

***Campbell Biology in Focus (Urry)***  
**Chapter 3 Carbon and the Molecular Diversity of Life**

3.1 Multiple-Choice Questions

1) The element present in all organic molecules is

A) hydrogen.

B) oxygen.

C) carbon.

D) nitrogen.

E) phosphorus.

Answer: C

Topic: Concept 3.1

Skill: Knowledge/Comprehension

Learning Outcome: 3.1

2) The complexity and variety of organic molecules is due to

A) the chemical versatility of carbon atoms.

B) the variety of rare elements in organic molecules.

C) the fact that they can be synthesized only in living organisms.

D) their interaction with water.

E) their tremendously large sizes.

Answer: A

Topic: Concept 3.1

Skill: Knowledge/Comprehension

Learning Outcome: 3.1

3) The experimental approach taken in current biological investigations presumes that

A) simple organic compounds can be synthesized in the laboratory from inorganic precursors, but complex organic compounds such as carbohydrates and proteins can only be synthesized by living organisms.

B) a life force ultimately controls the activities of living organisms, and this life force cannot be studied by physical or chemical methods.

C) although a life force, or vitalism, exists in living organisms, this life force cannot be studied by physical or chemical methods.

D) living organisms are composed of the same elements present in nonliving things, plus a few special trace elements found only in living organisms or their products.

E) living organisms can be understood in terms of the same physical and chemical laws that can be used to explain all natural phenomena.

Answer: E

Topic: Concept 3.1

Skill: Knowledge/Comprehension

Learning Outcome: 3.1

- 4) Differences among organisms are caused by
- A) large differences in elemental composition from organism to organism.
  - B) differences in the types and relative amounts of organic molecules synthesized by each organism.
  - C) differences in the elements that bond with carbon in each organism.
  - D) differences in the sizes of the organic molecules in each organism.
  - E) differences in the inorganic compounds present in each organism.

Answer: B

Topic: Concept 3.1

Skill: Application/Analysis

Learning Outcome: 3.1

- 5) How many electron pairs does carbon share in order to complete its valence shell?

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

Answer: D

Topic: Concept 3.1

Skill: Knowledge/Comprehension

Learning Outcome: 3.1

- 6) A carbon atom is most likely to form which of the following bonds with other atoms?

- A) ionic bond
- B) hydrogen bond
- C) covalent bond
- D) covalent bonds and hydrogen bonds
- E) ionic bonds, covalent bonds, and hydrogen bonds

Answer: C

Topic: Concept 3.1

Skill: Knowledge/Comprehension

Learning Outcome: 3.1

- 7) Research indicates that ibuprofen, a drug used to relieve inflammation and pain, is a mixture of two enantiomers, that is, molecules that

- A) have identical chemical formulas but differ in the branching of their carbon skeletons.
- B) are mirror images of one another.
- C) exist in either linear chain or ring forms.
- D) differ in the location of their double bonds.
- E) differ in the arrangement of atoms around their double bonds.

Answer: B

Topic: Concept 3.1

Skill: Knowledge/Comprehension

Learning Outcome: 3.1

8) What determines whether a carbon atom's covalent bonds to other atoms are in a tetrahedral configuration or a planar configuration?

- A) the presence or absence of bonds with oxygen atoms
- B) the presence or absence of double bonds between the carbon atom and other atoms
- C) the polarity of the covalent bonds between carbon and other atoms
- D) the presence or absence of bonds with nitrogen atoms
- E) the solvent that the organic molecule is dissolved in

Answer: B

Topic: Concept 3.1

Skill: Application/Analysis

Learning Outcome: 3.1

9) A compound contains hydroxyl groups as its predominant functional group. Which of the following statements is true concerning this compound?

- A) It lacks an asymmetric carbon, and it is probably a fat or lipid.
- B) It should dissolve in water.
- C) It should dissolve in a nonpolar solvent.
- D) It won't form hydrogen bonds with water.
- E) It is hydrophobic.

Answer: B

Topic: Concept 3.1

Skill: Knowledge/Comprehension

Learning Outcome: 3.1

10) Which two functional groups are always found in amino acids?

- A) ketone and methyl
- B) carbonyl and amino
- C) carboxyl and amino
- D) amino and sulfhydryl
- E) hydroxyl and carboxyl

Answer: C

Topic: Concept 3.1

Skill: Knowledge/Comprehension

Learning Outcome: 3.1

11) Amino acids are acids because they always possess which functional group?

- A) amino
- B) carbonyl
- C) carboxyl
- D) phosphate
- E) hydroxyl

Answer: C

Topic: Concept 3.1

Skill: Knowledge/Comprehension

Learning Outcome: 3.1

12) A carbon skeleton is covalently bonded to both an amino group and a carboxyl group. When placed in water it

- A) would function only as an acid because of the carboxyl group.
- B) would function only as a base because of the amino group.
- C) would function as neither an acid nor a base.
- D) would function as both an acid and a base.
- E) is impossible to determine how it would function

Answer: D

Topic: Concept 3.1

Skill: Application/Analysis

Learning Outcome: 3.1

13) Which chemical group can act as an acid?

- A) amino
- B) carbonyl
- C) carboxyl
- D) hydroxyl
- E) methyl

Answer: C

Topic: Concept 3.1

Skill: Knowledge/Comprehension

Learning Outcome: 3.1

14) Molecules with which functional groups may form polymers via dehydration reactions?

- A) hydroxyl groups
- B) carbonyl groups
- C) carboxyl groups
- D) either carbonyl or carboxyl groups
- E) either hydroxyl or carboxyl groups

Answer: E

Topic: Concept 3.1

Skill: Application/Analysis

Learning Outcome: 3.1, 3.2

15) Which of the following is *not* a monomer/polymer pairing?

- A) monosaccharide/polysaccharide
- B) amino acid/protein
- C) triglyceride/phospholipid bilayer
- D) deoxyribonucleotide/DNA
- E) ribonucleotide/RNA

Answer: C

Topic: Concept 3.2

Skill: Knowledge/Comprehension

Learning Outcome: 3.2, 3.3, 3.4, 3.5, 3.6

16) Which of these molecules is *not* formed by dehydration reactions?

- A) fatty acids
- B) disaccharides
- C) DNA
- D) protein
- E) amylose

Answer: A

Topic: Concept 3.2

Skill: Knowledge/Comprehension

Learning Outcome: 3.2, 3.3, 3.4, 3.5, 3.6

17) Which of the following is *not* a polymer?

