Test Bank for Cell Molecular Approach 8th Edition by Cooper

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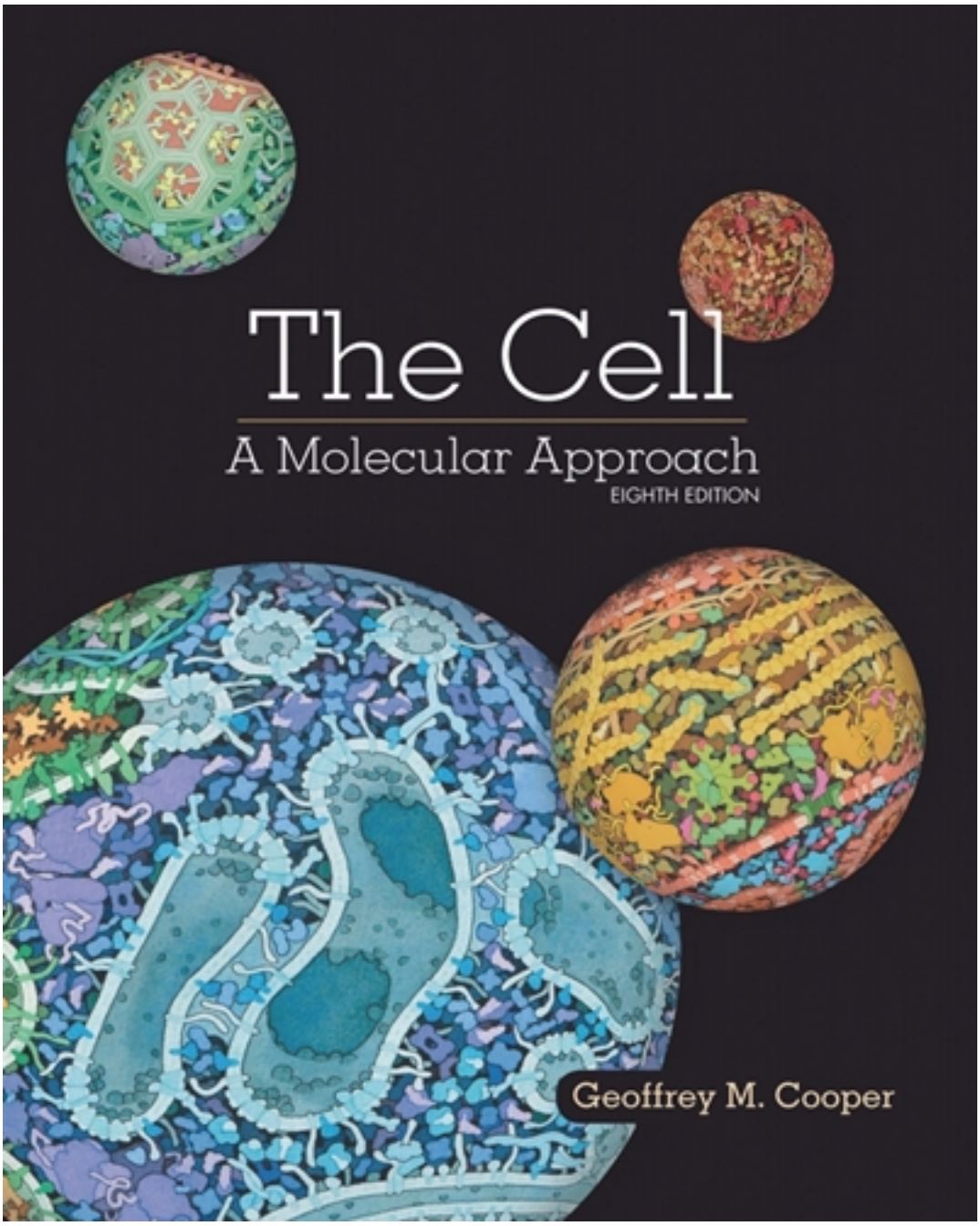

Test Bank

Test Bank

to accompany

The Cell: A Molecular Approach, Eighth Edition

Geoffrey M. Cooper

Chapter 2: Molecules and Membranes

TEST FILE QUESTIONS

Multiple Choice

1. The most abundant molecules in cells are
a. proteins.
b. carbohydrates.
c. lipids.
d. water.
Answer: d
Textbook Reference: The Molecules of Cells
Bloom's Category: 1. Remembering
Learning Objective: Explain the properties of different types of chemical bonds.

2. Water is an ideal solvent in cells because it
a. has low heat of vaporization.
b. is a polar molecule that can form hydrogen bonds with itself and with other polar molecules.
c. dissolves nonpolar molecules.
d. contracts when it freezes.
Answer: b
Textbook Reference: The Molecules of Cells
Bloom's Category: 2. Understanding
Learning Objective: Explain the properties of different types of chemical bonds.

3. In polysaccharides, sugars are linked together by means of _____ bonds.
a. phosphodiester
b. peptide
c. glycosidic
d. hydrophobic
Answer: c
Textbook Reference: The Molecules of Cells
Bloom's Category: 1. Remembering
Learning Objective: Diagram the structure of a simple carbohydrate.

4. Sugars can cyclize if they contain _____ or more carbons.
a. four

b. five
c. six
d. seven
Answer: b
Textbook Reference: The Molecules of Cells
Bloom's Category: 2. Understanding
Learning Objective: Diagram the structure of a simple carbohydrate.

