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Campbell Biology in Focus, 2e (Urry)

Chapter 3 Carbon and the Molecular Diversity of Life

Multiple-Choice Questions

1) When carbon forms single covalent bonds with four other atoms, the atoms joined to the carbon form a

- A) sphere.
- B) cube.
- C) tetrahedron.
- D) line.
- E) plane.

Answer: C

Topic: Concept 3.1

Skill: Knowledge/Comprehension

Learning Outcome: 3.1

2) When two carbon atoms are joined by a double bond, the atoms joined to the carbons form a

- A) sphere.
- B) cube.
- C) tetrahedron.
- D) line.
- E) plane.

Answer: E

Topic: Concept 3.1

Skill: Knowledge/Comprehension

Learning Outcome: 3.1

3) 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

4) When two carbon atoms are joined by a double bond, how many electron pairs are shared between the two carbons?

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

Answer: B

Topic: Concept 3.1

Skill: Knowledge/Comprehension

Learning Outcome: 3.1

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

- A) ionic bonds
- B) hydrogen bonds
- C) covalent bonds
- D) covalent bonds and hydrogen bonds

Answer: C

Topic: Concept 3.1

Skill: Knowledge/Comprehension

Learning Outcome: 3.1

6) 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 arrangement of atoms around their double bonds.

Answer: B

Topic: Concept 3.1

Skill: Knowledge/Comprehension

Learning Outcome: 3.1

7) Which of the following will result in changing the orientation of bonds between carbon and other atoms from a tetrahedral configuration to a planar configuration?

- A) the presence of single covalent bonds with oxygen atoms
- B) the presence of single covalent bonds with nitrogen atoms
- C) the presence of double covalent bonds between the carbon atom and other atoms
- D) the presence of polar covalent bonds between carbon and other atoms

Answer: C

Topic: Concept 3.1

Skill: Application/Analysis

Learning Outcome: 3.1

Global L.O.: G2

8) The primary functional groups in a common macromolecule are hydroxyl groups. Which of the following statements regarding this macromolecule is true?

- A) It lacks an asymmetric carbon, and it is probably a fat or lipid.
- B) It will not dissolve in water.
- C) It will dissolve in a nonpolar solvent.
- D) It will form hydrogen bonds with water.

Answer: D

Topic: Concept 3.1

Skill: Application/Analysis

Learning Outcome: 3.1

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

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

Answer: D

Topic: Concept 3.1

Skill: Knowledge/Comprehension

Learning Outcome: 3.1

10) Which of the following will dissolve in water?

- A) organic hydrocarbons
- B) organic molecules with hydroxyl groups
- C) carbon skeletons bound to hydrogen
- D) fats

Answer: B

Topic: Concept 3.1

Skill: Knowledge/Comprehension

Learning Outcome: 3.1

11) Which of the following functional groups is hydrophobic?

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

Answer: B

Topic: Concept 3.1

Skill: Knowledge/Comprehension

Learning Outcome: 3.1

12) 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

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

- A) will function only as an acid because of the carboxyl group.
- B) will function only as a base because of the amino group.
- C) will function as both an acid and a base.
- D) will function as neither an acid nor a base.

Answer: C

Topic: Concept 3.1

Skill: Application/Analysis

Learning Outcome: 3.1

Global L.O.: G2

14) Which functional group can act as a base?

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

Answer: A

Topic: Concept 3.1

Skill: Knowledge/Comprehension

Learning Outcome: 3.1

15) Which of the following functional groups may be used to form polymers via dehydration reactions?

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

Answer: D

Topic: Concepts 3.1, 3.2

Skill: Application/Analysis

Learning Outcome: 3.1, 3.2

16) Which of the following is a correct monomer/polymer pairing?

- A) monosaccharide/polypeptide
- B) amino acid/polysaccharide
- C) amino acid/polypeptide
- D) glycerol/triglyceride

Answer: C

Topic: Concepts 3.2, 3.3, 3.4, 3.5, 3.6

Skill: Knowledge/Comprehension

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

17) Which of the following chemical equations describes a hydrolysis reaction?

- A) monosaccharide + monosaccharide disaccharide + H₂O
- B) monosaccharide + monosaccharide + H₂O disaccharide
- C) disaccharide monosaccharide + monosaccharide + H₂O
- D) disaccharide + H₂O monosaccharide + monosaccharide

Answer: D

Topic: Concept 3.2

Skill: Application/Analysis

Learning Outcome: 3.2

Global L.O.: G2

18) Which of the following chemical equations describes a dehydration reaction?

- A) monosaccharide + monosaccharide disaccharide + H₂O
- B) monosaccharide + monosaccharide + H₂O disaccharide
- C) disaccharide monosaccharide + monosaccharide + H₂O
- D) disaccharide + H₂O monosaccharide + monosaccharide

Answer: A

Topic: Concept 3.2

Skill: Application/Analysis

Learning Outcome: 3.2

Global L.O.: G2

19) Which of the following is a monomer used to build a biological polymer?

- A) amino acid
- B) disaccharide
- C) triglyceride
- D) DNA

Answer: A

Topic: Concepts 3.2, 3.3, 3.6

Skill: Knowledge/Comprehension

Learning Outcome: 3.2, 3.3, 3.6

20) What is a common chemical reaction mechanism by which cells make polymers from monomers?

