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Chapter 1
What Is Chemistry?

True/False

1. Chemistry is the study of the interactions of matter with other matter and with energy.
   ANS: T **DIF: Easy** **REF: 1.1**

2. **Matter is anything that has a mass and takes up space.**
   ANS: T **DIF: Easy** **REF: 1.1**

3. Air found inside an empty chamber cannot be classified as matter.
   ANS: F **DIF: Easy** **REF: 1.1**

4. Physical properties are characteristics of matter that describe how matter changes form in the presence of other matter.
   ANS: F **DIF: Easy** **REF: 1.1**

5. Chemical properties are characteristics that describe matter as it exists.
   ANS: F **DIF: Easy** **REF: 1.1**

6. A physical change occurs when a sample of matter changes one or more of its physical properties.
   ANS: T **DIF: Easy** **REF: 1.1**

7. A burning sparkler is an example of chemical change.
   ANS: T **DIF: Easy** **REF: 1.1**

8. Ice melting is an example of a chemical change.
   ANS: F **DIF: Easy** **REF: 1.1**

9. A sample of matter that has the different physical and chemical properties throughout is called a substance.
   ANS: F **DIF: Easy** **REF: 1.1**

10. An element can be broken down into simpler chemical substances by chemical reactions.
    ANS: F **DIF: Easy** **REF: 1.1**

11. A compound is a combination of more than one element.
    ANS: T **DIF: Easy** **REF: 1.1**

12. A compound's physical and chemical properties are different than the physical and chemical properties of its constituent elements.
    ANS: T **DIF: Easy** **REF: 1.1**

13. Table salt has the same physical properties as its constituent elements, sodium and chlorine gas.
    ANS: F **DIF: Medium** **REF: 1.1**

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14. Carbonated water, before it is opened, is an example of heterogeneous mixtures.
ANS: F DIF: Medium REF: 1.1
(the CO_2 dissolved in the water makes it homogeneous. However, students will think of the water after it is opened, the CO_2 bubbles are present making it look like it is heterogeneous.)

15. Solution is another word used to describe homogenous mixtures.
ANS: F DIF: Easy REF: 1.1

16. A metal is an element that is brittle at room temperature.
ANS: F DIF: Easy REF: 1.1

17. Elements that have properties of both metals and nonmetals and are called antimetals.
ANS: F DIF: Easy REF: 1.1

18. Nonmetals do not conduct electricity or heat very well.
ANS: T DIF: Easy REF: 1.1

19. A semimetal can have properties of both metals and nonmetals.
ANS: T DIF: Easy REF: 1.1

20. Another name for a heterogeneous mixture is a solution.
ANS: F DIF: Easy REF: 1.1

21. Science is the process of knowing about the natural universe through observation and experiment.
ANS: T DIF: Easy REF: 1.2

22. A hypothesis is a general statement that explains a large number of observations.
ANS: F DIF: Easy REF: 1.2

23. Experiments are not performed if a hypothesis exists on the issue to be tested.
ANS: F DIF: Easy REF: 1.2

24. A law is a specific statement that is thought to be never violated by the entire natural universe.
ANS: T DIF: Easy REF: 1.2

25. Science is concerned only with the natural universe.
ANS: T DIF: Easy REF: 1.2

26. Physics and astronomy are scientific fields concerned with the fundamental interactions between matter and energy.
ANS: T DIF: Easy REF: 1.2

27. Chemistry is widely regarded as the language of science.
ANS: F DIF: Easy REF: 1.2

28. A qualitative description implies a description of the extent to which a compound is used in a reaction.
ANS: F DIF: Easy REF: 1.2

29. The temperature outside is 95 degrees Fahrenheit; this is an example of a quantitative description.
ANS: T DIF: Easy REF: 1.2

30. A qualitative description means knowing how much of something is present.
ANS: F DIF: Easy REF: 1.2

31. A speed limit is an example of a law as the term "law" is used by science.
ANS: F DIF: Easy REF: 1.2

32. In science, the terms "hypothesis" and "theory" have the same meaning.
ANS: F DIF: Easy REF: 1.2

Multiple Choice Questions

33. Which of the following statements is the correct description of chemistry?
a. It is the study of the interactions of matter with other matter and with energy.
b. It is the study of the static behavior of particles and substances.
c. It is the study of conversion of one form of energy to another form.
d. It is the science that deals with kinetic and potential energy.
e. It is the science that deals with matter, energy, and force.
ANS: a DIF: Easy REF: 1.1