- A) glucose
- B) starch
- C) cellulose
- D) chitin
- E) DNA

Answer: A

Topic: Concept 3.2

Skill: Knowledge/Comprehension

Learning Outcome: 3.2, 3.3, 3.6

18) What is the chemical reaction mechanism by which cells make polymers from monomers?

- A) phosphodiester linkages
- B) hydrolysis
- C) dehydration reactions
- D) ionic bonding of monomers
- E) the formation of disulfide bridges between monomers

Answer: C

Topic: Concept 3.2

Skill: Knowledge/Comprehension

Learning Outcome: 3.2

19) How many molecules of water are needed to completely hydrolyze a polymer that is 11 monomers long?

- A) 12
- B) 11
- C) 10
- D) 9
- E) 8

Answer: C

Topic: Concept 3.2

Skill: Knowledge/Comprehension

Learning Outcome: 3.2

20) Which of the following best summarizes the relationship between dehydration reactions and hydrolysis?

- A) Dehydration reactions assemble polymers, and hydrolysis reactions break down polymers.
- B) Dehydration reactions eliminate water from lipid membranes, and hydrolysis makes lipid membranes water permeable.
- C) Dehydration reactions can occur only after hydrolysis.
- D) Hydrolysis creates monomers, and dehydration reactions break down polymers.
- E) Dehydration reactions ionize water molecules and add hydroxyl groups to polymers; hydrolysis reactions release hydroxyl groups from polymers.

Answer: A

Topic: Concept 3.2

Skill: Knowledge/Comprehension

Learning Outcome: 3.2

21) Which of the following is an example of hydrolysis?

- A) the reaction of two monosaccharides, forming a disaccharide with the release of water
- B) the synthesis of two amino acids, forming a peptide with the release of water
- C) the reaction of a fat, forming glycerol and fatty acids with the release of water
- D) the reaction of a fat, forming glycerol and fatty acids with the consumption of water
- E) the synthesis of a nucleotide from a phosphate, a pentose sugar, and a nitrogenous base with the production of a molecule of water

Answer: D

Topic: Concept 3.2

Skill: Knowledge/Comprehension

Learning Outcome: 3.2, 3.3, 3.4, 3.5, 3.6

22) The molecular formula for glucose is  $C_6H_{12}O_6$ . What would be the molecular formula for a molecule made by linking three glucose molecules together by dehydration reactions?

- A)  $C_{18}H_{36}O_{18}$
- B)  $C_{18}H_{32}O_{16}$
- C)  $C_6H_{10}O_5$
- D)  $C_{18}H_{10}O_{15}$
- E)  $C_3H_6O_3$

Answer: B

Topic: Concept 3.2

Skill: Application/Analysis

Learning Outcome: 3.2

23) Which of the following is true of both starch and cellulose?

- A) They are both polymers of glucose.
- B) They are *cis-trans* isomers of each other.
- C) They can both be digested by humans.
- D) They are both used for energy storage in plants.
- E) They are both structural components of the plant cell wall.

Answer: A

Topic: Concept 3.2

Skill: Knowledge/Comprehension

Learning Outcome: 3.2

24) The bonding of two amino acid molecules to form a larger molecule requires

- A) the release of a water molecule.
- B) the release of a carbon dioxide molecule.
- C) the addition of a nitrogen atom.
- D) the addition of a water molecule.
- E) the release of a nitrous oxide molecule.

Answer: A

Topic: Concept 3.2

Skill: Knowledge/Comprehension

Learning Outcome: 3.2

25) Humans can digest starch but not cellulose because

- A) the monomer of starch is glucose, whereas the monomer of cellulose is galactose.
- B) humans have enzymes that can hydrolyze the  $\beta$  glycosidic linkages of starch but not the  $\alpha$  glycosidic linkages of cellulose.
- C) humans have enzymes that can hydrolyze the  $\alpha$  glycosidic linkages of starch but not the  $\beta$  glycosidic linkages of cellulose.
- D) humans harbor starch-digesting bacteria in the digestive tract.
- E) the monomer of starch is glucose, whereas the monomer of cellulose is glucose with a nitrogen-containing group.

Answer: C

Topic: Concept 3.2

Skill: Knowledge/Comprehension

Learning Outcome: 3.2

26) Polysaccharides, triacylglycerides, and proteins are similar in that they

- A) are synthesized from monomers by the process of hydrolysis.
- B) are synthesized from subunits by dehydration reactions.
- C) are synthesized as a result of peptide bond formation between monomers.
- D) are decomposed into their subunits by dehydration reactions.
- E) all contain nitrogen in their monomer building blocks.

Answer: B

Topic: Concept 3.2

Skill: Application/Analysis

Learning Outcome: 3.2

27) Dehydration reactions are used in forming which of the following compounds?

- A) triacylglycerides
- B) polysaccharides
- C) proteins
- D) triacylglycerides and proteins only
- E) triacylglycerides, polysaccharides, and proteins

Answer: E

Topic: Concept 3.2

Skill: Knowledge/Comprehension

Learning Outcome: 3.2

28) DNAase is an enzyme that catalyzes the hydrolysis of the covalent bonds that join nucleotides together. What would first happen to DNA molecules treated with DNAase?

- A) The two strands of the double helix would separate.
- B) The phosphodiester bonds between deoxyribose sugars would be broken.
- C) The purines would be separated from the deoxyribose sugars.
- D) The pyrimidines would be separated from the deoxyribose sugars.
- E) All bases would be separated from the deoxyribose sugars.

Answer: B

Topic: Concept3.2

Skill: Knowledge/Comprehension

Learning Outcome: 3.2, 3.6

29) Which of the following is true of cellulose?

- A) It is a polymer composed of enantiomers of glucose.
- B) It is a storage polysaccharide for energy in plant cells.
- C) It is digestible by bacteria in the human gut.
- D) It is a major structural component of plant cell walls.
- E) It is a polymer composed of enantiomers of glucose, it is a storage polysaccharide for energy in plant cells, it is digestible by bacteria in the human gut, and it is a major structural component of plant cell walls.

Answer: D

Topic: Concept 3.3

Skill: Knowledge/Comprehension

Learning Outcome: 3.2, 3.3

30) Which of the following polymers contain nitrogen?

- A) starch
- B) glycogen
- C) cellulose
- D) chitin
- E) amylopectin

Answer: D

Topic: Concept 3.3

Skill: Knowledge/Comprehension

Learning Outcome: 3.3



31) Which of the following classes of biological molecules consist of both small molecules and macromolecular polymers?

- A) lipids
- B) carbohydrates
- C) proteins
- D) nucleic acids
- E) Lipids, carbohydrates, proteins, and nucleic acids all consist of only macromolecular polymers.