- A) decreasing the pH
- B) hydrolysis reactions
- C) dehydration reactions
- D) the formation of disulfide bridges between monomers

Answer: C

Topic: Concept 3.2

Skill: Knowledge/Comprehension

Learning Outcome: 3.2

21) How many molecules of water are needed to completely hydrolyze a polysaccharide that is 10 monomers long?

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

Answer: D

Topic: Concept 3.2

Skill: Application/Analysis

Learning Outcome: 3.2

Global L.O.: G2

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

- A) Dehydration reactions split water molecules and add hydroxyl groups to polymers, and hydrolysis reactions remove hydroxyl groups from polymers.
- B) Dehydration reactions assemble polymers, and hydrolysis reactions break down polymers.
- C) Dehydration reactions create monomers, and hydrolysis reactions assemble polymers.
- D) Dehydration reactions break down polymers, and hydrolysis reactions create monomers.

Answer: B

Topic: Concept 3.2

Skill: Application/Analysis

Learning Outcome: 3.2

23) Which of the following is an example of a hydrolysis reaction?

- A) the reaction of two monosaccharides, forming a disaccharide with the release of water
- B) the synthesis of two amino acids, forming a peptide bond with the release of water
- C) the reaction of a fat with glycerol, forming fatty acids with the release of water
- D) the reaction of a fat, forming glycerol and fatty acids with the consumption of water

Answer: D

Topic: Concepts 3.2, 3.3, 3.4, 3.5, 3.6

Skill: Application/Analysis

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

Global L.O.: G2

24) Which of the following is an example of a dehydration reaction?

- A) the reaction of two monosaccharides, forming a disaccharide with the release of water
- B) the reaction of two amino acids, forming a peptide bond with the consumption of water
- C) the reaction of a fat with glycerol, forming fatty acids with the release of water
- D) the reaction of a fat, forming glycerol and fatty acids with the release of water

Answer: A

Topic: Concepts 3.2, 3.3, 3.4, 3.5, 3.6

Skill: Application/Analysis

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

Global L.O.: G2

25) 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) $C_{18}H_{30}O_{15}$
- E) $C_{16}H_{36}O_{16}$

Answer: B

Topic: Concept 3.2

Skill: Application/Analysis

Learning Outcome: 3.2

Global L.O.: G4

26) 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

27) The biochemical reaction that joins two amino acids to form a dipeptide is accompanied by

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

Answer: D

Topic: Concept 3.2

Skill: Application/Analysis

Learning Outcome: 3.2

28) Humans can digest starch but not cellulose because

A) the monomer of starch is glucose, whereas the monomer of cellulose is glucose modified by the addition of a nitrogen-containing group.

B) humans have enzymes that can hydrolyze the β glycosidic linkages of starch but not the α glycosidic linkages of cellulose.

C) humans have enzymes that can hydrolyze the α glycosidic linkages of starch but not the β glycosidic linkages of cellulose.

D) humans harbor starch-digesting bacteria in the digestive tract, but not cellulose-digesting bacteria.

Answer: C

Topic: Concept 3.2

Skill: Knowledge/Comprehension

Learning Outcome: 3.2

29) Polysaccharides, triacylglycerols, and proteins are similar in that they

A) are synthesized from monomers by hydrolysis reactions.

B) are synthesized from subunits by dehydration reactions.

C) are synthesized through the formation of peptide bonds between monomers.

D) are broken down into their subunits by dehydration reactions.

Answer: B

Topic: Concept 3.2

Skill: Application/Analysis

Learning Outcome: 3.2

30) Which of the following compounds are formed by dehydration reactions?

A) triacylglycerols

B) monosaccharides

C) amino acids

D) fatty acids

Answer: A

Topic: Concept 3.2

Skill: Knowledge/Comprehension

Learning Outcome: 3.2

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

A) The two strands of the double helix would separate.

B) The phosphodiester bonds between deoxyribose sugars would be broken.

C) The bases would be separated from the deoxyribose sugars.

D) Oxygen atoms would be removed from the deoxyribose sugars.

Answer: B

Topic: Concepts 3.2, 3.6

Skill: Knowledge/Comprehension

Learning Outcome: 3.2, 3.6

- 32) Which of the following is true of cellulose?
- A) It is a polymer composed of enantiomers of glucose.
 - B) It is a primary structural component of plant cell walls.
 - C) It is digestible by bacteria in the human gut.
 - D) It is a storage polysaccharide for energy in plant cells.
 - E) It is a polymer of glucose joined by α glycosidic linkages.

Answer: B

Topic: Concepts 3.2, 3.3

Skill: Knowledge/Comprehension

Learning Outcome: 3.2, 3.3

- 33) Which of the following polymers contains nitrogen?

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

Answer: D

Topic: Concept 3.3

Skill: Knowledge/Comprehension

Learning Outcome: 3.3

- 34) Which of the following polymers lacks nitrogen?

- A) protein
- B) RNA
- C) glycogen
- D) chitin

Answer: C

Topic: Concept 3.3

Skill: Knowledge/Comprehension

Learning Outcome: 3.3

- 35) 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

Answer: B

Topic: Concept 3.3

Skill: Knowledge/Comprehension

Learning Outcome: 3.3

36) The enzyme amylase can break glycosidic linkages between glucose monomers only if the monomers are the α form. Which of the following could amylase break down?

