to detect chemical reactions is to observe changes in physical properties of materials. For instance, formation of a **precipitate**, gas production, and a color change are possible evidence that a chemical reaction has taken place.

A chemical reaction occurs when atom bonds break and new bonds form. Breaking bonds requires

energy, while forming bonds releases energy. In an **exothermic reaction**, energy released as the products form is greater than the energy required to break the bonds of the reactants. The energy is usually released as heat. In an **endothermic reaction**, more energy is required to break the bonds of the reactants released by the formation of the products. When energy is absorbed, the surroundings become cooler.

On a separate sheet of paper, describe what happens when reactants form products.

Place the outside corner, the corner away from the dotted line, in the corner of your copy machine to copy onto letter-size paper.

Lesson Quiz

Observing Chemical Change

Write the letter of the correct answer on the line at the left.

1. ___ Which of the following is true about chemical reactions?
A They are accompanied by changes in energy.
B They form new substances with new properties.
C both A and B
D neither A nor B
2. ___ In an endothermic reaction, energy is
A absorbed
B released
C converted to mass
D synthesized
3. ___ Which of the following is NOT a physical property?
A melting point
B state of matter
C density
D flammability
4. ___ Substances formed as a result of a chemical reaction are called
A catalysts
B precipitates
C products
D reactants

If the statement is true, write *true*. If the statement is false, change the underlined word or words to make the statement true.

5. _____ In an exothermic reaction, products have more energy than reactants.
6. _____ Water boils at 100°C. This is an example of a chemical property.
7. _____ Substances that enter into a chemical reaction are called products.
8. _____ The ability to react with oxygen is an example of a chemical property.
9. _____ Another name for a chemical change is a chemical bond.
10. _____ In a physical change, some of the physical properties of the substance may be altered and the chemical composition remains the same.

Assess Your Understanding

Describing Chemical Reactions

What Information Does a Chemical Equation Contain?

1a. **EXPLAIN** What do the formulas, arrows, and plus signs tell you in a chemical equation?

b. **INTERPRET DATA** Write the chemical equation for the following reaction: The elements sodium and chlorine combine to yield the compound sodium chloride.

got it?

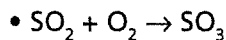
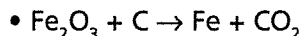
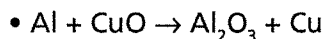
I get it! Now I know that a chemical equation tells you _____

I need extra help with _____

How Is Mass Conserved During a Chemical Reaction?

2a. **INFER** If the total mass of the products in a reaction is 90 grams, what was the total mass of the reactants?

b. **APPLY CONCEPTS** Balance the equations.



(continued)

Key Concept Summaries

Describing Chemical Reactions

What Information Does a Chemical Equation Contain?

<p>A chemical equation is a way to show a chemical reaction, using formulas and other symbols instead of words. The formula of a compound identifies the elements in the compound and the ratio in which the atoms or ions combine. A chemical equation tells you the substances you start with (reactants)</p>	<p>in a reaction and the substances that are formed at the end (products). The formulas for the reactants are written on the left, followed by an arrow, which is read as "yields." The formulas for the products are written to the right of the arrow. Plus signs are used to separate two or more reactants or products.</p>
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How Is Mass Conserved During a Chemical Reaction?

<p>In a chemical reaction, all of the atoms present at the start of the reaction are present at the end of the reaction. Atoms are neither created nor destroyed. They are rearranged to form one or more new substances. This principle is called the law of conservation of mass. All chemical reactions must obey this law. If a reaction takes place in an open system, matter can enter from or escape to the surroundings. In a closed system, matter does not enter or leave. To obey the law of conservation</p>	<p>of mass, a chemical equation must be balanced by showing the same number of atoms of each element on both sides of the equation. To begin, write the correct chemical formulas for both the reactants and the products, then count the number of atoms of each element on each side of the equation; use coefficients, which are numbers placed in front of a chemical formula in an equation; and check that the equation is balanced.</p>
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What Are Three Types of Chemical Reactions?

<p>Three types of chemical reactions are synthesis, decomposition, and replacement. In a synthesis reaction, two or more elements or compounds combine to form a more complex substance. A decomposition reaction occurs when compounds</p>	<p>break down into simpler products. In a replacement reaction, one element replaces another element in a compound (single replacement) or two elements in different compounds trade places (double replacement).</p>
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On a separate sheet of paper, identify the basic structure of a chemical equation, explain why an equation must be balanced, and describe the three types of chemical reactions.

Lesson Quiz

Describing Chemical Reactions

Write the letter of the correct answer on the line at the left.

