

***Fundamentals of Anatomy and Physiology, 9e (Martini)***  
**Chapter 2 The Chemical Level of Organization**

Multiple-Choice Questions

1) The smallest stable units of matter are

- A) atoms.
- B) molecules.
- C) protons.
- D) neutrons.
- E) electrons.

Answer: A

Learning Outcome: 2-1

Bloom's Taxonomy: Knowledge

2) The "atomic number" of an atom is determined by the number of \_\_\_\_\_ it has.

- A) electrons
- B) protons
- C) neutrons
- D) protons + neutrons
- E) protons + electrons

Answer: B

Learning Outcome: 2-1

Bloom's Taxonomy: Knowledge

3) The "atomic weight" of an atom reflects the average number of

- A) protons.
- B) neutrons.
- C) electrons.
- D) protons + neutrons.
- E) protons + neutrons + electrons.

Answer: E

Learning Outcome: 2-1

Bloom's Taxonomy: Knowledge

4) One mole of any element

- A) has the same mass.
- B) has the same weight.
- C) has the same number of atoms.
- D) has the same number of electrons.
- E) All of the answers are correct.

Answer: C

Learning Outcome: 2-1

Bloom's Taxonomy: Knowledge

5) The nucleus of an atom consists of

- A) electrons.
- B) protons.
- C) neutrons.
- D) protons + neutrons.
- E) protons + electrons.

Answer: D

Learning Outcome: 2-1

Bloom's Taxonomy: Knowledge

6) Isotopes of an element differ in the number of

- A) protons in the nucleus.
- B) electrons in the nucleus.
- C) neutrons in the nucleus.
- D) electron clouds.
- E) electrons in energy shells.

Answer: C

Learning Outcome: 2-1

Bloom's Taxonomy: Knowledge

7) The mass number represents the number of

- A) protons in an atom.
- B) electrons in an ion.
- C) neutrons in an atom.
- D) protons + neutrons.
- E) neutrons + electrons.

Answer: D

Learning Outcome: 2-1

Bloom's Taxonomy: Knowledge

8) The innermost electron shell in an atom holds up to \_\_\_\_\_ electrons.

- A) 1
- B) 2
- C) 4
- D) 6
- E) 8

Answer: B

Learning Outcome: 2-1

Bloom's Taxonomy: Knowledge

9) Radioisotopes have unstable

- A) ions.
- B) nuclei.
- C) isotopes.
- D) electron clouds.
- E) protons.

Answer: B

Learning Outcome: 2-1

Bloom's Taxonomy: Knowledge

10) By weight, which element is the most plentiful in the human body?

- A) sulfur
- B) sodium
- C) oxygen
- D) potassium
- E) carbon

Answer: C

Learning Outcome: 2-1

Bloom's Taxonomy: Knowledge

11) Indicate which of these lists contains only trace elements.

- A) sulfur, chlorine, oxygen
- B) selenium, hydrogen, calcium
- C) boron, oxygen, carbon
- D) silicon, fluorine, tin
- E) cobalt, calcium, sodium

Answer: D

Learning Outcome: 2-1

Bloom's Taxonomy: Knowledge

12) The atomic number represents the number of

- A) electrons in an atom.
- B) protons in an atom.
- C) neutrons in an atom.
- D) protons and neutrons in an atom.
- E) chemical bonds the atom may form.

Answer: B

Learning Outcome: 2-1

Bloom's Taxonomy: Knowledge

- 13) Helium (He) has an atomic number of 2. It is chemically stable because it
- A) is neutral in electrical charge.
  - B) readily ionizes to react with other atoms.
  - C) has a full outer electron shell.
  - D) will form a covalent bond with another He atom.
  - E) lacks electrons, thus the He atom is stable.

Answer: C

Learning Outcome: 2-1

Bloom's Taxonomy: Comprehension

- 14) Which element commonly has only a proton as its nucleus?

- A) helium
- B) neon
- C) argon
- D) hydrogen
- E) carbon

Answer: D

Learning Outcome: 2-1

Bloom's Taxonomy: Comprehension

- 15) By weight, which element is the second most abundant in the human body?

- A) oxygen
- B) carbon
- C) hydrogen
- D) nitrogen
- E) calcium

Answer: B

Learning Outcome: 2-1

Bloom's Taxonomy: Comprehension

- 16) The mass of an atom is largely determined by the number of \_\_\_\_\_ it has.

- A) electrons
- B) protons
- C) neutrons
- D) protons + neutrons
- E) protons + electrons

Answer: D

Learning Outcome: 2-1

Bloom's Taxonomy: Comprehension

17) If an isotope of oxygen has 8 protons, 10 neutrons, and 8 electrons, its mass number is

- A) 26.
- B) 16.
- C) 18.
- D) 8.
- E) 12.

Answer: C

Learning Outcome: 2-1

Bloom's Taxonomy: Application

18) If an element is composed of atoms with an atomic number of 6 and a mass number of 14, then a neutral atom of this element contains

- A) 6 protons.
- B) 8 electrons.
- C) 8 neutrons.
- D) 6 protons and 8 electrons.
- E) 6 protons and 8 neutrons.

Answer: E

Learning Outcome: 2-1

Bloom's Taxonomy: Application

19) The molecule NO is known as

- A) nitric oxide.
- B) noxious oxide.
- C) noxious oxygen.
- D) nitric oxygen.
- E) nitrous oxide.

Answer: A

Learning Outcome: 2-2

Bloom's Taxonomy: Knowledge

20) The molecule CO<sub>2</sub> is known as

- A) carbonized oxygen.
- B) carbonated oxygen.
- C) carbon monoxide.
- D) carbon oxide.
- E) carbon dioxide.

Answer: E

Learning Outcome: 2-2

Bloom's Taxonomy: Knowledge

21) The molecule H<sub>2</sub> is known as

- A) hydrohydrogen.
- B) hydrogen.
- C) hydroxide.
- D) helium.
- E) semi-water.