34. Anything that has mass and takes up space is known as _____.
a. gravity
b. matter
c. leverage
d. vacuum
e. force
ANS: b DIF: Easy REF: 1.1

35. Which of the following is not classified as matter?
a. air in a room
b. gas in a chamber
c. blood in blood vessels
d. thoughts of a human brain
e. air in human lungs
ANS: d DIF: Easy REF: 1.1

36. Which of the following statements describes a chemical property?
a. Mercury is the only metal that exists as a liquid at room temperature.
b. Women usually have long nails.
c. The stereo system is silver in color.
d. A kilogram of iron weighs one thousand grams.
e. Sodium reacts with water to produce sodium hydroxide and hydrogen.
ANS: e DIF: Moderate REF: 1.1

37. Chemical properties are characteristics of matter that describe
a. how matter changes form in the presence of other matter.
b. how matter changes form when it releases kinetic or static energy.

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c. how matter changes form when it acquires static energy.
d. how matter changes form when it acquires kinetic energy.
e. how matter changes form when it is heated or cooled.
ANS: a DIF: Easy REF: 1.1

38. Which of the following is an example of chemical change?
a. Ice melts to form water.
b. Water is turned to steam by heating.
c. Temperature of the engine goes up by 5°C.
d. Alkanes have less mass than alkenes.
e. Alkanes burn in the presence of oxygen.
ANS: e DIF: Easy REF: 1.1

39. A burning matchstick is an example of a(n) _____ change.
a. physical
b. mechanical
c. chemical
d. ionic
e. nuclear
ANS: c DIF: Easy REF: 1.1

40. A sample of matter that has the same physical and chemical properties throughout is called a _____.
a. form
b. base
c. substance
d. particle
e. structure
ANS: c DIF: Easy REF: 1.1

41. A(n) _____ is the simplest type of chemical substance; it cannot be broken down into simpler chemical substances by ordinary chemical means.
a. compound
b. element
c. mixture
d. base
e. structure
ANS: b DIF: Easy REF: 1.1

42. A _____ is a combination of more than one element.
a. physical change
b. phase
c. thought
d. chemical change
e. compound
ANS: e DIF: Easy REF: 1.1

43. Which of the following is an example of a heterogeneous mixture?
a. oxygen dissolved in water
b. carbon dioxide dissolved in water
c. sodium chloride in water

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d. a combination of salt and steel wool
e. a combination of oxygen and hydrogen
ANS: a DIF: Moderate REF: 1.1

44. A(n) _____ is an element that is solid at room temperature, is shiny and silvery, conducts electricity and heat well, can be pounded into thin sheets, and can be drawn into thin wires.
a. sub-atom
b. metal
c. ion
d. semimetal
e. nonmetal
ANS: b DIF: Easy REF: 1.1

45. Which of the following properties allows elements to be pounded into thin sheets?
a. conductivity
b. resistivity
c. malleability
d. ductility
e. impeditivity
ANS: c DIF: Easy REF: 1.1

46. Which of the following properties allows elements to be drawn into thin wires?
a. malleability
b. ductility
c. conductivity
d. resistivity
e. impeditivity
ANS: b DIF: Easy REF: 1.1

47. A nonmetal is an element that is _____.
a. brittle when solid
b. conductive to electricity
c. hard when solid
d. conductive to heat
e. characterized by high ductility
ANS: a DIF: Moderate REF: 1.1

48. Which of the following terms refers to the elements that have properties of both metals and nonmetals?
a. base metals
b. precious metals
c. noble metals
d. metalloids/semimetals
e. extracted metals
ANS: d DIF: Easy REF: 1.1

49. A combination of salt and pepper, in which both components are easily visible, is best described as a:
a. solution
b. homogeneous solution

c. heterogeneous solution
d. compound
e. physical property
ANS: c DIF: Easy REF: 1.1

50. _____ can be regarded as the process of knowing about the natural universe through observation and experiment.
a. Science
b. Civics
c. History
d. Psychology
e. Geography
ANS: a DIF: Easy REF: 1.2

51. Which of the following terms refers to an educated guess about how the natural universe works?
a. experimentation
b. empirical analysis
c. hypothesis
d. postdiction
e. intuition
ANS: c DIF: Easy REF: 1.2

52. Which of the following is the first step in a scientific method?
a. forming a theory
b. stating a hypothesis
c. refining a hypothesis
d. validating assumptions
e. validating a theory
ANS: b DIF: Easy REF: 1.2

53. Which of the following refer to tests of the natural universe to see if a hypothesis is correct?
a. sequences
b. topology
c. internship
d. amendments
e. experiments
ANS: e DIF: Easy REF: 1.2

