Introductory Chemistry, 4e (Tro)
Chapter 3 Matter and Energy

True/False Questions

1) Matter is defined as anything that is visible to the human eye.
Answer: FALSE
Diff: 1 Page Ref: 3.2

2) An amorphous solid has long range, repeating order.
Answer: FALSE
Diff: 1 Page Ref: 3.3

3) Gases are the only form of matter that is compressible.
Answer: TRUE
Diff: 1 Page Ref: 3.3

4) Liquids have definite volume and indefinite shape.
Answer: TRUE
Diff: 1 Page Ref: 3.3

5) Solids have indefinite shape and volume.
Answer: FALSE
Diff: 1 Page Ref: 3.3

6) In a solid substance, the atoms or molecules oscillate and vibrate about a fixed point.
Answer: TRUE
Diff: 1 Page Ref: 3.3

7) Liquid and gas molecules can be compressed while in a solid, the molecules are incompressible.
Answer: FALSE
Diff: 1 Page Ref: 3.3

8) A compound is a substance that cannot be broken down into a simpler substance.
Answer: FALSE
Diff: 1 Page Ref: 3.4

9) Water is a mixture.
Answer: FALSE
Diff: 1 Page Ref: 3.4

10) Saltwater is a homogeneous mixture.
Answer: TRUE
Diff: 1 Page Ref: 3.4

11) Skim milk is a heterogeneous mixture.
Answer: FALSE
Diff: 1 Page Ref: 3.4

12) Air is a pure substance.
Answer: FALSE
Diff: 1 Page Ref: 3.4

13) Sugar is a pure substance.
Answer: TRUE
Diff: 1 Page Ref: 3.4

14) Chemical properties of a substance are those that can be observed without changing the composition of a substance.
Answer: FALSE
Diff: 1 Page Ref: 3.5

15) Flammability of gasoline is a chemical property.
Answer: TRUE
Diff: 1 Page Ref: 3.5

16) The odor of gasoline is a chemical property.
Answer: FALSE
Diff: 1 Page Ref: 3.5

17) In a chemical reaction, the substances present after the chemical change are called reactants.
Answer: FALSE
Diff: 1 Page Ref: 3.6

18) The melting of ice is a physical change.
Answer: TRUE
Diff: 1 Page Ref: 3.6

19) Mixtures of miscible liquids that differ in their boiling points may be separated by distillation.
Answer: TRUE
Diff: 1 Page Ref: 3.6

20) The corrosion of iron is a physical change.
Answer: FALSE
Diff: 1 Page Ref: 3.6

21) An example of a chemical change is burning a wood log to give a pile of ashes.
Answer: TRUE
Diff: 1 Page Ref: 3.6

22) In physical changes, the atoms or molecules that compose the matter do not change their identity, even though the matter may change its appearance.
Answer: TRUE
Diff: 1 Page Ref: 3.6

23) When you dissolve solid sugar into water, this new solution will taste sweet. The sugar went through a chemical change.
Answer: FALSE
Diff: 1 Page Ref: 3.6

24) A chemical change occurs when matter does not change its composition.
Answer: FALSE
Diff: 1 Page Ref: 3.6

25) Matter can be destroyed in a combustion reaction (such as burning fuel).
Answer: FALSE
Diff: 1 Page Ref: 3.7

26) Like mass, energy can neither be created nor destroyed.
Answer: TRUE
Diff: 1 Page Ref: 3.8

27) The energy of position is called kinetic energy.
Answer: FALSE
Diff: 1 Page Ref: 3.8

28) A moving bowling ball has kinetic energy.
Answer: TRUE
Diff: 1 Page Ref: 3.8

29) Electrical energy is associated with the flow of electrical charge.
Answer: TRUE
Diff: 1 Page Ref: 3.8

30) A melting scoop of ice cream is an example of an exothermic process.
Answer: FALSE
Diff: 1 Page Ref: 3.9