Answer: B

Learning Outcome: 2-2

Bloom's Taxonomy: Knowledge

22) When electrons are transferred from one atom to another, and the two atoms unite as a result of the opposite charges,

- A) an ion is formed.
- B) a molecule is formed.
- C) a hydrogen bond is formed.
- D) an ionic bond is formed.
- E) a covalent bond is formed.

Answer: D

Learning Outcome: 2-2

Bloom's Taxonomy: Knowledge

23) Magnesium atoms have two electrons in the outermost shell. As a result, you would expect magnesium to form ions with a charge of

- A) +1.
- B) +2.
- C) -1.
- D) -2.
- E) either +2 or -2.

Answer: B

Learning Outcome: 2-2

Bloom's Taxonomy: Comprehension

24) Which of the following statements about hydrogen bonds is **false**?

- A) Hydrogen bonds are strong attractive forces between hydrogen atoms and negatively charged atoms.
- B) Hydrogen bonds can occur within a single molecule.
- C) Hydrogen bonds can form between neighboring molecules.
- D) Hydrogen bonds are important for holding large molecules together.
- E) Hydrogen bonds are responsible for many of the properties of water.

Answer: A

Learning Outcome: 2-2

Bloom's Taxonomy: Knowledge

25) The molecule O<sub>2</sub> is known as

- A) oxide.
- B) oxygen.
- C) organic.
- D) oxate
- E) a salt

Answer: B

Learning Outcome: 2-2

Bloom's Taxonomy: Knowledge

26) H<sub>2</sub>O is an example of a(n)

- A) ionic formula.
- B) glucose molecule.
- C) compound.
- D) ion.
- E) covalent formula.

Answer: C

Learning Outcome: 2-2

Bloom's Taxonomy: Knowledge

27) Which of the following is not a cation?

- A) Na<sup>+</sup>
- B) Cl<sup>-</sup>
- C) K<sup>+</sup>
- D) Ca<sup>2+</sup>
- E) Mg<sup>2+</sup>

Answer: B

Learning Outcome: 2-2

Bloom's Taxonomy: Knowledge

28) A dust particle floating on a water surface illustrates

- A) surface tension.
- B) chemical tension.
- C) static electricity.
- D) heat capacity.
- E) hydrophilic attraction.

Answer: A

Learning Outcome: 2-2

Bloom's Taxonomy: Knowledge

29) In an aqueous solution, cations are attracted toward

- A) sodium.
- B) salt.
- C) buffers.
- D) anions.
- E) hydrogen ions.

Answer: D

Learning Outcome: 2-2

Bloom's Taxonomy: Knowledge

30) In an aqueous solution, sodium ions would move toward

- A) a negative terminal.
- B) a positive terminal.
- C) a pH terminal.
- D) an organic terminal.
- E) the bottom.

Answer: A

Learning Outcome: 2-2

Bloom's Taxonomy: Knowledge

31) The chemical behavior of an atom is determined by

- A) the number of protons.
- B) the number of neutrons.
- C) the outermost electron shell.
- D) the size of the atom.
- E) the mass of the nucleus.

Answer: C

Learning Outcome: 2-2

Bloom's Taxonomy: Knowledge

32) Ions with a + charge are called

- A) cations.
- B) anions.
- C) radicals.
- D) positrons.
- E) isotopes.

Answer: A

Learning Outcome: 2-2

Bloom's Taxonomy: Knowledge



33) The weakest bond between two atoms is the \_\_\_\_\_ bond.

- A) ionic
- B) covalent
- C) polar
- D) nonpolar
- E) hydrogen

Answer: E

Learning Outcome: 2-2

Bloom's Taxonomy: Knowledge

34) When atoms complete their outer electron shell by sharing electrons, they form

- A) ionic bonds.
- B) covalent bonds.
- C) hydrogen bonds.
- D) anions.
- E) cations.

Answer: B

Learning Outcome: 2-2

Bloom's Taxonomy: Knowledge

35) Ionic bonds are formed when

- A) atoms share electrons.
- B) an electron or electrons are completely transferred from one atom to another.
- C) a pair of electrons is shared unequally by two atoms.
- D) hydrogen forms bonds with negatively charged atoms.
- E) two or more atoms lose electrons at the same time.

Answer: B

Learning Outcome: 2-2

Bloom's Taxonomy: Knowledge

36) If a pair of electrons is unequally shared between two atoms, a(n) \_\_\_\_\_ occurs.

- A) single covalent bond
- B) double covalent bond
- C) triple covalent bond
- D) polar covalent bond
- E) hydrogen bond

Answer: D

Learning Outcome: 2-2

Bloom's Taxonomy: Knowledge

37) Elements that have atoms with full outer shells of electrons

- A) will form many compounds.
- B) will normally form anions.
- C) will normally form cations.
- D) frequently form hydrogen bonds.
- E) are inert gases.

Answer: E

Learning Outcome: 2-2

Bloom's Taxonomy: Knowledge

38) Ions in an ionic molecule are held together due to

- A) the sharing of electrons.
- B) the attraction of opposite electrical charges.
- C) each electron orbiting all of the ions in the molecule.
- D) the presence of water molecules.
- E) the attraction of similar charges of the ions' protons.

Answer: B

Learning Outcome: 2-2

Bloom's Taxonomy: Knowledge

39) An unequal sharing of electrons results in what type of chemical bonds?

- A) polar covalent
- B) covalent
- C) ionic
- D) hydrogen
- E) peptide

Answer: A

Learning Outcome: 2-2

Bloom's Taxonomy: Knowledge

40) Sodium (Na) has an atomic number of 11. How many electrons are in the outer electron shell of a neutral sodium atom?

- A) 1
- B) 2
- C) 3
- D) 4
- E) 8

Answer: A

Learning Outcome: 2-2

Bloom's Taxonomy: Comprehension

41) Oxygen (atomic number 8) requires how many **additional** electrons to fill its outer electron shell?

- A) 1
- B) 2
- C) 4
- D) 6
- E) 8

Answer: B

Learning Outcome: 2-2

Bloom's Taxonomy: Comprehension

42) The formula for methane gas is  $\text{CH}_4$ . What does the formula  $4\text{CH}_4$  represent?