- A) starch
- B) cellulose
- C) chitin
- D) starch and chitin

Answer: A

Topic: Concept 3.3

Skill: Knowledge/Comprehension

Learning Outcome: 3.3

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

- A) cellulose
- B) polypeptides
- C) starch
- D) glycogen

Answer: A

Topic: Concept 3.3

Skill: Knowledge/Comprehension

Learning Outcome: 3.3

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

- A) hydrocarbon.
- B) lipid.
- C) monosaccharide
- D) glycerol.

Answer: C

Topic: Concept 3.3

Skill: Knowledge/Comprehension

Learning Outcome: 3.3

39) 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

40) Which of the following is the smallest carbohydrate?

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

Answer: A

Topic: Concept 3.3

Skill: Knowledge/Comprehension

Learning Outcome: 3.3

41) Testosterone and estradiol are male and female sex hormones, respectively, in many vertebrates. How 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 are enantiomers of the same organic molecule.

Answer: C

Topic: Concept 3.3

Skill: Knowledge/Comprehension

Learning Outcome: 3.3

42) 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.

Answer: B

Topic: Concepts 3.1, 3.4

Skill: Knowledge/Comprehension

Learning Outcome: 3.1, 3.4

43) Which of the following statements concerning saturated fats is true?

- A) They are more common in plants than in animals.
- B) They have multiple double bonds in the carbon chains of their fatty acids.
- C) They are generally solid at room temperature.
- D) They contain fewer hydrogen atoms than unsaturated fats having the same number of carbon atoms.

Answer: C

Topic: Concept 3.4

Skill: Knowledge/Comprehension

Learning Outcome: 3.4

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

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

Answer: A

Topic: Concept 3.4

Skill: Application/Analysis

Learning Outcome: 3.4

45) Which of the following statements regarding lipids is true?

- A) They generally contain nitrogen.
- B) They are made from glycerol and amino acids.
- C) A gram of lipid stores less energy than a gram of carbohydrate.
- D) They are insoluble in water.

Answer: D

Topic: Concept 3.4

Skill: Knowledge/Comprehension

Learning Outcome: 3.4

46) Hydrogenated vegetable oil is the primary ingredient in margarine. How does hydrogenated vegetable oil differ from nonhydrogenated vegetable oil?

- A) Hydrogenated vegetable oil has a lower melting point than nonhydrogenated vegetable oil.
- B) Hydrogenated vegetable oil is solid at room temperature, whereas nonhydrogenated vegetable oil is liquid.
- C) Hydrogenated vegetable oil has more kinks in its fatty acid chains than does nonhydrogenated vegetable oil.
- D) Hydrogenated vegetable oil contains more *cis* fatty acids than nonhydrogenated vegetable oil.

Answer: B

Topic: Concept 3.4

Skill: Application/Analysis

Learning Outcome: 3.4

Global L.O.: G2

47) Which of the following statements regarding saturated fatty acids is true?

- 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

48) Large organic molecules are generally synthesized by polymerization of a few types of simple subunits. Which of the following is an exception to this statement?

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

Answer: A

Topic: Concepts 3.2, 3.3, 3.4, 3.5, 3.6

Skill: Knowledge/Comprehension

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

49) Which of the following large biological molecules will self-assemble into a bilayer when mixed with water?

- A) proteins
- B) triacylglycerols
- C) cellulose
- D) phospholipids

Answer: D

Topic: Concepts 3.3, 3.4, 3.5, 3.6

Skill: Application/Analysis

Learning Outcome: 3.3, 3.4, 3.5, 3.6

50) Why are the vertebrate sex hormones estradiol and testosterone considered to be lipids?

- A) They are essential components of cell membranes.
- B) Their carbon skeletons are composed of primarily C–C and C–H bonds.
- C) They are made of fatty acids.
- D) They are hydrophilic compounds.

Answer: B

Topic: Concept 3.4

Skill: Knowledge/Comprehension

Learning Outcome: 3.4

51) Which of the following molecules lacks amino acids?

- A) hemoglobin
- B) insulin
- C) antibodies
- D) spider silk
- E) cholesterol

Answer: E

Topic: Concepts 3.4, 3.5

Skill: Knowledge/Comprehension

Learning Outcome: 3.4, 3.5

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

- A) different side chains (R groups) attached to the carboxyl carbon
- B) different side chains (R groups) attached to the amino groups
- C) different side chains (R groups) attached to an α carbon
- D) different asymmetric carbons

Answer: C

Topic: Concept 3.5

Skill: Knowledge/Comprehension

Learning Outcome: 3.5

53) How many peptide bonds are present in a polypeptide that contains 45 amino acids?

- A) 90
- B) 46
- C) 45
- D) 44

Answer: D

Topic: Concept 3.5

Skill: Knowledge/Comprehension

Learning Outcome: 3.5

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

- A) disulfide bonds
- B) hydrogen bonds
- C) peptide bonds
- D) phosphodiester bonds

Answer: C

Topic: Concept 3.5

Skill: Knowledge/Comprehension

Learning Outcome: 3.5

55) Which bonds maintain the primary structure of a protein?

- A) disulfide bonds
- B) hydrogen bonds
- C) ionic bonds
- D) peptide bonds

Answer: D

Topic: Concept 3.5

Skill: Knowledge/Comprehension

Learning Outcome: 3.5

56) What maintains the secondary structure of a protein?