31) When a chemical "cold pack" is activated, the chemical reactants absorb heat from the surroundings.
Answer: TRUE
Diff: 1 Page Ref: 3.9

32) The process of boiling water is an endothermic process.
Answer: TRUE
Diff: 1 Page Ref: 3.9

33) A chemical change that will lower the potential energy of the chemical results in an endothermic reaction.
Answer: FALSE
Diff: 1 Page Ref: 3.9

34) An energy diagram that shows the products having higher energy than the reactants illustrates an endothermic reaction.
Answer: TRUE
Diff: 1 Page Ref: 3.9

35) Temperature is simply a measure of the motion of atoms and molecules.
Answer: TRUE
Diff: 1 Page Ref: 3.10

36) Temperature is defined as the transfer of thermal energy caused by a temperature difference.
Answer: FALSE
Diff: 1 Page Ref: 3.10

37) The coldest temperature possible is 0 K.
Answer: TRUE
Diff: 1 Page Ref: 3.10

38) Temperatures reported in the Kelvin scale cannot be negative.
Answer: TRUE
Diff: 1 Page Ref: 3.10

39) Absolute zero is equivalent to a temperature of -273 K.
Answer: FALSE
Diff: 1 Page Ref: 3.10

40) A kelvin degree is the same size as a Celsius degree.
Answer: TRUE
Diff: 1 Page Ref: 3.10

41) The temperature of 0°F is colder than the temperature of 0°C.
Answer: TRUE
Diff: 1 Page Ref: 3.10

42) The amount of heat energy needed to increase the temperature of an object will vary depending on the heat capacity of the object.
Answer: TRUE
Diff: 1 Page Ref: 3.11

43) The heat capcity of a substance is the quantity of thermal heat required to change the temperature of a given amount of the substance by 100°C.
Answer: FALSE
Diff: 1 Page Ref: 3.11

44) The large heat capacity of water produces large fluctuations in temperature near bodies of water during the summer months.
Answer: FALSE
Diff: 1 Page Ref: 3.11

Multiple Choice Questions

1) Which of the following statements about matter is FALSE?
A) Matter occupies space and has mass.
B) Matter exists in either a solid, liquid or gas state.
C) Matter is ultimately composed of atoms.
D) Matter is smooth and continuous.
E) none of the above
Answer: D
Diff: 1 Page Ref: 3.2

2) Which of the following is NOT an example of *matter*?
A) a pencil eraser
B) a balloon full of helium
C) a dust particle
D) heat from a burning candle
E) none of the above
Answer: D
Diff: 1 Page Ref: 3.2

3) A solid form of matter in which there is long range repeating order is called _____.
A) amorphous
B) rigid
C) crystalline
D) fixed
E) none of the above
Answer: C
Diff: 1 Page Ref: 3.3

4) Which state of matter has atomic spacing that is close together and indefinite shape?
A) liquid
B) solid
C) gas
D) plasma
E) none of the above
Answer: A
Diff: 1 Page Ref: 3.3

5) Which state of matter has indefinite shape and is compressible?
A) liquid
B) solid
C) gas
D) plasma
E) none of the above
Answer: C
Diff: 1 Page Ref: 3.3

6) Which state of matter has atomic spacing that is close together and definite shape?
A) liquid
B) solid
C) gas
D) plasma
E) none of the above
Answer: B
Diff: 1 Page Ref: 3.3

7) Which among the following statements is FALSE?
A) A solid has a definite shape and a definite volume.
B) A liquid has a definite volume; but it has no definite shape.
C) A gas has neither definite volume nor definite shape.
D) Both solids and liquids are incompressible while gases are compressible.
E) none of the above
Answer: E
Diff: 1 Page Ref: 3.3

8) Which state of matter has atomic spacing that is far apart and definite shape?
A) liquid
B) solid
C) gas
D) plasma
E) none of the above
Answer: E
Diff: 1 Page Ref: 3.3