- A) a molecule with 4 carbon atoms
- B) a molecule with 4 carbon atoms and 16 hydrogen atoms
- C) 4 molecules, each containing a carbon and a hydrogen atom
- D) 4 molecules, each containing a carbon atom and 4 hydrogen atoms
- E) an inorganic compound with ionic bonds

Answer: D

Learning Outcome: 2-2

Bloom's Taxonomy: Comprehension

43) In an ionic bond, the electron donor is the \_\_\_\_\_, whereas the electron acceptor is the \_\_\_\_\_.

- A) acid, base
- B) salt, ion
- C) anion, cation
- D) base, acid
- E) cation, anion

Answer: E

Learning Outcome: 2-2

Bloom's Taxonomy: Comprehension

44) In a molecule of nitrogen, three pairs of electrons are shared by two nitrogen atoms. The type of bond that is formed is an example of a(n)

- A) single trivalent bond.
- B) double divalent bond.
- C) triple covalent bond.
- D) polar covalent bond.
- E) hydrogen bond.

Answer: C

Learning Outcome: 2-2

Bloom's Taxonomy: Comprehension

45) In chemical notation, the symbol  $\text{Ca}^{2+}$  means \_\_\_\_\_.

- A) two calcium atoms
- B) a calcium ion that has lost two electrons
- C) a calcium ion that has gained two protons
- D) a calcium ion that has gained two electrons
- E) a calcium ion that has lost two protons

Answer: B

Learning Outcome: 2-2

Bloom's Taxonomy: Comprehension

46) Magnesium atoms have two electrons in the outermost shell and chlorine atoms have seven.

The compound magnesium chloride would contain

- A) 1 magnesium and 1 chlorine.
- B) 1 magnesium and 2 chlorine.
- C) 2 magnesium and 1 chlorine.
- D) 2 magnesium and 7 chlorine.
- E) impossible to tell without more information

Answer: B

Learning Outcome: 2-2

Bloom's Taxonomy: Application

47)  $\text{AB} \rightarrow \text{A} + \text{B}$  is to decomposition as  $\text{A} + \text{B} \rightarrow \text{AB}$  is to

- A) exchange.
- B) synthesis.
- C) combustion.
- D) replacement.
- E) metabolism.

Answer: B

Learning Outcome: 2-3

Bloom's Taxonomy: Knowledge

48) The reaction  $\text{N}_2 + 3 \text{H}_2 \rightarrow 2 \text{NH}_3$  is an example of a(n)

- A) exchange reaction.
- B) decomposition reaction.
- C) synthesis reaction.
- D) enzyme reaction.
- E) metabolic reaction.

Answer: C

Learning Outcome: 2-3

Bloom's Taxonomy: Comprehension

49) The reaction  $A + B + \text{energy} \rightarrow AB$  is an example of a(n)

- A) exergonic reaction.
- B) endergonic reaction.
- C) equilibrium reaction.
- D) decomposition reaction.
- E) exchange reaction.

Answer: B

Learning Outcome: 2-3

Bloom's Taxonomy: Knowledge

50) In hydrolysis reactions, compounds react with

- A) hydrogen, causing decomposition.
- B) glucose, causing decomposition.
- C) water, causing decomposition.
- D) carbon, causing decomposition.
- E) water, causing synthesis.

Answer: C

Learning Outcome: 2-3

Bloom's Taxonomy: Knowledge

51) Which one of the following statements is **not** correct about the reaction  $H_2 + Cl_2 \rightarrow 2 HCl$ ?

- A)  $H_2$  and  $Cl_2$  are the reactants.
- B)  $HCl$  is the product.
- C) One molecule of hydrogen contains two atoms.
- D) Two molecules of  $HCl$  are formed in the reaction.
- E) This reaction is easily reversible.

Answer: E

Learning Outcome: 2-3

Bloom's Taxonomy: Comprehension

52) In dehydration synthesis reactions, compounds

- A) lose water molecules.
- B) gain water molecules.
- C) convert water molecules to hydrogen and oxygen.
- D) convert hydrogen and oxygen to water.
- E) gain electrons.

Answer: A

Learning Outcome: 2-3

Bloom's Taxonomy: Comprehension

53) In the reaction listed below, what coefficient needs to be added to balance the equation?



- A) 2
- B) 4
- C) 6
- D) 8
- E) 10

Answer: C

Learning Outcome: 2-3

Bloom's Taxonomy: Application

54) Chemical reactions that yield energy, such as heat, are said to be

- A) endergonic.
- B) activated.
- C) exergonic.
- D) neutral.
- E) thermonuclear.

Answer: C

Learning Outcome: 2-4

Bloom's Taxonomy: Knowledge

55) All of the following are true concerning enzymes, **except** that they

- A) are proteins.
- B) function as biological catalysts.
- C) lower the activation energy required for a reaction.
- D) affect only the rate of a chemical reaction.
- E) are consumed during the reaction.

Answer: E

Learning Outcome: 2-4

Bloom's Taxonomy: Knowledge

56) Compounds that can be synthesized or broken down by chemical reactions inside the body are called

- A) inorganic compounds.
- B) organic compounds.
- C) nutrients.
- D) metabolites.
- E) enzymes.

Answer: D

Learning Outcome: 2-5

Bloom's Taxonomy: Knowledge

57) Each of the following is an example of an inorganic compound, **except**

- A) water.
- B) acids.
- C) bases.
- D) salts.
- E) carbohydrates.

Answer: E

Learning Outcome: 2-5

Bloom's Taxonomy: Knowledge

58) Identify which of the following is both an anion and a compound:

- A)  $\text{Na}^+$
- B)  $\text{Cl}^-$
- C)  $\text{K}^+$
- D)  $\text{HCO}_3^-$
- E)  $\text{NaCl}$

Answer: D

Learning Outcome: 2-5

Bloom's Taxonomy: Knowledge

59) Nonpolar organic molecules are good examples of

- A) electrolytes.
- B) molecules that will dissociate when placed into water.
- C) hydrophobic compounds.
- D) hydrophilic compounds.
- E) solutes.