- A) peptide bonds between adjacent amino acids
- B) hydrogen bonds between the amino group of one peptide bond and the carboxyl group of another peptide bond
- C) disulfide bonds between the amino group of one peptide bond and the R group of another amino acid
- D) hydrogen bonds between the carboxyl group of one peptide bond and the R group of another amino acid

Answer: B

Topic: Concept 3.5

Skill: Knowledge/Comprehension

Learning Outcome: 3.5

57) Which type of interaction stabilizes the α helix and the β pleated sheet structures of proteins?

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

Answer: C

Topic: Concept 3.5

Skill: Knowledge/Comprehension

Learning Outcome: 3.5

58) The α helix and β pleated sheet are examples of which level of protein structure?

- 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

59) Lactase is an enzyme composed of a single polypeptide that hydrolyzes the disaccharide lactose to produce monosaccharides. The optimal pH for lactase activity is 6. Transfer of lactase to pH 5 results in a substantial decrease in enzyme activity, likely due to the disruption of

- A) only the primary structure of the enzyme.
- B) the primary and secondary structure of the enzyme.
- C) the secondary and tertiary structure of the enzyme.
- D) the secondary, tertiary, and quaternary structure of the enzyme.

Answer: C

Topic: Concept 3.5

Skill: Application/Analysis

Learning Outcome: 3.5

60) Collagen is a protein made of three identical polypeptides composed primarily of α helix structure. The α helix is an example of

- A) secondary structure stabilized by covalent bonds.
- B) secondary structure stabilized by hydrogen bonds.
- C) secondary structure stabilized by ionic bonds.
- D) tertiary structure stabilized by covalent bonds.
- E) tertiary structure stabilized by hydrogen bonds.

Answer: B

Topic: Concept 3.5

Skill: Knowledge/Comprehension

Learning Outcome: 3.5

61) The tertiary structure of a polypeptide is the

- A) linear sequence of amino acids in a polypeptide.
- B) localized region of a polypeptide chain that forms an α helix or β pleated sheet.
- C) overall three-dimensional shape of a fully folded polypeptide.
- D) overall three-dimensional shape of a protein composed of more than one polypeptide.

Answer: C

Topic: Concept 3.5

Skill: Knowledge/Comprehension

Learning Outcome: 3.5

62) A disulfide bridge is an example of which type of bond?

- A) ionic bond between R groups
- B) hydrophobic interaction between R groups
- C) hydrogen bond between R groups
- D) covalent bond between R groups

Answer: D

Topic: Concept 3.5

Skill: Knowledge/Comprehension

Learning Outcome: 3.5

63) Interactions between the side chains (R groups) in a polypeptide are most important in stabilizing which of the following?

- A) primary structure
- B) secondary structure
- C) tertiary structure
- D) quaternary structure

Answer: C

Topic: Concept 3.5

Skill: Knowledge/Comprehension

Learning Outcome: 3.5

64) The side chain (R group) of the amino acid serine is $-\text{CH}_2\text{OH}$. The 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 on the exterior, and leucine would be in the interior of the globular protein.
- B) Serine would be in the interior, and leucine 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.

Answer: A

Topic: Concept 3.5

Skill: Application/Analysis

Learning Outcome: 3.5

Global L.O.: G2

65) Changing a single amino acid in a protein consisting of 433 amino acids would

- A) always alter the primary structure of the protein but never alter its tertiary structure or function.
- B) always alter the primary structure of the protein and sometimes alter its tertiary structure or function.
- C) always alter the primary and tertiary structure of the protein but never alter its function.
- D) sometimes alter the primary and tertiary structure of the protein but always alter its function.

Answer: B

Topic: Concept 3.5

Skill: Application/Analysis

Learning Outcome: 3.5

Global L.O.: G2

66) Normal hemoglobin is a tetramer, consisting of two molecules of β -globin and two molecules of α -globin. 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

Global L.O.: G2

67) In a normal cellular protein, where would you expect to find a hydrophilic amino acid such as asparagine?

- 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) on the exterior surface of the protein, interacting with water, or in a transmembrane portion interacting with lipid fatty acid chains

Answer: B

Topic: Concept 3.5

Skill: Application/Analysis

Learning Outcome: 3.5

Global L.O.: G2

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

- A) phospholipids
- B) nucleic acids
- C) proteins
- D) starch

Answer: C

Topic: Concept 3.5

Skill: Application/Analysis

Learning Outcome: 3.5

69) If cells are grown in a medium containing radioactive ^{32}P , which of these molecules will be radioactively labeled?

- A) triacylglycerols
- B) nucleic acids
- C) fatty acids
- D) starch

Answer: B

Topic: Concept 3.5

Skill: Application/Analysis

Learning Outcome: 3.5

70) How will brief heating (to 95°C) affect macromolecular structures in aqueous solution?

- A) Unsaturated fatty acid tails will become saturated.
- B) Proteins will unfold (denature).
- C) Starch will hydrolyze into monomeric sugars.
- D) Proteins will hydrolyze into amino acids.

Answer: B

Topic: Concepts 3.5, 3.6

Skill: Application/Analysis

Learning Outcome: 3.5, 3.6

71) 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 nitrogenous base attached to the number 5 carbon of ribose.

Answer: B

Topic: Concept 3.6

Skill: Knowledge/Comprehension

Learning Outcome: 3.6

72) 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.

