

*An Introduction to General, Organic, and Biological Chemistry, 11e* (Timberlake)  
Chapter 2 Matter and Energy

2.1 Multiple-Choice Questions

1) Which of the following is an element?

- A) tin
- B) water
- C) salt
- D) sugar
- E) iced tea

Answer: A

Page Ref: 2.1

2) Helium is a(n)

- A) compound.
- B) heterogeneous mixture.
- C) element.
- D) homogeneous mixture.
- E) electron.

Answer: C

Page Ref: 2.1

3) Coins in a piggy bank are an example of a(n)

- A) compound.
- B) heterogeneous mixture.
- C) element.
- D) homogeneous mixture.
- E) none of the above

Answer: B

Page Ref: 2.1

4) Gold in a ring is a(n)

- A) compound.
- B) heterogeneous mixture.
- C) element.
- D) homogeneous mixture.
- E) none of the above

Answer: C

Page Ref: 2.1

5) Which of the following is not an element?

- A) tin
- B) water
- C) gold
- D) silver
- E) carbon

Answer: B

Page Ref: 2.1

6) Which of the following is a homogeneous mixture?

- A) noodle soup
- B) water
- C) sugar
- D) tea
- E) carbon

Answer: D

Page Ref: 2.1

7) Which of the following is a heterogeneous mixture?

- A) noodle soup
- B) water
- C) sugar
- D) tea
- E) carbon

Answer: A

Page Ref: 2.1

8) Which of the following is not a characteristic of the solid state?

- A) has a definite shape
- B) has a definite volume
- C) particles are close together
- D) particles are moving very fast
- E) particles are in fixed positions

Answer: D

Page Ref: 2.2

9) Which of the following is an example of a physical change?

- A) grinding coffee beans
- B) baking a cake
- C) converting water to hydrogen and oxygen
- D) digesting a cheeseburger
- E) burning coal

Answer: A

Page Ref: 2.2

10) Which of the following would not be a physical change?

- A) freezing water to make ice cubes
- B) tearing a piece of aluminum foil
- C) boiling water for soup
- D) burning gasoline in a lawnmower
- E) melting gold to make jewelry

Answer: D

Page Ref: 2.2

11) Which of the following is a chemical change?

- A) cutting a rope
- B) bending a steel rod
- C) making a snowman
- D) burning sugar
- E) melting gold

Answer: D

Page Ref: 2.2

12) Which of the following is a physical change?

- A) baking a cake
- B) dry ice subliming
- C) fermenting grapes to produce wine
- D) digesting a meal
- E) a tomato ripening

Answer: B

Page Ref: 2.2

13) Which of the following is a chemical change?

- A) burning natural gas
- B) melting ice
- C) hammering gold into foil
- D) cutting a tomato
- E) cutting paper

Answer: A

Page Ref: 2.2

14) Which of the following is a physical change?

- A) iron rusts
- B) ice melts
- C) sugar caramelizes
- D) food digests
- E) natural gas burns

Answer: B

Page Ref: 2.2

15) An example of kinetic energy is

- A) a coiled spring.
- B) running water.
- C) a tree.
- D) natural gas.
- E) chemical energy.

Answer: B

Page Ref: 2.3

16) The energy associated with the motion of particles in a substance is called

- A) temperature.
- B) electrical energy.
- C) heat.
- D) chemical energy.
- E) potential energy.

Answer: C

Page Ref: 2.3

17) Which of the following is an example of potential energy?

- A) chewing food
- B) water stored in a reservoir
- C) burning wood
- D) a fan blade turning
- E) riding an exercise bike

Answer: B

Page Ref: 2.3

18) The phrase "ability to do work" is a definition of

- A) specific heat.
- B) energy.
- C) calorie.
- D) heating.
- E) cooling.

Answer: B

Page Ref: 2.3

19) The energy stored in chemical bonds is

- A) specific heat.
- B) kinetic energy.
- C) potential energy.
- D) work.
- E) a calorie.