Answer: B

Topic: Concept 3.3

Skill: Knowledge/Comprehension

Learning Outcome: 3.3

32) The enzyme amylase can break glycosidic linkages between glucose monomers only if the monomers are the  $\alpha$  form. Which of the following could amylase break down?

- A) starch
- B) cellulose
- C) chitin
- D) starch and chitin only
- E) starch, cellulose, and chitin

Answer: A

Topic: Concept 3.3

Skill: Knowledge/Comprehension

Learning Outcome: 3.3

33) On food packages, to what does the term *insoluble fiber* refer?

- A) cellulose
- B) polypeptides
- C) starch
- D) amylopectin
- E) chitin

Answer: A

Topic: Concept 3.3

Skill: Knowledge/Comprehension

Learning Outcome: 3.3

34) A molecule with the chemical formula  $C_6H_{12}O_6$  is probably a

- A) carbohydrate.
- B) lipid.
- C) monosaccharide
- D) carbohydrate and lipid only.
- E) carbohydrate and monosaccharide only.

Answer: E

Topic: Concept 3.3

Skill: Knowledge/Comprehension

Learning Outcome: 3.3

35) Lactose, a sugar in milk, is composed of one glucose molecule joined by a glycosidic linkage to one galactose molecule. How is lactose classified?

- A) as a pentose
- B) as a hexose
- C) as a monosaccharide
- D) as a disaccharide
- E) as a polysaccharide

Answer: D

Topic: Concept 3.3

Skill: Knowledge/Comprehension

Learning Outcome: 3.3

36) All of the following are polysaccharides *except*

- A) lactose.
- B) glycogen.
- C) chitin.
- D) cellulose.
- E) amylopectin.

Answer: A

Topic: Concept 3.3

Skill: Knowledge/Comprehension

Learning Outcome: 3.3

37) Testosterone and estradiol are male and female sex hormones, respectively, in many vertebrates. In what way(s) do these molecules differ from each other?

- A) Testosterone and estradiol are structural isomers but have the same molecular formula.
- B) Testosterone and estradiol are *cis-trans* isomers but have the same molecular formula.
- C) Testosterone and estradiol have different functional groups attached to the same carbon skeleton.
- D) Testosterone and estradiol have distinctly different chemical structures, with one including four fused rings of carbon atoms, whereas the other has three rings.
- E) Testosterone and estradiol are enantiomers of the same organic molecule.

Answer: C

Topic: Concept 3.3

Skill: Knowledge/Comprehension

Learning Outcome: 3.3

38) Why are hydrocarbons insoluble in water?

- A) The majority of their bonds are polar covalent carbon-to-hydrogen linkages.
- B) The majority of their bonds are nonpolar covalent carbon-to-hydrogen linkages.
- C) They are hydrophilic.
- D) They exhibit considerable molecular complexity and diversity.
- E) They are lighter than water.

Answer: B

Topic: Concept 3.4

Skill: Knowledge/Comprehension

Learning Outcome: 3.1, 3.4

- 39) Which of the following statements concerning saturated fats is *not* true?
- A) They are more common in animals than in plants.
  - B) They have multiple double bonds in the carbon chains of their fatty acids.
  - C) They generally solidify at room temperature.
  - D) They contain more hydrogen than unsaturated fats having the same number of carbon atoms.
  - E) They are one of several factors that contribute to atherosclerosis.

Answer: B

Topic: Concept 3.4

Skill: Knowledge/Comprehension

Learning Outcome: 3.4

- 40) A molecule with the formula  $C_{18}H_{36}O_2$  is probably a

- A) carbohydrate.
- B) fatty acid.
- C) protein.
- D) nucleic acid.
- E) hydrocarbon.

Answer: B

Topic: Concept 3.4

Skill: Knowledge/Comprehension

Learning Outcome: 3.4

- 41) Which of the following statements is true for the class of biological molecules known as lipids?

- A) They are insoluble in water.
- B) They are made from glycerol, fatty acids, and phosphate.
- C) They contain less energy than proteins and carbohydrates.
- D) They are made by dehydration reactions.
- E) They contain nitrogen.

Answer: A

Topic: Concept 3.4

Skill: Knowledge/Comprehension

Learning Outcome: 3.4

- 42) The label on a container of margarine lists "hydrogenated vegetable oil" as the major ingredient. What is the result of adding hydrogens to vegetable oil?

- A) The hydrogenated vegetable oil has a lower melting point.
- B) The hydrogenated vegetable oil stays solid at room temperature.
- C) The hydrogenated vegetable oil has more "kinks" in the fatty acid chains.
- D) The hydrogenated vegetable oil has fewer trans fatty acids.
- E) The hydrogenated vegetable oil is less likely to clog arteries.

Answer: B

Topic: Concept 3.4

Skill: Knowledge/Comprehension

Learning Outcome: 3.4

- 43) Which of the following is true regarding saturated fatty acids?
- A) They are the predominant fatty acid in corn oil.
  - B) They have double bonds between the carbon atoms of the fatty acids.
  - C) They are the principal molecules in lard and butter.
  - D) They are usually liquid at room temperature.
  - E) They are usually produced by plants.

Answer: C

Topic: Concept 3.4

Skill: Knowledge/Comprehension

Learning Outcome: 3.4

- 44) Large organic molecules are usually assembled by polymerization of a few kinds of simple subunits. Which of the following is an exception to this statement?

- A) a steroid
- B) cellulose
- C) DNA
- D) an enzyme
- E) a contractile protein

Answer: A

Topic: Concept 3.4

Skill: Knowledge/Comprehension

Learning Outcome: 3.2, 3.3, 3.4, 3.5, 3.6

- 45) Why are human sex hormones considered to be lipids?

- A) They are essential components of cell membranes.
- B) They are not soluble in water.
- C) They are made of fatty acids.
- D) They are hydrophilic compounds.
- E) They contribute to atherosclerosis.

Answer: B

Topic: Concept 3.4

Skill: Knowledge/Comprehension

Learning Outcome: 3.4

- 46) All of the following contain amino acids *except*

- A) hemoglobin.
- B) cholesterol.
- C) antibodies.
- D) enzymes.
- E) insulin.

Answer: B

Topic: Concept 3.4

Skill: Knowledge/Comprehension

Learning Outcome: 3.4, 3.5

47) There are 20 different amino acids. What makes one amino acid different from another?

