CHAPTER 2—LIFE, CHEMISTRY, AND WATER

MULTIPLE CHOICE

1. According to studies by Norman Terry and coworkers, some plants can perform a version of bioremediation of selenium in wastewater by
   a. converting selenium to a form that kills waterfowl.
   b. using selenium to make a necessary supplement for humans.
   c. converting selenium into a relatively nontoxic gas.
   d. storing selenium in the soil.
   e. increasing the selenium concentration in the water.

   ANS: C PTS: 1 DIF: Easy
   OBJ: Bloom's Taxonomy: Knowledge TOP: 2.0 WHY IT MATTERS

2. The laws of chemistry and physics that govern living things are ____ the laws of chemistry and physics that govern nonliving things.
   a. different from
   b. the same as
   c. roughly half the same as and half different from
   d. mostly different from
   e. mostly the same as

   ANS: B PTS: 1 DIF: Easy
   OBJ: Bloom's Taxonomy: Knowledge TOP: 2.0 WHY IT MATTERS

3. A substance that cannot be broken down into simpler substances by ordinary chemical or physical techniques is a(n) ____.
   a. molecule
   b. chemical
   c. compound
   d. element
   e. biological compound

   ANS: D PTS: 1 DIF: Easy
   OBJ: Bloom's Taxonomy: Knowledge
   TOP: 2.1 THE ORGANIZATION OF MATTER: ELEMENTS AND ATOMS

4. Four elements make up more than 96% of the mass of most living organisms. Which of the following is NOT one of those four elements?
   a. sodium
   b. carbon
   c. oxygen
   d. nitrogen
   e. hydrogen

   ANS: A PTS: 1 DIF: Moderate
   OBJ: Bloom's Taxonomy: Knowledge
   TOP: 2.1 THE ORGANIZATION OF MATTER: ELEMENTS AND ATOMS

5. A trace element is one found in specific organisms in ____ quantities and is ____ for normal biological functions.
   a. moderate; unnecessary
   b. moderate; vital
   c. small; unnecessary
   d. large; unnecessary
   e. small; vital

   ANS: E PTS: 1 DIF: Moderate
   OBJ: Bloom's Taxonomy: Knowledge
   TOP: 2.1 THE ORGANIZATION OF MATTER: ELEMENTS AND ATOMS

6. The smallest unit that retains the chemical and physical properties of an element is a(n) ____.
   a. proton
   b. compound
   c. molecule
   d. neutron
   e. atom

   ANS: E PTS: 1 DIF: Easy
   OBJ: Bloom's Taxonomy: Knowledge
   TOP: 2.1 THE ORGANIZATION OF MATTER: ELEMENTS AND ATOMS

7. The substance H_2O is considered to be
   a. both a molecule and a compound.
   b. a compound but not a molecule.
   c. neither a molecule nor a compound.
   d. a molecule but not a compound.
   e. a chemical but not biological molecule.

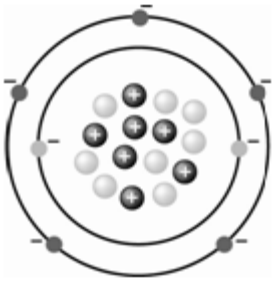
   ANS: A PTS: 1 DIF: Easy
   OBJ: Bloom's Taxonomy: Comprehension
   TOP: 2.1 THE ORGANIZATION OF MATTER: ELEMENTS AND ATOMS

8. The substance O_2 is considered to be
   a. both a molecule and a compound.
   b. a compound but not a molecule.
   c. neither a molecule nor a compound.
   d. a molecule but not a compound.
   e. a chemical but not a biological molecule.

   ANS: D PTS: 1 DIF: Moderate
   OBJ: Bloom's Taxonomy: Comprehension
   TOP: 2.1 THE ORGANIZATION OF MATTER: ELEMENTS AND ATOMS

9. An oxygen atom has ____ surrounding a nucleus composed of ____.
   a. neutrons; electrons and protons
   b. electrons; protons and neutrons
   c. protons and electrons; neutrons
   d. protons; neutrons and electrons
   e. electrons and neutrons; protons

   ANS: B PTS: 1 DIF: Easy
   OBJ: Bloom's Taxonomy: Knowledge TOP: 2.2 ATOMIC STRUCTURE



Use the figure above for the following question(s).

10. The mass number of the atom depicted in the figure is
    a. 5.
    b. 7.
    c. 8.
    d. 15.
    e. 22.

    ANS: D PTS: 1 DIF: Moderate REF: Figure 2.3
    OBJ: Bloom's Taxonomy: Analysis TOP: 2.2 ATOMIC STRUCTURE

11. The atomic number of the atom depicted in the figure is
    a. 5.
    b. 7.
    c. 8.
    d. 15.
    e. 22.

    ANS: B PTS: 1 DIF: Moderate REF: Figure 2.3
    OBJ: Bloom's Taxonomy: Analysis TOP: 2.2 ATOMIC STRUCTURE

12. The number of electrons for the atom depicted in the figure is
    a. 5.
    b. 7.
    c. 8.
    d. 15.
    e. 22.

    ANS: B PTS: 1 DIF: Easy REF: Figure 2.3
    OBJ: Bloom's Taxonomy: Analysis TOP: 2.2 ATOMIC STRUCTURE

13. The number of neutrons for the atom depicted in the figure is
    a. 5.
    b. 7.
    c. 8.
    d. 15.
    e. 22.

    ANS: C PTS: 1 DIF: Easy REF: Figure 2.3
    OBJ: Bloom's Taxonomy: Analysis TOP: 2.2 ATOMIC STRUCTURE

14. Which of the following are charged particles?
    a. electrons and protons
    b. neutrons only
    c. protons and neutrons
    d. electrons only
    e. protons, neutrons, and electrons

    ANS: A PTS: 1 DIF: Moderate
    OBJ: Bloom's Taxonomy: Knowledge TOP: 2.2 ATOMIC STRUCTURE

15. What is the atomic mass number of an atom with 7 electrons, 7 neutrons, and 7 protons?
    a. 7 daltons
    b. 10 daltons
    c. 14 daltons
    d. 21 daltons
    e. 28 daltons

    ANS: C PTS: 1 DIF: Easy
    OBJ: Bloom's Taxonomy: Comprehension TOP: 2.2 ATOMIC STRUCTURE

16. Isotopes of the same element differ from each other in the number of
    a. electrons and protons.
    b. neutrons only.
    c. protons and neutrons.
    d. electrons only.
    e. protons, neutrons, and electrons.