Answer: C

Page Ref: 2.3

20) The energy of motion is referred to as

- A) work.
- B) freezing.
- C) specific heat.
- D) potential energy.
- E) kinetic energy.

Answer: E

Page Ref: 2.3

21) Global warming is believed to result from all of the following except

- A) burning of fossil fuels.
- B) increasing levels of carbon dioxide in the atmosphere.
- C) deforestation.
- D) movement of the earth closer to the sun.
- E) carbon dioxide trapping the heat produced by the sun.

Answer: D

Page Ref: 2.3

22) In which of the following would the particles move most rapidly?

- A) ice at  $-20\text{ }^{\circ}\text{C}$
- B) water at  $20\text{ }^{\circ}\text{C}$
- C) steam at  $110\text{ }^{\circ}\text{C}$
- D) boiling water
- E) ice at  $0\text{ }^{\circ}\text{C}$

Answer: C

Page Ref: 2.4

23) 650. J is the same amount of energy as \_\_\_\_\_.

- A) 155 cal
- B) 2720 cal
- C) 650. cal
- D) 1550 cal
- E) 2.72 cal

Answer: A

Page Ref: 2.3

24) 3.25 kcal is the same amount of energy as \_\_\_\_\_.

- A) 3.25 J
- B) 0.777 J
- C) 777 J
- D) 13600 J
- E) 13.6 J

Answer: D

Page Ref: 2.3

25) A potato contains 20 g of carbohydrate. If carbohydrate has a caloric value of 4 kcal/g, how many kcal are obtained from the carbohydrate in the potato?

- A) 5 kcal
- B) 20 kcal
- C) 40 kcal
- D) 60 kcal
- E) 80 kcal

Answer: E

Page Ref: 2.6

26) One cup of kidney beans contains 15 g of protein, 1 g of fat, and 42 g of carbohydrate. How many kilocalories, to two significant figures, does this sample contain? (The caloric values are: 4 kcal/g for carbohydrate, 9 kcal/g for fat, and 4 kcal/g for protein.)

- A) 60. kcal
- B) 88 kcal
- C) 230 kcal
- D) 240 kcal
- E) 520 kcal

Answer: D

Page Ref: 2.6

27) A cheeseburger from a fast food restaurant contains 19 g of fat, 20 g of carbohydrate, and 28 g of protein. How many kcal of energy does the cheeseburger contain? (The caloric values are: 4 kcal/g for carbohydrate, 9 kcal/g for fat, and 4 kcal/g for protein.) Give the answer to 2 significant figures.

- A) 70. kcal
- B) 360 kcal
- C) 17 kcal
- D) 630 kcal
- E) 280 kcal

Answer: B

Page Ref: 2.6

28) A serving of fish contains 50 g protein and 4 g of fat. If protein has a caloric value of 4 kcal/g and fat has

9 kcal/g, how many kcal are in the serving? Give the answer to 2 significant figures.

- A) 240 kcal
- B) 54 kcal
- C) 470 kcal
- D) 220 kcal
- E) 490 kcal

Answer: A

Page Ref: 2.6

29) A slice of pizza contains 28 g of carbohydrate, 13 g of protein and fat. If the pizza contains 280 kcal, how many grams of fat are present?(The caloric values are: 4 kcal/g for carbohydrate, 9 kcal/g for fat, and 4 kcal/g for protein. Give the answer to 2 significant figures.)

- A) 28 g
- B) 13 g
- C) 10. g
- D) 55 g
- E) 250 g

Answer: B

Page Ref: 2.6

30) The dietary calorie(Cal) is equal to

- A) 1000 kilocalories.
- B) 1000 calories.
- C) 100 calories.
- D) 10 calories.
- E) 1 calorie.

Answer: B

Page Ref: 2.6

31) A temperature of 41 °F is the same as

- A) 5 °C.
- B) 310 °C.
- C) -9 °C.
- D) 16 °C.
- E) 42 °C.

Answer: A

Page Ref: 2.4

32) If the temperature is 20. °C, what is the corresponding temperature on the Fahrenheit scale?

