

General, Organic, and Biological Chemistry, 4e (Timberlake)
Chapter 2 Energy and Matter

2.1 Multiple-Choice Questions

1) An example of kinetic energy is

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

Answer: B

Objective: 2.1

Global Outcomes: GO7

2) 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

Objective: 2.1

Global Outcomes: GO7

3) 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

Objective: 2.1

Global Outcomes: GO2

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

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

Answer: B

Objective: 2.1

Global Outcomes: GO7

5) The energy stored in the chemical bonds of a carbohydrate molecule is

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

Answer: C

Objective: 2.1

Global Outcomes: GO2

6) The energy of motion is referred to as

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

Answer: E

Objective: 2.1

7) 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

Objective: 2.1

Global Outcomes: GO2

8) 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

Objective: 2.1

Global Outcomes: GO4

9) 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

Objective: 2.1

Global Outcomes: GO4

10) 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

Objective: 2.2

Global Outcomes: GO9

11) 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

Objective: 2.2

Global Outcomes: GO4

12) 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

Objective: 2.2

Global Outcomes: GO4

13) If the temperature is $-55\text{ }^{\circ}\text{C}$, 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: B

Objective: 2.2

Global Outcomes: GO4

14) 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

Objective: 2.2

Global Outcomes: GO4

15) 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 K
- C) -91 K
- D) 48 K
- E) 146 K

Answer: A

Objective: 2.2

Global Outcomes: GO4

16) 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

Objective: 2.2

Global Outcomes: GO4

17) 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 °F.
- D) the coldest temperature possible.
- E) the freezing point of liquid nitrogen.

Answer: D

Objective: 2.2

Global Outcomes: GO7

18) Helium is a(n)

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

Answer: C

Objective: 2.3

Global Outcomes: GO2

19) Air is a(n)

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

Answer: D

Objective: 2.3

Global Outcomes: GO7

20) Coins in a piggy bank is a(n)

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

Answer: B

Objective: 2.3

Global Outcomes: GO2

21) Gold in a wedding ring is a(n)

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

Answer: C

Objective: 2.3

Global Outcomes: GO2

22) The primary substances of which all other things are composed are

- A) molecules.
- B) compounds.
- C) elements.
- D) electrons.
- E) protons.

Answer: C

Objective: 2.3

Global Outcomes: GO2

23) 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

Objective: 2.4

Global Outcomes: GO2

24) 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

Objective: 2.4

Global Outcomes: GO2

25) 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

Objective: 2.4

Global Outcomes: GO2

26) 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

Objective: 2.4

Global Outcomes: GO2

27) 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

Objective: 2.4

Global Outcomes: GO2

28) 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

Objective: 2.4

Global Outcomes: GO7

- 29) 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

Objective: 2.4

Global Outcomes: GO2

- 30) 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

Objective: 2.4

Global Outcomes: GO2

- 31) 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

Objective: 2.4

Global Outcomes: GO9

- 32) 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

Objective: 2.4

Global Outcomes: GO9

33) 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

Objective: 2.4

Global Outcomes: GO2

34) 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

Objective: 2.4

Global Outcomes: GO2

35) 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

Objective: 2.4

Global Outcomes: GO2

36) 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

Objective: 2.4

Global Outcomes: GO2

37) 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 °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

Objective: 2.5

Global Outcomes: GO2

38) 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

Objective: 2.5

Global Outcomes: GO7

39) 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

Objective: 2.5

Global Outcomes: GO4

40) 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 0.588 cal/g °C.

- A) 83 cal
- B) 0.63 cal
- C) 92 cal
- D) 0.54 cal
- E) 170 cal

Answer: C

Objective: 2.5

Global Outcomes: GO4

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

Objective: 2.5

Global Outcomes: GO4

42) 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 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

Objective: 2.5

Global Outcomes: GO2

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

- A) 384 cal.
- B) 1.3 cal.
- C) 1300 cal.
- D) 1700 cal.
- E) 0.76 cal.

Answer: C

Objective: 2.5

Global Outcomes: GO4

44) The specific heat of copper is 0.0920 cal/g °C, and the specific heat of silver is 0.0562 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

Objective: 2.5

Global Outcomes: GO2

45) 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

Objective: 2.5

Global Outcomes: GO2

46) A 2.5 g sample of french fries is placed in a calorimeter with 500.0 g of water at an initial temperature of 21 °C. After combustion of the french fries, the water has a temperature of 48 °C. What is the caloric value (kcal/g) of the french fries?