- A) different side chains (R groups) attached to a carboxyl carbon
- B) different side chains (R groups) attached to the amino groups
- C) different side chains (R groups) attached to an  $\alpha$  carbon
- D) different structural and optical isomers
- E) different asymmetric carbons

Answer: C

Topic: Concept 3.5

Skill: Knowledge/Comprehension

Learning Outcome: 3.5

48) Upon chemical analysis, a particular polypeptide was found to contain 100 amino acids. How many peptide bonds are present in this protein?

- A) 101
- B) 100
- C) 99
- D) 98
- E) 97

Answer: C

Topic: Concept 3.5

Skill: Knowledge/Comprehension

Learning Outcome: 3.5

49) Which bonds are created during the formation of the primary structure of a protein?

- A) peptide bonds
- B) hydrogen bonds
- C) disulfide bonds
- D) phosphodiester bonds
- E) peptide bonds, hydrogen bonds, and disulfide bonds

Answer: A

Topic: Concept 3.5

Skill: Knowledge/Comprehension

Learning Outcome: 3.5

50) What maintains the secondary structure of a protein?

- A) peptide bonds
- B) hydrogen bonds between the amino group of one peptide bond and the carboxyl group of another peptide bond
- C) disulfide bonds
- D) hydrophobic interactions
- E) hydrogen bonds between the R groups

Answer: B

Topic: Concept 3.5

Skill: Knowledge/Comprehension

Learning Outcome: 3.5

51) Which type of interaction stabilizes the  $\alpha$  helix and the  $\beta$  pleated sheet structures of proteins?

- A) hydrophobic interactions
- B) disulfide bonds
- C) ionic bonds
- D) hydrogen bonds
- E) peptide bonds

Answer: D

Topic: Concept 3.5

Skill: Knowledge/Comprehension

Learning Outcome: 3.5

52) Which level of protein structure do the  $\alpha$  helix and the  $\beta$  pleated sheet represent?

- A) primary
- B) secondary
- C) tertiary
- D) quaternary
- E) primary, secondary, tertiary, and quaternary

Answer: B

Topic: Concept 3.5

Skill: Knowledge/Comprehension

Learning Outcome: 3.5

53) The amino acids of the protein keratin are arranged predominantly in an  $\alpha$  helix. This secondary structure is stabilized by

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

Answer: E

Topic: Concept 3.5

Skill: Knowledge/Comprehension

Learning Outcome: 3.5

54) The tertiary structure of a protein is the

- A) bonding together of several polypeptide chains by weak bonds.
- B) order in which amino acids are joined in a polypeptide chain.
- C) unique three-dimensional shape of the fully folded polypeptide.
- D) organization of a polypeptide chain into an  $\alpha$  helix or  $\beta$  pleated sheet.
- E) overall protein structure resulting from the aggregation of two or more polypeptide subunits.

Answer: C

Topic: Concept 3.5

Skill: Knowledge/Comprehension

Learning Outcome: 3.5

55) What type of covalent bond between amino acid side chains (R groups) functions in maintaining a polypeptide's specific three-dimensional shape?

- A) ionic bond
- B) hydrophobic interaction
- C) van der Waals interaction
- D) disulfide bond
- E) hydrogen bond

Answer: D

Topic: Concept 3.5

Skill: Knowledge/Comprehension

Learning Outcome: 3.5

56) At which level(s) of protein structure are interactions between the side chains (R groups) most important?

- A) primary
- B) secondary
- C) tertiary
- D) quaternary
- E) primary, secondary, tertiary, and quaternary

Answer: C

Topic: Concept 3.5

Skill: Knowledge/Comprehension

Learning Outcome: 3.5

57) The R group or side chain of the amino acid serine is  $-\text{CH}_2\text{-OH}$ . The R group or side chain of the amino acid leucine is  $-\text{CH}_2\text{-CH}(\text{CH}_3)_2$ . Where would you expect to find these amino acids in a globular protein in aqueous solution?

- A) Serine would be in the interior, and leucine would be on the exterior of the globular protein.
- B) Leucine would be in the interior, and serine would be on the exterior of the globular protein.
- C) Both serine and leucine would be in the interior of the globular protein.
- D) Both serine and leucine would be on the exterior of the globular protein.
- E) Both serine and leucine would be in the interior and on the exterior of the globular protein.

Answer: B

Topic: Concept 3.5

Skill: Application/Analysis

Learning Outcome: 3.5

58) Misfolding of polypeptides is a serious problem in cells. Which of the following diseases is (are) associated with an accumulation of misfolded polypeptides?

- A) Alzheimer's only
- B) Parkinson's only
- C) diabetes mellitus only
- D) Alzheimer's and Parkinson's only
- E) Alzheimer's, Parkinson's, and diabetes mellitus

Answer: D

Topic: Concept 3.5

Skill: Knowledge/Comprehension

Learning Outcome: 3.5

59) Changing a single amino acid in a protein consisting of 325 amino acids would

- A) alter the primary structure of the protein but not its tertiary structure or function.
- B) cause the tertiary structure of the protein to unfold.
- C) always alter the biological activity or function of the protein.
- D) always alter the primary structure of the protein and disrupt its biological activity.
- E) always alter the primary structure of the protein, sometimes alter the tertiary structure of the protein, and sometimes affect its biological activity.

Answer: E

Topic: Concept 3.5

Skill: Application/Analysis

Learning Outcome: 3.5

60) Normal hemoglobin is a tetramer, consisting of two molecules of  $\beta$  hemoglobin and two molecules of  $\alpha$  hemoglobin. In sickle-cell disease, as a result of a single amino acid change, the mutant hemoglobin tetramers associate with each other and assemble into large fibers. Based on this information alone, we can conclude that sickle-cell hemoglobin exhibits

- A) altered primary structure.
- B) altered secondary structure.
- C) altered tertiary structure.
- D) altered quaternary structure.
- E) altered primary structure and altered quaternary structure; the secondary and tertiary structures may or may not be altered.

Answer: E

Topic: Concept 3.5

Skill: Application/Analysis

Learning Outcome: 3.5



61) In a normal cellular protein, where would you expect to find a hydrophobic amino acid such as valine?

- A) in the interior of the folded protein, away from water
- B) on the exterior surface of the protein, interacting with water
- C) in the transmembrane portion interacting with lipid fatty acid chains
- D) in the interior of the folded protein, away from water, or in a transmembrane portion interacting with lipid fatty acid chains
- E) anywhere in the protein, with equal probability

Answer: D

Topic: Concept 3.5

Skill: Application/Analysis

Learning Outcome: 3.5

62) If cells are grown in a medium containing radioactive  $^{35}\text{S}$ , which of these molecules will be labeled?

