

Human Physiology: An Integrated Approach, 6e (Silverthorn)

Chapter 2 Molecular Interactions

1) Stanley Miller set out to demonstrate an explanation for the origins of organic molecules using a combination of simple organic molecules, heat and periodic burst of electricity through the mixture, ultimately producing what kind of molecules?

- A) carbohydrates
- B) amino acids
- C) lipids
- D) glycoproteins
- E) nucleic acids

Answer: B

Section Title: Molecules and Bonds

Learning Outcome: 2.1

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Comprehension)

2) Glycosylated molecules are those formed with which group of organic compounds?

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

Answer: D

Section Title: Molecules and Bonds

Learning Outcome: 2.1

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Knowledge)

3) Cells regulate their level of activity by regulating the amount of proteins present in the cell at any given time, so an up regulation of enzymes would be expected to

- A) increase the level of productivity of chemical reactions that rely on them.
- B) decrease the level of productivity of chemical reactions that rely on them.
- C) increase the rate of reactions catalyzed by the enzymes.
- D) decrease the rate of reactions catalyzed by the enzymes.
- E) both decrease the level of productivity of chemical reactions that rely on them and decrease the rate of reactions catalyzed by the enzymes.

Answer: A

Section Title: Protein Interactions

Learning Outcome: 2.10

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Comprehension)

- 4) When an enzyme reaches its saturation point,
A) the amount of substrate for the enzyme to act upon is very high.
B) the amount of substrate for the enzyme to act upon is very low.
C) the amount of product produced continues to increase.
D) the amount of product produced by the enzyme decreases.
E) the amount of substrate for the enzyme to act upon is very low and the amount of product produced by the enzyme decreases.

Answer: A

Section Title: Protein Interactions

Learning Outcome: 2.9

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Comprehension)

- 5) Which group of elements makes up more than 90% of the body's mass?

- A) O, H, Na
- B) C, Na, K
- C) O, Ca, H
- D) Ca, C, O
- E) O, C, H

Answer: E

Section Title: Molecules and Bonds

Learning Outcome: 2.1

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Comprehension)

- 6) The organic molecules known as phospholipids are key components of cell membranes and composed of what monomeric units?

- A) amino acids
- B) nucleotides
- C) glycerol
- D) fatty acids
- E) both glycerol and fatty acids

Answer: E

Section Title: Molecules and Bonds

Learning Outcome: 2.1

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Knowledge)

- 7) Chromium is

- A) a major essential element.
- B) a minor essential element.
- C) a dietary supplement with no natural role in the body.
- D) None of the answers are correct.

Answer: D

Section Title: Running Problem

Learning Outcome: 2.1

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Comprehension)

8) Which of the following is a way to recognize a carbohydrate by looking at its name only?

- A) It always ends in -ase.
- B) It ends in -ose
- C) It begins with nucleo-.
- D) It begins with proteo-.
- E) It begins with lipo-.

Answer: B

Section Title: Molecules and Bonds

Learning Outcome: 2.1

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Comprehension)

9) Which of the following is NOT considered an essential element for a living organism?

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

Answer: C

Section Title: Molecules and Bonds

Learning Outcome: 2.1

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Knowledge)

10) The largest carbohydrate molecules are called polysaccharides because they are composed of _____ molecules bonded together with one another.

- A) amino acid
- B) nucleotide
- C) purine
- D) pyrimidine
- E) sugar

Answer: E

Section Title: Molecules and Bonds

Learning Outcome: 2.1

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Knowledge)

11) Essential amino acids that are used to build proteins

- A) exist in twenty six different configurations.
- B) are linked together by ionic chemical bonds in proteins.
- C) can be used medically for both diagnosis and treatment of diseases.
- D) can be derived from the foods we eat and digest.
- E) can only be made by cells within our bodies.

Answer: E

Section Title: Molecules and Bonds

Learning Outcome: 2.1

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Comprehension)

12) Which of the following are examples of cations?

A) SO_4^{2-}

B) Ca^{2+}

C) HPO_4^{2-}

D) HCO_3^-

E) Cl^-

Answer: B

Section Title: Molecules and Bonds

Learning Outcome: 2.1

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Comprehension)

13) A positively charged ion is called a(n)

A) electron.

B) proton.

C) neutron.

D) cation.

E) anion.

Answer: D

Section Title: Molecules and Bonds

Learning Outcome: 2.2

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Comprehension)

14) The most important polar molecule is _____ because it is practically a universal solvent.

A) water

B) bicarbonate

C) sodium chloride

D) magnesium sulfate

E) nucleic acid

Answer: A

Section Title: Molecules and Bonds

Learning Outcome: 2.4

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Comprehension)

15) A molecule referred to as highly soluble is

A) very likely to dissolve in water.

B) not very likely to dissolve in water.

C) called aqueous.

D) very likely to dissolve in water and is called aqueous.

E) not very likely to dissolve in water and is called aqueous.

Answer: D

Section Title: Noncovalent Interactions

Learning Outcome: 2.4

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Comprehension)

- 16) A free radical is a
- A) charged particle.
 - B) molecule with an extra electron.
 - C) molecule with an extra neutron.
 - D) molecule with an extra proton.
 - E) molecule with an unpaired electron.

Answer: E

Section Title: Molecules and Bonds

Learning Outcome: 2.2

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Comprehension)

- 17) The chemical bonding behavior of an atom is directly determined by
- A) the number of protons.
 - B) the number of neutrons.
 - C) the number and arrangement of electrons.
 - D) the size of the atom.
 - E) the mass of the atom.

Answer: C

Section Title: Molecules and Bonds

Learning Outcome: 2.2

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Comprehension)

- 18) Atoms in a covalent molecule
- A) share electrons in single pairs.
 - B) share electrons in double pairs.
 - C) share electrons in triple pairs.
 - D) share electrons singly, never in pairs.
 - E) can share electrons in single pairs, double pairs, or triple pairs.

Answer: E

Section Title: Molecules and Bonds

Learning Outcome: 2.3

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Comprehension)

- 19) The weak interactions between atoms that keep atoms near each other but don't tightly bind them together are called
- A) hydrogen bonds.
 - B) van der Waals forces.
 - C) ionic bonds.
 - D) hydrogen bonds and van der Waals forces.
 - E) van der Waals forces and ionic bonds.

Answer: D

Section Title: Molecules and Bonds

Learning Outcome: 2.3

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Comprehension)

20) All of these statements about carbohydrates are true except one. Identify the exception.

- A) Simple sugars include lactose, glucose, and ribose.
- B) Cellulose is the most abundant carbohydrate on earth.
- C) Glycogen is a storage polysaccharide made by animal cells.
- D) Polysaccharides are important both for energy storage and to provide structure to cells.
- E) Glycogen is important both for energy storage and to provide structure for cells.

