

Chapter 5 Reactions

Physical Changes

5. d. *Students know* physical processes include freezing and boiling, in which a material changes form with no chemical reaction.

Changes of State

A physical change differs from a chemical change in that chemical bonds are neither broken nor formed. The appearance of the substance involved in a physical change will change, but its chemical makeup is still the same. For example, when water changes from a liquid to a solid, the appearance of the water changes. However, both ice and liquid water have the same chemical formula: H_2O . The arrangement of atoms in the water molecules has not changed. But there is a change in the energy of the molecules.

Melting is the change from the solid to the liquid state of matter. When ice melts, it absorbs energy. The **melting point** of a substance is the temperature at which it changes from a solid to a liquid. The water molecules in ice are closely packed together and can only vibrate in place. As heat is added to ice and the temperature rises, the water molecules vibrate faster and faster until they break free of the pattern and become liquid water. The particles in a liquid are more loosely connected.

As more heat is added to liquid water, the water molecules gain even more energy and vibrate faster and move farther and farther apart. At its **boiling point**, the temperature at which a substance changes from a liquid to a gas, the liquid water becomes water vapor. The water is still water, it has only changed its form.

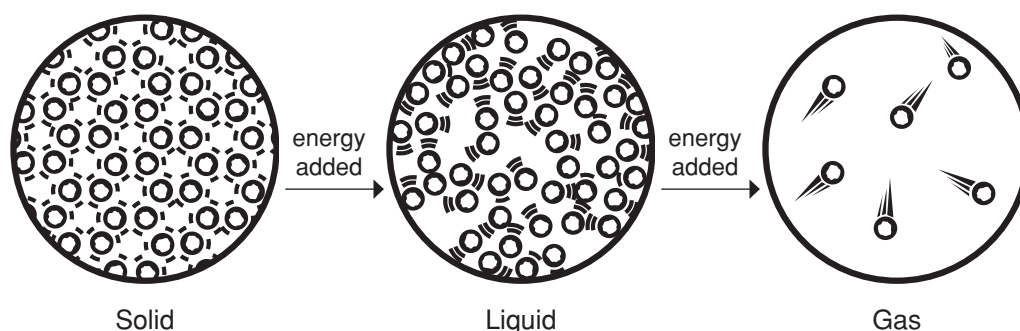


Figure 5-5 States of matter As matter changes state from solid to liquid to gas, the energy of its molecules change, but the chemical makeup of the substance remains the same.

Chapter 5 Reactions

The reverse occurs when heat is removed from a substance. When water vapor is cooled, the water molecules move more slowly and move closer together as water vapor cools to liquid water. As liquid water becomes cooler it freezes. **Freezing** is the change from the liquid to the solid state of matter. The molecules move very slowly and become tightly packed. These changes of state are reversible. The same sample of water can be frozen, melted, and boiled.

Solutions

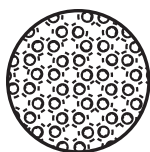
A **mixture** is made of two or more substances that are together in the same place but are not chemically combined. Making a mixture is a physical change because the parts of the mixture can be separated. For example, sand and iron filings mixed together are easily separated with a magnet. Both parts of the mixture, the sand and the iron filings, still have their chemical and physical properties while part of the mixture. In fact, a physical property of iron, its ability to attract to magnets, can be used to separate the filings from the mixture.

A **solution** is a uniform mixture that has the same properties throughout. Sugar mixed with water forms a solution. The sugar dissolves completely into the water and cannot be seen. However, no chemical reaction has occurred. The sugar is still sugar, and the water is still water. The sugar is easily separated from the solution by allowing the water to evaporate.

Standard 5. d. Check

- 14** A change of state is a physical change because
- A the parts of the mixture can be separated.
 - B the atoms of the substance form new chemical bonds.
 - C the boiling point of the substance changes.
 - D the chemical makeup of the substance stays the same.

- 15** Which of the following is *not* a physical change?
- A freezing
 - B burning
 - C boiling
 - D melting

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State A



State B



State C

In which state of matter do the particles of the substance have the *most* energy?

- A** State A
- B** State B
- C** State C
- D** States A and B

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The parts of a mixture can be separated by

- A** using the physical properties of its parts.
- B** causing a chemical reaction to occur.
- C** using the chemical properties of its parts.
- D** breaking and reforming chemical bonds.