Answer: C

Learning Outcome: 2-6

Bloom's Taxonomy: Knowledge

60) During ionization, water molecules disrupt the ionic bonds of a salt to produce a mixture of ions. These ions can carry a current and so are called

- A) cations.
- B) anions.
- C) acids.
- D) electrolytes.
- E) counterions.

Answer: D

Learning Outcome: 2-6

Bloom's Taxonomy: Knowledge

61) Oppositely charged ions in solution are prevented from combining by

- A) heat capacity of water.
- B) hydration spheres.
- C) water's nonpolar nature.
- D) free radicals.
- E) hydrogen bonding.

Answer: B

Learning Outcome: 2-6

Bloom's Taxonomy: Knowledge

62) An example of an inorganic substance is

- A) fructose.
- B) water.
- C) glycerol.
- D) carbon dioxide.
- E) water and carbon dioxide.

Answer: E

Learning Outcome: 2-6

Bloom's Taxonomy: Knowledge

63) Hydrophilic molecules readily associate with

- A) lipid molecules.
- B) hydrophobic molecules.
- C) water molecules.
- D) acids.
- E) salts.

Answer: C

Learning Outcome: 2-6

Bloom's Taxonomy: Knowledge

64) Which of the following statements about water is **not** correct?

- A) It is composed of polar molecules.
- B) It is responsible for much of the mass of the human body.
- C) It has a relatively low heat capacity.
- D) It can dissolve many substances.
- E) It contains hydrogen bonds.

Answer: C

Learning Outcome: 2-6

Bloom's Taxonomy: Knowledge



65) Which property of water helps keeps body temperature stabilized?

- A) kinetic energy
- B) lubrication
- C) surface tension
- D) reactivity
- E) thermal inertia

Answer: E

Learning Outcome: 2-6

Bloom's Taxonomy: Knowledge

66) Of the list below, which has the highest concentration of hydroxide ions?

- A) pH 1
- B) pH 14
- C) pH 7
- D) pH 10
- E) pH 2

Answer: B

Learning Outcome: 2-7

Bloom's Taxonomy: Knowledge

67) Which pH is closest to normal body pH?

- A) pH 7
- B) pH 8
- C) pH 4
- D) pH 3
- E) pH 2

Answer: A

Learning Outcome: 2-7

Bloom's Taxonomy: Knowledge

68) A(n) \_\_\_\_\_ removes hydrogen ions and a(n) \_\_\_\_\_ releases hydrogen ions.

- A) acid; base
- B) base; acid
- C) compound; element
- D) element; compound
- E) molecule; acid

Answer: B

Learning Outcome: 2-7

Bloom's Taxonomy: Knowledge

69) An excess of hydrogen ions in the body fluids can have fatal results because this can

- A) break chemical bonds.
- B) change the shape of large complex molecules, rendering them nonfunctional.
- C) disrupt tissue functions.
- D) change body fluid pH.
- E) All of the answers are correct.

Answer: E

Learning Outcome: 2-7

Bloom's Taxonomy: Knowledge

70) A solution containing equal numbers of hydrogen ions and hydroxide ions is

- A) acidic.
- B) basic.
- C) neutral.
- D) alkaline.
- E) in equilibrium.

Answer: C

Learning Outcome: 2-7

Bloom's Taxonomy: Knowledge

71) The chemical notation that indicates concentration is represented as

- A) ().
- B) <>.
- C) [ ].
- D) { }.
- E) ||.

Answer: C

Learning Outcome: 2-7

Bloom's Taxonomy: Knowledge

72) If a substance has a pH that is greater than 7, it is

- A) neutral.
- B) acidic.
- C) alkaline.
- D) a buffer.
- E) a salt.

Answer: C

Learning Outcome: 2-7

Bloom's Taxonomy: Knowledge

73) Which pH of the following is the most acidic?

- A) pH 2
- B) pH 6
- C) pH 4
- D) pH 3
- E) pH 1

Answer: E

Learning Outcome: 2-7

Bloom's Taxonomy: Knowledge

74) Which pH of the following is the least acidic?

- A) pH 2
- B) pH 6
- C) pH 4
- D) pH 3
- E) pH 1

Answer: E

Learning Outcome: 2-7

Bloom's Taxonomy: Knowledge

75) An important buffer in body fluids is

- A) NaCl.
- B) NaOH.
- C) HCl.
- D) NaHCO<sub>3</sub>.
- E) H<sub>2</sub>O.

Answer: D

Learning Outcome: 2-7

Bloom's Taxonomy: Knowledge

76) Which of the following substances would be most acidic?

- A) lemon juice, pH = 2
- B) urine, pH = 6
- C) tomato juice, pH = 4
- D) white wine, pH = 3
- E) stomach secretions, pH = 1

Answer: E

Learning Outcome: 2-7

Bloom's Taxonomy: Comprehension

77) Of the following choices, the pH of the least acidic solution is

- A) 6.0.
- B) 4.5.
- C) 2.3.
- D) 1.0.
- E) 12.0.

Answer: E

Learning Outcome: 2-7

Bloom's Taxonomy: Comprehension

78) Which has the greater concentration of hydrogen ions, a substance with a pH of 5 or a substance with a pH of 4?

- A) A pH of 4 is greater.
- B) A pH of 5 is greater.
- C) They are both equal; 4 and 5 are relative values.
- D) pH 9, if you mixed the solutions.
- E) There is not enough information to determine.

Answer: A

Learning Outcome: 2-7

Bloom's Taxonomy: Comprehension

79) In the body, inorganic compounds

- A) can serve as buffers.
- B) can make up proteins.
- C) are made from organic compounds.
- D) are structural components of cells.
- E) are metabolized for cellular energy.

Answer: A

Learning Outcome: 2-8

Bloom's Taxonomy: Knowledge

80) When placed in water, an inorganic compound dissociates 99 percent, forming hydrogen ions and anions. This compound would be

- A) a strong base.
- B) a weak base.
- C) a strong acid.
- D) a weak acid.
- E) a salt.