- A) -22 °F
- B) 68 °F
- C) 43 °F
- D) 239 °F
- E) 94 °F

Answer: B

Page Ref: 2.4

33) If the temperature is -55 °F, what is the corresponding temperature on the Kelvin scale?

- A) 225 K
- B) 218 K
- C) 55 K
- D) 273 K
- E) 328 K

Answer: A

Page Ref: 2.4

34) A patient has a temperature of  $38.5\text{ }^{\circ}\text{C}$ . What is the temperature in degrees Fahrenheit?

- A)  $70.5\text{ }^{\circ}\text{F}$
- B)  $311\text{ }^{\circ}\text{F}$
- C)  $126.9\text{ }^{\circ}\text{F}$
- D)  $101.3\text{ }^{\circ}\text{F}$
- E)  $11.7\text{ }^{\circ}\text{F}$

Answer: D

Page Ref: 2.4

35) The temperature of liquid nitrogen is  $-196\text{ }^{\circ}\text{C}$ . What is the corresponding reading on the Kelvin scale?

- A) 77 K
- B)  $-127\text{ K}$
- C)  $-91\text{ K}$
- D) 48 K
- E) 146 K

Answer: A

Page Ref: 2.4

36) On a hot day, the thermometer read  $95\text{ }^{\circ}\text{F}$ . What is the temperature in degrees Celsius?

- A)  $77\text{ }^{\circ}\text{C}$
- B)  $113\text{ }^{\circ}\text{C}$
- C)  $35\text{ }^{\circ}\text{C}$
- D)  $63\text{ }^{\circ}\text{C}$
- E)  $178\text{ }^{\circ}\text{C}$

Answer: C

Page Ref: 2.4

37) Absolute zero is

- A) the freezing point of water using the Celsius scale.
- B) the boiling point of liquid nitrogen.
- C) the temperature on the Kelvin scale corresponding to  $32\text{ }^{\circ}\text{F}$ .
- D) the coldest temperature possible.
- E) the freezing point of liquid nitrogen.

Answer: D

Page Ref: 2.4

38) The specific heat of a substance is the amount of heat needed to

- A) change 1 g of the substance from the solid to the liquid state.
- B) raise the temperature of 1 g of the substance by  $1\text{ }^{\circ}\text{C}$ .
- C) change 1 g of the substance from the liquid to the solid state.
- D) convert 1 g of a liquid to gas.
- E) convert 1 g of a solid to a gas.

Answer: B

Page Ref: 2.5



39) A kilocalorie of heat is required to raise the temperature of

A) 1 g of water from 14 °C to 15 °C.

B) 1 g of water by 10 °C.

C) 10 g of water by 10 °C.

D) 100 g of water by 10 °C.

E) 100 g of water by 100 °C.

Answer: D

Page Ref: 2.5

40) How many calories are required to raise the temperature of a 35.0 g sample of iron from 25 °C to 35 °C? Iron has a specific heat of 0.108 cal/g °C.

A) 38 cal

B) 1.1 cal

C) 3.8 cal

D) 93 cal

E) 130 cal

Answer: A

Page Ref: 2.5

41) How many calories are required to raise the temperature of a 150. g sample of gold from 25 °C to 175 °C? The specific heat of gold is 0.0308 cal/g °C.

A) 4.62 cal

B) 116 cal

C) 22500 cal

D) 693 cal

E) 130. cal

Answer: D

Page Ref: 2.5

42) How many calories are required to increase the temperature of 13 g of alcohol from 11 °C to 23 °C? The specific heat of alcohol is 0.59 cal/g °C.

A) 83 cal

B) 0.63 cal

C) 92 cal

D) 0.54 cal

E) 170 cal

Answer: C

Page Ref: 2.5

43) The specific heat of copper is 0.092 cal/g °C, and the specific heat of silver is 0.057 cal/g °C. If 100 cal of heat is added to one g of each metal at 25 °C, what is the expected result?