Answer: E

Section Title: Molecules and Bonds

Learning Outcome: 2.1

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Comprehension)

21) In regard to lipids, the term unsaturated refers to

- A) the lack of double bonds between adjacent carbon atoms in a fatty acid.
- B) the presence of double bonds between adjacent carbon atoms in a fatty acid.
- C) the ring structure of steroids.
- D) glycerol, which acts as an anchor for joined fatty acids.
- E) fats, such as butter and lard, which come from animal sources.

Answer: B

Section Title: Molecules and Bonds

Learning Outcome: 2.1

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Comprehension)

22) Each amino acid differs from others in the

- A) number of central carbon atoms.
- B) size of the amino group.
- C) number of carboxyl groups.
- D) chemical structure of the R group.
- E) number of peptide bonds in the molecule.

Answer: D

Section Title: Molecules and Bonds

Learning Outcome: 2.1

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Comprehension)

23) The alpha-helix and pleated sheet are examples of the _____ structure of a protein.

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

Answer: B

Section Title: Noncovalent Interactions

Learning Outcome: 2.6

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Comprehension)

24) Interactions between different globular or fibrous polypeptide chains result in which type of structure?

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

Answer: D

Section Title: Noncovalent Interactions

Learning Outcome: 2.6

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Comprehension)

25) The concentration of a solution expresses the amount of

- A) solvent per volume of solute.
- B) solute per volume of solvent.
- C) solvent per volume of solution.
- D) solute per volume of solution.
- E) None of the answers are correct.

Answer: D

Section Title: Noncovalent Interactions

Learning Outcome: 2.5

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Knowledge)

26) Nucleic acids are polymers of units called

- A) amino acids.
- B) fatty acids.
- C) bases.
- D) ribose.
- E) nucleotides.

Answer: E

Section Title: Molecules and Bonds

Learning Outcome: 2.1

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Comprehension)

27) A nucleotide consists of a

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

Answer: D

Section Title: Molecules and Bonds

Learning Outcome: 2.1

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Knowledge)

28) According to the rules of complementary base pairing, a nucleotide containing the base cytosine would only pair with a nucleotide containing the base

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

Answer: E

Section Title: Molecules and Bonds

Learning Outcome: 2.1

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Knowledge)

29) The most important energy-transferring compound in cells is a nucleotide known as

- A) glucose.
- B) fructose.
- C) protein.
- D) adenosine triphosphate.
- E) deoxyribonucleic acid.

Answer: D

Section Title: Molecules and Bonds

Learning Outcome: 2.1

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Knowledge)

30) Which bases below are purines?

- 1. adenine
- 2. cytosine
- 3. guanine
- 4. thymine
- 5. uracil

- A) 1 and 2
- B) 2 and 3
- C) 1, 3, and 5
- D) 1 and 3
- E) 2, 4, and 5

Answer: D

Section Title: Molecules and Bonds

Learning Outcome: 2.1

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Comprehension)

31) Polymers are a typical formation of _____ molecules.

- A) organic
- B) inorganic
- C) either organic or inorganic

Answer: A

Section Title: Molecules and Bonds

Learning Outcome: 2.1

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Comprehension)

32) Cholesterol is

- A) a precursor to steroid hormones.
- B) a structural component of cell membranes.
- C) a dangerous fat that is absent from a healthy body.
- D) a precursor to steroid hormones and a structural component of cell membranes.
- E) a precursor to steroid hormones, a structural component of cell membranes, and a dangerous fat that is absent from a healthy body.

Answer: D

Section Title: Molecules and Bonds

Learning Outcome: 2.1

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Comprehension)

33) A component of an important buffer in the human body is

- A) NaCl.
- B) H⁺.
- C) HCl.
- D) HCO₃⁻.
- E) H₂O.

Answer: D

Section Title: Noncovalent Interactions

Learning Outcome: 2.7

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Comprehension)

34) Which of the following substances is most alkaline?

- 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: B

Section Title: Noncovalent Interactions

Learning Outcome: 2.7

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Comprehension)

35) If a substance has a pH that is less than 7, it is considered

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

Answer: B

Section Title: Noncovalent Interactions

Learning Outcome: 2.7

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Comprehension)

36) Protein specificity is

- A) the activation of a specific protein that is needed to perform a particular function.
- B) the degree to which a protein is attracted to a ligand.
- C) the ability of a protein to bind a certain ligand or a group of related ligands.
- D) the degree to which a protein-ligand complex initiates a response.
- E) the degree to which a protein is attracted to a ligand and the ability of a protein to bind a certain ligand or a group of related ligands.

Answer: C

Section Title: Protein Interactions

Learning Outcome: 2.9

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Comprehension)

37) Which of the following is a common feature of soluble proteins?

- A) structural support
- B) noncovalent interaction
- C) receptor binding
- D) chemical modulation
- E) All of the answers are correct.

Answer: B

Section Title: Protein Interactions

Learning Outcome: 2.6

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Comprehension)

Match the correct subatomic particle with the statement about it. Answers may be used once, more than once, or not at all.

- A. proton(s)
- B. neutron(s)
- C. electron(s)

38) An ion has gained or lost _____.

Answer: C

Section Title: Molecules and Bonds

Learning Outcome: 2.2

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Knowledge)

39) Isotopes of the same element differ by having different numbers of _____.

Answer: B

Section Title: Molecules and Bonds

Learning Outcome: 2.1

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Comprehension)

40) The identity of an element can be determined by the number of _____.

Answer: A

Section Title: Molecules and Bonds

Learning Outcome: 2.1

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Comprehension)

41) This particle has a charge of +1 and a mass of 1.

Answer: A

Section Title: Molecules and Bonds

Learning Outcome: 2.1

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Comprehension)

42) This particle has a charge of -1 and a negligible mass.

Answer: C

Section Title: Molecules and Bonds

Learning Outcome: 2.1

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Comprehension)

43) This particle has a neutral charge and a mass of 1.

Answer: B

Section Title: Molecules and Bonds

Learning Outcome: 2.1

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Comprehension)

Match the symbol with the correct element:

A. P

B. Na

C. Ca

D. C

E. K

F. Pb

44) calcium

Answer: C

Section Title: Molecules and Bonds

Learning Outcome: 2.1

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Knowledge)

45) carbon

Answer: D

Section Title: Molecules and Bonds

Learning Outcome: 2.1

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Knowledge)

46) potassium

Answer: E

Section Title: Molecules and Bonds

Learning Outcome: 2.1

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Knowledge)

47) phosphorus

Answer: A

Section Title: Molecules and Bonds

Learning Outcome: 2.1

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Knowledge)

48) lead

Answer: F

Section Title: Molecules and Bonds

Learning Outcome: 2.1

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Comprehension)

49) sodium

Answer: B

Section Title: Molecules and Bonds

Learning Outcome: 2.1

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Comprehension)

Identify each of the following as an element (A) or a compound (B).