9) A pure substance is:
A) composed of two or more different types of atoms or molecules combined in variable proportions.
B) composed of only one type of atom or molecule.
C) composed of two or more regions with different compositions.
D) composed of two or more different types of atoms or molecules that has constant composition.
E) none of the above
Answer: B
Diff: 1 Page Ref: 3.4

10) Which of the following items is a pure substance?
A) air
B) seawater
C) brass
D) ice
E) none of the above
Answer: D
Diff: 1 Page Ref: 3.4

11) Which of the following items is a mixture?
A) water
B) helium
C) brass
D) sugar
E) none of the above
Answer: C
Diff: 1 Page Ref: 3.4

12) Which of the following is a heterogenous mixture?
A) milk
B) sugar water
C) raisin bran
D) air
E) none of the above
Answer: C
Diff: 1 Page Ref: 3.4

13) Which of the following is a homogeneous mixture?
A) trail mix
B) stainless steel
C) water
D) molten iron
E) none of the above
Answer: B
Diff: 1 Page Ref: 3.4

14) Which of the following statements about compounds is TRUE?
A) A substance that cannot be broken down into simpler substances.
B) A pure substance that has variable composition throughout.
C) A substance composed of two or more elements in fixed, definite proportions.
D) A substance that is not as common as pure elements.
E) none of the above
Answer: C
Diff: 1 Page Ref: 3.4

15) Which of the following statements is FALSE?
A) Matter may be a pure substance or it may be a mixture.
B) A pure substance may either be an element or a compound.
C) A mixture may be either homogeneous or heterogeneous.
D) Mixtures may be composed of two or more elements, two or more compounds, or a combination of both.
E) All of the above statements are true.
Answer: E
Diff: 1 Page Ref: 3.4

16) How would you classify salt water?
A) pure substance-compound
B) mixture-heterogeneous
C) pure substance-element
D) mixture-homogeneous
E) none of the above
Answer: D
Diff: 1 Page Ref: 3.4

17) How would you classify raisin bran?
A) pure substance-compound
B) mixture-heterogeneous
C) pure substance-element
D) mixture-homogeneous
E) none of the above
Answer: B
Diff: 1 Page Ref: 3.4

18) How would you classify sugar?
A) pure substance-compound
B) mixture-heterogeneous
C) pure substance-element
D) mixture-homogeneous
E) none of the above
Answer: A
Diff: 1 Page Ref: 3.4

19) A solution is an example of a (an)
A) pure substance.
B) element.
C) compound.
D) homogeneous mixture.
E) heterogeneous mixture.
Answer: D
Diff: 1 Page Ref: 3.4

20) Physical properties are:
A) those that a substance displays only through changing its composition.
B) those that cause atoms and molecules to change.
C) those that a substance displays without changing its composition.
D) identical for all solid matter.
E) none of the above
Answer: C
Diff: 1 Page Ref: 3.5

21) All of the following can be considered physical properties EXCEPT
A) taste.
B) color.
C) flammability.
D) density.
E) boiling point.
Answer: C
Diff: 1 Page Ref: 3.5

22) Which of the following items is a physical property?
A) the corrosive action of acid rain on granite
B) the odor of spearmint gum
C) the combustion of gasoline
D) the tarnishing of a copper statue
E) none of the above
Answer: B
Diff: 1 Page Ref: 3.5

23) Which of the following items is a chemical property?
A) the paint color on a new red Corvette
B) the odor of spearmint gum
C) the melting and boiling point of water
D) the tarnishing of a copper statue
E) none of the above
Answer: D
Diff: 1 Page Ref: 3.5

24) Which of the following statements about physical and chemical changes is FALSE?
A) In a chemical change, matter changes its composition.
B) In a physical change, matter does not change its composition.
C) Phase changes are always physical changes.
D) Chemical reactions are chemical changes.
E) All of the above statements are true.
Answer: E
Diff: 1 Page Ref: 3.6

