CHAPTER 2—LIFE'S CHEMICAL BASIS

MULTIPLE CHOICE

Mercury Rising

1. Toxic elements such as mercury are found in the human body because
   a. of contamination from the environment.
   b. trace amounts of these elements have vital biological functions.
   c. they are needed to kill bacteria.
   d. they may be ingested with food but inactivated by cells.
   e. in small amounts they are biologically inactive and tolerated by cells.

   ANS: A PTS: 1
   DIF: Easy
   OBJ: Bloom's Taxonomy: Comprehension

2. How much mercury can the average human safely consume per day?
   a. 1 microgram.
   b. 3 micrograms.
   c. 7 micrograms.
   d. 10 micrograms.
   e. 100 micrograms.

   ANS: C PTS: 1
   DIF: Moderate
   OBJ: Bloom's Taxonomy: Knowledge

Start with Atoms

3. Which is the smallest unit of an element that retains the properties of the element?
   a. atom
   b. compound
   c. ion
   d. molecule
   e. mixture

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

4. Which is NOT an element?
   a. water
   b. oxygen
   c. carbon
   d. chlorine
   e. hydrogen

   ANS: A PTS: 1
   DIF: Easy
   OBJ: Bloom's Taxonomy: Comprehension | Bloom's Taxonomy: Analysis

5. The atomic number refers to the
   a. mass of an atom.
   b. number of protons in an atom.
   c. number of both protons and neutrons in an atom.
   d. number of neutrons in an atom.
   e. number of electrons in an atom.

   ANS: B PTS: 1
   DIF: Easy
   OBJ: Bloom's Taxonomy: Knowledge

6. Isotopes of atoms
   a. are electrically unbalanced.
   b. behave the same chemically and physically but differ biologically from other isotopes.
   c. are the same physically and biologically but differ from other isotopes chemically.
   d. have the same number of protons but a different number of neutrons.
   e. are produced when atoms lose electrons.

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

7. The subatomic particle(s) with a negative charge is(are)
   a. the neutron.
   b. the proton.
   c. the electron.
   d. both the neutron and proton.
   e. both the proton and electron.

   ANS: C PTS: 1
   DIF: Easy
   OBJ: Bloom's Taxonomy: Knowledge

8. The nucleus of an atom contains
   a. neutrons and protons.
   b. neutrons and electrons.
   c. protons and electrons.
   d. protons only.
   e. neutrons only.

   ANS: A PTS: 1
   DIF: Easy
   OBJ: Bloom's Taxonomy: Knowledge

9. Which components of an atom have negative charges?
   I. electrons
   II. protons
   III. neutrons

   a. I only
   b. II only
   c. III only
   d. I and II
   e. II and III

   ANS: A PTS: 1
   DIF: Easy
   OBJ: Bloom's Taxonomy: Knowledge | Bloom's Taxonomy: Analysis

10. Which components of an atom do not have a charge?
   I. electrons
   II. protons
   III. neutrons

   a. I only
   b. II only
   c. III only
   d. I and II
   e. II and III

   ANS: C PTS: 1
   DIF: Easy
   OBJ: Bloom's Taxonomy: Knowledge | Bloom's Taxonomy: Analysis

11. The atomic mass (mass number) of an atom is determined by the combined masses of its
   a. neutrons and protons.
   b. neutrons and electrons.
   c. protons and electrons.
   d. protons, neutrons, and electrons.
   e. neutrons, nucleus, and electrons.

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

12. Which of the following is false concerning the atom in the figure?
   a. The number of protons and the number of electrons are equal.
   b. It has an atomic mass of 4.
   c. Electrons are moving around the nucleus.
   d. It has an atomic number of 2.
   e. The number of electrons exceeds the number of protons.

   ANS: E PTS: 1
   DIF: Easy
   OBJ: Bloom's Taxonomy: Comprehension | Bloom's Taxonomy: Application | Bloom's Taxonomy: Synthesis

13. Which of the following statements is NOT true?
   a. All isotopes of an element have the same number of electrons.
   b. All isotopes of an element have the same number of protons.
   c. All isotopes of an element have the same number of neutrons.
   d. We refer to isotopes by mass number.
   e. ^{12}C and ^{13}C are isotopes.