50) CO₂

Answer: B

Section Title: Molecules and Bonds

Learning Outcome: 2.1

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Comprehension)

51) C

Answer: A

Section Title: Molecules and Bonds

Learning Outcome: 2.1

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Comprehension)

52) O₂

Answer: A

Section Title: Molecules and Bonds

Learning Outcome: 2.1

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Comprehension)

Match each bond type with its description.

- A. van der Waals
- B. ionic
- C. hydrogen
- D. covalent

53) This results when an atom has such a strong attraction for electrons that it pulls one or more electrons completely away from another atom.

Answer: B

Section Title: Molecules and Bonds

Learning Outcome: 2.3

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Comprehension)

54) These are weak attractive forces between hydrogen and certain other atoms.

Answer: C

Section Title: Molecules and Bonds

Learning Outcome: 2.3

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Comprehension)

55) These result when two atoms share a pair of electrons.

Answer: D

Section Title: Molecules and Bonds

Learning Outcome: 2.3

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Comprehension)

56) These are weak attractive forces between the nucleus of one atom and the electrons of another atom close by.

Answer: A

Section Title: Molecules and Bonds

Learning Outcome: 2.3

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Comprehension)

Match each class of biomolecules to the correct statement about it.

- A. carbohydrates
- B. lipids
- C. proteins
- D. nucleotides

57) Glucose and ribose are examples; these molecules provide energy or structure.

Answer: A

Section Title: Molecules and Bonds

Learning Outcome: 2.1

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Comprehension)

58) ATP and DNA are examples; they transfer energy and encode genetic information.

Answer: D

Section Title: Molecules and Bonds

Learning Outcome: 2.1

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Comprehension)

59) Composed of units called amino acids, these can be linked into chains over 100 peptides long.

Answer: C

Section Title: Molecules and Bonds

Learning Outcome: 2.1

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Comprehension)

60) Triglycerides and steroids are members of this group. As a class they are hydrophobic.

Answer: B

Section Title: Molecules and Bonds

Learning Outcome: 2.1

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Comprehension)

Match each level of protein structure with its description.

- A. primary
- B. secondary
- C. tertiary
- D. quaternary

61) applies to proteins containing more than one peptide chain

Answer: D

Section Title: Protein Interactions

Learning Outcome: 2.8

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Comprehension)

62) the sequence and number of amino acids in the chain

Answer: A

Section Title: Protein Interactions

Learning Outcome: 2.8

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Comprehension)

63) the three-dimensional shape of an amino acid chain; can be fibrous or globular

Answer: C

Section Title: Protein Interactions

Learning Outcome: 2.8

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Comprehension)

64) the spatial arrangement of amino acids; can be a helix or a pleated sheet

Answer: B

Section Title: Protein Interactions

Learning Outcome: 2.8

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Comprehension)

Match the descriptions to the correct protein category.

- A. fibrous
- B. globular

65) soluble in water

Answer: B

Section Title: Protein Interactions

Learning Outcome: 2.8

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Comprehension)

66) keratin

Answer: A

Section Title: Protein Interactions

Learning Outcome: 2.8

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Comprehension)

67) disulfide bond

Answer: B

Section Title: Protein Interactions

Learning Outcome: 2.8

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Comprehension)

68) lipid carriers

Answer: B

Section Title: Protein Interactions

Learning Outcome: 2.8

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Comprehension)

69) structural components

Answer: A

Section Title: Protein Interactions

Learning Outcome: 2.8

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Comprehension)

For the following questions, match the type of modulator with the best description below.

- A. involved in phosphorylation
- B. cannot be displaced by competition
- C. bind to proteins away from the active site
- D. reversible antagonist

70) irreversible antagonist

Answer: B

Section Title: Protein Interactions

Learning Outcome: 2.10

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Comprehension)

71) covalent modulator

Answer: A

Section Title: Protein Interactions

Learning Outcome: 2.10

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Comprehension)

72) competitive inhibitor

Answer: D

Section Title: Protein Interactions

Learning Outcome: 2.10

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Comprehension)

73) allosteric modulator

Answer: C

Section Title: Protein Interactions

Learning Outcome: 2.10

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Comprehension)

74) The smallest unit of an element is a(n) _____.

Answer: atom

Section Title: Molecules and Bonds

Learning Outcome: 2.1

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Knowledge)

75) When two or more atoms are chemically linked, the smallest unit of the resulting material is referred to as a(n) _____.

Answer: molecule

Section Title: Molecules and Bonds

Learning Outcome: 2.1

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Knowledge)

76) A(n) _____ is a substance that consists entirely of atoms with the same atomic number.

Answer: element

Section Title: Molecules and Bonds

Learning Outcome: 2.1

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Knowledge)

77) The center of an atom is called the _____.

Answer: nucleus

Section Title: Molecules and Bonds

Learning Outcome: 2.1

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Knowledge)

78) Electrons travel around the center of the atom at high speed forming a(n) _____.

Answer: shell (or orbital)

Section Title: Molecules and Bonds

Learning Outcome: 2.2

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Comprehension)

79) A combination of two or more atoms that has physical and chemical properties that differ from the atoms that compose it is called a(n) _____.

Answer: compound

Section Title: Molecules and Bonds

Learning Outcome: 2.1

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Comprehension)

80) Ions with a positive charge are called _____.

Answer: cations

Section Title: Molecules and Bonds

Learning Outcome: 2.1

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Knowledge)

81) Ions with a negative charge are called _____.

Answer: anions

Section Title: Molecules and Bonds

Learning Outcome: 2.1

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Knowledge)

82) A(n) _____ is a homogeneous mixture containing a solvent and a solute.

Answer: solution

Section Title: Noncovalent Interactions

Learning Outcome: 2.5

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Knowledge)

83) Molecules that readily dissolve in water are called _____.

Answer: hydrophilic (most are also polar)

Section Title: Noncovalent Interactions

Learning Outcome: 2.5

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Knowledge)

84) Molecules that do not dissolve in water are called _____.

Answer: hydrophobic (most are also nonpolar)

Section Title: Noncovalent Interactions

Learning Outcome: 2.5

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Knowledge)

85) _____ is any molecule that binds to another molecule.

Answer: Ligand

Section Title: Protein Interactions

Learning Outcome: 2.9

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Knowledge)

86) Two methods of protein activation include _____ and _____.