Answer: B

Topic: Concept 3.6

Skill: Knowledge/Comprehension

Learning Outcome: 3.6

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

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

Answer: D

Topic: Concept 3.6

Skill: Application/Analysis

Learning Outcome: 3.6

Global L.O.: G2

74) A nucleotide is composed of

- 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 nitrogenous base, a phosphate group, a pentose sugar, and an amino acid.

Answer: C

Topic: Concept 3.6

Skill: Knowledge/Comprehension

Learning Outcome: 3.6

75) Which of the following are pyrimidines?

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

Answer: B

Topic: Concept 3.6

Skill: Knowledge/Comprehension

Learning Outcome: 3.6

76) Which of the following are purines?

- 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

77) If a DNA sample were composed of 15% adenine, what would be the percentage of thymine?

- A) 15
- B) 30
- C) 35
- D) 50

Answer: A

Topic: Concept 3.6

Skill: Knowledge/Comprehension

Learning Outcome: 3.6

78) If a DNA sample were composed of 15% adenine, what would be the percentage of guanine?

- A) 15
- B) 30
- C) 35
- D) 50

Answer: C

Topic: Concept 3.6

Skill: Application/Analysis

Learning Outcome: 3.6

Global L.O.: G2

79) 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 adenine and 120 guanine molecules.
- C) 120 cytosine and 120 thymine molecules.
- D) 120 thymine and 120 adenine molecules.

Answer: D

Topic: Concept 3.6

Skill: Application/Analysis

Learning Outcome: 3.6

Global L.O.: G2

80) 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) is a five-carbon sugar and the sugar in RNA is a six-carbon sugar.
- C) is in the α configuration and the sugar in RNA is in the β configuration.
- D) contains one less oxygen atom than the sugar in RNA.

Answer: D

Topic: Concept 3.6

Skill: Knowledge/Comprehension

Learning Outcome: 3.6

81) The sequence 5'-GAACUT-3' may be found in which of the following?

- A) DNA only
- B) RNA only
- C) either DNA or RNA
- D) neither DNA nor RNA

Answer: D

Topic: Concept 3.6

Skill: Knowledge/Comprehension

Learning Outcome: 3.6

82) The sequence 5'- GAACGA'3' may be found in which of the following?

- A) DNA only
- B) RNA only
- C) either DNA or RNA
- D) neither DNA nor RNA

Answer: C

Topic: Concept 3.6

Skill: Knowledge/Comprehension

Learning Outcome: 3.6

83) If one strand of a DNA molecule has the sequence of bases 5'-ATTGCA-3', the other complementary strand would have the sequence

- A) 5-'TAACGT-3'.
- B) 5'-TGCAAT-3'.
- C) 5'-UAACGU-3'.
- D) 3'-UAACGU-5'.

Answer: B

Topic: Concept 3.6

Skill: Application/Analysis

Learning Outcome: 3.6

84) If cells are grown in a medium containing radioactive ^{15}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: Concepts 3.5, 3.6

Skill: Application/Analysis

Learning Outcome: 3.5, 3.6

Global L.O.: G2

Art Questions

1)

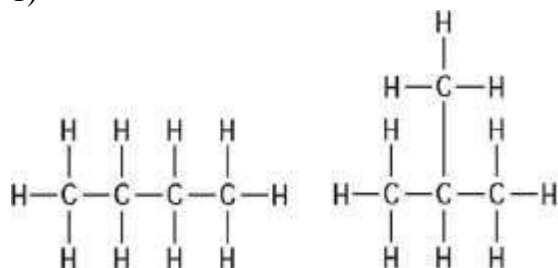


Figure 3.1

The two molecules shown in Figure 3.1 are best described as

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

Answer: C

Topic: Concept 3.1

Skill: Knowledge/Comprehension

Learning Outcome: 3.1

2)

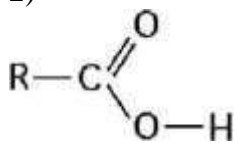


Figure 3.2

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

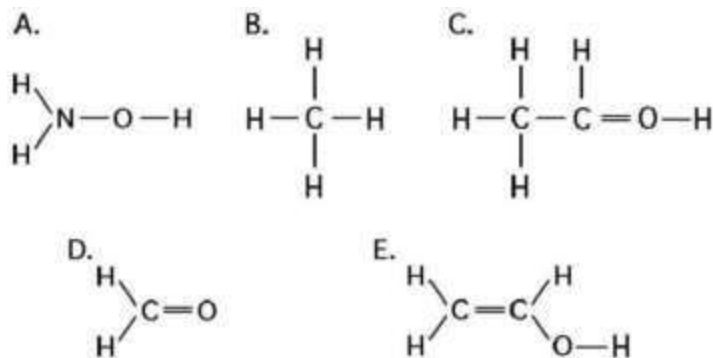


Figure 3.3

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: Application/Analysis

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 structure(s) illustrated in Figure 3.3 are all bonds with hydrogen polar covalent bonds?

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

Answer: A

Topic: Concept 3.1

Skill: Application/Analysis

Learning Outcome: 3.1

6) Which of the structures illustrated in Figure 3.3 contain only nonpolar single covalent bonds?