Answer: C

Learning Outcome: 2-8

Bloom's Taxonomy: Comprehension

81) When a small amount of HCl or NaOH is added to a solution of  $\text{Na}_2\text{HPO}_4$ , the pH of the solution barely changes. Based on these observations, all of the following are true concerning the compound  $\text{Na}_2\text{HPO}_4$ , **except**

- A)  $\text{Na}_2\text{HPO}_4$  is able to accept extra hydrogen ions from the HCl.
- B)  $\text{Na}_2\text{HPO}_4$  is able to donate hydrogen ions to the  $\text{OH}^-$  from NaOH.
- C)  $\text{Na}_2\text{HPO}_4$  adsorbs excess  $\text{H}^+$  and  $\text{OH}^-$  directly onto the surface of its crystalline structure.
- D)  $\text{Na}_2\text{HPO}_4$  is a salt formed from reacting a strong base with a weak acid.
- E)  $\text{Na}_2\text{HPO}_4$  acts as a buffer.

Answer: C

Learning Outcome: 2-8

Bloom's Taxonomy: Comprehension

82) Carbohydrates, lipids, and proteins are classified as

- A) organic molecules.
- B) inorganic molecules.
- C) acids.
- D) salts.
- E) bases.

Answer: A

Learning Outcome: 2-9

Bloom's Taxonomy: Knowledge

83) A functional group is best described as reoccurring clusters of

- A) elements that occur in a salt.
- B) atoms that greatly influence the chemical properties of molecules they are part of.
- C) atoms that function in the body.
- D) elements that form at high pH.
- E) amino acids in a globular protein.

Answer: B

Learning Outcome: 2-9

Bloom's Taxonomy: Knowledge

84) Artificial sweeteners

- A) are naturally similar to sugars.
- B) are always some form of carbohydrate.
- C) are usually not broken down by the body.
- D) are inorganic sugar substitutes.
- E) provide the same number of calories as an equivalent amount of sucrose.

Answer: C

Learning Outcome: 2-9

Bloom's Taxonomy: Knowledge

- 85) Fructose is
- A) a hexose.
  - B) an isomer of glucose.
  - C) found in male reproductive fluids.
  - D) a carbohydrate.
  - E) All of the answers are correct.

Answer: E

Learning Outcome: 2-9

Bloom's Taxonomy: Knowledge

- 86) Molecules that have the same molecular formula but different structural formulas are called
- A) isotopes.
  - B) isomers.
  - C) isozymes.
  - D) isotypes.
  - E) isomoles.

Answer: B

Learning Outcome: 2-9

Bloom's Taxonomy: Knowledge

- 87) The most important metabolic fuel molecule in the body is
- A) sucrose.
  - B) caffeine.
  - C) protein.
  - D) vitamins.
  - E) glucose.

Answer: E

Learning Outcome: 2-9

Bloom's Taxonomy: Knowledge

- 88) A polysaccharide that is formed in liver and muscle cells to store glucose is
- A) lactose.
  - B) cellulose.
  - C) glycogen.
  - D) sucrose.
  - E) fructose.

Answer: C

Learning Outcome: 2-9

Bloom's Taxonomy: Knowledge

89) The group of organic compounds containing carbon, hydrogen, and oxygen in a near 1:2:1 ratio is defined as a

- A) carbohydrate.
- B) lipid.
- C) protein.
- D) nucleic acid.
- E) saturated fat.

Answer: A

Learning Outcome: 2-9

Bloom's Taxonomy: Knowledge

90) An example of an organic substance is:

- A) sucrose
- B) carbonic acid
- C) sodium chloride
- D) oxygen
- E) nitric oxide

Answer: A

Learning Outcome: 2-9

Bloom's Taxonomy: Knowledge

91) Carbohydrate molecules

- A) are the building blocks of cellular membranes.
- B) form the regulatory molecules known as enzymes.
- C) are the body's most readily available source of energy.
- D) are composed of C, H, O, and N atoms.
- E) contain the genetic information found in cells.

Answer: C

Learning Outcome: 2-9

Bloom's Taxonomy: Knowledge

92) When two monosaccharides undergo a dehydration synthesis,

- A) two new monosaccharides are formed.
- B) a disaccharide is formed.
- C) a polysaccharide is formed.
- D) a starch is formed.
- E) hydrolysis occurs.

Answer: B

Learning Outcome: 2-9

Bloom's Taxonomy: Comprehension

93) To bond two monomers together, a molecule of water must be \_\_\_\_\_ to/from from monomers. This process is called \_\_\_\_\_.

- A) added; hydrolysis
- B) removed; dehydration synthesis
- C) removed; crenation
- D) added; denaturation
- E) added; ionization

Answer: B

Learning Outcome: 2-9

Bloom's Taxonomy: Comprehension

94) Lipids

- A) form essential structural components of cells.
- B) provide a significant energy reserve.
- C) help to maintain body temperature.
- D) cushion organs against shocks.
- E) All of the answers are correct.

Answer: E

Learning Outcome: 2-10

Bloom's Taxonomy: Knowledge

95) A fatty acid that contains two or more double covalent bonds is said to be

- A) saturated.
- B) monounsaturated.
- C) polyunsaturated.
- D) hydrogenated.
- E) carboxylated.

Answer: C

Learning Outcome: 2-10

Bloom's Taxonomy: Knowledge

96) Alaska Natives have a lower incidence of heart disease even though their diets are high in fat and cholesterol. This may be due to the large amount of \_\_\_\_\_ in their diets.

- A) vitamins
- B) triglycerides
- C) prostaglandins
- D) omega-3 fatty acids
- E) oleic acid

Answer: D

Learning Outcome: 2-10

Bloom's Taxonomy: Knowledge



97) Which of the following is/are needed to form a triglyceride molecule?