Answer: proteolytic (removal of portions of the molecule), cofactor binding

Section Title: Protein Interactions

Learning Outcome: 2.8

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Comprehension)

87) The molecule DNA contains the five-carbon sugar _____.

Answer: deoxyribose

Section Title: Molecules and Bonds

Learning Outcome: 2.1

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Knowledge)

88) The molecule RNA contains the five-carbon sugar _____.

Answer: ribose

Section Title: Molecules and Bonds

Learning Outcome: 2.1

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Knowledge)

89) The purines found in DNA are _____ and _____.

Answer: adenine, guanine

Section Title: Molecules and Bonds

Learning Outcome: 2.1

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Knowledge)

90) The pyrimidines found in DNA are _____ and _____.

Answer: thymine, cytosine

Section Title: Molecules and Bonds

Learning Outcome: 2.1

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Knowledge)

91) In a chemical reaction, _____ between atoms are broken as atoms are rearranged in new combinations to form different chemical substances.

Answer: chemical bonds

Section Title: Molecules and Bonds

Learning Outcome: 2.3

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Knowledge)

92) The reaction rates of many chemical reactions that occur in the body are controlled by special protein molecules called _____.

Answer: enzymes

Section Title: Protein Interactions

Learning Outcome: 2.10

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Knowledge)

93) List the following in order of increasing mass: atom, molecule, proton, neutron, electron.

Answer: electron < proton = neutron < atom < molecule

Section Title: Molecules and Bonds

Learning Outcome: 2.1

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Comprehension)

94) How many milliequivalents are represented by a mole of bicarbonate ions (HCO_3^-)?

Answer: 1000 milliequivalents. This is calculated by taking the equivalent value of the molecule, which equals the molarity of the molecule (1 in this case) times the number of charges the molecule carries (in this case, the minus symbol indicates a charge of negative one, i.e., -1), so $1 \times 1 = 1$ equivalent. 1 equivalent = 1000 milliequivalents.

Section Title: Noncovalent Interactions

Learning Outcome: N/A

Skill: Level IV: Quantitative Problems (Bloom's Taxonomy: Application)

95) List and briefly describe the seven categories of soluble proteins.

Answer: The seven categories: enzymes, membrane transporters, signal molecules, receptors, binding proteins, regulatory proteins, and immunoglobulins. See the "Protein Interactions" section of the chapter.

Section Title: Protein Interactions

Learning Outcome: 2.8

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Comprehension)

96) Which of the following elements combine to form nonpolar covalent bonds?

A) carbon and hydrogen

B) nitrogen and hydrogen

C) sodium and chlorine

D) hydrogen and oxygen

E) carbon and chlorine

Answer: A

Section Title: Molecules and Bonds

Learning Outcome: 2.4

Skill: Level II: Reviewing Concepts (Bloom's Taxonomy: Comprehension)

- 97) The designation Ca^{2+} means
- A) calcium has space for two more electrons.
 - B) calcium has gained two more electrons.
 - C) calcium has space for two more protons.
 - D) calcium has gained two more protons.

Answer: A

Section Title: Molecules and Bonds

Learning Outcome: 2.2

Skill: Level II: Reviewing Concepts (Bloom's Taxonomy: Comprehension)

- 98) In a 5% NaCl solution,
- A) this means there are 5 grams of sodium chloride for every 100 mL of water.
 - B) this means there are 5 grams of sodium chloride for every 100 mL of total solution.
 - C) the solute is water.
 - D) this means there are 5 grams of sodium chloride for every 100 mL of water and there are 5 grams of sodium chloride for every 100 mL of total solution.
 - E) this means there are 5 grams of sodium chloride for every 100 mL of total solution and the solute is water.

Answer: B

Section Title: Noncovalent Interactions

Learning Outcome: 2.5

Skill: Level II: Reviewing Concepts (Bloom's Taxonomy: Comprehension)

- 99) A molecule of sucrose has a molecular weight of 342 daltons. How many grams of sucrose would be required to make one liter of a 2.5 Molar solution of sucrose?

Answer: 805 grams (per liter). This is calculated by multiplying the amount of sucrose in one liter of a 1 molar solution (342 grams) times the molar concentration (2.5). $342 \times 2.5 = 805$ grams

Section Title: Noncovalent Interactions

Learning Outcome: 2.9

Skill: Level IV: Quantitative Problems (Bloom's Taxonomy: Application)

- 100) A double covalent bond is formed when atoms
- A) share one pair of electrons (a total of two).
 - B) share two pairs of electrons (a total of four).
 - C) swap two pairs of electrons.
 - D) transfer a pair of electrons from one atom to the other.
 - E) transfer two pairs of electrons from one atom to the other.

Answer: B

Section Title: Molecules and Bonds

Learning Outcome: 2.3

Skill: Level II: Reviewing Concepts (Bloom's Taxonomy: Comprehension)

- 101) The term *polar* is used to describe molecules because
- A) polar covalent molecules are found in colder climates.
 - B) polar covalent molecules were first discovered in polar bears.
 - C) there are at least two distinct ends of the molecule regarding electron position and the resulting charge.
 - D) there are at least two distinct ends of the molecule regarding hydrogen placement.
 - E) such molecules are always linear in shape.

Answer: C

Section Title: Molecules and Bonds

Learning Outcome: 2.3

Skill: Level II: Reviewing Concepts (Bloom's Taxonomy: Comprehension)

- 102) What makes vegetable oils with trans fats similar in structure to saturated animal fats? Which type of fat is harmful, and in what way?

Answer: Trans fats have hydrogen atoms attached to make them more saturated and solid at room temperature, like animal fats. Both vegetable trans fats and saturated animal fats are associated with cardiovascular disease.

Section Title: Molecules and Bonds

Learning Outcome: 2.3

Skill: Level II: Reviewing Concepts (Bloom's Taxonomy: Application)

- 103) Lipids are hydrophobic, and do not usually dissolve in water. Because blood is water-based, the lipid cholesterol is combined with _____ so that it can be transported by blood.

- A) a hydrophilic molecule
- B) a hydrophobic molecule
- C) nothing; cholesterol is not transported in blood
- D) a cation
- E) an anion

Answer: A

Section Title: Noncovalent Interactions

Learning Outcome: 2.6

Skill: Level II: Reviewing Concepts (Bloom's Taxonomy: Application)

- 104) Only free H^+ contributes to the hydrogen ion concentration.