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

Answer: B

Topic: Concept 3.1

Skill: Application/Analysis

Learning Outcome: 3.1

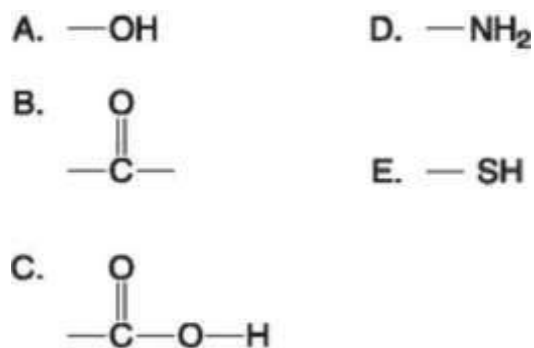


Figure 3.4

7) 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

8) Which two functional groups shown in Figure 3.4 are present in all amino acids?

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

Answer: D

Topic: Concept 3.1

Skill: Knowledge/Comprehension

Learning Outcome: 3.1

9) During the synthesis of a polypeptide the next amino acid in the growing polymer is added to which functional group shown in Figure 3.4?

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

Answer: C

Topic: Concept 3.1

Skill: Application/Analysis

Learning Outcome: 3.1

10) 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

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

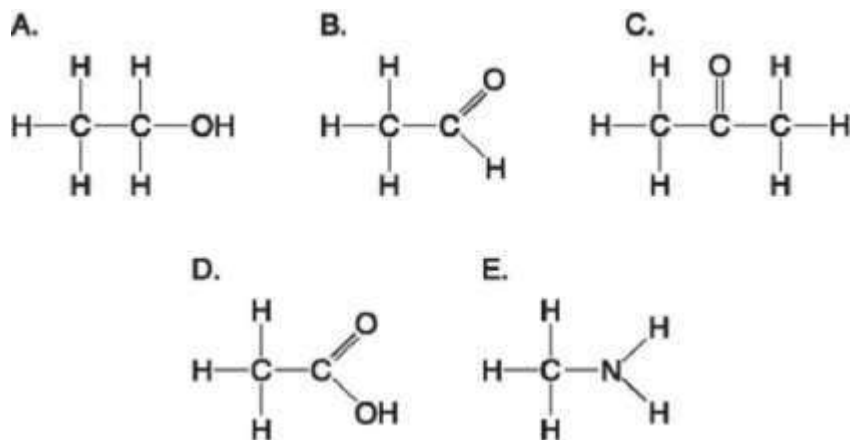


Figure 3.5

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

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: Concepts 3.1, 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: Concepts 3.1, 3.3

Skill: Knowledge/Comprehension

Learning Outcome: 3.1, 3.3

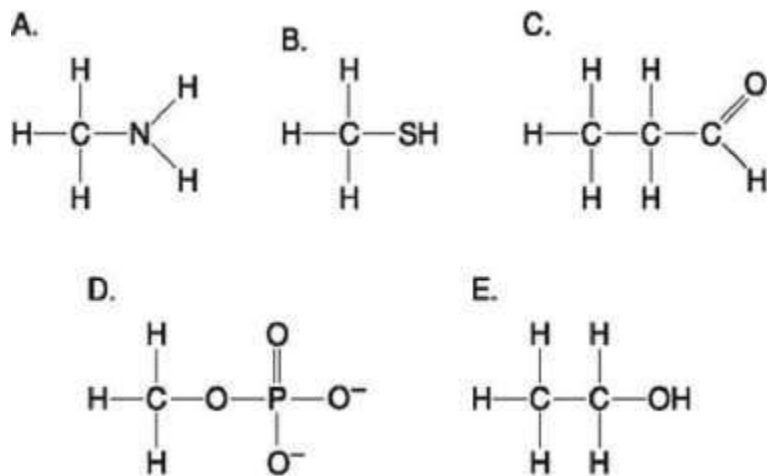


Figure 3.6

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 covalent bond between side chains (R groups) in a polypeptide?

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

Answer: B

Topic: Concepts 3.1, 3.5

Skill: Knowledge/Comprehension

Learning Outcome: 3.1, 3.5

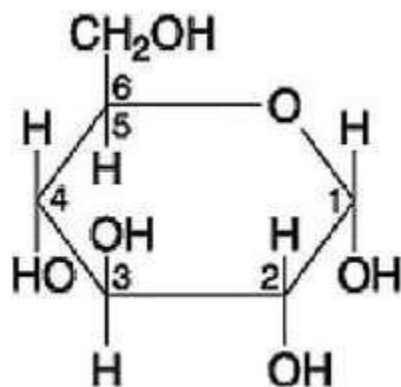


Figure 3.7

25) If two of the molecules shown in Figure 3.7 were linked together, carbon-1 of one molecule to carbon-4 of the other, the bond that is formed may be found in which of the following polymers?

- A) cellulose
- B) glycogen
- C) chitin
- D) polypeptide
- E) nucleic acid

Answer: B

Topic: Concept 3.3

Skill: Knowledge/Comprehension

Learning Outcome: 3.3

26) Which of the following describes the molecule shown in Figure 3.7?