A) The copper will reach a higher temperature.

B) The silver will reach a higher temperature.

C) The two samples will reach the same temperature.

D) The copper will reach a temperature lower than 25 °C.

E) The silver will soften.

Answer: B

Page Ref: 2.5

44) Which of the following quantities is not required to calculate the amount of heat energy required to heat water from 25 °C to 55 °C?

- A) the mass of the water sample
- B) the initial temperature
- C) the final temperature
- D) the specific heat of water
- E) the heat of vaporization for water

Answer: E

Page Ref: 2.5

45) Raising the temperature of 10.0 g of water from 10.0 °C to 20.0 °C requires 100.0 cal of energy, while raising the temperature of 10.0 g of aluminum from 10.0 °C to 20.0 °C requires 22.0 cal. More calories are required to heat the water because

- A) water is a liquid and aluminum is a solid at 10.0 °C.
- B) ten grams of water occupies a larger volume than 10.0 g of aluminum.
- C) water has a greater potential energy than aluminum.
- D) water has a larger specific heat than aluminum.
- E) 10.0 °C is closer to the melting point of water than to the melting point of aluminum.

Answer: D

Page Ref: 2.5

46) The number of calories needed to raise the temperature of 32 g of water from 12 °C to 54 °C is

- A) 380 cal.
- B) 1.3 cal.
- C) 1300 cal.
- D) 1700 cal.
- E) 0.76 cal.

Answer: C

Page Ref: 2.5

47) Which of the following is a property of a solid?

- A) It takes the shape of the container.
- B) It fills the volume of the container.
- C) The particles move at a rapid rate.
- D) The interactions between its particles are very weak.
- E) The particles have fixed positions and are very close together.

Answer: E

Page Ref: 2.2

48) In a gas, the distance between the particles is

- A) very close relative to the size of the molecules.
- B) close relative to the size of the molecules.
- C) fixed relative to the size of the molecules.
- D) small relative to the size of the molecules.
- E) very large relative to the size of the molecules.

Answer: E

Page Ref: 2.2

49) Which of the following is a physical property of both liquids and gases?

- A) has its own shape
- B) has a definite volume
- C) has strong interactions between its particles
- D) has randomly arranged particles
- E) has large spaces between molecules

Answer: D

Page Ref: 2.2

50) Which one of the following properties describes a liquid?

- A) has its own shape
- B) particles are close together and move randomly
- C) particles move very rapidly
- D) fills the entire volume of the container
- E) There is essentially no interaction between the particles.

Answer: B

Page Ref: 2.2

51) The physical state(s) present when a substance is melting is (are)

- A) solid.
- B) liquid.
- C) gas.
- D) solid + liquid.
- E) liquid + gas.

Answer: D

Page Ref: 2.7

52) If the heat of fusion for water is 80. cal/g, how many calories are needed to melt 45.0 g of ice at 0 °C?

- A) 3.6 cal
- B)  $3.6 \times 10^3$  cal
- C) 1.8 cal
- D) 80. cal
- E) 0.56 cal

Answer: B

Page Ref: 2.7

53) The formation of a gas resulting from the escape of high-energy particles from the surface of a liquid is known as

- A) evaporation.
- B) deposition.
- C) boiling.
- D) melting.
- E) sublimation.

Answer: A

Page Ref: 2.7

54) When a solid is converted directly to a gas, the change of state is called

- A) freezing.
- B) melting.
- C) boiling.
- D) condensation.
- E) sublimation.

Answer: E

Page Ref: 2.7

55) A burn from steam at 100 °C is expected to be more severe than a burn from boiling water at 100°C because

- A) the steam is hotter than the boiling water.
- B) there is more steam than water.
- C) the steam will give off a large amount of heat as it condenses.
- D) you are more likely to come into contact with the steam than with the boiling water.
- E) All of these answers are correct.

Answer: C

Page Ref: 2.7

56) The heat of fusion for water is 80. cal/g. How many calories of heat are released when 20.0 g of water at 0 °C is frozen to ice?