54. A(n) _____ is a general statement that explains a large number of observations.
a. hypothesis
b. model
c. purpose
d. theory
e. experiment
ANS: d DIF: Easy REF: 1.2

55. A specific statement that is thought to be never violated by the entire natural universe is called a(n) _____.

a. premise
b. hypothesis
c. law
d. theory
e. observation
ANS: c DIF: Easy REF: 1.2

56. The fact that all matter attracts all other matter is an example of a(n) _____.
a. law
b. observation
c. argument
d. purpose
e. hypothesis
ANS: a DIF: Easy REF: 1.2

57. Which of the following scientific fields is known as the language of science?
a. physics
b. mathematics
c. chemistry
d. botany
e. zoology
ANS: b DIF: Easy REF: 1.2

58. A _____ description implies a description of the features of an object.
a. static
b. quantitative
c. qualitative
d. descriptive
e. dynamic
ANS: c DIF: Easy REF: 1.2

59. Which of the following types of descriptions represents the specific amount of something?
a. qualitative
b. descriptive
c. static
d. dynamic
e. quantitative
ANS: e DIF: Easy REF: 1.2

60. The compound sulfur is yellow colored. This description of sulfur is an example of a _____ description.
a. qualitative
b. dynamic
c. static
d. quantitative
e. descriptive
ANS: a DIF: Easy REF: 1.2

61. A scientist drops two different pieces of matter to see if they fall at different speeds. This activity is best described as a(n) _____.

a. experiment
b. theory
c. law
d. hypothesis
e. science
ANS: a DIF: Easy REF: 1.2

62. A colleague remarks "English is not a science and so is not worth studying." Which statement would be the best reply?
a. "Not all topics worth knowing are classified as science."
b. "You're correct; let's ignore anything that isn't science."
c. "English is the only language science uses, so we need to learn some of it."
d. "Studying any language is a waste of time."
e. "If English were expressed using numbers, it would be important to science."
ANS: a DIF: Easy REF: 1.2

Essay Questions

63. What is matter? Explain by providing examples.
Matter is anything that has mass and takes up space. A book, a computer, and food are examples of matter. Air is also an example of matter because it occupies space.
DIF: Easy REF: 1.1

64. What is meant by physical properties of matter?
Physical properties are characteristics that describe matter as it exists. Some of many physical characteristics of matter are shape, color, size, and temperature. An important physical property is the phase (or state) of matter. The three fundamental phases of matter are solid, liquid, and gas.
DIF: Easy REF: 1.1

65. What is meant by chemical properties of matter?
Chemical properties are characteristics of matter that describe how matter changes form in the presence of other matter. Burning is an example of a chemical property.
DIF: Easy REF: 1.1

66. What is physical change? Provide an example.
A physical change occurs when a sample of matter changes one or more of its physical properties. For example, a solid may melt, or alcohol in a thermometer may change volume as the temperature changes. A physical change does not affect the chemical composition of matter.
DIF: Easy REF: 1.1

67. From the following, which is not an example of a chemical change? Be sure to explain your reasoning.
1. Burning a plastic water bottle
2. Production of hydrogen gas from water
3. Tarnishing a copper penny
4. Chopping a log into sawdust
5. Charging a cell phone

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A chemical change is the process of demonstrating a chemical property. Chopping a log into sawdust is an example of a physical change and not a chemical change. The log is being chopped into smaller pieces, but is not changing the chemical composition of the log. The other choices are all examples of chemical changes. Chemical changes are frequently accompanied by physical changes, as the new matter will likely have different physical properties from the original matter.
DIF: Moderate **REF: 1.1**

68. What is called a substance? Provide an example.
A sample of matter that has the same physical and chemical properties throughout is called a substance. Examples are carbon blocks, water etc.
DIF: Easy **REF: 1.1**

69. What are elements? Compare elements with compounds.
An element is the simplest type of chemical substance. It cannot be broken down into simpler chemical substances by ordinary chemical means. Each element has its own unique set of physical and chemical properties. Examples of elements include iron, carbon, and gold. A compound is a combination of more than one element. The physical and chemical properties of a compound are different from the physical and chemical properties of its constituent elements.
DIF: Moderate **REF: 1.1**

70. What are mixtures? Write the types of mixtures, and then give an example for each type.
Physical combinations of more than one substance are called mixtures. There are two types of mixtures. A heterogeneous mixture is a mixture composed of two or more substances (oil and water). It is easy to tell, sometimes by the naked eye, that more than one substance is present. A homogeneous mixture is a combination of two or more substances that is so intimately mixed that the mixture behaves as a single substance (salt water).
DIF: Moderate **REF: 1.1**