    ANS: B PTS: 1 DIF: Moderate
    OBJ: Bloom's Taxonomy: Knowledge | Bloom's Taxonomy: Comprehension
    TOP: 2.2 ATOMIC STRUCTURE

17. A carbon atom with six protons, seven neutrons, and six electrons has a mass number of
    a. 6.
    b. 7.
    c. 12.
    d. 13.
    e. 19.

    ANS: D PTS: 1 DIF: Moderate
    OBJ: Bloom's Taxonomy: Application TOP: 2.2 ATOMIC STRUCTURE

18. Which element would the element lithium most likely form an ionic bond with?
    a. Aluminum; atomic number = 13
    b. Chlorine; atomic number = 17
    c. Magnesium; atomic number = 12
    d. Nitrogen; atomic number = 7
    e. Silicon; atomic number = 14

    ANS: B PTS: 1 DIF: Moderate
    OBJ: Bloom's Taxonomy: Analysis TOP: 2.2 ATOMIC STRUCTURE

19. ^{14}C is heavier than ^{12}C because it has _____.
    a. two more electrons than ^{12}C
    b. two more neutrons than ^{12}C
    c. two more protons than ^{12}C
    d. one more proton and one more electron than ^{12}C
    e. one more proton and one more neutron than ^{12}C

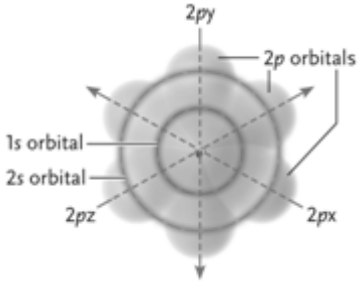
    ANS: B PTS: 1 DIF: Moderate
    OBJ: Bloom's Taxonomy: Analysis TOP: 2.2 ATOMIC STRUCTURE

20. The isotope ^{14}C undergoes radioactive decay with a neutron splitting into an electron and a proton. This decay produces an atom of
    a. iron.
    b. carbon.
    c. hydrogen.
    d. oxygen.
    e. nitrogen.

    ANS: E PTS: 1 DIF: Difficult
    OBJ: Bloom's Taxonomy: Knowledge TOP: 2.2 ATOMIC STRUCTURE

21. An orbital describes the ____ of an electron.
    a. exact location
    b. exact path
    c. most frequent locations
    d. charge
    e. chemical bonds

    ANS: C PTS: 1 DIF: Moderate
    OBJ: Bloom's Taxonomy: Comprehension TOP: 2.2 ATOMIC STRUCTURE



Use the figure above for the following question(s).

22. The electrons at the lowest energy level in the neon atom depicted in the figure above are found in which orbital?
    a. 1*s*
    b. 2*s*
    c. 2*p*x
    d. 2*p*y
    e. 2*p*z

    ANS: A PTS: 1 DIF: Moderate REF: Figure 2.5
    OBJ: Bloom's Taxonomy: Comprehension TOP: 2.2 ATOMIC STRUCTURE

23. All of the orbitals shown in the neon atom in the figure are completely filled with electrons. How many electrons does this neon atom have?
    a. 5
    b. 6
    c. 8
    d. 10
    e. 16

    ANS: D PTS: 1 DIF: Moderate REF: Figure 2.5
    OBJ: Bloom's Taxonomy: Application TOP: 2.2 ATOMIC STRUCTURE

24. Under the right conditions, an electron can
    a. move to a lower energy level.
    b. enter an orbital shared by two atoms.
    c. move to a higher energy level.
    d. move from one atom to another atom.
    e. all of these

    ANS: E PTS: 1 DIF: Moderate
    OBJ: Bloom's Taxonomy: Knowledge TOP: 2.2 ATOMIC STRUCTURE

25. Sodium has one valence electron in its third energy level. To reach a stable energy configuration, sodium will tend to
    a. take up an electron from another atom.
    b. move its valence electron to the second energy shell.
    c. give up an electron to another atom.
    d. share its valence electron with another atom.
    e. move an electron from the second energy level to the valence shell.

    ANS: C PTS: 1 DIF: Moderate
    OBJ: Bloom's Taxonomy: Application TOP: 2.2 ATOMIC STRUCTURE

26. Which of the following is most likely to share electrons with other atoms in joint orbitals?
    a. chlorine (7 valence electrons)
    b. calcium (2 valence electrons)
    c. argon (8 valence electrons)
    d. carbon (4 valence electrons)
    e. potassium (1 valence electron)

    ANS: D PTS: 1 DIF: Difficult
    OBJ: Bloom's Taxonomy: Synthesis TOP: 2.2 ATOMIC STRUCTURE

27. Which of the following is likely to be chemically unreactive?
    a. chlorine (7 valence electrons)
    b. calcium (2 valence electrons)
    c. argon (8 valence electrons)
    d. carbon (4 valence electrons)
    e. potassium (1 valence electron)

    ANS: C PTS: 1 DIF: Difficult
    OBJ: Bloom's Taxonomy: Synthesis TOP: 2.2 ATOMIC STRUCTURE

28. Which of the following is most likely to take up an electron from another atom?
    a. chlorine (7 valence electrons)
    b. calcium (2 valence electrons)
    c. neon (8 valence electrons)
    d. carbon (4 valence electrons)
    e. potassium (1 valence electron)

    ANS: A PTS: 1 DIF: Moderate
    OBJ: Bloom's Taxonomy: Synthesis TOP: 2.2 ATOMIC STRUCTURE

29. Radioactive ____ is commonly used to treat patients with dangerously overactive thyroid glands.
    a. carbon
    b. radium
    c. iodine
    d. thallium
    e. cobalt

    ANS: C PTS: 1 DIF: Moderate
    OBJ: Bloom's Taxonomy: Knowledge
    TOP: CHAPTER 2 FOCUS ON RESEARCH: USING RADIOISOTOPES TO SAVE LIVES

30. In radiation therapy, cancer cells are killed by ____.
    a. carbon
    b. radium
    c. iodine
    d. thallium
    e. nitrogen