- A) 620 cal
- B) 1600 cal
- C) 2000 cal
- D) 2200 cal
- E) 0 cal

Answer: B

Page Ref: 2.7

57) The heat of fusion for water is 80. cal/g. How many calories of heat are needed to melt a 35 g ice cube that has a temperature of 0 °C?

- A) 2300 cal
- B) 1600 cal
- C) 2800 cal
- D) 540 cal
- E) 0 cal

Answer: C

Page Ref: 2.7

58) The heat of vaporization for water is 540 cal/g. How many kilocalories are needed to change 22 g of liquid water to steam at 100 °C ?

- A) 540 kcal
- B) 12 kcal
- C) 12000 kcal
- D) 25 kcal
- E) 1.8 kcal

Answer: B

Page Ref: 2.7

59) If the heat of vaporization for water is 540 cal/g, how many kilocalories are released when 5.00 g of steam is converted to liquid at 100 °C?

- A) 540 kcal
- B) 5.0 kcal
- C) 110 kcal
- D) 2.7 kcal
- E) 5.4 kcal

Answer: D

Page Ref: 2.7

60) Which of the following does not involve a change of state?

- A) melting ice
- B) freezing water
- C) vaporization of alcohol
- D) sublimation of dry ice
- E) pouring water into a vacuum-insulated bottle

Answer: E

Page Ref: 2.7

61) A heating curve illustrates

- A) what a substance looks like as it is heated.
- B) what happens to the particles of a substance as it is heated.
- C) what happens to the heat applied as the temperature is increased.
- D) the changes in the temperature and physical state of a substance as it is heated.
- E) the chemical changes that occur as the substance is heated.

Answer: D

Page Ref: 2.7

62) On a heating curve a plateau corresponds to

- A) a change in temperature of a liquid.
- B) a change in temperature of a solid.
- C) a change in temperature of a gas.
- D) a change of state.
- E) the solid being broken into smaller pieces.

Answer: D

Page Ref: 2.7

63) Which of the following does not represent a step on the heating curve of water?

- A) The temperature of steam cannot exceed 100 °C.
- B) The temperature of ice remains at 0 °C as it melts.
- C) The temperature of liquid water increases linearly as it is heated.
- D) The temperature of liquid water remains at 100 °C as it boils.
- E) Both liquid water and ice are present at 0 °C.

Answer: A

Page Ref: 2.7

## 2.2 Short Answer Questions

1) Liquid water changing to ice is an example of a \_\_\_\_\_ change.

Answer: physical

Page Ref: 2.2

2) Iron rusting is an example of a \_\_\_\_\_ change.

Answer: chemical

Page Ref: 2.2

3) Air is an example of a \_\_\_\_\_ mixture.

Answer: homogeneous

Page Ref: 2.1

4) The change of state from solid to gas is termed \_\_\_\_\_.

Answer: sublimation

Page Ref: 2.7

5) The \_\_\_\_\_ state of matter has a constant shape and volume.

Answer: solid

Page Ref: 2.2

6) The heat of fusion is the amount of heat necessary to change one gram of a substance from the solid to the \_\_\_\_\_ state.

Answer: liquid

Page Ref: 2.7

7) The amount of heat necessary for one gram of a substance to change from the solid state to the liquid state is the \_\_\_\_\_.

Answer: heat of fusion

Page Ref: 2.7

8) When a liquid boils, the process by which the molecules leave its surface is called \_\_\_\_\_.

Answer: evaporation

Page Ref: 2.7

*Bromine (Br<sub>2</sub>) has a freezing point of -7 °C, and a boiling point of 60 °C.  
Indicate the state present or the change of state occurring at each temperature.*

9) 30 °C

Answer: liquid

Page Ref: 2.7

10) 60 °C

Answer: boiling or condensation

Page Ref: 2.7

11) -7 °C

Answer: melting

Page Ref: 2.7

12) -15 °C

Answer: solid

Page Ref: 2.7

13) 70 °C

Answer: gas

Page Ref: 2.7

### 2.3 True/False Questions

1) Air is a heterogeneous mixture.