- A) 3 glycerol molecules
- B) 1 glycerol molecule
- C) 3 fatty acid molecules
- D) 3 glycerol molecules and 3 fatty acid molecules
- E) 3 fatty acid molecules and 1 glycerol molecule

Answer: E

Learning Outcome: 2-10

Bloom's Taxonomy: Knowledge

98) A shortage of steroids in the body would result in a shortage of

- A) sex hormones.
- B) proteins.
- C) plasma membranes.
- D) glycogen.
- E) sex hormones and plasma membranes.

Answer: E

Learning Outcome: 2-10

Bloom's Taxonomy: Knowledge

99) Most of the fat found in the human body is in the form of

- A) cholesterol.
- B) phospholipids.
- C) triglycerides.
- D) prostaglandins.
- E) monoglycerides.

Answer: C

Learning Outcome: 2-10

Bloom's Taxonomy: Knowledge

100) Lipids that are produced by nearly every tissue in the body and act as local regulators are the

- A) prostaglandins.
- B) steroids.
- C) monoglycerides.
- D) phospholipids.
- E) glycolipids.

Answer: A

Learning Outcome: 2-10

Bloom's Taxonomy: Knowledge

101) Cholesterol, phospholipids, and glycolipids are examples of

- A) dietary fats.
- B) prostaglandins.
- C) structural lipids.
- D) lipid drugs.
- E) steroids.

Answer: C

Learning Outcome: 2-10

Bloom's Taxonomy: Knowledge

102) A fatty acid with no double bonds between carbon atoms is

- A) unsaturated.
- B) polyunsaturated.
- C) dehydrated.
- D) saturated.
- E) denatured.

Answer: D

Learning Outcome: 2-10

Bloom's Taxonomy: Knowledge

103) Lipids are composed of fatty acids and

- A) glycerol.
- B) amino acids.
- C) sugars.
- D) monosaccharides.
- E) polypeptides.

Answer: A

Learning Outcome: 2-10

Bloom's Taxonomy: Knowledge

104) The monomers of protein are

- A) glucose.
- B) fatty acids.
- C) amino acids.
- D) nucleotides.
- E) nitrogen base.

Answer: C

Learning Outcome: 2-11

Bloom's Taxonomy: Knowledge

105) Substrate molecules bind to enzymes at the \_\_\_\_\_ sites.

- A) amino
- B) active
- C) carboxyl
- D) reactant
- E) neutral

Answer: B

Learning Outcome: 2-11

Bloom's Taxonomy: Knowledge

106) You would expect a peptide bond to link

- A) two simple sugars.
- B) two amino acids.
- C) two nucleotides.
- D) a sugar and a peptide.
- E) a peptide and a fatty acid.

Answer: B

Learning Outcome: 2-11

Bloom's Taxonomy: Knowledge

107) Each amino acid differs from another in the

- A) number of central carbon atoms.
- B) size of the amino group.
- C) number of carboxyl groups.
- D) nature of the side chain.
- E) number of peptide bonds in the molecule.

Answer: D

Learning Outcome: 2-11

Bloom's Taxonomy: Knowledge

108) The term \_\_\_\_\_ means each enzyme catalyzes only one type of reaction.

- A) saturation
- B) specificity
- C) inertia
- D) activation
- E) monoreactive

Answer: B

Learning Outcome: 2-11

Bloom's Taxonomy: Knowledge

109) A side chain on an amino acid is sometimes called \_\_\_\_\_.

- A) fibrous or globular
- B) a polypeptide chain
- C) an R group
- D) an isozyme
- E) nucleic acid

Answer: C

Learning Outcome: 2-11

Bloom's Taxonomy: Knowledge

110) The alpha-helix and pleated sheet are examples of \_\_\_\_\_ protein structure.

- A) primary
- B) secondary
- C) tertiary
- D) quaternary
- E) pentanary

Answer: B

Learning Outcome: 2-11

Bloom's Taxonomy: Knowledge

111) Interaction between individual polypeptide chains to form a protein complex is \_\_\_\_\_ structure.

- A) primary
- B) secondary
- C) tertiary
- D) quaternary
- E) pentagonal

Answer: D

Learning Outcome: 2-11

Bloom's Taxonomy: Knowledge

112) Glycoproteins and proteoglycans are combinations of amino acids and

- A) carbohydrates.
- B) fatty acids.
- C) lipids.
- D) nucleic acids.
- E) inorganic compounds.

Answer: A

Learning Outcome: 2-11

Bloom's Taxonomy: Knowledge

113) Which of the following is the symbol for an amino group?

- A) -COOH
- B) -PO<sub>3</sub>
- C) -NH<sub>2</sub>
- D) -AMO
- E) -OH

Answer: C

Learning Outcome: 2-11

Bloom's Taxonomy: Knowledge

114) The maximum rate of an enzyme reaction occurs at

- A) dehydration.
- B) hydrolysis.
- C) synthesis.
- D) reversible.
- E) saturation limit.

Answer: E

Learning Outcome: 2-11

Bloom's Taxonomy: Knowledge

115) How would the lack of a cofactor for an enzyme affect that enzyme's function?

- A) The enzyme's function would not be altered.
- B) The enzyme would function more slowly.
- C) The enzyme would function more quickly.
- D) The enzyme would not be able to function.
- E) The enzyme would cease to function after reaching a maximum rate.

Answer: D

Learning Outcome: 2-11

Bloom's Taxonomy: Comprehension

116) An example of an organic substance is:

- A) lipid
- B) nucleic acid
- C) protein
- D) lipid and protein
- E) lipid, nucleic acid, and protein

Answer: E

Learning Outcome: 2-12

Bloom's Taxonomy: Knowledge

117) Molecules that store and process genetic information are the

- A) proteins.
- B) nucleic acids.
- C) carbohydrates.
- D) lipids.
- E) steroids.

Answer: B

Learning Outcome: 2-12

Bloom's Taxonomy: Knowledge

118) An amino acid is to a protein as \_\_\_\_\_ is to a nucleic acid.

- A) a purine
- B) a nucleotide
- C) a protein
- D) a proton
- E) a neutron

Answer: B

Learning Outcome: 2-12

Bloom's Taxonomy: Knowledge

119) A nucleotide consists of

- A) a five-carbon sugar and phosphate group.
- B) a five-carbon sugar and a nitrogenous base.
- C) a phosphate group and a nitrogenous base.
- D) a five-carbon sugar, a nitrogenous base, and a phosphate group.
- E) a five-carbon sugar and an amino acid.