- A) 14 kcal/g
- B) 11 kcal/g
- C) 0.14 kcal/g
- D) 4.2 kcal/g
- E) 5.4 kcal/g

Answer: E

Objective: 2.5, 2.6

Global Outcomes: GO9

47) 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

Objective: 2.6

Global Outcomes: GO4

48) The dietary calorie (Cal) is equal to (2.6)

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

Answer: B

Objective: 2.6

Global Outcomes: GO7

49) 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 accepted caloric values for foods are 4.0 kcal/g for carbohydrate, 9 kcal/g for fat, and 4 kcal/g for protein.)

Report the answer to 2 significant figures.

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

Answer: B

Objective: 2.6

Global Outcomes: GO4

50) A serving of fish contains 50 g of protein and 4 g of fat. If protein has a caloric value of 4.0 kcal/g and fat has 9.1 kcal/g, how many kcal are in the serving? Report the answer to 2 significant figures.

- A) 240 kcal
- B) 54.0 kcal
- C) 470 kcal
- D) 220 kcal
- E) 490 kcal

Answer: A

Objective: 2.6

Global Outcomes: GO4

51) A slice of pizza contains 29 g of carbohydrate, 13 g of protein and an unknown amount of fat. If the pizza contains 280 kcal, how many grams of fat are present? Report the answer to 2 significant figures.

- A) 10. g
- B) 12 g
- C) 25 g
- D) 55 g
- E) 250 g

Answer: B

Objective: 2.6

Global Outcomes: GO4

52) A diet has a total caloric intake of 1400 kcal. The diet consists of 50.% carbohydrate, 35% protein, and 15% fat. The number of kcal of protein in the diet is

- A) 700 kcal.
- B) 490 kcal.
- C) 210 kcal.
- D) 460 kcal.
- E) 1200 kcal.

Answer: B

Objective: 2.6

Global Outcomes: GO4

53) 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?

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

Answer: D

Objective: 2.6

Global Outcomes: GO4

2.2 Short Answer Questions

1) The energy of motion is called _____ energy.

Answer: kinetic

Objective: 2.1

Global Outcomes: GO2

2) The lowest temperature on the Kelvin scale is _____ kelvin.

Answer: 0 (zero)

Objective: 2.2

Global Outcomes: GO2

3) The simplest type of pure substance is an _____.

Answer: element

Objective: 2.3

Global Outcomes: GO2

4) A mixture which has uniform properties is a _____ mixture.

Answer: homogeneous

Objective: 2.3

Global Outcomes: GO2

5) The change of state from solid to gas is termed _____.

Answer: sublimation

Objective: 2.4

Global Outcomes: GO2

6) When a liquid boils, the process by which the molecules leave its surface is called _____.

Answer: evaporation

Objective: 2.4

Global Outcomes: GO2

7) The units of specific heat are _____.

Answer: cal/g °C or J/g °C

Objective: 2.5

Global Outcomes: GO7

8) The nutritional calorie (Cal) is the same as _____ cal.

Answer: 1000

Objective: 2.6

Global Outcomes: GO7

9) Will the caloric value of a 100. g hamburger be higher or lower than the caloric value of 100. g of sugar?

Answer: higher. (2.6)

Objective: 2.6

Global Outcomes: GO2

10) Will the caloric value of a 100.g hamburger be higher or lower than the caloric value of 100. g of cooking oil?

Answer: lower

Objective: 2.6

Global Outcomes: GO2

Bromine (Br₂) has a freezing point of -7 °C, and a boiling point of 60 °C.

Indicate the state or change of state occurring at each temperature.

11) 30 °C

Answer: liquid

Objective: 2.4

Global Outcomes: GO3

12) 60 °C

Answer: boiling

Objective: 2.4

Global Outcomes: GO3

13) -7 °C

Answer: melting

Objective: 2.4

Global Outcomes: GO3

14) -15 °C

Answer: solid

Objective: 2.4

Global Outcomes: GO3

15) 70 °C

Answer: gas

Objective: 2.4

Global Outcomes: GO3

2.3 True/False Questions

1) As heat is removed from a solid, its temperature decreases.

Answer: TRUE

Objective: 2.1

Global Outcomes: GO2

2) Water freezes at 100 °C.

Answer: FALSE

Objective: 2.2

Global Outcomes: GO2

3) A solid has a constant shape and volume.