- A) True
- B) False

Answer: A

Section Title: Noncovalent Interactions

Learning Outcome: 2.5

Skill: Level II: Reviewing Concepts (Bloom's Taxonomy: Comprehension)

105) In the equation $\text{CO}_2 + \text{H}_2\text{O} \rightleftharpoons \text{H}_2\text{CO}_3 \rightleftharpoons \text{H}^+ + \text{HCO}_3^-$, which of these is an acid?

- A) HCO_3^-
- B) H_2CO_3
- C) H_2O
- D) CO_2
- E) H^+

Answer: B

Section Title: Noncovalent Interactions

Learning Outcome: 2.7

Skill: Level II: Reviewing Concepts (Bloom's Taxonomy: Comprehension)

106) Chemical reactions that occur in the human body proceed at a faster rate due to special catalytic molecules called

- A) enzymes.
- B) cytozymes.
- C) cofactors.
- D) activators.
- E) None of the answers are correct.

Answer: A

Section Title: Protein Interactions

Learning Outcome: 2.8

Skill: Level II: Reviewing Concepts (Bloom's Taxonomy: Comprehension)

107) The fuel molecule all cells in the body can use is

- A) sucrose.
- B) starch.
- C) protein.
- D) vitamins.
- E) glucose.

Answer: E

Section Title: Noncovalent Interactions

Learning Outcome: 2.1

Skill: Level II: Reviewing Concepts (Bloom's Taxonomy: Comprehension)

108) A fatty acid that contains three double bonds in its carbon chain is said to be

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

Answer: C

Section Title: Molecules and Bonds

Learning Outcome: 2.1

Skill: Level II: Reviewing Concepts (Bloom's Taxonomy: Comprehension)

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

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

Answer: C

Section Title: Molecules and Bonds

Learning Outcome: 2.1

Skill: Level II: Reviewing Concepts (Bloom's Taxonomy: Comprehension)

110) Each of the following is a function of proteins except one. Identify the exception.

- A) support and structure
- B) transport
- C) catalyst
- D) storage of genetic information
- E) carrying of messages

Answer: D

Section Title: Protein Interactions

Learning Outcome: 2.8

Skill: Level II: Reviewing Concepts (Bloom's Taxonomy: Comprehension)

111) If a polypeptide contains 10 peptide bonds, how many amino acids does it contain?

- A) 0
- B) 5
- C) 10
- D) 11
- E) 12

Answer: D

Section Title: Protein Interactions

Learning Outcome: 2.10

Skill: Level II: Reviewing Concepts (Bloom's Taxonomy: Comprehension)

112) Glycoprotein molecules

- A) act as receptors on the surface of cell membranes.
- B) function as cell markers.
- C) are present in the secretions coating the respiratory tract.
- D) function as hormones from the pancreas.
- E) act as receptors on the surface of cell membranes and function as cell markers.

Answer: E

Section Title: Protein Interactions

Learning Outcome: 2.8

Skill: Level II: Reviewing Concepts (Bloom's Taxonomy: Comprehension)

113) Define and describe the role of up-regulation and down-regulation of proteins.

Answer: These terms refer to the net change in the amount of a functional protein present in a cell in response to a signal. Up-regulation is an increase in the amount of the protein, whereas down-regulation is a decrease.

Section Title: Protein Interactions

Learning Outcome: 2.8

Skill: Level II: Reviewing Concepts (Bloom's Taxonomy: Application)

114) What is the induced-fit model? List the types of bonds involved and classify them as strong or weak.

Answer: The interaction between a protein binding site and a ligand that are in close proximity results in a conformational change of the protein to fit more closely to the ligand. The bonds involved are hydrogen (weak), ionic (strong), and van der Waals (weak).

Section Title: Protein Interactions

Learning Outcome: 2.8

Skill: Level II: Reviewing Concepts (Bloom's Taxonomy: Application)

115) The _____ of a solution is the negative logarithm of the hydrogen ion concentration, expressed in moles per liter of solution.

Answer: pH

Section Title: Noncovalent Interactions

Learning Outcome: 2.7

Skill: Level II: Reviewing Concepts (Bloom's Taxonomy: Comprehension)

116) When a nitrogenous base is bonded to a pentose sugar and a phosphate, a _____ is formed.

Answer: nucleotide

Section Title: Molecules and Bonds

Learning Outcome: 2.1

Skill: Level II: Reviewing Concepts (Bloom's Taxonomy: Comprehension)

117) Solutions are formed with water and _____ molecules as solutes which dissolve in them.

Answer: hydrophilic

Section Title: Noncovalent Interactions

Learning Outcome: 2.5

Skill: Level II: Reviewing Concepts (Bloom's Taxonomy: Comprehension)

118) The _____ molecules which form the bilayer region of the cell membrane exhibit hydrophilic properties on the outer surface and hydrophobic properties on the inner surface.

Answer: phospholipid

Section Title: Molecules and Bonds

Learning Outcome: 2.1

Skill: Level I: Reviewing Facts and Terms (Bloom's Taxonomy: Comprehension)

119) Compare/contrast the chemical bonds between adjacent monomers in DNA, and between two strands of DNA.

Answer: The bonds holding monomers together are covalent bonds, between sugar and phosphate molecules. The bonds holding neighboring strands together at the complementary bases are hydrogen bonds.

Section Title: Noncovalent Interactions

Learning Outcome: 2.6

Skill: Level II: Reviewing Concepts (Bloom's Taxonomy: Application)

120) Explain the general chemical structure for monosaccharides and amino acids.

Answer: Monosaccharides consist of carbon, hydrogen, and oxygen, in the ratio C:H:O of 1:2:1. Amino acids consist of a central carbon (CH), a carboxylic acid (COOH), an amine (NH₂), and an organic side chain of variable structure (mainly a hydrocarbon chain, designated as R).

Section Title: Molecules and Bonds

Learning Outcome: 2.1

Skill: Level II: Reviewing Concepts (Bloom's Taxonomy: Application)

121) What are functional groups? List the most common functional groups found in biological molecules.

Answer: Several combinations of atoms that occur repeatedly in biological molecules. See Table 2.1 in the main text.

Section Title: Molecules and Bonds

Learning Outcome: 2.1

Skill: Level II: Reviewing Concepts (Bloom's Taxonomy: Application)

122) True or False? Lipids contain substantially more oxygen than carbohydrate molecules. Based on your answer, what does that suggest about lipid solubility in water?

Answer: False. Lipids contain much less oxygen than carbohydrates. Oxygen often participates in hydrogen bonding. With less oxygen, lipids are not able to hydrogen bond with water molecules and therefore are relatively insoluble in aqueous environments.

Section Title: Noncovalent Interactions

Learning Outcome: 2.4

Skill: Level II: Reviewing Concepts (Bloom's Taxonomy: Application)

123) Explain the polar character of an ammonia molecule (NH₃). What is the cause of the partial charges? What is the overall charge for NH₃?