    ANS: B PTS: 1 DIF: Moderate
    OBJ: Bloom's Taxonomy: Knowledge
    TOP: CHAPTER 2 FOCUS ON RESEARCH: USING RADIOISOTOPES TO SAVE LIVES

31. The chemical bonds that form when atoms that have lost electrons are electrically attracted to atoms that have gained electrons are called ____.
    a. polar covalent bonds
    b. van der Waals forces
    c. ionic bonds
    d. hydrogen bonds
    e. nonpolar covalent bonds

    ANS: C PTS: 1 DIF: Easy
    OBJ: Bloom's Taxonomy: Knowledge
    TOP: 2.3 CHEMICAL BONDS AND CHEMICAL REACTIONS

32. The chemical bonds that are formed when atoms share electrons equally are called ____.
    a. polar covalent bonds
    b. van der Waals forces
    c. ionic bonds
    d. hydrogen bonds
    e. nonpolar covalent bonds

    ANS: E PTS: 1 DIF: Moderate
    OBJ: Bloom's Taxonomy: Knowledge | Bloom's Taxonomy: Comprehension
    TOP: 2.3 CHEMICAL BONDS AND CHEMICAL REACTIONS

33. The chemical bonds that are formed when atoms share electrons unequally are called ____.
    a. polar covalent bonds
    b. van der Waals forces
    c. ionic bonds
    d. hydrogen bonds
    e. nonpolar covalent bonds

    ANS: A PTS: 1 DIF: Moderate
    OBJ: Bloom's Taxonomy: Knowledge | Bloom's Taxonomy: Comprehension
    TOP: 2.3 CHEMICAL BONDS AND CHEMICAL REACTIONS

34. The chemical bonds that are formed when atoms with temporary zones of positive charge are attracted to other atoms with temporary zones of negative charge are called ____.
    a. polar covalent bonds
    b. van der Waals forces
    c. ionic bonds
    d. hydrogen bonds
    e. nonpolar covalent bonds

    ANS: B PTS: 1 DIF: Difficult
    OBJ: Bloom's Taxonomy: Knowledge | Bloom's Taxonomy: Comprehension
    TOP: 2.3 CHEMICAL BONDS AND CHEMICAL REACTIONS

35. Chemical bonds that are formed when one atom with a partial positive charge (created from unequal sharing of electrons) is electrically attracted to another atom with a partial negative charge (also created from unequal sharing of electrons) are called ____.
    a. polar covalent bonds
    b. van der Waals forces
    c. ionic bonds
    d. hydrogen bonds
    e. nonpolar covalent bonds

    ANS: D PTS: 1 DIF: Moderate
    OBJ: Bloom's Taxonomy: Knowledge | Bloom's Taxonomy: Comprehension
    TOP: 2.3 CHEMICAL BONDS AND CHEMICAL REACTIONS

36. Which of the following types of chemical linkages is the weakest?
    a. polar covalent bonds
    b. van der Waals forces
    c. ionic bonds
    d. hydrogen bonds
    e. nonpolar covalent bonds

    ANS: B PTS: 1 DIF: Difficult
    OBJ: Bloom's Taxonomy: Synthesis
    TOP: 2.3 CHEMICAL BONDS AND CHEMICAL REACTIONS

37. The attraction between Na^+ cations and Cl^- anions forms ____ that hold together the compound NaCl.
    a. polar covalent bonds
    b. van der Waals forces
    c. ionic bonds
    d. hydrogen bonds
    e. nonpolar covalent bonds

    ANS: C PTS: 1 DIF: Easy

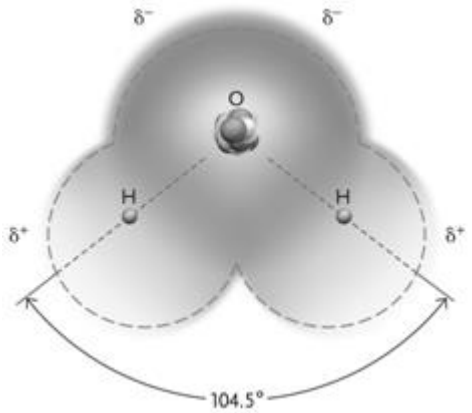
OBJ: Bloom's Taxonomy: Application
TOP: 2.3 CHEMICAL BONDS AND CHEMICAL REACTIONS

38. Geckos are able to cling to vertical walls due to ____.
    a. polar covalent bonds
    b. van der Waals forces
    c. ionic bonds
    d. hydrogen bonds
    e. nonpolar covalent bonds

    ANS: B PTS: 1 DIF: Difficult
    OBJ: Bloom's Taxonomy: Knowledge
    TOP: 2.3 CHEMICAL BONDS AND CHEMICAL REACTIONS

39. Molecules such as H–H and O=O are held together by ____.
    a. polar covalent bonds
    b. van der Waals forces
    c. ionic bonds
    d. hydrogen bonds
    e. nonpolar covalent bonds

    ANS: E PTS: 1 DIF: Moderate
    OBJ: Bloom's Taxonomy: Synthesis
    TOP: 2.3 CHEMICAL BONDS AND CHEMICAL REACTIONS



40. The molecule shown in the figure above is held together by ____.
    a. polar covalent bonds
    b. van der Waals forces
    c. ionic bonds
    d. hydrogen bonds
    e. nonpolar covalent bonds

    ANS: A PTS: 1 DIF: Moderate REF: Figure 2.9
    OBJ: Bloom's Taxonomy: Application
    TOP: 2.3 CHEMICAL BONDS AND CHEMICAL REACTIONS

41. Metallic ions such as Ca^{2+}, Na^{+}, and Fe^{3+} readily form ____.
    a. polar covalent bonds
    b. van der Waals forces
    c. ionic bonds
    d. hydrogen bonds
    e. nonpolar covalent bonds

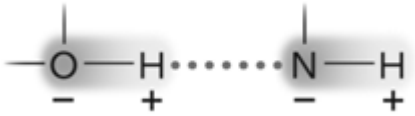
    ANS: C PTS: 1 DIF: Moderate
    OBJ: Bloom's Taxonomy: Comprehension
    TOP: 2.3 CHEMICAL BONDS AND CHEMICAL REACTIONS

42. The chemical linkages that exert an attractive force over the greatest distance are ____.
    a. polar covalent bonds
    b. van der Waals forces
    c. ionic bonds
    d. hydrogen bonds
    e. nonpolar covalent bonds