Answer: D

Learning Outcome: 2-12

Bloom's Taxonomy: Knowledge

120) According to the rules of complementary base pairing in nucleic acids, cytosine would pair with the base

- A) thymine.
- B) adenine.
- C) uracil.
- D) cytosine.
- E) guanine.

Answer: E

Learning Outcome: 2-12

Bloom's Taxonomy: Knowledge

- 121) Adenine and guanine are
- A) purines represented by T and C.
  - B) pyrimidines represented by A and G.
  - C) purines represented by A and G.
  - D) pyrimidines represented by T and C.
  - E) nucleotides represented by A and G.

Answer: C

Learning Outcome: 2-12

Bloom's Taxonomy: Knowledge

- 122) The structure of RNA differs from DNA in that
- A) the backbone of RNA contains ribose.
  - B) RNA contains pyrimidines but not purines.
  - C) RNA contains purines but not pyrimidines.
  - D) DNA contains pyrimidines but not purines.
  - E) DNA contains purines but not pyrimidines.

Answer: A

Learning Outcome: 2-12

Bloom's Taxonomy: Knowledge

- 123) The most abundant high-energy compound in cells is
- A) DNA.
  - B) adenosine diphosphate.
  - C) adenosine monophosphate.
  - D) adenosine triphosphate.
  - E) RNA.

Answer: D

Learning Outcome: 2-13

Bloom's Taxonomy: Knowledge

- 124) A high-energy bond in ATP is present
- A) between adenine and ribose.
  - B) between adenine and a phosphate group.
  - C) between the first and second phosphate group.
  - D) between the second and third phosphate group.
  - E) between phosphate groups 1 and 2 and between phosphate groups 2 and 3.

Answer: E

Learning Outcome: 2-13

Bloom's Taxonomy: Knowledge

125) The phosphorylation of adenosine forms

- A) ADP.
- B) ATP.
- C) AMP.
- D) 2ATP.
- E) ribose.

Answer: C

Learning Outcome: 2-13

Bloom's Taxonomy: Application

126) Identify the product formed from the phosphorylation of ADP.

- A) adenosine diphosphate
- B) adenine
- C) adenosine triphosphate
- D) deoxyribonucleic acid
- E) ribose

Answer: C

Learning Outcome: 2-13

Bloom's Taxonomy: Knowledge

127)  $AMP + P \rightarrow$

- A) ADP
- B) 2ADP
- C) DNA
- D) ATP
- E) adenine

Answer: A

Learning Outcome: 2-13

Bloom's Taxonomy: Knowledge

128) The average time between synthesis and breakdown is known as the \_\_\_\_\_ time.

- A) metabolism
- B) anabolism
- C) catabolism
- D) specificity
- E) turnover

Answer: E

Learning Outcome: 2-14

Bloom's Taxonomy: Knowledge



129) Muscle proteins are destroyed after 17 days and then replaced. This is an example of

- A) metabolic turnover.
- B) surveillance.
- C) surface tension.
- D) disease.
- E) specificity.

Answer: A

Learning Outcome: 2-14

Bloom's Taxonomy: Knowledge

130) Continuous breakdown and replacement of cellular molecules is termed

- A) metabolism.
- B) metabolic turnover.
- C) anabolic turnover.
- D) catabolic turnover.
- E) organic chemistry

Answer: B

Learning Outcome: 2-14

Bloom's Taxonomy: Knowledge

#### Short Answer Questions

131) A(n) \_\_\_\_\_ is a pure substance composed of atoms of only one kind.

Answer: element

Learning Outcome: 2-1

Bloom's Taxonomy: Knowledge

132) The center of an atom is called the \_\_\_\_\_.

Answer: nucleus

Learning Outcome: 2-1

Bloom's Taxonomy: Knowledge

133) Electrons whirl around the center of the atom at high speed, forming a(n) \_\_\_\_\_.

Answer: electron cloud

Learning Outcome: 2-1

Bloom's Taxonomy: Knowledge

134) Electrons in an atom occupy an orderly series of electron shells or \_\_\_\_\_.

Answer: energy levels

Learning Outcome: 2-1

Bloom's Taxonomy: Knowledge

135) The actual mass of an atom is known as its \_\_\_\_\_.

Answer: atomic weight

Learning Outcome: 2-1

Bloom's Taxonomy: Knowledge

136) Atoms of the same element whose nuclei contain the same number of protons, but different numbers of neutrons, are called \_\_\_\_\_.

Answer: isotopes

Learning Outcome: 2-1

Bloom's Taxonomy: Knowledge

137) The \_\_\_\_\_ of a radioactive substance is the time required for 50 percent of a given amount of radioisotope to decay.

Answer: half-life

Learning Outcome: 2-1

Bloom's Taxonomy: Knowledge

138) Ions with a positive charge are called \_\_\_\_\_.

Answer: cations

Learning Outcome: 2-2

Bloom's Taxonomy: Knowledge

139) Ions with a negative charge are called \_\_\_\_\_.

Answer: anions

Learning Outcome: 2-2

Bloom's Taxonomy: Knowledge

140) Kinetic energy is stored as \_\_\_\_\_ energy when a spring is stretched.

Answer: potential

Learning Outcome: 2-3

Bloom's Taxonomy: Knowledge

141) Chemical reactions that release energy are called \_\_\_\_\_.

Answer: exergonic

Learning Outcome: 2-3

Bloom's Taxonomy: Knowledge

142) Chemical reactions that absorb energy are called \_\_\_\_\_.

Answer: endergonic

Learning Outcome: 2-3

Bloom's Taxonomy: Knowledge

143) The three familiar states of matter are solids, liquids, and \_\_\_\_\_.

Answer: gases

Learning Outcome: 2-3

Bloom's Taxonomy: Knowledge

144) Chemical reactions that occur in the body are accelerated by \_\_\_\_\_.