- A) phospholipids
- B) nucleic acids
- C) proteins
- D) amylose
- E) both proteins and nucleic acids

Answer: C

Topic: Concept 3.5

Skill: Application/Analysis

Learning Outcome: 3.5

63) How will brief heating (to  $95^\circ\text{C}$ ) affect macromolecular structures in aqueous solution?

- A) DNA duplexes will unwind and separate.
- B) Proteins will unfold (denature).
- C) Starch will hydrolyze into monomeric sugars.
- D) Proteins will hydrolyze into amino acids.
- E) DNA duplexes will unwind and separate, and proteins will unfold (denature).

Answer: E

Topic: Concept 3.5

Skill: Application/Analysis

Learning Outcome: 3.5, 3.6

64) Which of the following statements about the 5' end of a polynucleotide strand of RNA is correct?

- A) The 5' end has a hydroxyl group attached to the number 5 carbon of ribose.
- B) The 5' end has a phosphate group attached to the number 5 carbon of ribose.
- C) The 5' end has phosphate attached to the number 5 carbon of the nitrogenous base.
- D) The 5' end has a carboxyl group attached to the number 5 carbon of ribose.
- E) The 5' end is the fifth position on one of the nitrogenous bases.

Answer: B

Topic: Concept 3.6

Skill: Knowledge/Comprehension

Learning Outcome: 3.6

- 65) One of the primary functions of RNA molecules is to
- A) transmit genetic information to offspring.
  - B) function in the synthesis of proteins.
  - C) make a copy of itself, thus ensuring genetic continuity.
  - D) act as a pattern or blueprint to form DNA.
  - E) form the genes of higher organisms.

Answer: B

Topic: Concept 3.6

Skill: Knowledge/Comprehension

Learning Outcome: 3.6

- 66) If  $^{14}\text{C}$ -labeled uracil is added to the growth medium of cells, what macromolecules will be labeled?

- A) phospholipids
- B) DNA
- C) RNA
- D) both DNA and RNA
- E) proteins

Answer: C

Topic: Concept 3.6

Skill: Application/Analysis

Learning Outcome: 3.6

- 67) Which of the following descriptions best fits the class of molecules known as nucleotides?

- A) a nitrogenous base and a phosphate group
- B) a nitrogenous base and a pentose sugar
- C) a nitrogenous base, a phosphate group, and a pentose sugar
- D) a phosphate group and an adenine or uracil
- E) a pentose sugar and a purine or pyrimidine

Answer: C

Topic: Concept 3.6

Skill: Knowledge/Comprehension

Learning Outcome: 3.6

- 68) Which of the following are nitrogenous bases of the pyrimidine type?

- A) guanine and adenine
- B) cytosine and uracil
- C) thymine and guanine
- D) ribose and deoxyribose
- E) adenine and thymine

Answer: B

Topic: Concept 3.6

Skill: Knowledge/Comprehension

Learning Outcome: 3.6

69) Which of the following are nitrogenous bases of the purine type?

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

Answer: B

Topic: Concept 3.6

Skill: Knowledge/Comprehension

Learning Outcome: 3.6

70) If a DNA sample were composed of 10% thymine, what would be the percentage of guanine?

- A) 10
- B) 20
- C) 40
- D) 80
- E) impossible to tell from the information given

Answer: C

Topic: Concept 3.6

Skill: Application/Analysis

Learning Outcome: 3.6

71) A double-stranded DNA molecule contains a total of 120 purines and 120 pyrimidines. This DNA molecule could be composed of

- A) 120 adenine and 120 uracil molecules.
- B) 120 thymine and 120 adenine molecules.
- C) 120 cytosine and 120 thymine molecules.
- D) 120 adenine and 120 cytosine molecules.
- E) 120 guanine and 120 thymine molecules.

Answer: B

Topic: Concept 3.6

Skill: Application/Analysis

Learning Outcome: 3.6

72) The difference between the sugar in DNA and the sugar in RNA is that the sugar in DNA

- A) is a six-carbon sugar and the sugar in RNA is a five-carbon sugar.
- B) can form a double-stranded molecule.
- C) is an aldehyde sugar and the sugar in the RNA is a keto sugar.
- D) is in the  $\alpha$  configuration and the sugar in RNA is in the  $\beta$  configuration.
- E) contains one less oxygen atom.

Answer: E

Topic: Concept 3.6

Skill: Knowledge/Comprehension

Learning Outcome: 3.6

73) Which of the following statements best summarizes the differences between DNA and RNA?

- A) DNA encodes hereditary information, whereas RNA does not.
- B) The bases in DNA form base-paired duplexes, whereas the bases in RNA do not.
- C) DNA nucleotides contain a different sugar than RNA nucleotides.
- D) DNA contains the base uracil, whereas RNA contains the base thymine.
- E) DNA encodes hereditary information, whereas RNA does not; the bases in DNA form base-paired duplexes, whereas the bases in RNA do not; and DNA nucleotides contain a different sugar than RNA nucleotides.

Answer: C

Topic: Concept 3.6

Skill: Knowledge/Comprehension

Learning Outcome: 3.6

74) If one strand of a DNA molecule has the sequence of bases 5'ATTGCA3', the other complementary strand would have the sequence

- A) 5'TAACGT3'.
- B) 5'TGCAAT3'.
- C) 5'UAACGU3'.
- D) 3'UAACGU5'.
- E) 5'UGCAAU3'.

Answer: B

Topic: Concept 3.6

Skill: Application/Analysis

Learning Outcome: 3.6

75) What is the structural feature that allows DNA to replicate?

- A) sugar-phosphate backbone
- B) complementary pairing of the nitrogenous bases
- C) disulfide bonding (bridging) of the two helices
- D) twisting of the molecule to form an  $\alpha$  helix
- E) three-component structure of the nucleotides

Answer: B

Topic: Concept 3.6

Skill: Knowledge/Comprehension

Learning Outcome: 3.6

76) If cells are grown in a medium containing radioactive  $^{32}\text{P}$ -labeled phosphate, which of these molecules will be labeled?

- A) phospholipids
- B) nucleic acids
- C) proteins
- D) amylose
- E) both phospholipids and nucleic acids

Answer: E

Topic: Concept 3.6

Skill: Application/Analysis

Learning Outcome: 3.4, 3.6

77) If cells are grown in a medium containing radioactive  $^{15}\text{N}$ , which of these molecules will be labeled?