    ANS: C PTS: 1 DIF: Difficult
    OBJ: Bloom's Taxonomy: Knowledge
    TOP: 2.3 CHEMICAL BONDS AND CHEMICAL REACTIONS

43. In contrast to ionic bonds, covalent bonds ____.
    a. hold atoms together
    b. have distinct, three-dimensional forms
    c. transfer electrons from one atom to another
    d. are relatively weak
    e. are transient

    ANS: B PTS: 1 DIF: Moderate
    OBJ: Bloom's Taxonomy: Synthesis
    TOP: 2.3 CHEMICAL BONDS AND CHEMICAL REACTIONS



44. The dotted line in the figure above indicates ____.
    a. a polar covalent bond
    b. van der Waals forces
    c. an ionic bond
    d. a hydrogen bond
    e. a nonpolar covalent bond

    ANS: D PTS: 1 DIF: Easy REF: Figure 2.10
    OBJ: Bloom's Taxonomy: Analysis
    TOP: 2.3 CHEMICAL BONDS AND CHEMICAL REACTIONS

45. In a molecule of methane, CH_4, each hydrogen atom shares an orbital with the carbon atom. The total number of shared electrons in CH_4 is ____.
    a. 4
    b. 2
    c. 1
    d. 8
    e. 5

    ANS: D PTS: 1 DIF: Difficult
    OBJ: Bloom's Taxonomy: Analysis
    TOP: 2.3 CHEMICAL BONDS AND CHEMICAL REACTIONS

46. A polar covalent bond would be most likely to form between
    a. atoms with different electronegativities.
    b. cations and anions.
    c. atoms with $\delta+$ and $\delta-$ charges.
    d. atoms with filled valence shells.
    e. atoms of the same element.

    ANS: A PTS: 1 DIF: Moderate
    OBJ: Bloom's Taxonomy: Evaluation
    TOP: 2.3 CHEMICAL BONDS AND CHEMICAL REACTIONS

47. Which of these types of chemical bonds would you not expect to find in biological molecules?
    a. covalent bonds
    b. van der Waals forces
    c. ionic bonds
    d. hydrogen bonds
    e. all of these types of bonds are found in biological molecules

    ANS: E PTS: 1 DIF: Easy
    OBJ: Bloom's Taxonomy: Synthesis
    TOP: 2.3 CHEMICAL BONDS AND CHEMICAL REACTIONS

48. In the presence of water, nonpolar associations form between molecules or regions of molecules that are ____.
    a. partially charged
    b. hydrophobic and hydrophilic
    c. hydrophobic
    d. fully charged
    e. hydrophilic

    ANS: C PTS: 1 DIF: Easy
    OBJ: Bloom's Taxonomy: Knowledge
    TOP: 2.3 CHEMICAL BONDS AND CHEMICAL REACTIONS

49. A mixture of vegetable oil and water will separate into layers because oil is ____ and forms ____.
    a. hydrophobic; nonpolar associations
    b. hydrophilic; nonpolar associations
    c. hydrophilic; polar associations
    d. hydrophobic; polar associations
    e. hydrophobic; ionic associations

    ANS: A PTS: 1 DIF: Moderate
    OBJ: Bloom's Taxonomy: Application

TOP: 2.3 CHEMICAL BONDS AND CHEMICAL REACTIONS

50. Analyze this chemical reaction:

$6\ CO_2 + 6\ H_2O \rightarrow C_6H_{12}O_6 + 6\ O_2$

Which of the following is FALSE?
a. Water is a reactant.
b. $C_6H_{12}O_6$ is a product.
c. Molecular oxygen is a product.
d. CO_2 is a reactant.
e. Molecular carbon is a reactant.

ANS: E PTS: 1 DIF: Moderate
OBJ: Bloom's Taxonomy: Analysis
TOP: 2.3 CHEMICAL BONDS AND CHEMICAL REACTIONS

51. The formation and breaking of bonds between atoms requires
a. a chemical reaction.
b. van der Walls forces.
c. partial charges.
d. an empty valence shell.
e. an enzyme.

ANS: A PTS: 1 DIF: Moderate
OBJ: Bloom's Taxonomy: Knowledge
TOP: 2.3 CHEMICAL BONDS AND CHEMICAL REACTIONS

52. What do cohesion, surface tension, and specific heat have in common concerning the properties of water?
a. All are produced by covalent bonding.
b. All are properties related to hydrogen bonding.
c. All have to do with nonpolar covalent bonds.
d. All increase when temperature increases.
e. All are produced by covalent bonding and all increase when temperature increases.

ANS: B PTS: 1 DIF: Easy
OBJ: Bloom's Taxonomy: Knowledge
TOP: 2.4 HYDROGEN BONDS AND THE PROPERTIES OF WATER

53. A molecule of water in the middle of a chunk of ice will usually have ____ hydrogen bonds with other water molecules.
a. 3
b. 3.4
c. 6
d. 4
e. 2

ANS: D PTS: 1 DIF: Moderate
OBJ: Bloom's Taxonomy: Application
TOP: 2.4 HYDROGEN BONDS AND THE PROPERTIES OF WATER

54. Which of the following would have the most difficulty entering a water lattice?
    a. table salt (NaCl)
    b. a nonpolar molecule
    c. a sodium ion
    d. a proton (H^+)
    e. an electron

    ANS: B PTS: 1 DIF: Moderate
    OBJ: Bloom's Taxonomy: Application
    TOP: 2.4 HYDROGEN BONDS AND THE PROPERTIES OF WATER

55. Ice floats in liquid water because
    a. ice forms hydrogen bonds with the surface of liquid water.
    b. ice forms hydrogen bonds but liquid water does not.
    c. the hydrogen bonds of liquid water are fixed in place.
    d. liquid water forms hydrogen bonds but ice does not.
    e. the distance between water molecules is maximized due to the hydrogen bonds which are fixed in place.

    ANS: E PTS: 1 DIF: Difficult
    OBJ: Bloom's Taxonomy: Application
    TOP: 2.4 HYDROGEN BONDS AND THE PROPERTIES OF WATER

56. Biological membranes are held together mainly by
    a. hydrogen bonds between lipid molecules.
    b. hydration layers over lipid molecules.
    c. exclusion of the nonpolar regions of lipids by water.
    d. hydrogen bonds between water molecules.
    e. surface tension at the interface between layers of water molecules.