- A) pentose
- B) fructose
- C) α glucose
- D) β glucose
- E) ribose

Answer: C

Topic: Concept 3.3

Skill: Knowledge/Comprehension

Learning Outcome: 3.3

27)

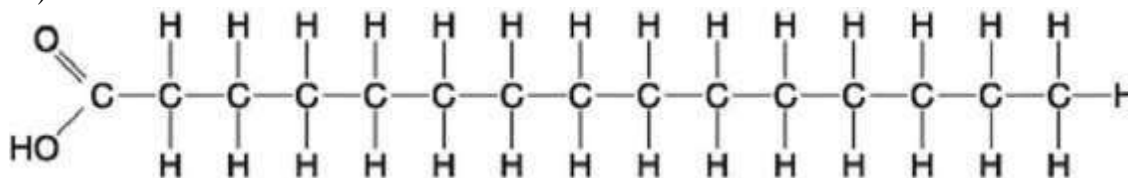


Figure 3.8

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

- A) It is a saturated fatty acid.
- B) It is an entirely nonpolar molecule.
- C) Molecules of this type are usually liquid at room temperature.
- D) It would be highly soluble in water.

Answer: A

Topic: Concept 3.4

Skill: Knowledge/Comprehension

Learning Outcome: 3.4

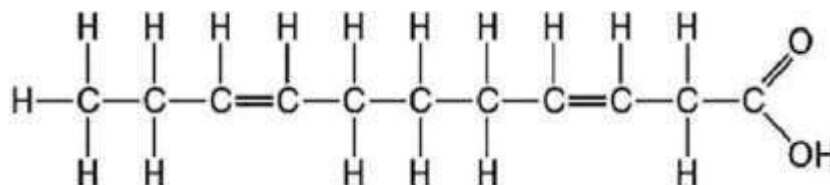


Figure 3.9

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

- A) It is a saturated fatty acid.
- B) It is an entirely nonpolar molecule.
- C) Molecules of this type are usually liquid at room temperature.
- D) It is highly soluble in water.

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) saturated fatty acid.
- C) triacylglycerol.
- D) unsaturated fatty acid.

Answer: D

Topic: Concept 3.4

Skill: Knowledge/Comprehension

Learning Outcome: 3.4

30)

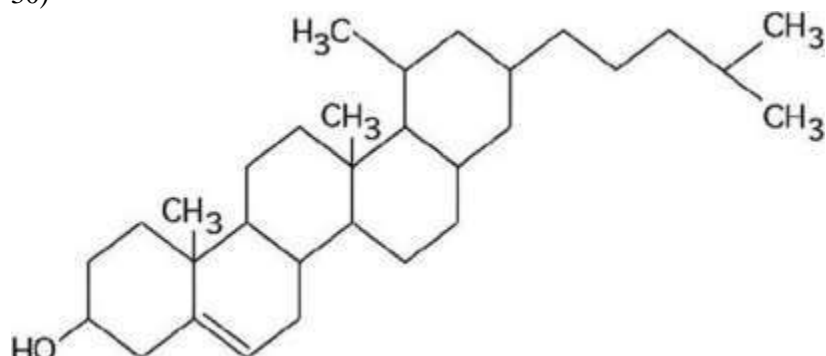


Figure 3.10

What is the structure shown in Figure 3.10?

- A) fatty acid molecule
- B) steroid molecule
- C) triacylglycerol molecule
- D) phospholipid molecule

Answer: B

Topic: Concept 3.4

Skill: Knowledge/Comprehension

Learning Outcome: 3.4

31)

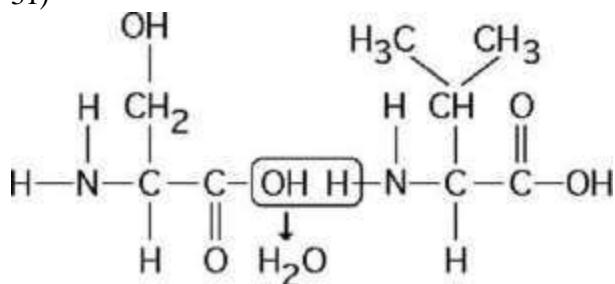


Figure 3.11

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

- A) It is a hydrolysis reaction.
- B) It results in a peptide bond.
- C) It forms a disaccharide.
- D) It forms two amino acids.

Answer: B

Topic: Concept 3.5

Skill: Application/Analysis

Learning Outcome: 3.5

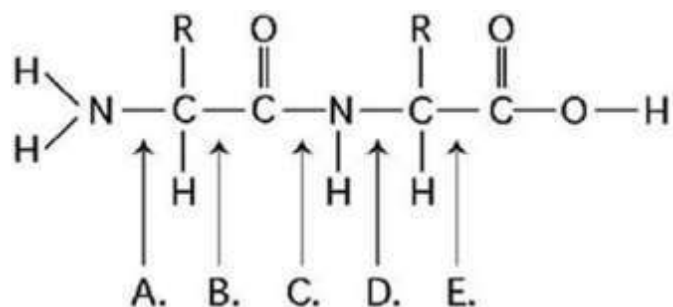


Figure 3.12

32) At which bond in Figure 3.12 would water need to be added to achieve hydrolysis of the dipeptide, 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 in Figure 3.12 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 in Figure 3.12 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

35) Which bond in Figure 3.12 is farthest from an carbon?

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

Answer: C

Topic: Concept 3.5

Skill: Knowledge/Comprehension

Learning Outcome: 3.5

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

Global L.O.: G2

2) 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: Evaluation/Synthesis

Learning Outcome: 3.5

Global L.O.: G2

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

Global L.O.: G2

4) A nutritional supplement developed for athletes is shown to contain only carbon, hydrogen, and oxygen. Based on these data, you may safely conclude that

- A) the food may contain carbohydrates and protein.
- B) the food may contain carbohydrates and nucleic acids.
- C) the food may contain lipids and protein.
- D) the food may contain carbohydrates and lipids, but not protein.