25) If you hold a solid piece of pure gallium metal in your hand, your body heat will melt the gallium into its liquid form. This illustrates which of the following?
A) distillation
B) physical change
C) chemical change
D) chemical property
E) none of the above
Answer: B
Diff: 1 Page Ref: 3.6

26) Which statement below best describes the process of the paint on a vehicle fading over time?
A) Chemical change because the paint molecules are changing composition.
B) Physical change because the paint molecules are still paint molecules.
C) Chemical change because the paint molecules are changing phases.
D) Physical change because the paint molecules have risen to the surface of the clear coat finish.
E) none of the above
Answer: A
Diff: 1 Page Ref: 3.6

27) When methane is burned with oxygen the products are carbon dioxide and water. If you produce 36 grams of water and 44 grams of carbon dioxide from 16 grams of methane, how many grams of oxygen were needed for the reaction?
A) 32
B) 80
C) 96
D) 64
E) none of the above
Answer: D
Diff: 1 Page Ref: 3.7

28) When methane is burned with oxygen, the products are carbon dioxide and water. If you produce 18 grams of water from 8 grams of methane and 32 grams of oxygen, how many grams of carbon dioxide were produced in the reaction?
A) 40
B) 22
C) 58
D) 18
E) none of the above
Answer: B
Diff: 1 Page Ref: 3.7

29) When methane is burned with oxygen, the products are carbon dioxide and water. If you produce 9 grams of water and 11 grams of carbon dioxide from 16 grams of oxygen, how many grams of methane were needed for the reaction?
A) 4
B) 20
C) 31
D) 40
E) none of the above
Answer: A
Diff: 1 Page Ref: 3.7

30) Which of the following statements about energy is FALSE?
A) An object possessing energy can do work on another object.
B) Energy can neither be created nor destroyed.
C) Energy is the single main component of the universe.
D) Energy is the capacity to do work.
E) All of the above statements are true.
Answer: C
Diff: 1 Page Ref: 3.8

31) Which type of energy is associated with motion?
A) chemical
B) electrical
C) potential
D) kinetic
E) none of the above
Answer: D
Diff: 1 Page Ref: 3.8

32) Which type of energy is associated with position?
A) chemical
B) electrical
C) potential
D) kinetic
E) none of the above
Answer: C
Diff: 1 Page Ref: 3.8

33) What type of energy is associated with the burning of gasoline?
A) kinetic
B) potential
C) electrical
D) chemical
E) none of the above
Answer: D
Diff: 1 Page Ref: 3.8

34) Which of the following items is NOT a common unit of energy?
A) joule
B) torr
C) calorie
D) kilowatt-hour
E) none of the above
Answer: B
Diff: 1 Page Ref: 3.8

35) How many calories are there in a 255 Calorie snack bar?
A) 2.55×10^5
B) 1.07×10^3
C) 60.9
D) 1×10^3
E) none of the above
Answer: A
Diff: 1 Page Ref: 3.8

36) How many joules are there in a 255 calorie snack bar?
A) 2.55×10^5
B) 1.07×10^6
C) 1.07×10^3
D) 6.09×10^4
E) none of the above
Answer: C
Diff: 2 Page Ref: 3.8

37) How many kilojoules are there in 95.0 Calories?
A) 2.27×10^7
B) 3.97×10^{-4}
C) 397
D) 22.7
E) none of the above
Answer: C
Diff: 2 Page Ref: 3.8

38) If a particular process is endothermic, the reverse process must be a (an)
A) chemical change.
B) isothermal process.
C) exothermic process.
D) endothermic process.
E) none of the above
Answer: C
Diff: 1 Page Ref: 3.9