   ANS: C PTS: 1
   DIF: Difficult
   OBJ: Bloom's Taxonomy: Comprehension | Bloom's Taxonomy: Analysis

14. In the chemical shorthand ^{14}C, the 14 represents the number of
   a. excess neutrons.
   b. protons plus neutrons.
   c. electrons.
   d. protons plus electrons.
   e. radioactive particles.

   ANS: B PTS: 1
   DIF: Moderate
   OBJ: Bloom's Taxonomy: Knowledge | Bloom's Taxonomy: Application

15. In a chemical equation, the chemicals to the left of the arrow are
   a. products.
   b. in greater abundance.
   c. at higher energy levels.
   d. reactants.
   e. all of these.

   ANS: D PTS: 1
   DIF: Easy
   OBJ: Bloom's Taxonomy: Knowledge | Bloom's Taxonomy: Application

16. Radioactive isotopes have
    a. excess electrons.
    b. excess protons.
    c. excess neutrons.
    d. insufficient neutrons.
    e. insufficient protons.
    ANS: C PTS: 1
    DIF: Moderate
    OBJ: Bloom's Taxonomy: Knowledge

17. Tracers are elements that
    a. are used in minute amounts in plants.
    b. can be monitored through biochemical reactions.
    c. must be inert.
    d. have an unbalanced electrical charge.
    e. must have a stable nucleus.
    ANS: B PTS: 1
    DIF: Difficult
    OBJ: Bloom's Taxonomy: Knowledge

18. Which statement concerning radioisotope ^{14}C is false?
    a. It can be substituted for ^{12}C in glucose and the body will still be able to use the compound.
    b. It has a different number of protons than ^{12}C.
    c. It has more neutrons than ^{12}C.
    d. It behaves the same chemically as ^{12}C.
    e. It has six carbons and eight neutrons.
    ANS: B PTS: 1
    DIF: Moderate
    OBJ: Bloom's Taxonomy: Comprehension | Bloom's Taxonomy: Analysis

19. The radioactive decay of ^{14}C produces
    a. carbon 12.
    b. carbon 13.
    c. more carbon 14.
    d. nitrogen 14.
    e. oxygen 14.
    ANS: D PTS: 1
    DIF: Moderate
    OBJ: Bloom's Taxonomy: Knowledge

Why Electrons Matter

20. Argon has 18 protons. How many electrons are in its third energy level?
    a. 2
    b. 4
    c. 6
    d. 8
    e. 10
    ANS: D PTS: 1
    DIF: Moderate
    OBJ: Bloom's Taxonomy: Application

21. Which statement is NOT true?
    a. Electrons closest to the nucleus are at the lowest energy level.
    b. No more than two electrons can occupy a single orbital.
    c. Electrons are unable to move out of the assigned orbital space.
    d. The innermost orbital holds two electrons.
    e. At the second energy level there are four possible orbitals with a total of eight electrons.
    ANS: C PTS: 1
    DIF: Moderate
    OBJ: Bloom's Taxonomy: Comprehension | Bloom's Taxonomy: Analysis

22. Which of the following is NOT accurate concerning ionization?
    a. When one atom loses electrons, another must gain electrons.
    b. When an atom loses an electron, it becomes negatively charged.
    c. Ionic bonds form between ionized atoms.
    d. In the compound NaCl, Na loses an electron to become positive.
    e. In an ion, the number of protons and electrons is unequal.
    ANS: B PTS: 1
    DIF: Difficult
    OBJ: Bloom's Taxonomy: Comprehension | Bloom's Taxonomy: Analysis

23. Nitrogen, with an atomic number of 7, has ____ electrons in the first energy level and ____ electrons in the second energy level.
    a. 1; 6
    b. 2; 5
    c. 3; 4
    d. 4; 3
    e. 5; 2
    ANS: B PTS: 1
    DIF: Difficult
    OBJ: Bloom's Taxonomy: Application

Chemical Bonds: From Atoms to Molecules

24. Carbon dioxide is an example of a(n)
    a. atom.
    b. ion.
    c. compound.
    d. mixture.
    e. element.
    ANS: C PTS: 1
    DIF: Easy
    OBJ: Bloom's Taxonomy: Knowledge

25. Which statement is false?
    a. A molecule is made of at least two atoms.
    b. Compounds are made of elements.
    c. Two atoms of oxygen make a molecule of oxygen.
    d. Proportions of elements in compounds vary according to their source in nature.
    e. Elements are found in compounds and molecules.
    ANS: D PTS: 1
    DIF: Moderate
    OBJ: Bloom's Taxonomy: Comprehension | Bloom's Taxonomy: Analysis