Answer: TRUE

Objective: 2.3

Global Outcomes: GO2

4) Molecules of a gas are very close together.

Answer: FALSE

Objective: 2.3

Global Outcomes: GO2

5) Water vapor is a gas.

Answer: TRUE

Objective: 2.4

Global Outcomes: GO2

6) When a liquid is boiling, its temperature does not change.

Answer: TRUE

Objective: 2.4

Global Outcomes: GO2

7) Condensation occurs when a liquid is converted to a solid.

Answer: FALSE

Objective: 2.4

Global Outcomes: GO2

8) As a solid melts, its temperature does not change.

Answer: TRUE

Objective: 2.4

Global Outcomes: GO2

9) The temperature at which water melts and freezes is the same.

Answer: TRUE

Objective: 2.4

Global Outcomes: GO2

10) The units of specific heat are cal g/°F.

Answer: FALSE

Objective: 2.5

Global Outcomes: GO2

11) Carbohydrates and proteins have the same caloric value per gram.

Answer: TRUE

Objective: 2.6

Global Outcomes: GO2

12) Condensation occurs when a liquid is converted to a solid.

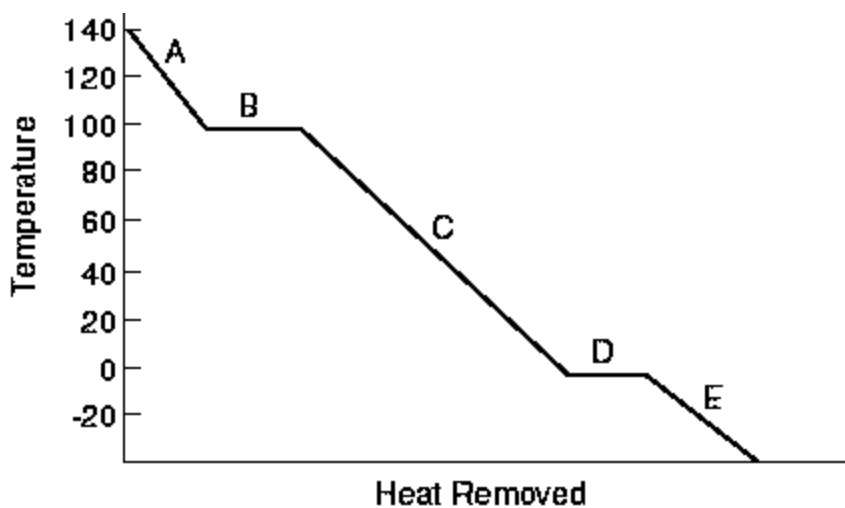
Answer: FALSE

Objective: 2.4

Global Outcomes: GO2

2.4 Matching Questions

Identify the physical state(s) corresponding to the regions on the cooling curve below.



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

1) A

Objective: 2.4

Global Outcomes: GO3

2) B

Objective: 2.4

Global Outcomes: GO3

3) C

Objective: 2.4

Global Outcomes: GO3

4) D

Objective: 2.4

Global Outcomes: GO3

5) E

Objective: 2.4

Global Outcomes: GO3

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

Match the state of matter with each of the following descriptions of a substance.

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

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

Objective: 2.4

Global Outcomes: GO2

7) Great distances exist between the particles.

Objective: 2.4

8) This substance is boiling.

Objective: 2.4

Global Outcomes: GO2

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

Objective: 2.4

Global Outcomes: GO2

10) This substance is melting.

Objective: 2.4

Global Outcomes: GO2

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

Identify each of the following transformations as a chemical or physical change

A) physical

B) chemical

11) water evaporating

Objective: 2.4

Global Outcomes: GO2

12) a button falling off of a shirt

Objective: 2.4

Global Outcomes: GO2

13) silver tarnishing

Objective: 2.4

Global Outcomes: GO2

14) cutting the grass

Objective: 2.4

Global Outcomes: GO2

15) a nail rusting

Objective: 2.4

Global Outcomes: GO2

16) baking a cake

Objective: 2.4

Global Outcomes: GO2

17) placing photographs in a scrapbook

Objective: 2.4

18) formation of green leaves on a plant

Objective: 2.4

Global Outcomes: GO2

19) burning leaves

Objective: 2.4

Global Outcomes: GO2

20) melting ice

Objective: 2.4

Global Outcomes: GO2

Answers: 11) A 12) A 13) B 14) A 15) B 16) B 17) A 18) B 19) B 20) A