Answer: FALSE

Page Ref: 2.1

2) Black coffee is a homogeneous mixture.

Answer: TRUE

Page Ref: 2.1

3) A liquid has its own volume and shape.

Answer: FALSE

Page Ref: 2.2

4) A compound only contains one type of atom.

Answer: FALSE

Page Ref: 2.1

5) Iron rusting is a chemical change.

Answer: TRUE

Page Ref: 2.2

6) Ice melting is a chemical change.

Answer: FALSE

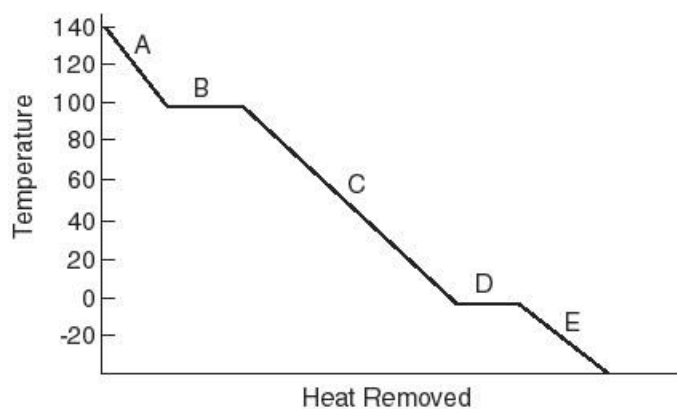
Page Ref: 2.2

- 7) The heat of fusion is greater than the heat of vaporization.  
Answer: FALSE  
Page Ref: 2.7
- 8) As heat is removed from a solid, its temperature decreases.  
Answer: TRUE  
Page Ref: 2.7
- 9) Water vapor is a gas.  
Answer: TRUE  
Page Ref: 2.2
- 10) When a liquid is boiling, its temperature does not change.  
Answer: TRUE  
Page Ref: 2.7
- 11) As a solid melts, its temperature does not change.  
Answer: TRUE  
Page Ref: 2.7
- 12) Steam at 100 °C holds the same amount of heat as water at 100 °C.  
Answer: FALSE  
Page Ref: 2.7
- 13) The temperature at which water melts and freezes is the same.  
Answer: TRUE  
Page Ref: 2.7
- 14) Water freezes at 100 °C.  
Answer: FALSE  
Page Ref: 2.7
- 15) The heat of fusion of water is larger than the heat of vaporization.  
Answer: FALSE  
Page Ref: 2.7
- 16) One gram of fat has less energy than one gram of protein.  
Answer: FALSE  
Page Ref: 2.6
- 17) Carbohydrates and proteins have the same caloric value per gram.  
Answer: TRUE  
Page Ref: 2.6
- 18) Condensation occurs when a liquid is converted to a solid.  
Answer: FALSE  
Page Ref: 2.7



## 2.4 Matching Questions

Identify the physical state(s) corresponding to labeled regions on the cooling curve of water shown below.



- A) solid and gas
- B) solid
- C) liquid and solid
- D) gas
- E) liquid and gas
- F) liquid

1) A  
Page Ref: 2.7

2) B  
Page Ref: 2.7

3) C  
Page Ref: 2.7

4) D  
Page Ref: 2.7

5) E  
Page Ref: 2.7

Answers: 1) D 2) E 3) F 4) C 5) B

*Match the state(s) of matter with each of the following descriptions of a substance.*

- A) solid
- B) gas
- C) liquid + gas
- D) liquid
- E) solid + liquid

6) Particles are held close together in a random pattern.

Page Ref: 2.2

7) Great distances exist between the particles.

Page Ref: 2.2

8) This material has a definite volume, and a definite shape.

Page Ref: 2.2

9) This substance is boiling.

Page Ref: 2.2

10) This substance is melting.

Page Ref: 2.2

Answers: 6) D 7) B 8) A 9) C 10) E