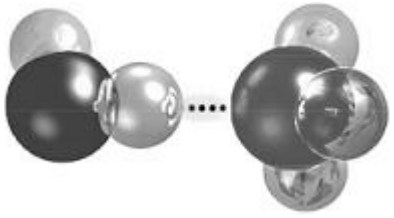
26. A molecule is
    a. a combination of two or more atoms.
    b. a mixture of atoms.
    c. electrically charged.
    d. a carrier of one or more extra neutrons.
    e. none of these.
    ANS: A PTS: 1
    DIF: Moderate
    OBJ: Bloom's Taxonomy: Knowledge

27. The bond in table salt (NaCl) is
    a. polar.
    b. ionic.
    c. covalent.
    d. double.
    e. nonpolar.
    ANS: B PTS: 1
    DIF: Moderate
    OBJ: Bloom's Taxonomy: Knowledge

28. In ____ bonds, both atoms exert the same pull on shared electrons.
    a. nonpolar covalent
    b. polar covalent
    c. double covalent
    d. triple covalent
    e. coordinate covalent
    ANS: A PTS: 1
    DIF: Difficult
    OBJ: Bloom's Taxonomy: Knowledge

29. Which of these statements is false concerning covalent bonds?
    a. Atoms share electrons.
    b. Molecules may possess many covalent bonds.
    c. Water contains polar covalent bonds.
    d. Covalent bonds may be "double bonds."
    e. In polar covalent bonds, electrons are shared equally.
    ANS: E PTS: 1
    DIF: Moderate
    OBJ: Bloom's Taxonomy: Knowledge | Bloom's Taxonomy: Synthesis

Hydrogen Bonds and Water



30. The dots in the figure represent a(n)
    a. covalent bond.
    b. ionic bond.
    c. hydrogen bond.
    d. polar covalent bond.
    e. hydrophobic interaction.
    ANS: C PTS: 1
    DIF: Easy
    OBJ: Bloom's Taxonomy: Comprehension

31. A hydrogen bond is a(n)
    a. sharing of a pair of electrons between a hydrogen and an oxygen nucleus.
    b. sharing of a pair of electrons between a hydrogen nucleus and either an oxygen or a nitrogen nucleus.
    c. attractive force between a hydrogen atom and either an oxygen or a nitrogen atom that are in other molecules or within the same molecule.
    d. covalent bond between two hydrogen atoms.
    e. covalent bond between a hydrogen atom and either an oxygen atom or a nitrogen atom.
    ANS: C PTS: 1
    DIF: Difficult
    OBJ: Bloom's Taxonomy: Knowledge

32. Water is important to the interactions of biological molecules because it
    a. promotes hydrophobic and hydrophilic interactions.
    b. stabilizes temperature.
    c. is an excellent solvent for polar and ionic substances.
    d. has strong cohesive properties.
    e. does all of these.
    ANS: E PTS: 1
    DIF: Moderate
    OBJ: Bloom's Taxonomy: Comprehension

33. The most likely reason that glucose dissolves in water is that it is
    a. an ionic compound.
    b. a polysaccharide.
    c. polar and forms many hydrogen bonds with the water molecules.
    d. a very unstable molecule.
    e. highly nonpolar.
    ANS: C PTS: 1
    DIF: Difficult
    OBJ: Bloom's Taxonomy: Comprehension

34. The solvent, cohesive, and temperature stabilization properties of water are due to its
    a. ability to promote hydrophilic interactions.
    b. ionic bonds.
    c. hydrogen bonds.
    d. ability to promote hydrophobic interactions.
    e. nonpolar nature.
    ANS: C PTS: 1
    DIF: Difficult
    OBJ: Bloom's Taxonomy: Knowledge | Bloom's Taxonomy: Evaluation

35. The column of water extending in tubes from plant roots to leaves is maintained by
    a. cohesion among water molecules.
    b. ionic bonds.
    c. covalent bonds.
    d. hydrophobic interactions.
    e. hydrophilic interactions.
    ANS: A PTS: 1
    DIF: Moderate
    OBJ: Bloom's Taxonomy: Knowledge