Answer: D

Topic: Concepts 3.3, 3.4, 3.5, 3.6

Skill: Application/Analysis

Learning Outcome: 3.3, 3.4, 3.5, 3.6

Global L.O.: G2

5) A nutritional supplement developed for athletes is shown to contain only carbon, hydrogen, oxygen, and sulfur. Based on these data, you may safely conclude that

- A) the food may contain carbohydrates, lipids, and protein.
- B) the food may contain carbohydrates, lipids, and nucleic acids.
- C) the food may contain carbohydrates, phospholipids, and protein.
- D) the food may contain carbohydrates and lipids, but not protein.

Answer: A

Topic: Concepts 3.3, 3.4, 3.5, 3.6

Skill: Application/Analysis

Learning Outcome: 3.3, 3.4, 3.5, 3.6

Global L.O.: G2

6) A nutritional supplement developed for athletes is shown to contain only carbon, hydrogen, nitrogen, and oxygen. Based on these data, you may safely conclude that

- A) the food does not contain protein.
- B) the food does not contain nucleic acids.
- C) the food does not contain carbohydrates.
- D) the food does not contain lipids.

Answer: B

Topic: Concepts 3.3, 3.4, 3.5, 3.6

Skill: Application/Analysis

Learning Outcome: 3.3, 3.4, 3.5, 3.6

Global L.O.: G2

7) A scientist suspects that food in an ecosystem may have been contaminated by radioactive nitrogen over a period of several months. Which of the following should be isolated from mammals living in the ecosystem and examined for radioactivity in order to test the hypothesis?

- A) glycogen
- B) DNA
- C) hair
- D) fat

Answer: C

Topic: Concepts 3.3, 3.4, 3.5, 3.6

Skill: Evaluation/Synthesis

Learning Outcome: 3.3, 3.4, 3.5, 3.6

Global L.O.: G2

8) A food company wishes to convert corn oil into a spread that is solid at room temperature. One way to accomplish this goal would be to

- A) remove hydrogens, increasing the number of double bonds in the oil molecules.
- B) remove hydrogens, decreasing the number of double bonds in the oil molecules.
- C) add hydrogens, increasing the number of double bonds in the oil molecules.
- D) add hydrogens, decreasing the number of double bonds in the oil molecules.

Answer: D

Topic: Concept 3.4

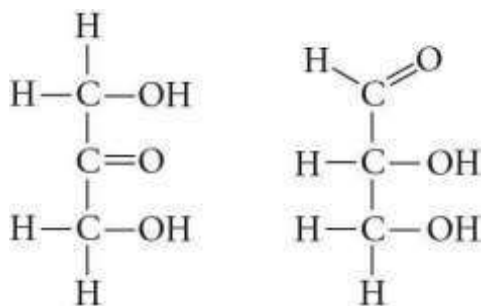
Skill: Application/Analysis

Learning Outcome: 3.4

Global L.O.: G2

End-of-Chapter Questions

1) Choose the term that correctly describes the relationship between these two sugar molecules:



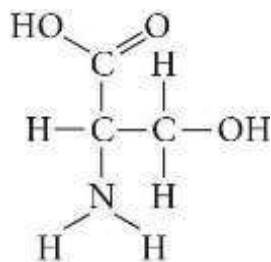
- A) structural isomers
- B) *cis-trans* isomers
- C) enantiomers
- D) isotopes

Answer: A

Topic: End-of-Chapter Questions

Skill: Knowledge/Comprehension

2) 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

3) 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) amino
- D) phosphate

Answer: C

Topic: End-of-Chapter Questions

Skill: Knowledge/Comprehension

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

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

Answer: C

Topic: End-of-Chapter Questions

Skill: Knowledge/Comprehension

5) 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 their fatty acid chains.
- C) They generally solidify at room temperature.
- D) They contain more hydrogen than do saturated fats having the same number of carbon atoms.

Answer: B

Topic: End-of-Chapter Questions

Skill: Knowledge/Comprehension

6) 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.

Answer: A

Topic: End-of-Chapter Questions

Skill: Knowledge/Comprehension

7) Enzymes that break down DNA catalyze the hydrolysis of the covalent bonds that join nucleotides together. What would happen to DNA molecules treated with these enzymes?

- A) The two strands of the double helix would separate.
- B) The phosphodiester linkages of the polynucleotide backbone would be broken.
- C) The pyrimidines would be separated from the deoxyribose sugars.
- D) All bases would be separated from the deoxyribose sugars.

Answer: B

Topic: End-of-Chapter Questions

Skill: Knowledge/Comprehension

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

A) C₃H₈

B) C₂H₆

C) C₂H₄

D) C₂H₂

Answer: C

Topic: End-of-Chapter Questions

Skill: Application/Analysis

9) The molecular formula for glucose is C₆H₁₂O₆. What would be the molecular formula for a polymer made by linking ten glucose molecules together by dehydration reactions?

A) C₆₀H₁₂₀O₆₀

B) C₆₀H₁₀₂O₅₁

C) C₆₀H₁₀₀O₅₀

D) C₆₀H₁₁₁O₅₁

Answer: B

Topic: End-of-Chapter Questions

Skill: Application/Analysis