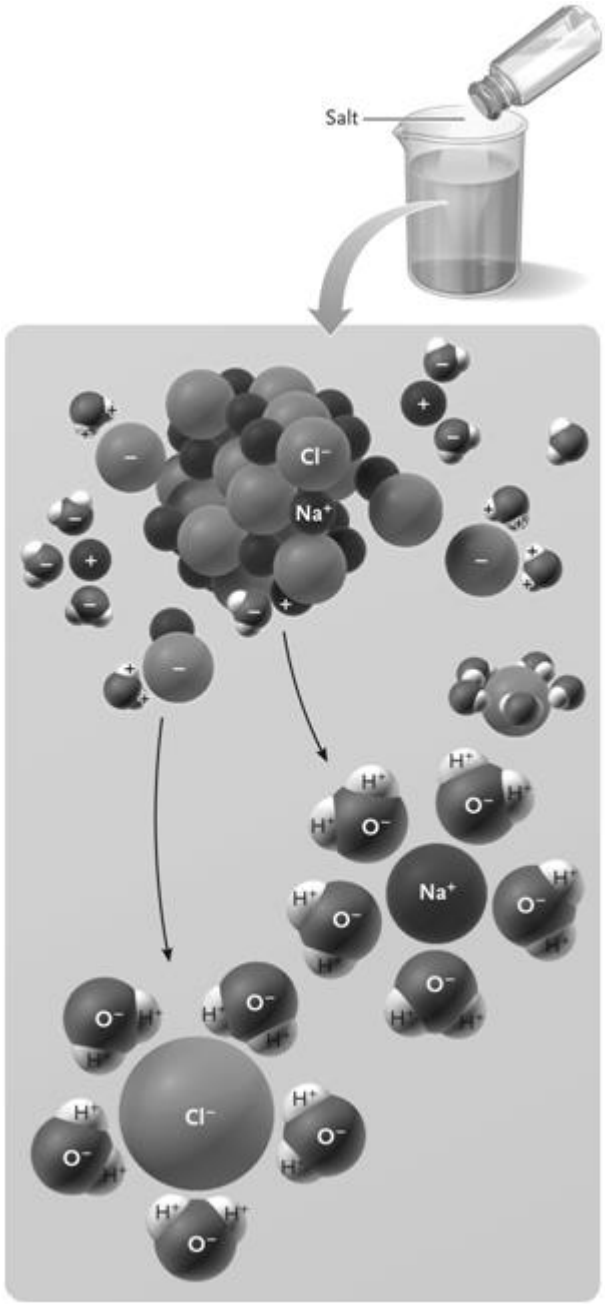
    ANS: C PTS: 1 DIF: Moderate
    OBJ: Bloom's Taxonomy: Knowledge
    TOP: 2.4 HYDROGEN BONDS AND THE PROPERTIES OF WATER

57. A ____ is formed when a ____ is dissolved in a ____.
    a. solution; solute; solvent
    b. solute; solvent; solution
    c. solution; solvent; solute
    d. solvent; solution; solute
    e. solvent; solute; solution

    ANS: A PTS: 1 DIF: Moderate
    OBJ: Bloom's Taxonomy: Knowledge
    TOP: 2.4 HYDROGEN BONDS AND THE PROPERTIES OF WATER

58. When sugar dissolves in water, water is acting as a ____ and the sugar molecules are acting as ____.
    a. solution; solvents
    b. solute; solutions
    c. solvent; solutes
    d. solute; solvents
    e. solvent; solutions

    ANS: C PTS: 1 DIF: Moderate
    OBJ: Bloom's Taxonomy: Application
    TOP: 2.4 HYDROGEN BONDS AND THE PROPERTIES OF WATER



59. When salt dissolves in water as illustrated in the figure above, the water molecules form ____ around the Na^+ and Cl^- ions.
    a. covalent bonds
    b. hydration layers
    c. nonpolar interactions
    d. membranes
    e. ionic bonds

    ANS: B PTS: 1 DIF: Easy REF: Figure 2.15
    OBJ: Bloom's Taxonomy: Comprehension
    TOP: 2.4 HYDROGEN BONDS AND THE PROPERTIES OF WATER

60. Water has a molecular weight of 18 g per mole, and glucose has a molecular weight of 180 g per mole. Which of the following would have an approximately equal number of water and glucose molecules?
    a. 1 g of water and 180 g of glucose
    b. 90 g of water and 9 g of glucose
    c. 180 g of water and 1 g of glucose
    d. 9 g of water and 90 g of glucose
    e. 90 g of water and 90 g of glucose

    ANS: D PTS: 1 DIF: Difficult
    OBJ: Bloom's Taxonomy: Application
    TOP: 2.4 HYDROGEN BONDS AND THE PROPERTIES OF WATER

61. Water has an unusually high boiling point for its molecular weight because water molecules
    a. are very dense.
    b. get much heavier as they are heated.
    c. are held to each other by hydrogen bonds.
    d. are held together by covalent bonds.
    e. form hydration layers.

    ANS: C PTS: 1 DIF: Moderate
    OBJ: Bloom's Taxonomy: Comprehension
    TOP: 2.4 HYDROGEN BONDS AND THE PROPERTIES OF WATER

62. The hydrogen-bond lattice causes water to have an unusually ____ specific heat and an unusually ____ heat of vaporization for its molecular weight.
    a. high; high
    b. low; high
    c. high; low
    d. low; low

    ANS: A PTS: 1 DIF: Easy
    OBJ: Bloom's Taxonomy: Comprehension
    TOP: 2.4 HYDROGEN BONDS AND THE PROPERTIES OF WATER

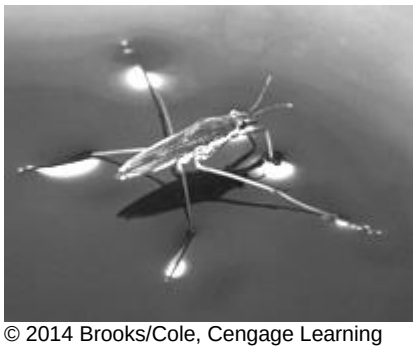
63. Water is useful for cooling organisms mainly due to its
    a. hydration layers.
    b. specific heat.
    c. low calories.
    d. surface tension.
    e. heat of vaporization.