Answer: When chemically bonded with each other, the nitrogen atom is partially negative whereas the hydrogen atoms are partially positive. The nitrogen atom in a molecule of ammonia has a stronger attraction for the electrons participating in the covalent bonds than the hydrogen atoms. The net charge on the molecule is still zero, however.

Section Title: Noncovalent Interactions

Learning Outcome: 2.4

Skill: Level II: Reviewing Concepts (Bloom's Taxonomy: Application)

124) Water striders are insects that literally walk on water. These insects are frequently found living on ponds. If hydrogen bonds did not exist, how would this affect the life of water striders?

Answer: Hydrogen bonds are responsible for the surface tension of water, the attractive force between water molecules that can make it difficult to separate them. The surface tension is strong enough to support the weight of water striders thus allowing them to walk on water. If water molecules could not form hydrogen bonds, the water striders would not be able to walk on water because there would be no surface tension to support their weight. Therefore, these insects would have to adapt to terrestrial conditions near ponds or lakes rather than living on them.

Section Title: Noncovalent Interactions

Learning Outcome: 2.4

Skill: Level III: Problem Solving (Bloom's Taxonomy: Synthesis)

125) If the dissociation constant of a protein is less than one ($K_d < 1$), what can you conclude about the affinity of the protein for the ligand?

Answer: Since $K_d < 1$, you know that $[P][L] < [PL]$. Therefore, at equilibrium, there is a higher concentration of protein-ligand complex suggesting that the protein has a relatively high binding affinity for the ligand.

Section Title: Protein Interactions

Learning Outcome: 2.10

Skill: Level III: Problem Solving (Bloom's Taxonomy: Analysis)

126) Do you know what kinds of cell markers your red blood cells have? Do you know your own blood type? How are these two pieces of information related?

Answer: Glycoproteins and glycolipids can act as cell surface markers. On blood cells, some of these markers are designated as the blood type. The most common blood typing system is the A-B-O system, usually paired with the rh system, so your blood type may be, for example, B+ or O-. Some of this information is in Chapter 16.

Section Title: Protein Interactions

Learning Outcome: 2.8

Skill: Level III: Problem Solving (Bloom's Taxonomy: Analysis)

127) Sally Student does not understand the differences between ions, isotopes, and free radicals. Assuming she has learned and understood some basic chemistry, what is the likely source of her confusion? Review the definitions of these terms, then make a table or flow chart to help her sort this out.

Answer: Her confusion may arise from the fact that all of these terms describe a structure that has either gained or lost *something*. An *ion* is an *atom* that has gained or lost one or more *electrons* and thus bears an electrical *charge*. Ions form when salts dissolve in water and are required for normal cell function. An ion's charge affects both its behavior in solution and its chemical reactivity. An *isotope* is an *atom* that has gained or lost one or more *neutrons*; as neutrons lack a charge, isotopes remain *neutral*. Some isotopes emit *radiation*, a type of energy, rendering them both useful and dangerous; compared to ions, they are rare in nature. A *free radical* is an *atom* or *molecule* that has at least one *unpaired* electron (an electron is more stable if paired with another electron). Free radicals can be either electrically *charged* (e.g., superoxide) or *neutral* (e.g., hydroxy), depending upon the total number of protons and electrons present. Because free radicals are unstable, they are highly reactive and disruptive to cell function; compared to ions, they are rare in the body. Neither isotopes nor free radicals are known to be required for normal cell function.

Section Title: Molecules and Bonds

Learning Outcome: 2.2

Skill: Level III: Problem Solving (Bloom's Taxonomy: Analysis)

128) Sydney Student is trying to memorize chemical structures of every compound his professor has indicated are important to the human body. Explain to him that an easier way is to memorize a few rules of chemical bonding and then figure out the structure of the important compounds, especially the simpler compounds.

Answer: Elements combine to form molecules in predictable ways because of how the outer shell electrons combine between atoms. In most cases, the outer shell will be most stable with a total of eight electrons. This information is easily discernible from the periodic table. Therefore an atom with seven outer shell electrons, such as K, combines very readily with an atom with one outer shell electron, such as Cl; an atom with six outer shell electrons, such as Ca will combine with an atom with two outer shell electrons or with two atoms with one outer shell electron each, and so on. Examples: KCl, CaCl₂, CH₄.

Section Title: Molecules and Bonds

Learning Outcome: 2.3

Skill: Level III: Problem Solving (Bloom's Taxonomy: Application)

129) Your roommate is not a science major but is interested in science and asks you to verify a rumor he has heard: it is theoretically possible for two people to walk *through* each other without causing harm. Confirm or refute what he has heard, and explain.

Answer: People are composed of molecules, which are in turn composed of atoms. Each atom is mostly empty space, because the protons, neutrons, and electrons are extremely tiny, and the electrons are relatively distant from each other and from the nucleus. A scientist acknowledges that there is often a finite probability, however small, that a very unlikely event could happen. If all of each person's subatomic particles were aligned just right, they could move through the other person's empty atomic space. This is so unlikely as to be practically impossible, however.

Section Title: Molecules and Bonds

Learning Outcome: 2.1

Skill: Level III: Problem Solving (Bloom's Taxonomy: Analysis)

130) Define polar covalent, nonpolar covalent, ionic, and hydrogen bonding. Which of these bonds involves more than one molecule? Which of these bonds is/are important in determining the properties of water? Explain.

Answer: Polar covalent bonds occur *within a single molecule* that shares electrons unequally; i.e., the constantly orbiting electrons spend more time at some locations and less at others. Nonpolar covalent bonds occur *within a single molecule* that shares electrons equally; i.e., the probability of an electron occupying a particular location is the same at all locations. Ionic bonds occur *within a single molecule* in which one atom completely loses an electron to another, causing each to develop an opposite charge; it is this electrical attraction that holds the molecule together. Hydrogen bonding occurs *between separate molecules* that contain polar covalent bonds; where electrons spend more time the molecule is partially negative, and where electrons spend less time the molecule is partially positive. The ends of different molecules are thus electrically attracted to each other. Water is a polar covalent molecule, with the oxygen end being partially negative and attracted to the partially positive hydrogen portions of other water molecules. Hydrogen-bonding between water molecules is responsible for surface tension and the crystalline structure of ice.

Section Title: Noncovalent Interactions

Learning Outcome: 2.4

Skill: Level III: Problem Solving (Bloom's Taxonomy: Analysis)

131) Ionic bonds are considered to be strong chemical bonds. Yet, ions dissociate in water. Explain this apparent contradiction.

