

## Chapter 14 Thermal Energy and Heat

## Study Guide

1. Temperature and Thermal Energy
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  - b. Temperature Scales
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      1. **Absolute Zero**
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2. The Nature of Heat
  - a. How Is Heat Transferred?
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      1. **Convection Current**
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  - c. Conductors and **Insulators**
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3. Thermal Energy and States of Matter
  - a. Three **States** of Matter
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      1. **Freezing Point**
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- i. Thermometers
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**1. Bimetallic Strips**

**4. Uses of Heat**

**a. Heat Engines**

- i. **External Combustion Engines**
- ii. **Internal Combustion Engines**

**b. Refrigerators**

**SECTION 14-1**

**REVIEW AND REINFORCE**

# Temperature and Thermal Energy

## ◆ Understanding Main Ideas

Write an answer for each of the following questions in the spaces provided.

1. If two glasses of water have the same temperature, do they necessarily have the same thermal energy? Explain.

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2. Fill in the blanks in the table below.

Temperature	Temperature Scales		
	Kelvin (K)	a.	Fahrenheit (°F)
absolute zero	b.	-273	-460
water freezes	273	c.	32
water boils	373	100	d.

## ◆ Building Vocabulary

Match each term with its definition by writing the letter of the correct definition on the line beside the term.

- \_\_\_\_\_ 3. Fahrenheit scale  
 \_\_\_\_\_ 4. Celsius scale  
 \_\_\_\_\_ 5. Kelvin scale  
 \_\_\_\_\_ 6. absolute zero  
 \_\_\_\_\_ 7. thermal energy  
 \_\_\_\_\_ 8. temperature

- a. the temperature scale used in most of the world  
 b. the total energy of all the particles in a substance  
 c. the temperature at which no more energy can be removed from matter  
 d. a temperature scale in which the interval between the freezing point and the boiling point of water is divided into 180 equal parts  
 e. a measure of the average kinetic energy of the individual particles in an object  
 f. a temperature scale with no negative numbers

**SECTION 14-2****REVIEW AND REINFORCE****The Nature of Heat****◆ Understanding Main Ideas**

Fill in the spaces in the table below by writing whether the heat is transferred by convection, radiation, or conduction.

Heat Transfer Example	Method of Heat Transfer
An entire lake is heated by water from a hot spring at the bottom of the lake.	1.
Sunlight melts a wax crayon left outside.	2.
A burner on a stove heats the bottom of a pot.	3.
The inside frame of your front door feels cold during winter.	4.
A kite rises high above a hot, sandy beach.	5.
You feel the warm glow of a bonfire.	6.

**◆ Building Vocabulary**

Fill in the blank to complete each sentence.

7. Heat is transferred directly from one particle of matter to another by the process of \_\_\_\_\_.
8. \_\_\_\_\_ is a transfer of thermal energy from a warmer object to a cooler object.
9. A circular flow of warmer fluid and cooler fluid is called a(n) \_\_\_\_\_.
10. The amount of energy required to raise the temperature of 1 kilogram of a substance by 1 kelvin is called its \_\_\_\_\_.
11. A(n) \_\_\_\_\_ is a material that does not conduct heat well.
12. \_\_\_\_\_ is the transfer of energy by electromagnetic waves.
13. Heat is transferred by the movement of currents within a fluid by a process called \_\_\_\_\_.
14. A(n) \_\_\_\_\_ is a material that transfers heat well.

**SECTION 14-3****REVIEW AND REINFORCE****Thermal Energy and States of Matter****◆ Understanding Main Ideas**

Answer the following questions on a separate sheet of paper.

1. A glass of ice at  $0^{\circ}\text{C}$  changes to a glass of water at  $0^{\circ}\text{C}$ . What caused the ice to change to water?
2. Why didn't the temperature of the water change in Question 1?
3. Lengths of railway tracks have small gaps between them. Why are the tracks built this way and what might happen if there were no gaps?