- A) fatty acids only
- B) nucleic acids only
- C) proteins only
- D) both fatty acids and proteins
- E) both proteins and nucleic acids

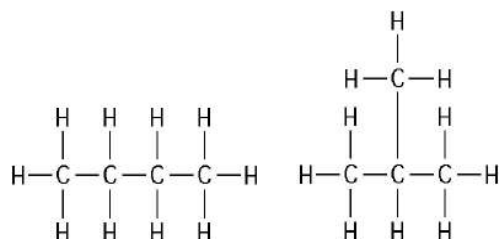
Answer: E

Topic: Concept 3.6

Skill: Application/Analysis

Learning Outcome: 3.5, 3.6

### 3.2 Art Questions



**Figure 3.1**

1) The two molecules shown in Figure 3.1 are best described as

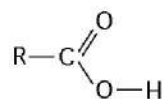
- A) optical isomers.
- B) enantiomers.
- C) structural isomers.
- D) *cis-trans* isomers.
- E) chain length isomers.

Answer: C

Topic: Concept 3.1

Skill: Knowledge/Comprehension

Learning Outcome: 3.1



**Figure 3.2**

2) What is the name of the functional group shown in Figure 3.2?

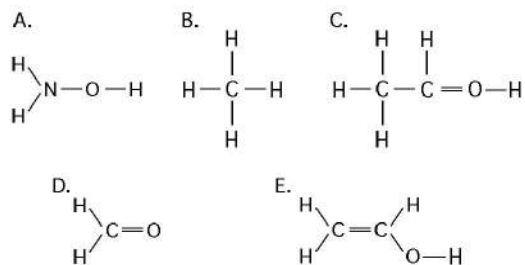
- A) carbonyl
- B) ketone
- C) aldehyde
- D) carboxyl
- E) hydroxyl

Answer: D

Topic: Concept 3.1

Skill: Knowledge/Comprehension

Learning Outcome: 3.1



**Figure 3.3**

3) Which of the structures illustrated in Figure 3.3 is an impossible covalently bonded molecule?

- A) A
- B) B
- C) C
- D) D
- E) E

Answer: C

Topic: Concept 3.1

Skill: Knowledge/Comprehension

Learning Outcome: 3.1

4) Which of the structures illustrated in Figure 3.3 contain(s) a carbonyl functional group?

- A) A
- B) C and D
- C) C
- D) D
- E) C and E

Answer: D

Topic: Concept 3.1

Skill: Knowledge/Comprehension

Learning Outcome: 3.1

5) In which of the structures illustrated in Figure 3.3 are the atoms bonded by ionic bonds?

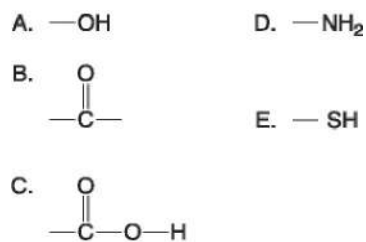
- A) A
- B) B
- C) C
- D) C, D, and E only
- E) none of the structures

Answer: E

Topic: Concept 3.1

Skill: Knowledge/Comprehension

Learning Outcome: 3.1



**Figure 3.4**

6) Which functional group shown in Figure 3.4 is characteristic of alcohols?

- A) A
- B) B
- C) C
- D) D
- E) E

Answer: A

Topic: Concept 3.1

Skill: Knowledge/Comprehension

Learning Outcome: 3.1

7) Which functional group(s) shown in Figure 3.4 is (are) present in all amino acids?

- A) A and B
- B) B and D
- C) C only
- D) D only
- E) C and D

Answer: E

Topic: Concept 3.1

Skill: Knowledge/Comprehension

Learning Outcome: 3.1

8) Which of the groups shown in Figure 3.4 is a carbonyl functional group?

- A) A
- B) B
- C) C
- D) D
- E) E

Answer: B

Topic: Concept 3.1

Skill: Knowledge/Comprehension

Learning Outcome: 3.1



9) Which of the groups shown in Figure 3.4 is a functional group that helps stabilize proteins by forming covalent cross-links within or between protein molecules?

- A) A
- B) B
- C) C
- D) D
- E) E

Answer: E

Topic: Concept 3.1

Skill: Knowledge/Comprehension

Learning Outcome: 3.1

10) Which of the groups in Figure 3.4 is a carboxyl functional group?

- A) A
- B) B
- C) C
- D) D
- E) E

Answer: C

Topic: Concept 3.1

Skill: Knowledge/Comprehension

Learning Outcome: 3.1

11) Which of the groups in Figure 3.4 is an acidic functional group that can dissociate and release  $H^+$  into a solution?

- A) A
- B) B
- C) C
- D) D
- E) E

Answer: C

Topic: Concept 3.1

Skill: Knowledge/Comprehension

Learning Outcome: 3.1

12) Which of the groups in Figure 3.4 is a basic functional group that can accept  $H^+$  and become positively charged?

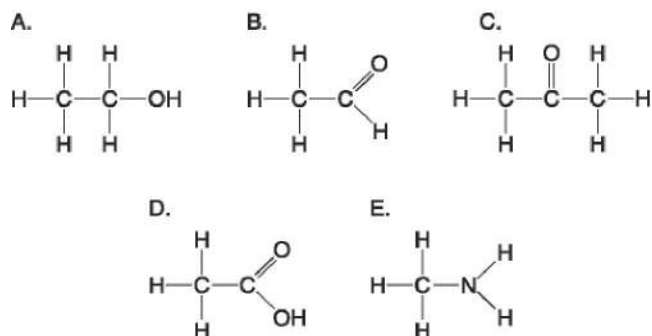
- A) A
- B) B
- C) C
- D) D
- E) E

Answer: D

Topic: Concept 3.1

Skill: Knowledge/Comprehension

Learning Outcome: 3.1



**Figure 3.5**

13) Which molecule shown in Figure 3.5 would have a positive charge in a cell?

- A) A
- B) B
- C) C
- D) D
- E) E

Answer: E

Topic: Concept 3.1

Skill: Knowledge/Comprehension

Learning Outcome: 3.1

14) Which molecule(s) shown in Figure 3.5 is (are) ionized in a cell?

- A) A
- B) B and D
- C) D and E
- D) D
- E) E

Answer: C

Topic: Concept 3.1

Skill: Application/Analysis

Learning Outcome: 3.1

15) Which molecules shown in Figure 3.5 contain a carbonyl group?

- A) A and B
- B) B and C
- C) B, C, and D
- D) D and E
- E) E and A

Answer: B

Topic: Concept 3.1

Skill: Knowledge/Comprehension

Learning Outcome: 3.1

16) Which molecule shown in Figure 3.5 contains a carboxyl group?