Answer: enzymes

Learning Outcome: 2-4

Bloom's Taxonomy: Knowledge

145) In living cells, complex metabolic reactions proceed in a series of steps called a(n) \_\_\_\_\_.

Answer: pathway

Learning Outcome: 2-4

Bloom's Taxonomy: Knowledge

146) Compounds that contain carbon as the primary structural atom are called \_\_\_\_\_ molecules.

Answer: organic

Learning Outcome: 2-5

Bloom's Taxonomy: Knowledge

147) Compounds that do not usually contain carbon as the primary structural atom are called \_\_\_\_\_ molecules.

Answer: inorganic

Learning Outcome: 2-5

Bloom's Taxonomy: Knowledge

148) A(n) \_\_\_\_\_ is a homogeneous mixture containing a solvent and a solute.

Answer: solution

Learning Outcome: 2-6

Bloom's Taxonomy: Knowledge

149) Soluble inorganic compounds whose solutions will conduct an electric current are called \_\_\_\_\_.

Answer: electrolytes

Learning Outcome: 2-6

Bloom's Taxonomy: Knowledge

150) Molecules that do not readily interact with water are called \_\_\_\_\_.

Answer: hydrophobic

Learning Outcome: 2-6

Bloom's Taxonomy: Knowledge

151) The \_\_\_\_\_ of a solution is the negative logarithm of the hydrogen ion concentration expressed in moles per liter.

Answer: pH

Learning Outcome: 2-7

Bloom's Taxonomy: Knowledge

152) All fatty acids contain a functional group at one end called the \_\_\_\_\_.

Answer: carboxylic acid group

Learning Outcome: 2-10

Bloom's Taxonomy: Knowledge

153) In water, phospholipids tend to form tiny droplets with hydrophobic tails buried inside called \_\_\_\_\_.

Answer: micelles

Learning Outcome: 2-10

Bloom's Taxonomy: Knowledge

154) Molecules with two fatty acid chains and a phosphate group that form biological membranes are called \_\_\_\_\_.

Answer: phospholipids

Learning Outcome: 2-10

Bloom's Taxonomy: Knowledge

155) Individual steroids differ in the \_\_\_\_\_ attached to the carbon rings.

Answer: side chains

Learning Outcome: 2-10

Bloom's Taxonomy: Knowledge

156) The molecule DNA contains a five-carbon sugar called \_\_\_\_\_.

Answer: deoxyribose

Learning Outcome: 2-12

Bloom's Taxonomy: Knowledge

157) The purines found in DNA are \_\_\_\_\_ and guanine.

Answer: adenine

Learning Outcome: 2-12

Bloom's Taxonomy: Knowledge

158) The pyrimidine bases found in DNA are \_\_\_\_\_ and cytosine.

Answer: thymine

Learning Outcome: 2-12

Bloom's Taxonomy: Knowledge

159) The three structural components of a nucleotide are a pentose, a phosphate group, and a \_\_\_\_\_ base.

Answer: nitrogenous

Learning Outcome: 2-12

Bloom's Taxonomy: Knowledge

160) A(n) \_\_\_\_\_ is a covalent bond that stores an unusually large amount of energy.

Answer: high-energy bond

Learning Outcome: 2-13

Bloom's Taxonomy: Knowledge

161) In the process of \_\_\_\_\_ a phosphate group is transferred to a molecule.

Answer: phosphorylation

Learning Outcome: 2-13

Bloom's Taxonomy: Knowledge

162) The hydrolysis of ATP yields ADP, phosphate ion, and \_\_\_\_\_.

Answer: energy

Learning Outcome: 2-13

Bloom's Taxonomy: Knowledge

### Essay Questions

163) The element sulfur has an atomic number of 16 and mass number of 32. How many neutrons are in the nucleus of a sulfur atom? If sulfur forms covalent bonds with hydrogen, how many hydrogen atoms can bond to one sulfur atom?

Answer: The number of neutrons in an atom is equal to the mass number minus the atomic number. Thus, sulfur has  $32 - 16 = 16$  neutrons. The atomic number indicates the number of protons, so a neutral sulfur atom contains 16 protons plus 16 electrons to balance the protons electrically. The electrons would be distributed as follows: 2 in the first electron shell, 8 in the second, and the remaining 6 in the third. To achieve a full 8 electrons in the third (outermost) electron shell, the sulfur atom can accept 2 electrons in an ionic bond or can share 2 electrons in a covalent bond. Because hydrogen atoms can share one electron in a covalent bond, the sulfur atom can form two covalent bonds with hydrogen, one with each of two hydrogen atoms. In chemical notation, this is  $\text{H}_2\text{S}$ .

Learning Outcome: 2-2

Bloom's Taxonomy: Application

164) What role do buffer systems play in the human body?

Answer: Buffer systems help maintain pH within normal limits by removing or replacing hydrogen ions as needed.

Learning Outcome: 2-7

Bloom's Taxonomy: Comprehension

165) Blood has a very narrow normal pH range but urine has a very broad normal pH range. What does that indicate about the physiology of pH?

Answer: Homeostasis requires that the pH of body fluids be maintained almost constant to avoid disruptions of healthy function. To accomplish this, the urinary system eliminates or retains hydrogen ion as needed. These actions cause the pH of urine to vary widely, depending on whether there is too much or not enough hydrogen ion in the body.

Learning Outcome: 2-7

Bloom's Taxonomy: Application

166) Explain the role of water molecules in polysaccharide formation.

Answer: Water molecules are removed in the dehydration synthesis of polysaccharides.

Learning Outcome: 2-9

Bloom's Taxonomy: Comprehension

167) How does the DNA molecule control the appearance and function of a cell?

Answer: The DNA molecule controls the synthesis of enzymes and structural proteins. By controlling the synthesis of structural proteins, the DNA is able to influence the physical appearance of a cell. By controlling the production of enzymes, the DNA is able to control all aspects of cellular metabolism and thus control the activity and biological functions of the cell.

Learning Outcome: 2-12

Bloom's Taxonomy: Application