- | | |
|---|--|
| <p>1. ____ In a balanced chemical equation,</p> <p>A atoms are conserved</p> <p>B coefficients are equal</p> <p>C molecules are equal</p> <p>D energy is not conserved</p> | <p>2. ____ When the equation $\text{Al} + \text{Br}_2 \rightarrow \text{AlBr}_3$ is balanced, the coefficient for Al is</p> <p>A 1</p> <p>B 2</p> <p>C 3</p> <p>D 4</p> |
| <p>3. ____ The reaction in which hydrogen and oxygen are produced by running an electric current through water is an example of</p> <p>A single replacement</p> <p>B decomposition</p> <p>C synthesis</p> <p>D double replacement</p> | <p>4. ____ A reaction that has two compounds as reactants and two compounds as products is most likely a</p> <p>A synthesis reaction</p> <p>B single replacement reaction</p> <p>C double replacement reaction</p> <p>D decomposition reaction</p> |

Fill in the blank to complete each statement.

5. A number written in front of a chemical formula is a(n) _____.
6. The principle that states that matter is neither created nor destroyed during a chemical reaction is called the law of _____.
7. The production of carbon dioxide during the burning of a fuel is an example of a(n) _____ reaction.
8. In a chemical equation, the arrow is read as _____.
9. In the balanced chemical equation for the formation of ammonia (NH_3) from nitrogen (N_2) and hydrogen (H_2), the sum of the coefficients is _____.
10. The law of conservation of mass was first demonstrated by the French chemist _____.

Assess Your Understanding

Controlling Chemical Reactions

How Do Reactions Get Started?

got it?

- I get it! Now I know that in order for reactions to get started _____

- I need extra help with _____

What Affects the Rate of a Chemical Reaction?

- 1a. **DESCRIBE** To slow down a reaction, you can (increase/decrease) the concentration of the reactants.
- 1b. **COMPARE AND CONTRAST** What would react more quickly in the air, a pile of grain or a cloud of grain dust? Explain.

- 1c. **EXPLAIN** How do enzymes speed up chemical reactions in your body?

got it?

- I get it! Now I know that the rate of a chemical reaction can be affected by _____

- I need extra help with _____

Key Concept Summaries

Controlling Chemical Reactions

How Do Reactions Get Started?

Chemical reactions need energy to break the chemical bonds of the reactants so that the atoms can be rearranged to form the new bonds of the products. Activation energy is the minimum amount of energy needed to start a chemical reaction. All chemical reactions need a certain amount of activation energy to get started. Usually, once a few molecules react, the rest will	follow. The first few reactions provide the activation energy for more molecules to react. On an energy graph, activation energy is the top of the energy curve. Both endothermic and exothermic reactions require activation energy.
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What Affects the Rate of a Chemical Reaction?

Chemical reactions do not all occur at the same rate. A particular reaction can occur at different rates depending on the conditions. A chemical reaction will happen faster if there are more reactant particles, if the reactant particles react more quickly, or if the reactant particles react with more energy. Factors that can affect rates of reactions include surface area, temperature, concentration, and the presence of catalysts and inhibitors. Factors that increase the rate of a chemical reaction include increases of surface area, where reactant particles	react more quickly; temperature, when reactant particles react with more energy; and concentration, where more reactant particles react. Concentration refers to the amount of a substance in a given volume. A catalyst increases the reaction rate by lowering the activation energy needed. A catalyst is not permanently changed by a reaction and is not considered a reactant. Biological catalysts found in the human body are called enzymes . A substance used to decrease the rate of a chemical reaction is called an inhibitor .
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On a separate sheet of paper, identify the relationship between activation energy and the start of a chemical reaction. Then describe the factors that affect reaction rates.

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Lesson Quiz

Controlling Chemical Reactions

If the statement is true, write *true*. If the statement is false, change the underlined word or words to make the statement true.

1. _____ Increasing the surface area of the reactants will decrease the rate of the reaction.
2. _____ The amount of a substance in a given volume is the concentration of the substance.
3. _____ The effect of a catalyst on a reaction is to raise the activation energy.
4. _____ Only some reactions require activation energy.
5. _____ A(n) inhibitor decreases the rate of a reaction.

Fill in the blank to complete each statement.

6. The burning of fuels, such as coal, natural gas, or oil, involves a(n) _____ reaction.
7. In an endothermic reaction, the energy of the products is _____ than the energy of the reactants.
8. Increasing the temperature of a reaction will _____ the rate of the reaction.
9. The amount of a substance in a given volume is called _____.
10. Biological catalysts in the human body are called _____.