    ANS: E PTS: 1 DIF: Moderate
    OBJ: Bloom's Taxonomy: Knowledge
    TOP: 2.4 HYDROGEN BONDS AND THE PROPERTIES OF WATER

64. Water has an important stabilizing effect on temperature in living organisms and their environments because as water absorbs heat, much of the energy is used to ____ instead of raising the temperature.
    a. create hydrogen bonds
    b. create covalent bonds
    c. break surface tension
    d. break hydrogen bonds
    e. create hydration layers

    ANS: D PTS: 1 DIF: Moderate
    OBJ: Bloom's Taxonomy: Comprehension

TOP: 2.4 HYDROGEN BONDS AND THE PROPERTIES OF WATER



65. The water strider shown in the figure above is able to stand on water because of the ____ of water.
    a. covalent bonds
    b. surface tension
    c. van der Waals forces
    d. density
    e. hydration layer

    ANS: B PTS: 1 DIF: Easy REF: Figure 2.13
    OBJ: Bloom's Taxonomy: Knowledge
    TOP: 2.4 HYDROGEN BONDS AND THE PROPERTIES OF WATER

66. When added to water, a base will act as a(n) ____ and cause the pH of the solution to ____.
    a. proton acceptor; rise
    b. proton donor; rise
    c. proton acceptor; fall
    d. proton donor; fall
    e. acid; fall

    ANS: A PTS: 1 DIF: Easy
    OBJ: Bloom's Taxonomy: Comprehension
    TOP: 2.5 WATER IONIZATION AND ACIDS, BASES, AND BUFFERS

67. When added to water at neutral pH (7.0), an acid will
    a. act as a proton donor, raising the pH of the solution.
    b. act as a proton acceptor, raising the pH of the solution.
    c. act as a proton donor, lowering the pH of the solution.
    d. act as a proton acceptor, lowering the pH of the solution.
    e. do nothing since the aqueous solution is neutral.

    ANS: C PTS: 1 DIF: Moderate
    OBJ: Bloom's Taxonomy: Application
    TOP: 2.5 WATER IONIZATION AND ACIDS, BASES, AND BUFFERS

68. A pH of 6 is ____ times more ____ than a pH of 2.
    a. 3; acidic
    b. 4; acidic
    c. 3; basic
    d. 10,000; basic
    e. 40; basic

    ANS: D PTS: 1 DIF: Moderate
    OBJ: Bloom's Taxonomy: Application

TOP: 2.5 WATER IONIZATION AND ACIDS, BASES, AND BUFFERS

69. For pure water, which has a pH of 7.0, which of the following is true?
    a. $[H^+] < [OH^-]$
    b. $[H^+] = [OH^-]$
    c. $[H^+] = 0$
    d. $[OH^-] = 0$
    e. $[H^+] > [OH^-]$

    ANS: B PTS: 1 DIF: Moderate
    OBJ: Bloom's Taxonomy: Knowledge | Bloom's Taxonomy: Application
    TOP: 2.5 WATER IONIZATION AND ACIDS, BASES, AND BUFFERS

70. For acid rainwater, which has a pH as low as 3.0, which of the following is true?
    a. $[H^+] < [OH^-]$
    b. $[H^+] = [OH^-]$
    c. $[H^+] = 0$
    d. $[OH^-] = 0$
    e. $[H^+] > [OH^-]$

    ANS: E PTS: 1 DIF: Moderate
    OBJ: Bloom's Taxonomy: Knowledge | Bloom's Taxonomy: Application
    TOP: 2.5 WATER IONIZATION AND ACIDS, BASES, AND BUFFERS

71. Solution A has a pH of 6 and solution B has a pH of 8. Which of the following is true regarding the concentration of hydrogen ions in each solution?
    a. A has 100 times greater H^+ concentration than B.
    b. B has 100 times greater H^+ concentration than A.
    c. A has 7/9 of the H^+ concentration of B.
    d. A has 9/7 of the H^+ concentration of B.
    e. A has 1,000 times greater H^+ concentration than B.

    ANS: A PTS: 1 DIF: Moderate
    OBJ: Bloom's Taxonomy: Analysis
    TOP: 2.5 WATER IONIZATION AND ACIDS, BASES AND BUFFERS

72. In water, NaOH almost completely separates into Na^+ and OH^- ions. Thus, NaOH is _____.
    a. a strong acid
    b. a strong base
    c. a weak acid
    d. a weak base
    e. neutral

    ANS: B PTS: 1 DIF: Moderate
    OBJ: Bloom's Taxonomy: Comprehension
    TOP: 2.5 WATER IONIZATION AND ACIDS, BASES AND BUFFERS

73. Seawater typically is
    a. highly basic.
    b. neutral.
    c. somewhat basic.
    d. somewhat acidic.
    e. highly basic.

    ANS: C PTS: 1 DIF: Difficult

OBJ: Bloom's Taxonomy: Knowledge | Bloom's Taxonomy: Analysis
TOP: 2.5 WATER IONIZATION AND ACIDS, BASES, AND BUFFERS

74. Without ____, living organisms would often experience major changes in pH in their cells.
    a. buffers
    b. acids
    c. surface tension
    d. nonpolar bonds
    e. bases

    ANS: A PTS: 1 DIF: Easy
    OBJ: Bloom's Taxonomy: Knowledge
    TOP: 2.5 WATER IONIZATION AND ACIDS, BASES, AND BUFFERS

75. Most pH buffers are
    a. strong acids.
    b. weak acids or weak bases.
    c. weak acids.
    d. strong bases.
    e. strong acids or strong bases.