Answer: Molecules such as sodium chloride are bonded by ionic bonds. So much energy would be required to separate a molecule of NaCl into Na^+ and Cl^- that it is practically impossible. That is, if the sodium chloride is *dry*. Because water molecules have partial charges resulting from their polar covalent bonds, sodium chloride dissociates in water. This means that the ions separate and function relatively independently. An attraction between sodium and chloride still exists, however, and the dissociation can be described as an increase in bond length rather than a loss of the bond. Evaporate the water, though, and the sodium chloride crystals re-form.

Section Title: Noncovalent Interactions

Learning Outcome: 2.3

Skill: Level III: Problem Solving (Bloom's Taxonomy: Analysis)

132) Your swimming buddy Mark jumped into a pool parallel to the water surface. When he stood up, he yelled "ouch" and you noticed that the skin on his chest and belly looked red and irritated. How would you describe the properties of water to explain to Mark why this happened? Why doesn't it hurt when pool water is penetrated perpendicular to the surface, as with a hands-first or feet-first dive?

Answer: Because Mark was parallel to the water surface, the force of his mass was spread out over a relatively large area of the water, making the force per unit water lower than in a typical dive. The surface tension of water, while not strong enough to keep Mark from penetrating the water surface, was strong enough to momentarily resist him. The force of the water pushing back on Mark, however briefly, was enough to cause pain. In a typical dive position, the force of Mark's entire mass is spread only over a tiny area of the water, and thus the force per unit water surface is greater. This higher force is sufficient to immediately break the hydrogen bonds and overcome the surface tension.

Section Title: Noncovalent Interactions

Learning Outcome: 2.3

Skill: Level III: Problem Solving (Bloom's Taxonomy: Analysis)

133) You are helping your dad prepare food in the kitchen. Dad has a tablespoon of water in one hand and a tablespoon of vegetable oil in the other, when he trips over the rug and spills both spoons on the countertop. Dad notices that the oil forms a thin film on the countertop, whereas spilled water forms smaller, taller beads. How should you explain the different behavior of these liquids to your dad?

Answer: Water forms beads when it strikes a nonabsorptive surface because of surface tension resulting from the hydrogen bonds between neighboring water molecules. Vegetable oil molecules are nonpolar covalent, therefore there is no hydrogen bonding between the lipid molecules and no bead formation.

Section Title: Noncovalent Interactions

Learning Outcome: 2.3

Skill: Level III: Problem Solving (Bloom's Taxonomy: Analysis)

134) Stanley Student is confused on the similarities and differences between proteins and nucleic acids. Assuming he has learned and understood the basic chemistry, what is the likely source of his confusion? To help him sort this out, make a table or flow chart to explain the structure of these molecules and their relationship to each other.

Answer: His confusion probably stems from the fact that both proteins and nucleic acids are classified as macromolecules, and both are assembled by covalently bonding certain monomers in a particular order. Also, nucleic acids contain the information necessary for manufacturing proteins, the term acid is used in describing the structure of both nucleic acids and proteins, and both nucleic acids and proteins must contain nitrogen. The monomer of protein is the amino acid, which has a central carbon, a variable chain denoted as R, and a nitrogen-containing amino group. There are 20 naturally occurring amino acids. The monomer of the nucleic acid is the nucleotide, which has a sugar attached to a nitrogen-containing base, and a phosphate. There are five different bases and two different sugars. The sequence of bases in a DNA or RNA molecule determines the sequence of amino acids in the protein.

Section Title: Molecules and Bonds

Learning Outcome: 2.1

Skill: Level III: Problem Solving (Bloom's Taxonomy: Analysis)

135) Proteins are described as having different levels of structure. List and distinguish between the level(s) that produce a linear shape vs. a globular shape, and explain why one of those levels can result in either a linear or globular shape.

Answer: Linear shapes: primary, secondary, quaternary. Primary structure is simply the sequence of covalently bonded amino acids in a peptide chain. Secondary structure is further bonding between nearby amino acids in a peptide chain, with the molecule still retaining a strand-like shape. Quaternary structure can involve separate linear polypeptide chains held together in a strand. Globular shapes: tertiary and quaternary. Tertiary structure involves bonding between distant amino acids, which causes the molecule to be wadded. Quaternary structure occurs when more than one globular peptide chain bonds together.

Section Title: Protein Interactions

Learning Outcome: 2.10

Skill: Level III: Problem Solving (Bloom's Taxonomy: Analysis)

136) While every level of a protein's structure is important to the function of that protein, which level of structure is most important to the function of enzymes, and why?

Answer: Enzymes and other globular proteins depend upon the three-dimensional shape resulting from the globular folding. Under conditions in which this shape is altered by denaturing agents such as heat, the protein ceases to function, though the primary and secondary structure may be unchanged.

Section Title: Protein Interactions

Learning Outcome: 2.8

Skill: Level III: Problem Solving (Bloom's Taxonomy: Analysis)

137) You are a student intern in the research and development department of a pharmaceutical company. You have discovered a compound that destroys the common cold virus in cultured human cells.

Chemical characterization reveals that carbon, hydrogen, and oxygen are present, in a 20:40:4 ratio of C:H:O. What chemical class is this compound? Experiments in rats show that neither oral nor injectable treatment with the compound was effective in destroying the virus. Discuss some possible reasons for this lack of effectiveness.

Answer: The relatively low amount of oxygen and high carbon and hydrogen indicate that this compound is probably a lipid. Oral administration may result in digestion of the compound so that none is absorbed into the blood. Lipids are not highly soluble in water, and because blood is a watery medium, the injected lipid may not transport well in the blood. Also, human cells as well as the viruses may behave differently in culture compared to in a real patient.

Section Title: Noncovalent Interactions

Learning Outcome: 2.4

Skill: Level III: Problem Solving (Bloom's Taxonomy: Evaluation)

138) Describe what happens to NaCl when placed in water.

Answer: Water molecules break the ionic bonds holding Na^+ and Cl^- together. Each sodium ion becomes surrounded by polar water molecules, with the electronegative ends of water molecules interacting with the ion. Each chloride ion also becomes surrounded by polar water molecules, but in this case it is the electropositive ends of the water molecules that bind to the ion. A consequence is that sodium and chloride ions can function relatively independently of each other when in solution.

Section Title: Noncovalent Interactions

Learning Outcome: 2.4

Skill: Level III: Problem Solving (Bloom's Taxonomy: Application)

139) How many grams of glucose, m.w. 180 daltons, is necessary to make 1 liter of a 1.0 molar solution?