- A) A
- B) B
- C) C
- D) D
- E) E

Answer: D

Topic: Concept 3.1

Skill: Knowledge/Comprehension

Learning Outcome: 3.1

17) Which molecule shown in Figure 3.5 can increase the concentration of hydrogen ions in a solution and is therefore an organic acid?

- A) A
- B) B
- C) C
- D) D
- E) E

Answer: D

Topic: Concept 3.1

Skill: Knowledge/Comprehension

Learning Outcome: 3.1

18) Which molecule shown in Figure 3.5 has a carbonyl functional group in the form of a ketone?

- A) A
- B) B
- C) C
- D) D
- E) E

Answer: C

Topic: Concept 3.3

Skill: Knowledge/Comprehension

Learning Outcome: 3.1, 3.3

19) Which molecule shown in Figure 3.5 has a carbonyl functional group in the form of an aldehyde?

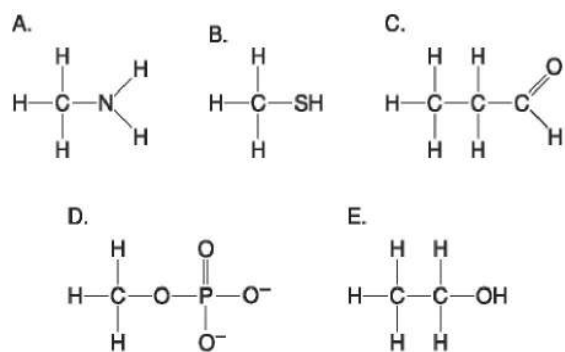
- A) A
- B) B
- C) C
- D) D
- E) E

Answer: B

Topic: Concept 3.3

Skill: Knowledge/Comprehension

Learning Outcome: 3.1, 3.3



**Figure 3.6**

20) Which molecule shown in Figure 3.6 is a thiol?

- A) A
- B) B
- C) C
- D) D
- E) E

Answer: B

Topic: Concept 3.1

Skill: Knowledge/Comprehension

Learning Outcome: 3.1

21) Which molecule shown in Figure 3.6 contains an amino functional group, but is not an amino acid?

- A) A
- B) B
- C) C
- D) D
- E) E

Answer: A

Topic: Concept 3.1

Skill: Knowledge/Comprehension

Learning Outcome: 3.1

22) Which molecule shown in Figure 3.6 contains a functional group that cells use to transfer energy between organic molecules?

- A) A
- B) B
- C) C
- D) D
- E) E

Answer: D

Topic: Concept 3.1

Skill: Application/Analysis

Learning Outcome: 3.1

23) Which molecule shown in Figure 3.6 can function as a base?

- A) A
- B) B
- C) C
- D) D
- E) E

Answer: A

Topic: Concept 3.1

Skill: Knowledge/Comprehension

Learning Outcome: 3.1

24) Which molecule shown in Figure 3.6 can form a cross linkage?

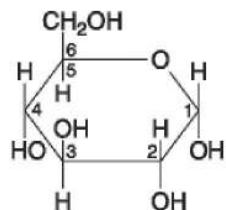
- A) A
- B) B
- C) C
- D) D
- E) E

Answer: B

Topic: Concept 3.5

Skill: Knowledge/Comprehension

Learning Outcome: 3.1, 3.5



**Figure 3.7**

25) If two molecules of the general type shown in Figure 3.7 were linked together, carbon-1 of one molecule to carbon-4 of the other, the single molecule that would result would be

- A) maltose.
- B) fructose.
- C) glucose.
- D) galactose.
- E) sucrose.

Answer: A

Topic: Concept 3.3

Skill: Knowledge/Comprehension

Learning Outcome: 3.3

26) Which of the following descriptors is true of the molecule shown in Figure 3.7?

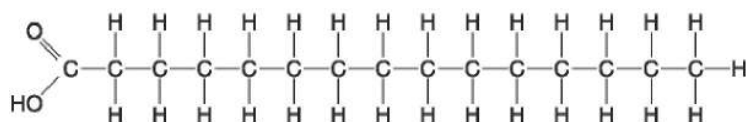
- A) hexose
- B) fructose
- C) glucose
- D) hexose and fructose only
- E) hexose and glucose only

Answer: E

Topic: Concept 3.3

Skill: Knowledge/Comprehension

Learning Outcome: 3.3



**Figure 3.8**

27) Which of the following statements is true regarding the molecule illustrated in Figure 3.8?

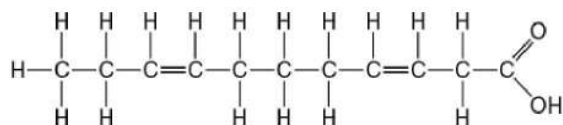
- A) It is a saturated fatty acid.
- B) A diet rich in this molecule may contribute to atherosclerosis.
- C) Molecules of this type are usually liquid at room temperature.
- D) It is a saturated fatty acid, and a diet rich in this molecule may contribute to atherosclerosis.
- E) It is a saturated fatty acid, a diet rich in this molecule may contribute to atherosclerosis, and molecules of this type are usually liquid at room temperature.

Answer: D

Topic: Concept 3.4

Skill: Knowledge/Comprehension

Learning Outcome: 3.4



**Figure 3.9**

28) Which of the following statements is true regarding the molecule illustrated in Figure 3.9?

- A) It is a saturated fatty acid.
- B) A diet rich in this molecule may contribute to atherosclerosis.
- C) Molecules of this type are usually liquid at room temperature.
- D) It is a saturated fatty acid, and a diet rich in this molecule may contribute to atherosclerosis.
- E) It is a saturated fatty acid, a diet rich in this molecule may contribute to atherosclerosis, and molecules of this type are usually liquid at room temperature.

Answer: C

Topic: Concept 3.4

Skill: Knowledge/Comprehension

Learning Outcome: 3.4

29) The molecule shown in Figure 3.9 is a(n)

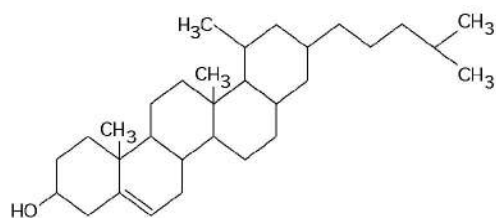
- A) polysaccharide.
- B) polypeptide.
- C) saturated fatty acid.
- D) triacylglycerol.
- E) unsaturated fatty acid.