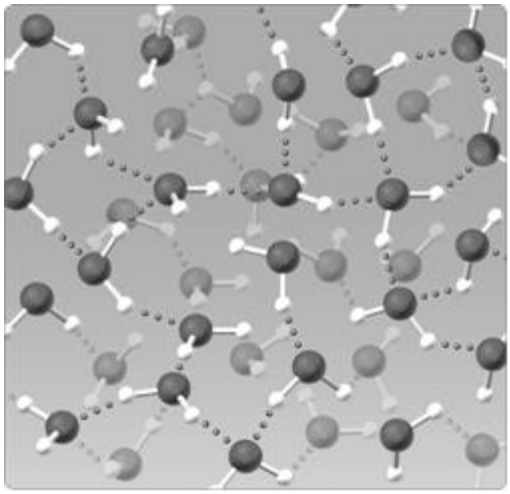
    ANS: B PTS: 1 DIF: Moderate
    OBJ: Bloom's Taxonomy: Knowledge
    TOP: 2.5 WATER IONIZATION AND ACIDS, BASES, AND BUFFERS

76. A research group led by Li Li has found a(n) ____ that potentially can be used in uranium bioremediation.
    a. amoeba
    b. plant
    c. alga
    d. bacterium
    e. fungus

    ANS: D PTS: 1 DIF: Moderate
    OBJ: Bloom's Taxonomy: Knowledge TOP: CHAPTER 2 UNANSWERED QUESTIONS

77. The most common isotope of carbon has an atomic number of 6 and a mass number of 12, while the most common isotope of oxygen has an atomic number of 8 and a mass number of 16. A molecule of CO_2 made up of these common isotopes has a molecular weight of ____.
    a. 28
    b. 44
    c. 56
    d. 14
    e. 22

    ANS: B PTS: 1 DIF: Difficult
    REF: Section 2.2 | Section 2.3 | Section 2.4
    OBJ: Bloom's Taxonomy: Synthesis MSC: Integrative Multiple Choice



78. The water lattice illustrated in the figure above forms as a result of ____ between water molecules.
    a. covalent bonds
    b. hydrogen bonds
    c. nonpolar interactions
    d. ionic bonds
    e. van der Walls forces

    ANS: B PTS: 1 DIF: Easy
    REF: Figure 2.12 | Section 2.3 | Section 2.4
    OBJ: Bloom's Taxonomy: Application | Bloom's Taxonomy: Synthesis
    MSC: Integrative Multiple Choice

MATCHING

Match each of the following terms with its correct definition.
a. Anything that occupies space and has mass
b. A pure substance that cannot be broken down into simpler substances by ordinary chemical or physical techniques
c. An atom with the same number of protons as another atom but a different number of neutrons
d. The locations around an atomic nucleus where an electron occurs most frequently
e. A molecule whose component atoms are different from each other

79. element
80. compound
81. matter
82. orbital
83. isotope

79. ANS: B PTS: 1 DIF: Moderate REF: Section 2.1 | Section 2.2
    OBJ: Bloom's Taxonomy: Knowledge
80. ANS: E PTS: 1 DIF: Moderate REF: Section 2.1 | Section 2.2
    OBJ: Bloom's Taxonomy: Knowledge
81. ANS: A PTS: 1 DIF: Moderate REF: Section 2.1 | Section 2.2
    OBJ: Bloom's Taxonomy: Knowledge
82. ANS: D PTS: 1 DIF: Moderate REF: Section 2.1 | Section 2.2
    OBJ: Bloom's Taxonomy: Knowledge

83. ANS: C PTS: 1 DIF: Moderate REF: Section 2.1 | Section 2.2
OBJ: Bloom's Taxonomy: Knowledge

For each of the following situations, choose the correct type of chemical bond.
a. ionic bond(s)
b. nonpolar covalent bond(s)
c. polar covalent bond(s)
d. hydrogen bond(s)
e. van der Waals forces

84. Occurs when electrons are shared equally between two atoms
85. Used by geckos for clinging to and climbing up smooth vertical surfaces
86. Formed by the attraction between partial positive and partial negative charges created by unequal electron sharing
87. Occurs in sodium chloride (NaCl)
88. The weakest of the chemical linkages listed
89. Occurs in a water molecule (H_2O)
90. Characteristic of molecules that contain atoms of only one kind
91. Forms when atoms gain or lose valence electrons completely
92. Attraction that arises when the constant movement of electrons, by chance, produces temporary zones of partial positive and partial negative charges
93. Occurs when electrons are shared unequally between two atoms
94. Creates a region that is hydrophobic
95. Occurs between water molecules
96. Occurs in molecular oxygen (O_2)

84. ANS: B PTS: 1 DIF: Moderate REF: Section 2.3
OBJ: Bloom's Taxonomy: Knowledge | Bloom's Taxonomy: Application
MSC: Choice
85. ANS: E PTS: 1 DIF: Moderate REF: Section 2.3
OBJ: Bloom's Taxonomy: Knowledge | Bloom's Taxonomy: Application
MSC: Choice
86. ANS: D PTS: 1 DIF: Moderate REF: Section 2.3
OBJ: Bloom's Taxonomy: Knowledge | Bloom's Taxonomy: Application
MSC: Choice
87. ANS: A PTS: 1 DIF: Moderate REF: Section 2.3
OBJ: Bloom's Taxonomy: Knowledge | Bloom's Taxonomy: Application
MSC: Choice
88. ANS: E PTS: 1 DIF: Moderate REF: Section 2.3
OBJ: Bloom's Taxonomy: Knowledge | Bloom's Taxonomy: Application
MSC: Choice
89. ANS: C PTS: 1 DIF: Moderate REF: Section 2.3
OBJ: Bloom's Taxonomy: Knowledge | Bloom's Taxonomy: Application
MSC: Choice
90. ANS: B PTS: 1 DIF: Moderate REF: Section 2.3
OBJ: Bloom's Taxonomy: Knowledge | Bloom's Taxonomy: Application
MSC: Choice
91. ANS: A PTS: 1 DIF: Moderate REF: Section 2.3
OBJ: Bloom's Taxonomy: Knowledge | Bloom's Taxonomy: Application
MSC: Choice
92. ANS: E PTS: 1 DIF: Moderate REF: Section 2.3

OBJ: Bloom's Taxonomy: Knowledge | Bloom's Taxonomy: Application
MSC: Choice

93. ANS: C PTS: 1 DIF: Moderate REF: Section 2.3
OBJ: Bloom's Taxonomy: Knowledge | Bloom's Taxonomy: Application
MSC: Choice

94. ANS: B PTS: 1 DIF: Moderate REF: Section 2.3
OBJ: Bloom's Taxonomy: Knowledge | Bloom's Taxonomy: Application
MSC: Choice

95. ANS: D PTS: 1 DIF: Moderate REF: Section 2.3
OBJ: Bloom's Taxonomy: Knowledge | Bloom's Taxonomy: Application
MSC: Choice

96. ANS: B PTS: 1 DIF: Moderate REF: Section 2.3
OBJ: Bloom's Taxonomy: Knowledge | Bloom's Taxonomy: Application
MSC: Choice

SHORT ANSWER

97. Why is iodine considered a trace element that is vital for biological function in humans?

ANS:
Iodine is 0.0004% of a human's weight, compared to elements that occur at quantities greater than 0.01%. Iodine is required for proper thyroid gland function. Lack of iodine affects metabolism and growth. In the short-term iodine deficiency results in lethargy, apathy and sensitivity to cold temperatures, in the long-term, iodine deficiency causes a goiter.