39) An energy diagram that shows the reactants having greater energy than the products illustrates an
A) endothermic reaction.
B) exothermic reaction.
C) isothermic reaction.
D) impossible reaction.
E) none of the above
Answer: B
Diff: 1 Page Ref: 3.9

40) If a solid piece of shiny sodium metal is exposed to chlorine gas, a large amount of heat is released and the white solid sodium chloride (table salt) forms. Based on this information, which of the following statements is TRUE?
A) This process represents a physical change.
B) Mass is lost during this process.
C) Sodium chloride is an element.
D) This process was exothermic.
E) none of the above
Answer: D
Diff: 1 Page Ref: 3.9, 3.4, 3.6

41) In order, what is the freezing point, room temperature and boiling point of water according to the Fahrenheit scale?
A) 32-75-212
B) 0-75-100
C) 0-25-100
D) 0-298-373
E) none of the above
Answer: A
Diff: 1 Page Ref: 3.10

42) In order, what is the freezing point, room temperature and boiling point of water according to the Celsius scale?
A) 32-75-212
B) 0-75-100
C) 0-25-100
D) 0-298-373
E) none of the above
Answer: C
Diff: 1 Page Ref: 3.10

43) The boiling point of water is
(1) 212 °F (2) 0°C (3) 373 K
A) 1 and 2 only
B) 2 and 3 only
C) 1 and 3 only
D) all of 1, 2, and 3
E) none of 1, 2, and 3
Answer: C
Diff: 2 Page Ref: 3.10

44) What is the value of 27°C on the Kelvin temperature scale?
A) 273
B) 246
C) 300
D) 81
E) none of the above
Answer: C
Diff: 1 Page Ref: 3.10

45) What is the value of 27°C on the Fahrenheit temperature scale?
A) -6.8
B) 106
C) 300
D) 81
E) none of the above
Answer: D
Diff: 1 Page Ref: 3.10

46) What is the value of 98 °F in units of °C?
A) 72
B) 37
C) 371
D) 22
E) none of the above
Answer: B
Diff: 1 Page Ref: 3.10

47) What is the value of 335 K on the Celsius temperature scale?
A) 62
B) 167
C) 608
D) 66.4
E) none of the above
Answer: A
Diff: 1 Page Ref: 3.10

48) Melting point can be defined as the temperature when a solid becomes a liquid. The melting point of the chemical *acetone* is -95°C. Which state of matter would you expect to exist for acetone at a temperature of -94°C?
A) solid
B) liquid
C) gas
D) plasma
Answer: B
Diff: 2 Page Ref: 3.10

49) In calculating the relationship between the amount of heat added to a substance and the corresponding temperature change, the specific heat capacity is usually represented by which symbol?
A) C
B) q
C) ΔT
D) m
E) none of the above
Answer: A
Diff: 3 Page Ref: 3.11

50) A 15.0 gram lead ball at 25.0°C was heated with 40.5 joules of heat. Given the specific heat of lead is 0.128 J/g·°C, what is the final temperature of the lead?
A) 21.1°C
B) 46.1°C
C) 77.8°C
D) 0.844°C
E) none of the above
Answer: B
Diff: 3 Page Ref: 3.11

51) What is the specific heat (J/g·°C) of a metal object whose temperature increases by 3.0°C when 17.5 g of metal was heated with 38.5 J?
A) 4.18
B) 0.15
C) 0.73
D) 1.4
E) none of the above
Answer: C
Diff: 3 Page Ref: 3.11

52) How much heat (kJ) is needed to raise the temperature of 100.0 grams of water from 25.0°C to 50.0°C?
A) 10450
B) 0.598
C) 1.05
D) 10.5
E) none of the above
Answer: D
Diff: 2 Page Ref: 3.11

53) From the following list of substances and heat capacities, choose the one that will have the lowest temperature after absorbing 100.0 kJ of heat. Assume identical masses of each substance start at the same initial temperature.
A) lead-0.128 J/g·°C
B) copper-0.385 J/g·°C
C) ethanol-2.42 J/g·°C
D) water-4.18 J/g·°C
E) not enough information
Answer: D
Diff: 3 Page Ref: 3.11

54) Consider the following specific heats of metals.