Answer: E

Topic: Concept 3.4

Skill: Knowledge/Comprehension

Learning Outcome: 3.4



**Figure 3.10**

30) What is the structure shown in Figure 3.10?

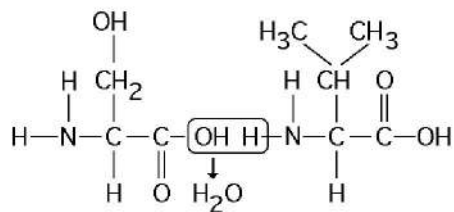
- A) pentose molecule
- B) fatty acid molecule
- C) steroid molecule
- D) oligosaccharide molecule
- E) phospholipid molecule

Answer: C

Topic: Concept 3.4

Skill: Knowledge/Comprehension

Learning Outcome: 3.4



**Figure 3.11**

31) Which of the following statements is true regarding the chemical reaction illustrated in Figure 3.11?

- A) It is a hydrolysis reaction.
- B) It results in a peptide bond.
- C) It joins two fatty acids together.
- D) It is a hydrolysis reaction and it results in a peptide bond.
- E) It is a hydrolysis reaction, it results in a peptide bond, and it joins two fatty acids together.

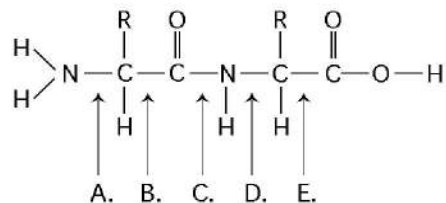
Answer: B

Topic: Concept 3.5

Skill: Application/Analysis

Learning Outcome: 3.5

Refer to Figure 3.12 to answer the following questions.



**Figure 3.12**

32) At which bond would water need to be added to achieve hydrolysis of the peptide, back to its component amino acids?

- A) A
- B) B
- C) C
- D) D
- E) E

Answer: C

Topic: Concept 3.5

Skill: Knowledge/Comprehension

Learning Outcome: 3.5



33) Which bond is a peptide bond?

- A) A
- B) B
- C) C
- D) D
- E) E

Answer: C

Topic: Concept 3.5

Skill: Knowledge/Comprehension

Learning Outcome: 3.5

34) Which bond is closest to the amino terminus of the molecule?

- A) A
- B) B
- C) C
- D) D
- E) E

Answer: A

Topic: Concept 3.5

Skill: Knowledge/Comprehension

Learning Outcome: 3.5

### 3.3 Scenario Questions

1) A chemist wishes to make an organic molecule less acidic. Which of the following functional groups should be added to the molecule in order to do so?

- A) carboxyl
- B) sulfhydryl
- C) hydroxyl
- D) amino
- E) phosphate

Answer: D

Topic: Concept 3.1

Skill: Application/Analysis

Learning Outcome: 3.1

2) Use the following information to answer the question below.

Approximately 32 different monomeric carbohydrate subunits are found in various natural polysaccharides. Proteins are composed of 20 different amino acids. DNA and RNA are each synthesized from four nucleotides.

Which class of biological polymer has the greatest functional variety?

- A) polysaccharides
- B) proteins
- C) DNA
- D) RNA

Answer: B

Topic: Concept 3.5

Skill: Synthesis/Evaluation

Learning Outcome: 3.5

3) A new organism is discovered in the forests of Costa Rica. Scientists there determine that the polypeptide sequence of hemoglobin from the new organism has 72 amino acid differences from humans, 65 differences from a gibbon, 49 differences from a rat, and 5 differences from a frog.

These data suggest that the new organism is more closely related to

- A) humans than to frogs.
- B) frogs than to humans.
- C) rats than to frogs.
- D) humans than to rats.
- E) gibbons than to rats.

Answer: B

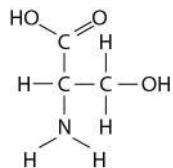
Topic: Concept 3.5

Skill: Application/Analysis

Learning Outcome: 3.5

### 3.4 End-of-Chapter Questions

1) Which functional group is *not* present in this molecule?



- A) carboxyl
- B) sulfhydryl
- C) hydroxyl
- D) amino

Answer: B

Topic: End-of-Chapter Questions

Skill: Knowledge/Comprehension

Learning Outcome: No L.O. Specified

2) Which chemical group is most likely to be responsible for an organic molecule behaving as a base (see Concept 2.5)?

- A) hydroxyl
- B) carbonyl
- C) carboxyl
- D) amino
- E) phosphate

Answer: D

Topic: End-of-Chapter Questions

Skill: Knowledge/Comprehension

Learning Outcome: No L.O. Specified

3) Which of the following categories includes all others in the list?

- A) monosaccharide
- B) disaccharide
- C) starch
- D) carbohydrate
- E) polysaccharide

Answer: D

Topic: End-of-Chapter Questions

Skill: Knowledge/Comprehension

Learning Outcome: No L.O. Specified

4) Which of the following statements concerning *unsaturated* fats is true?

- A) They are more common in animals than in plants.
- B) They have double bonds in the carbon chains of their fatty acids.
- C) They generally solidify at room temperature.
- D) They contain more hydrogen than do saturated fats having the same number of carbon atoms.
- E) They have fewer fatty acid molecules per fat molecule.

Answer: B

Topic: End-of-Chapter Questions

Skill: Knowledge/Comprehension

Learning Outcome: No L.O. Specified

5) The structural level of a protein *least* affected by a disruption in hydrogen bonding is the

- A) primary level.
- B) secondary level.
- C) tertiary level.
- D) quaternary level.
- E) All structural levels are equally affected.

Answer: A

Topic: End-of-Chapter Questions

Skill: Knowledge/Comprehension

Learning Outcome: No L.O. Specified

6) Which of the following hydrocarbons has a double bond in its carbon skeleton?

- A)  $C_3H_8$
- B)  $C_2H_6$
- C)  $CH_4$
- D)  $C_2H_4$
- E)  $C_2H_2$

Answer: D

Topic: End-of-Chapter Questions

Skill: Application/Analysis

Learning Outcome: No L.O. Specified

7) The molecular formula for glucose is  $C_6H_{12}O_6$ . What would be the molecular formula for a polymer made by linking ten glucose molecules together by dehydration reactions?

- A)  $C_{60}H_{120}O_{60}$
- B)  $C_6H_{12}O_6$
- C)  $C_{60}H_{102}O_{51}$
- D)  $C_{60}H_{100}O_{50}$
- E)  $C_{60}H_{111}O_{51}$

Answer: C

Topic: End-of-Chapter Questions

Skill: Application/Analysis

Learning Outcome: No L.O. Specified