**◆ Building Vocabulary**

From the list below, choose the term that best completes each sentence.

state	change of state	boiling	evaporation
thermal expansion	thermostat	freezing	
bimetallic strip	freezing point	condensation	

4. The change from a gas to a liquid is called \_\_\_\_\_.
5. A solid, a liquid, and a gas are all examples of a(n) \_\_\_\_\_ of matter.
6. The temperature at which matter changes from a liquid to a solid is called the \_\_\_\_\_.
7. A(n) \_\_\_\_\_ is a device that regulates heat.
8. The expansion of matter when it is heated is known as \_\_\_\_\_.
9. The physical change from one state of matter to another is called \_\_\_\_\_.
10. A strip of two different metals joined together is called a(n) \_\_\_\_\_.
11. When vaporization takes place on the surface of a liquid, the process is called \_\_\_\_\_.
12. When vaporization takes place on and below the surface of a liquid at higher temperature, the process is called \_\_\_\_\_.

**SECTION 14-4**

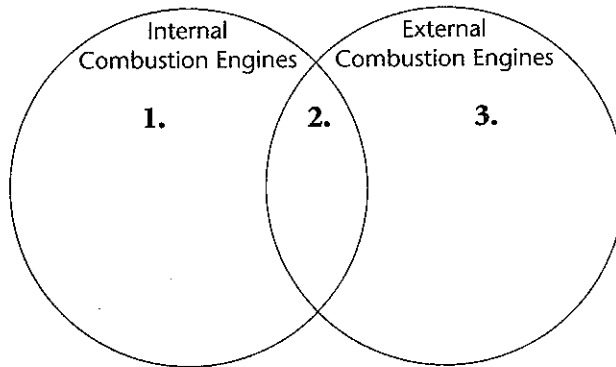
**REVIEW AND REINFORCE**

# Uses of Heat

## ◆ Understanding Main Ideas

Write the letter of each characteristic in the correct area of the Venn diagram.

- a. Contains pistons and cylinders.
- b. Fuel is burned outside the engine.
- c. Examples are diesel and gasoline engines.
- d. An example is a steam engine.
- e. Thermal energy is converted to mechanical energy.
- f. Fuel is burned inside the engine.



## ◆ Building Vocabulary

Match each term with its definition by writing the letter of the correct definition on the line beside the term.

- \_\_\_\_\_ 4. heat engine
- \_\_\_\_\_ 5. external combustion engine
- \_\_\_\_\_ 6. internal combustion engine
- \_\_\_\_\_ 7. refrigerator
- \_\_\_\_\_ 8. combustion

- a. the process of burning a fuel such as wood or oil
- b. a device that converts thermal energy to mechanical energy
- c. a heat engine in which fuel is burned inside the engine
- d. a device that transfers thermal energy from a cool area to a warm area by using an outside energy source
- e. a heat engine in which fuel is burned outside the engine

Name: \_\_\_\_\_

Class: \_\_\_\_\_

Choose the letter of the correct answer.

1. A measure of the average kinetic energy of the individual particles in an object is called  
[A] conduction. [B] convection. [C] temperature. [D] thermal energy.
2. Which statement is true of gases?  
[A] The particles that make up gases are packed together in a relatively fixed position.  
[B] Gases have a definite shape.  
[C] Gases have a definite volume.  
[D] Gases expand to fill all the space available.
3. Heated air moves from baseboard heaters to the rest of a room in a process called  
[A] conduction. [B] convection. [C] insulation. [D] radiation.
4. The transfer of energy by electromagnetic waves is called  
[A] insulation. [B] radiation. [C] convection. [D] conduction.
5. Heat transfer occurs  
[A] only from cold objects to warmer ones.  
[B] only from warm objects to colder ones.  
[C] both from warm objects to colder ones and from cold objects to warmer ones.  
[D] in many directions.
6. A steam engine is an example of a(n)  
[A] eight-cylinder engine. [B] internal combustion engine.  
[C] external combustion engine. [D] four-stroke engine.
7. A device that uses an outside energy source to transfer thermal energy from a cool area to a warm area is called  
[A] a refrigerator. [B] a combustion engine. [C] a vaporizer. [D] a thermometer.
8. The conversion of thermal energy into mechanical energy requires a  
[A] vaporizer. [B] thermometer. [C] heat engine. [D] thermostat.

Choose the letter of the correct answer.

9. The addition or loss of thermal energy changes the arrangement of the particles during  
[A] a change of state. [B] radiation. [C] convection. [D] conduction.
10. Heat, like work, is an energy transfer measured in  
[A] watts. [B] degrees. [C] kelvins. [D] joules.
11. The amount of energy required to raise the temperature of 1 kilogram of a substance by 1 kelvin is called its  
[A] specific heat. [B] change of state. [C] heat transfer. [D] melting point.

Fill in the word or phrase that best completes the statement(s).