36. Sodium chloride (KCl) in water can be described by any EXCEPT which of the following?
    a. K^+ and Cl^- form
    b. a solute
    c. ionized
    d. forms hydrophobic interactions
    e. dissolved
    ANS: D PTS: 1
    DIF: Difficult
    OBJ: Bloom's Taxonomy: Comprehension | Bloom's Taxonomy: Analysis

37. A salt will dissolve in water to form
    a. acids.
    b. hydrogen bonds.
    c. ions other than H^+ and OH^-.
    d. bases.
    e. buffers.
    ANS: C PTS: 1
    DIF: Moderate
    OBJ: Bloom's Taxonomy: Knowledge

Acids and Bases

38. "Acidic" is an appropriate description for all EXCEPT which one of the following?
    a. excess hydrogen ions
    b. the contents of the stomach
    c. magnesium hydroxide
    d. HCl
    e. a pH less than 7
    ANS: C PTS: 1
    DIF: Moderate
    OBJ: Bloom's Taxonomy: Comprehension | Bloom's Taxonomy: Analysis

39. A solution with a pH of 9 has how many times fewer hydrogen ions than a solution with a pH of 6?
    a. 2
    b. 4
    c. 10
    d. 100
    e. 1,000
    ANS: E PTS: 1
    DIF: Difficult
    OBJ: Bloom's Taxonomy: Application

40. Blood pH is kept near a value of 7.3 - 7.5 because of
    a. salts.
    b. buffers.
    c. acids.
    d. bases.
    e. water.
    ANS: B PTS: 1
    DIF: Moderate
    OBJ: Bloom's Taxonomy: Comprehension

MATCHING

Classification. The various energy levels in an atom of magnesium ($^{24}_{12}Mg$) have different numbers of electrons. Use the numbers below to answer the following questions.
a. 1
b. 2
c. 3
d. 6
e. 8

41. number of electrons in the first energy level
42. number of electrons in the second energy level
43. number of electrons in the third energy level

41. ANS: B PTS: 1 DIF: Difficult
    OBJ: Bloom's Taxonomy: Application MSC: Classification
42. ANS: E PTS: 1 DIF: Difficult
    OBJ: Bloom's Taxonomy: Application MSC: Classification
43. ANS: E PTS: 1 DIF: Difficult
    OBJ: Bloom's Taxonomy: Application MSC: Classification

Classification. The following are types of chemical bonds. Answer the questions below by matching the descriptions with the most appropriate bond type.
a. hydrogen
b. ionic
c. covalent
d. polar covalent
e. double bond

44. the bond between the atoms of table salt (NaCl)
45. the bond type holding several molecules of water together
46. the bond between the oxygen atoms of oxygen gas (O_2)
47. the bond that breaks when salts dissolve in water
48. a bond in which connected atoms share electrons

44. ANS: B PTS: 1 DIF: Moderate
    OBJ: Bloom's Taxonomy: Comprehension MSC: Classification
45. ANS: A PTS: 1 DIF: Moderate
    OBJ: Bloom's Taxonomy: Comprehension MSC: Classification
46. ANS: E PTS: 1 DIF: Moderate

OBJ: Bloom's Taxonomy: Comprehension MSC: Classification

47. ANS: B PTS: 1 DIF: Moderate
OBJ: Bloom's Taxonomy: Comprehension MSC: Classification

48. ANS: C PTS: 1 DIF: Moderate
OBJ: Bloom's Taxonomy: Comprehension MSC: Classification

SHORT ANSWER

49. Water surface tension is caused by _____ bonds.

ANS: hydrogen PTS: 1 DIF: Easy
OBJ: Bloom's Taxonomy: Knowledge

50. Two pairs of electrons shared between two atoms is called a _____.

ANS: double bond PTS: 1 DIF: Moderate
OBJ: Bloom's Taxonomy: Knowledge

51. C^{14} is a radioactive isotope, and it turns into _____ when it decays.

ANS: nitrogen PTS: 1 DIF: Easy
OBJ: Bloom's Taxonomy: Knowledge

52. An atom with more protons than electrons is called a(n) _____.

ANS: cation PTS: 1 DIF: Moderate
OBJ: Bloom's Taxonomy: Knowledge

54. The ability of a solution to resist changes in pH depends on its _____.

ANS: buffering capacity

PTS: 1 DIF: Moderate OBJ: Bloom's Taxonomy: Knowledge
TOP: ACIDS AND BASES