Changes of State

Key Concepts

- What happens to a substance during changes between solid and liquid?
- What happens to a substance during changes between liquid and gas?
- What happens to a substance during changes between solid and gas?

The physical state of a substance is related to its thermal energy. Particles of a liquid have more thermal energy than particles of the same substance in solid form. As a gas, the particles have even more thermal energy. A substance changes state when its thermal energy increases or decreases sufficiently.

The change in state from a solid to a liquid is called **melting.** In most pure substances, melting occurs at a characteristic temperature called the **melting point.** As a solid absorbs thermal energy, its molecules vibrate faster, raising the temperature of the substance. **When a substance melts, the particles in the solid vibrate so fast that they break free from their fixed positions.** The temperature of the substance stops increasing. The added energy leads to the change in the arrangement of particles from a solid to a liquid.

Freezing is the change of state from liquid to solid—the reverse of melting. **When a substance freezes, the particles in the liquid move so slowly that they begin to take on fixed positions.** The liquid becomes a solid.

The change from a liquid to a gas is called **vaporization. Vaporization takes place when the particles in a liquid gain enough energy to move independently, forming a gas.** When vaporization takes place only on a liquid's surface, the process is called **evaporation.** When vaporization takes place throughout a liquid, the process is called **boiling.** A pure substance boils at a certain temperature, called its **boiling point.** The boiling point of a liquid also depends on the pressure of the air above the liquid. Lower air pressure decreases the boiling point of a liquid. Higher pressure increases the boiling point.

The opposite of vaporization is called **condensation. During condensation, the particles in a gas lose enough thermal energy to form a liquid.** Clouds usually form when water vapor in the atmosphere condenses into liquid droplets. It rains when the droplets get heavy enough.

Sublimation occurs when the surface particles of a solid gain enough energy to become a gas. **During sublimation, particles of a solid do not pass through the liquid state as they form a gas.** Dry ice is solid carbon dioxide that changes directly into a gas. As it changes state, the carbon dioxide absorbs thermal energy. This is why dry ice is used to keep materials cold.

Changes of State (pp. 96–101)

This section explains what happens to substances during changes of state.

Use Target Reading Skills

As you read, complete the outline about changes in state. Use the red headings for the main ideas. Use the blue headings for subtopics when possible. Add supporting ideas to the subtopics.

Changes in State
I. Changes Between Solid and Liquid A. Melting 1. Melting point 2. Particles vibrate faster and break free from fixed position. B. II. Changes Between Liquid and Gas A. B. C. III.

Changes of State *(continued)*

Changes Between Solid and Liquid (pp. 97–88)

1. A change from a solid to a liquid involves a(n) _____ in thermal energy.
2. A change from a liquid to a solid involves a(n) _____ in thermal energy.
3. The change in state from a solid to a liquid is called _____.
4. In most pure substances, melting occurs at a characteristic temperature called the _____.
5. Describe what happens to the water molecules in an ice cube that is set on the kitchen counter. What does this action cause?

_____

_____

_____

_____

_____

_____

6. The change of state from liquid to solid is called _____.
7. Is the following sentence true or false? At its freezing point, the particles of a solid are vibrating so fast that they break free from their fixed positions. _____

Changes Between Liquid and Gas (pp. 98–100)

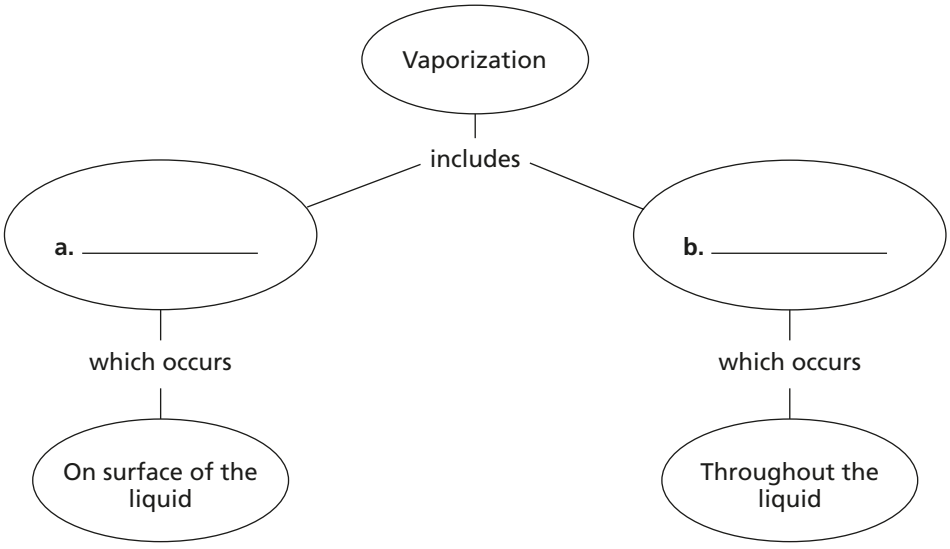
8. The change from a liquid to a gas is called _____.
9. When does vaporization take place?

_____

_____

_____

10. Complete the concept map.



11. Each liquid boils only at a certain temperature, which is called its _____.

12. Why is the boiling point of water lower in the mountains than it is at sea level?

_____

_____

_____

_____

_____

13. Is the following sentence true or false? Condensation is the opposite of vaporization. _____

14. When condensation occurs, does a gas lose or gain thermal energy?

_____

_____

Changes of State *(continued)*

Match the term with its example.

	Term		Example
____	**15.** vaporization	**a.**	A pot of water on a stove reaches its boiling point.
____	**16.** evaporation	**b.**	Liquid water changes into water vapor.
____	**17.** boiling	**c.**	Clouds form from water vapor in the sky.
____	**18.** condensation	**d.**	A puddle dries up after a rain shower.

Changes Between Solid and Gas (p. 101)

19. During _____, particles of a solid do not pass through the liquid state as they form a gas.

20. Give an example of sublimation.

_____

_____

_____

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