Metal	Specific Heat (J/g·°C)
Aluminum	0.903
Copper	0.385
Gold	0.128
Iron	0.449
Silver	0.235

If the same amount of heat is added to 50.0 g samples of each of the metals, which are all at the same temperature, which metal will reach the highest temperature?
A) aluminum
B) copper
C) gold
D) iron
E) silver
Answer: C
Diff: 3 Page Ref: 3.11

55) When 49.5 J of heat was transferred to 7.3 g iron at 22°C, the temperature of iron increases to 37°C. What is the specific heat of iron in J/g·°C?
A) 4.5
B) 0.45
C) 2.2
D) 24
E) none of the above
Answer: B
Diff: 3 Page Ref: 3.11

56) Suppose it took 108 joules of energy to raise a bar of gold from 25.0°C to 29.7°C. Given that the specific heat capacity of gold is 0.128 J/g·°C, what is the mass (in grams) of the bar of gold?
A) 6.5×10^1 g
B) 1.8×10^2 g
C) 1.28×10^2 g
D) 1.08×10^2 g
E) none of the above
Answer: B
Diff: 2 Page Ref: 3.12

Algorithmic Questions

1) How many Calories are in 575.0 calories?
A) 575,000
B) 0.5750
C) 137.6
D) 2,404
E) none of the above
Answer: B
Diff: 1 Page Ref: 3.8

2) How many joules are in 55.2 calories?
A) 13,200
B) 55,200
C) 13.2
D) 231
E) none of the above
Answer: D
Diff: 1 Page Ref: 3.8

3) What is the value of -25°C on the Kelvin scale?
A) 248
B) -32
C) -13
D) -298
E) none of the above
Answer: A
Diff: 1 Page Ref: 3.10

4) What is the value of 27°C on the Fahrenheit scale?
A) 73
B) 52
C) 81
D) 91
Answer: A
Diff: 3 Page Ref: 3.10

5) What is the value of 783 K in units of °C?
A) 417
B) 1441
C) 510.
D) 1056
E) none of the above
Answer: C
Diff: 1 Page Ref: 3.10

6) Given the table of specific heat values below, what is the identity of a 10.0 g metal sample that increases by 14.0°C when 62.9 J of energy is absorbed?

Element	Specific Heat(J/g°C)
Au	0.128
Ag	0.235
Cu	0.385
Fe	0.449
Al	0.903

A) Fe
B) Al
C) Au
D) Ag
E) none of the above
Answer: A
Diff: 1 Page Ref: 3.11

7) Given the table of specific heat values below, what is the identity of a 26.2 g metal sample that increases by 8.5°C when 100.0 J of energy is absorbed?

Element	Specific Heat(J/g°C)
Au	0.128
Ag	0.235
Cu	0.385
Fe	0.449
Al	0.903

A) Fe
B) Al
C) Au
D) Ag
E) none of the above
Answer: A
Diff: 1 Page Ref: 3.11

8) How much heat (kJ) is absorbed by 948.0 g of water in order for the temperature to increase from 25.00°C to 32.50°C?
A) 7.5
B) 31.4
C) 30.2
D) 29.7
E) none of the above
Answer: D
Diff: 3 Page Ref: 3.11

9) What is the final temperature of 25.0 grams of water at 22.0°C after it absorbs 454 J of heat?
A) 17.7
B) 4.29
C) 26.3
D) 15.8
E) none of the above
Answer: C
Diff: 3 Page Ref: 3.11

10) How many grams of water when supplied with 348 J of heat will gain a temperature of 5.2°C?
A) 15
B) 17
C) 19
D) 16
E) none of the above
Answer: D
Diff: 1 Page Ref: 3.11