71. What is a metal? How is it different from a nonmetal?
A metal is an element that is solid at room temperature, is shiny and silvery, conducts electricity and heat well, can be pounded into thin sheets, and can be drawn into thin wires. A nonmetal is an element that is brittle when solid, does not conduct electricity or heat very well, and cannot be made into thin sheets or wires. Nonmetals also exist in a variety of phases and colors at room temperature.
DIF: Easy **REF: 1.1**

72. Explain the concepts of malleability and ductility.
Metals can be pounded into thin sheets. This property is called malleability.
Metals can be drawn into thin wires. This property is called ductility.
DIF: Easy **REF: 1.1**

73. What is science? What is its importance?
Science is the process of knowing about the natural universe through observation and experiment. Science is not the only process of knowing, but it has evolved over more than 350 years into the best process that humanity has devised to date to learn about the universe around us.
DIF: Easy **REF: 1.2**

74. What is a hypothesis? Provide an example.
An educated guess about how the natural universe works is called a hypothesis. 'If I mix one part of hydrogen with one part of oxygen, I can make a substance that contains both the elements.' This is made before an experiment.
DIF: Easy **REF: 1.2**

75. What are experiments? Why are they used?
Experiments are tests of the natural universe to see if a hypothesis is correct. An experiment to test our previous hypothesis would be to actually mix hydrogen and oxygen and see what happens. Most experiments include observations of small, well-defined parts of the natural universe designed to see results of the experiments.
DIF: Moderate **REF: 1.2**

76. What is a theory? Provide an example.
A theory is a general statement that explains a large number of observations. "All matter is composed of atoms" is a general statement, a theory, which explains many observations in chemistry.
DIF: Easy **REF: 1.2**

77. Science can be either qualitative or quantitative. Explain with examples.
Qualitative implies a description of the quality of an object. For example, physical properties are generally qualitative descriptions: sulfur is yellow, your math book is heavy, or that statue is pretty. A quantitative description represents the specific amount of something; it means knowing how much of something is present, usually by counting or measuring it.
DIF: Moderate **REF: 1.2**

Fill in the Blanks

78. _____ is the study of the interactions of matter with other matter and with energy.
ANS: Chemistry **DIF: Easy** **REF: 1.1**

79. Anything that has mass and takes up space can be called _____.
ANS: matter **DIF: Easy** **REF: 1.1**

80. A(n) _____ refers to a characteristic that describes matter as it exists.
ANS: physical property **DIF: Easy** **REF: 1.1**

81. A(n) _____ refers to a change that occurs when a sample of matter changes one or more of its physical properties.
ANS: physical change **DIF: Easy** **REF: 1.1**

82. A(n) _____ change is the process of demonstrating a chemical property.
ANS: chemical **DIF: Easy** **REF: 1.1**

83. A(n) _____ refers to a substance that cannot be broken down into simpler chemical substances by ordinary chemical means.
ANS: element **DIF: Easy** **REF: 1.1**

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84. A(n) _____ is a combination of more than one element and its physical and chemical properties are different from the physical and chemical properties of its constituent elements.
ANS: compound DIF: Easy REF: 1.1

85. The constituents of a mixture that are clearly visible to the naked eye, is called a(n) _____.
ANS: heterogeneous mixture DIF: Easy REF: 1.1

86. A combination of two or more substances that is so intimately mixed that the mixture behaves as a single substance is called a(n) _____.
ANS: homogeneous mixture DIF: Easy REF: 1.1

87. _____ is the process of knowing about the natural universe through observation and experiment.
ANS: Science DIF: Easy REF: 1.2

88. A(n) _____ refers to an educated guess about how the natural universe works.
ANS: hypothesis DIF: Easy REF: 1.2

89. A(n) _____ refers to a test of the natural universe to see if a guess (hypothesis) is correct.
ANS: experiment DIF: Easy REF: 1.2

90. A(n) _____ is a general statement that explains a large number of observations.
ANS: theory DIF: Moderate REF: 1.2

91. A(n) _____ refers to a specific statement that is thought to be never violated by the entire natural universe.
ANS: law DIF: Easy REF: 1.2

92. A(n) _____ description represents the specific amount of something.
ANS: quantitative DIF: Easy REF: 1.2

93. A(n) _____ description describes some property of something.
ANS: qualitative DIF: Easy REF: 1.2