12. Iron has a higher specific heat than silver. If 1 kg of iron and 1 kg of silver absorb equal amounts of heat, the temperature of the \_\_\_\_\_ will increase by a greater amount.
13. Most gasoline engines are \_\_\_\_\_-stroke engines.
14. The handle of a spoon in a bowl of soup becomes warm because of heat transfer by the process of \_\_\_\_\_.
15. Stars transfer thermal energy by the process of \_\_\_\_\_.
16. Boiling is vaporization that takes place at or \_\_\_\_\_ the surface of a liquid.
17. An increase in the total energy of the particles in a substance results in an increase in the \_\_\_\_\_ energy of the substance.
18. The bimetallic strip in a thermostat bends as it is heated because the two metals in the strip \_\_\_\_\_ at different rates.
19. The joule per kilogram-kelvin is the SI unit for \_\_\_\_\_.
20. Even though the water in a filled bathtub may be at the same temperature as water in a teacup, the water in the bathtub has more \_\_\_\_\_ because it contains a greater number of water molecules.

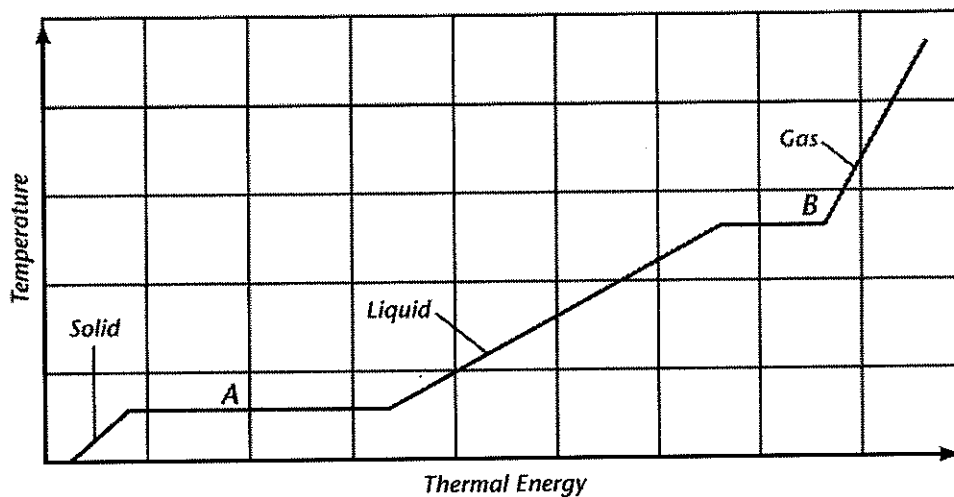


If the statement is true, write true. If it is false, change the underlined word or words to make the statement true.

21. The more particles a substance has at a given temperature, the more thermal energy it has.
22. Trapped air is a good conductor because it reduces heat transfer.
23. A student lists three temperature measurements: 100°F, 100°C, and 100 K. Of the three measurements, 100 K is the highest temperature.
24. Particles of matter in the solid state are held together but can move around each other.
25. During the power stroke of a four-stroke engine, the fuel mixture is squeezed into a smaller volume.

Use the graph to answer the question(s).

### Changes of State



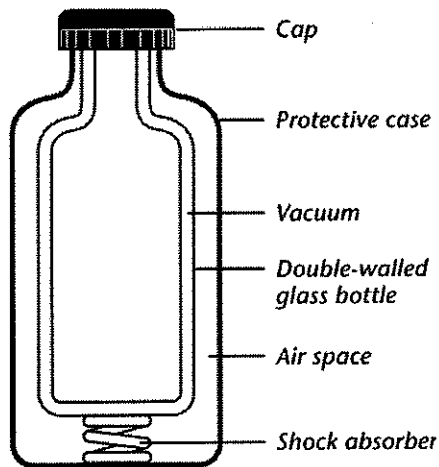
26. What happens to each of the variables—temperature and thermal energy—during the changes indicated by line segments A and B?

Write an answer to the following question(s).

30. What is the difference between thermal energy and heat?

Use the diagram to answer the question(s).

**Thermos Bottle**



27. What purpose do you think the air space serves?
28. The glass walls of the device are covered with a shiny metallic coating. What type of heat transfer does the coating reduce? Explain.
29. The cap on the thermos bottle is made of plastic. How does the use of this material help the thermos bottle function?