PTS: 1 DIF: Easy REF: Section 2.1
OBJ: Bloom's Taxonomy: Knowledge

98. Place a large amount of hydrogen gas and oxygen gas in the presence of a fire and you will get an explosion. In light of this, explain how it is possible that water, which is composed of hydrogen and oxygen, is often used to put out fires.

ANS:
Water is a compound, and compounds typically have chemical and physical properties that are distinct from the atoms that make them up. So, water had different properties than the hydrogen and oxygen that it is made of and thus behaves differently from them in the presence of fire.

PTS: 1 DIF: Moderate REF: Section 2.1
OBJ: Bloom's Taxonomy: Analysis

99. How could you use ^{14}C to deduce the overall reaction of photosynthesis?

ANS:
The radioactive isotope of carbon could be traced from labeled carbon dioxide. The carbon on the reactant, carbon dioxide, would ultimately be found in one of the products, a sugar. The reaction could be stopped at various points and reveal intermediate reactions.

PTS: 1 DIF: Difficult REF: Section 2.2 | Section 2.4
OBJ: Bloom's Taxonomy: Application | Bloom's Taxonomy: Comprehension

100. If van der Waals forces are weak, how can geckos utilize these forces to cling to and walk up vertical smooth surfaces?

ANS:
The toes of geckos are covered by millions of hairs (setae). At the tip of each setae are hundreds of thousands of pads, where each pad forms a weak interaction with a smooth surface due to van der Waal forces. Collectively, these forces form strong attractive forces.

PTS: 1 DIF: Easy REF: Section 2.3
OBJ: Bloom's Taxonomy: Knowledge | Bloom's Taxonomy: Comprehension

101. Describe the difference between cohesion and adhesion, and how they combine to allow water to move upward in plants.

ANS:
Cohesion is the resistance of a molecule to separate, where adhesion is the ability of molecules to stick to surfaces. Cohesion in water is the resistance to separate due to the hydrogen-bond lattice. Adhesion in water is the ability of hydrogen bonds to form with charged and polar groups associated with surfaces. A water column in a plant is a result of cohesion – water molecules being held together – and maintained by water adhering to the walls of the water conducting tissue (xylem).

PTS: 1 DIF: Moderate REF: Section 2.4
OBJ: Bloom's Taxonomy: Comprehension | Bloom's Taxonomy: Synthesis

MODIFIED TRUE/FALSE

If the statement is true, answer "T". If the statement is false, answer "F" and make it correct by changing the underlined word(s) and writing the correct word(s) in the answer blank(s).

102. An understanding of the relationship between the structure of <u>elemental</u> substances and their behavior is the first step in learning biology.

ANS: F, chemical

PTS: 1 DIF: Moderate REF: Section 2.1
OBJ: Bloom's Taxonomy: Knowledge

103. Carbon dioxide is <u>an element.</u>

ANS: F, a compound

PTS: 1 DIF: Moderate REF: Section 2.1
OBJ: Bloom's Taxonomy: Knowledge

104. Atoms with atomic numbers between lithium and neon have two energy levels.

ANS: T PTS: 1 DIF: Moderate
REF: Section 2.2 OBJ: Bloom's Taxonomy: Knowledge

105. Radioactivity can destroy cancerous tissue but not healthy tissue.

ANS: F, also

PTS: 1 DIF: Moderate
REF: Focus on Research: Using Radioisotopes to Save Lives
OBJ: Bloom's Taxonomy: Knowledge | Bloom's Taxonomy: Comprehension

106. Polar molecules that associate readily with carbon dioxide are hydrophilic.

ANS: F, water

PTS: 1 DIF: Easy REF: Section 2.3
OBJ: Bloom's Taxonomy: Knowledge

107. A typical candy bar has approximately 250,000 Calories.

ANS: F, calories

PTS: 1 DIF: Moderate REF: Section 2.4
OBJ: Bloom's Taxonomy: Knowledge

108. Vinegar is a good cleaning solution because it is a weak acid, while ammonia is a good cleaner because it is a weak base.

ANS: T PTS: 1 DIF: Moderate
REF: Section 2.5 OBJ: Bloom's Taxonomy: Knowledge

109. The metabolism of some bacteria transforms uranium from its soluble form to an insoluble form.

ANS: T PTS: 1 DIF: Moderate
REF: Unanswered Questions OBJ: Bloom's Taxonomy: Knowledge

ESSAY

110. Oxygen generally forms two covalent bonds, while carbon generally forms four covalent bonds. In contrast, helium is inert (generally does not form any bonds). Explain the reason for the differences in chemical behavior between these three elements.

ANS:
The number of valence electrons in the outermost energy level, or valence shell, determines chemical reactivity. Atoms of an element with a filled valence shell, such as helium, are nonreactive. In contrast, atoms with an unfilled valence shell are reactive; they will tend to gain, lose, or share electrons so that they wind up with a filled valence shell. Oxygen needs two electrons to fill its valence shell, so it tends to form two covalent bonds. Carbon needs four electrons to fill its valence shell so it tends to form four covalent bonds.

PTS: 1 DIF: Moderate REF: Section 2.2
OBJ: Bloom's Taxonomy: Application | Bloom's Taxonomy: Synthesis

111. Describe how the interaction of water with dual polarity lipid molecules establishes biological membranes.

ANS:
The hydrogen bonding between water molecules forms a lattice that resists invasion by nonpolar molecules. However, polar molecules can interact with the hydrogen-bond lattice. Lipid molecules with both polar and nonpolar regions can align in a bilayer, with the lipid molecules oriented so that their polar regions are on either side of the bilayer and their nonpolar regions are buried in the middle of the bilayer. In this arrangement only the polar ends are exposed to the water. This creates a membrane of lipid molecules that separates the watery solution on one side of the bilayer from the watery solution on the other side of the bilayer.

PTS: 1 DIF: Moderate REF: Section 2.4
OBJ: Bloom's Taxonomy: Synthesis