A) 180

B) 360

C) 90

D) 6.02×10^{23}

E) 1.0

Answer: A

Section Title: Noncovalent Interactions

Learning Outcome: 2.5

Skill: Level IV: Quantitative Problems (Bloom's Taxonomy: Application)

140) A 5 M solution of 100 mL of glucose contains how many grams of glucose, m.w. 180 daltons?

- A) 180
- B) 360
- C) 90
- D) 6.02×10^{23}
- E) 1.0

Answer: C

Section Title: Noncovalent Interactions

Learning Outcome: 2.5

Skill: Level IV: Quantitative Problems (Bloom's Taxonomy: Application)

141) If 100 mL of water contains 5 grams of NaCl, m.w. 58.5 daltons, what is the molarity of the solution in moles/L?

- A) 0.05
- B) 0.85
- C) 2.92
- D) 0.085
- E) 0.25

Answer: B

Section Title: Noncovalent Interactions

Learning Outcome: 2.5

Skill: Level IV: Quantitative Problems (Bloom's Taxonomy: Application)

142) How many grams of NaCl, m.w. 58.5 daltons, are the molar equivalent to 90 g of glucose (m.w. 180 daltons)?

- A) 0.25
- B) 0.5
- C) 29.25
- D) 117
- E) 14.6

Answer: C

Section Title: Noncovalent Interactions

Learning Outcome: 2.5

Skill: Level IV: Quantitative Problems (Bloom's Taxonomy: Application)

143) How many grams of NaCl, m.w. 58.5 daltons, are necessary to make 1 liter of 5% saline?

- A) 58.5
- B) 1
- C) 50
- D) 6.02×10^{23}
- E) 2.9

Answer: C

Section Title: Noncovalent Interactions

Learning Outcome: 2.5

Skill: Level IV: Quantitative Problems (Bloom's Taxonomy: Application)

144) 100 mg/dL is a typical blood concentration of glucose. The molecular weight of glucose is approximately 180 daltons. What is the molarity of this solution in millimoles?

- A) 100
- B) 10
- C) 0.56
- D) 18
- E) 5.6

Answer: E

Section Title: Noncovalent Interactions

Learning Outcome: 2.5

Skill: Level IV: Quantitative Problems (Bloom's Taxonomy: Application)

145) If in an acid-base reaction $\text{H}_2\text{SO}_4^{2-}$ donates two H^+ , one mole of $\text{H}_2\text{SO}_4^{2-}$ would equal how many equivalents?

- A) 0.75
- B) 1
- C) 4
- D) 0.5
- E) 2

Answer: E

Section Title: Noncovalent Interactions

Learning Outcome: 2.5

Skill: Level IV: Quantitative Problems (Bloom's Taxonomy: Application)

146) Using NaCl to illustrate, explain atomic mass and molecular mass, and an estimated and true mass of one molecule. Your explanation should include the appropriate measurement unit for each, and why the estimated and true masses are not exactly identical.

Answer: The atomic mass is the actual mass of an atom, expressed in atomic mass units (amu) or daltons (Da), where $1 \text{ amu} = 1.6 \times 10^{-27} \text{ kg}$. Because most of the mass of an atom is contributed by the protons and neutrons, each of which is about 1 amu, the mass can be estimated by counting the number of these particles. The number of protons and neutrons is roughly equal, so the atomic number can simply be doubled to estimate the atomic mass. From the atomic number (see the periodic table) the estimated atomic mass of sodium is 22 amu and of chloride is 34 amu. The mass of a molecule (usually expressed in Da instead of amu) of NaCl is $22 + 34 = 56 \text{ Da}$. From the periodic table, the true weight of Cl is actually closer to 36 amu and of Na is 23 amu, so the true mass of NaCl is closer to 59 Da. There are two reasons why the estimated and actual are not the same: the mass of protons and neutrons is actually greater than one, and the number of neutrons may be more or less than double the number of protons.

Section Title: Noncovalent Interactions

Learning Outcome: 2.5

Skill: Level IV: Quantitative Problems (Bloom's Taxonomy: Application)

- 147) A. Distinguish between the mass of a molecule and the mass of a mole, using NaCl in your example.
 B. Calculate the mass of a mole of NaCl in g, using the mass of one Da (amu).
 C. Calculate the mass of a dozen NaCl molecules, a dozen donuts, and a mole of donuts, assuming a 30 gram donut.

Answer:

A. The mass of a molecule is determined by the mass of its component atoms. From the periodic table, the mass of Na is 23 amu and of Cl is nearly 36 amu, so the mass of one molecule of NaCl is 59 Da. A mole is like a dozen, i.e., it is a particular number of items, specifically 6.02×10^{23} .

B. A mole of NaCl = $59 \text{ Da} \times 6.02 \times 10^{23} = 3.55 \times 10^{25} \text{ Da}$.

1 Da = $1.66 \times 10^{-27} \text{ kg}$, so $3.55 \times 10^{25} \text{ Da} \times 1.66 \times 10^{-27} \text{ kg/Da} \times 1000 \text{ g/kg} = 59 \text{ g}$.

C. A dozen NaCl molecules: $12 \times 59 \text{ Da} \times 1.66 \times 10^{-27} \text{ kg/Da} \times 1000 \text{ g/kg} = 1.2 \times 10^{-21} \text{ g}$.

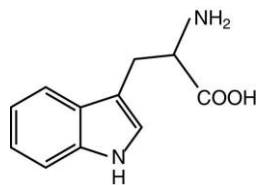
A dozen donuts: $12 \times 30 \text{ g} = 360 \text{ g}$. A mole of donuts: $6.02 \times 10^{23} \times 30 \text{ g} = 1.8 \times 10^{25} \text{ g}$.

Section Title: Noncovalent Interactions

Learning Outcome: 2.5

Skill: Level IV: Quantitative Problems (Bloom's Taxonomy: Application)

- 148) Write the chemical formula for the molecule drawn below. Which class of organic molecule does it belong to? Is it most likely polar or nonpolar?



Answer: $\text{C}_{11}\text{H}_{12}\text{N}_2\text{O}_2$. The presence of the carboxylic acid (COOH) and amine (NH_2) indicates this is an amino acid. Because of the R group structure, it is relatively nonpolar (this amino acid is tryptophan).

Section Title: Molecules and Bonds

Learning Outcome: 2.1

Skill: Level IV: Quantitative Problems (Bloom's Taxonomy: Analysis)

- 149) What is the pH of a 0.005 M HCl solution? Assume complete dissociation.

Answer: $\text{pH} = 2.3$. If $\text{pH} = -\log [\text{H}^+]$ and HCl is a strong acid, we can assume complete dissociation will occur in solution.

Section Title: Noncovalent Interactions

Learning Outcome: 2.7

Skill: Level IV: Quantitative Problems (Bloom's Taxonomy: Application)