5. A few sugars joined together are called a(n)
a. glycoside.
b. oligosaccharide.
c. polysaccharide.
d. starch.
Answer: b
Textbook Reference: The Molecules of Cells
Bloom's Category: 1. Remembering
Learning Objective: Diagram the structure of a simple carbohydrate.

6. The major bonds in glycogen are _____ glycosidic bonds.
a. $\alpha(1\rightarrow4)$
b. $\alpha(1\rightarrow6)$
c. $\beta(1\rightarrow4)$
d. $\beta(1\rightarrow6)$
Answer: a
Textbook Reference: The Molecules of Cells
Bloom's Category: 1. Remembering
Learning Objective: Diagram the structure of a simple carbohydrate.

7. Cell membranes are composed principally of
a. carbohydrates.
b. nucleic acids.
c. phospholipids.
d. proteins.
Answer: c
Textbook Reference: The Molecules of Cells
Bloom's Category: 1. Remembering
Learning Objective: Compare the structures of fatty acids, phospholipids, and steroid hormones.

8. Lipids play a major role in cells as
a. a form of energy storage.
b. components of cell membranes.
c. part of the cell signaling function.
d. All of the above
Answer: d
Textbook Reference: The Molecules of Cells

Bloom's Category: 2. Understanding
Learning Objective: Compare the structures of fatty acids, phospholipids, and steroid hormones.

9. Fatty acids are stored in fat droplets in the form of
a. triacylglycerols.
b. phospholipids.
c. cholesterol.
d. glycolipids.
Answer: a
Textbook Reference: The Molecules of Cells
Bloom's Category: 1. Remembering
Learning Objective: Compare the structures of fatty acids, phospholipids, and steroid hormones.

10. Which of the following molecules stores the most chemical energy per unit of weight?
a. Carbohydrates
b. Lipids
c. Proteins
d. Nucleic acids
Answer: b
Textbook Reference: The Molecules of Cells
Bloom's Category: 2. Understanding
Learning Objective: Compare the structures of fatty acids, phospholipids, and steroid hormones.

11. Sphingomyelin contains two hydrocarbon chains linked to
a. glycerol.
b. choline.
c. serine.
d. glycine.
Answer: c
Textbook Reference: The Molecules of Cells
Bloom's Category: 1. Remembering
Learning Objective: Compare the structures of fatty acids, phospholipids, and steroid hormones.

12. An amphipathic molecule is
a. water-soluble.
b. water-insoluble.
c. part water-soluble and part water-insoluble.
d. hydrophilic.
Answer: c
Textbook Reference: The Molecules of Cells
Bloom's Category: 1. Remembering

Learning Objective: Compare the structures of fatty acids, phospholipids, and steroid hormones.

13. Steroid hormones are derivatives of
a. cholesterol.
b. phospholipids.
c. amino acids.
d. sugars.
Answer: a
Textbook Reference: The Molecules of Cells
Bloom's Category: 1. Remembering
Learning Objective: Compare the structures of fatty acids, phospholipids, and steroid hormones.

14. RNA in cells can serve as a
a. regulator of gene expression.
b. carrier of information from the nucleus to the cytoplasm.
c. catalyst or enzyme.
d. All of the above
Answer: d
Textbook Reference: The Molecules of Cells
Bloom's Category: 2. Understanding
Learning Objective: Contrast the structures of RNA and DNA.

15. The pyrimidine bases in DNA are
a. adenine and guanine.
b. adenine and cytosine.
c. cytosine and thymine.
d. cytosine and guanine.
Answer: c
Textbook Reference: The Molecules of Cells
Bloom's Category: 1. Remembering
Learning Objective: Contrast the structures of RNA and DNA.

16. Complementary base pairs form _____ bonds to direct replication of DNA.
a. hydrogen
b. phosphodiester
c. glycosidic
d. covalent
Answer: a
Textbook Reference: The Molecules of Cells
Bloom's Category: 1. Remembering
Learning Objective: Contrast the structures of RNA and DNA.

17. Which of the following is *not* a way in which DNA differs from RNA?
a. DNA contains deoxyribose sugars.

b. DNA is usually a double-stranded molecule.
c. DNA contains thymine as one of its bases.
d. DNA can form hydrogen bonds with complementary sequences.
Answer: d
Textbook Reference: The Molecules of Cells
Bloom's Category: 2. Understanding
Learning Objective: Contrast the structures of RNA and DNA.

18. Nucleotides function in cells as all of the following *except*
a. building blocks of nucleic acids.
b. carriers of chemical energy.
c. intracellular signal molecules.
d. defenders against infection.
Answer: d
Textbook Reference: The Molecules of Cells
Bloom's Category: 1. Remembering
Learning Objective: Contrast the structures of RNA and DNA.

19. In DNA,
a. G pairs with T and A pairs with C.
b. G pairs with A and C pairs with T.
c. G pairs with C and A pairs with T.
d. G pairs with C and U pairs with A.
Answer: c
Textbook Reference: The Molecules of Cells
Bloom's Category: 1. Remembering
Learning Objective: Contrast the structures of RNA and DNA.

20. Polymerization of nucleotides to form nucleic acids involves the formation of _____ bonds.
a. peptide
b. phosphodiester
c. glycosidic
d. hydrogen
Answer: b
Textbook Reference: The Molecules of Cells
Bloom's Category: 2. Understanding
Learning Objective: Contrast the structures of RNA and DNA.

21. The main difference between double-stranded DNA (dsDNA) and single-stranded DNA (ssDNA) is that
a. dsDNA has bases that include thymine (T), while ssDNA has bases including uracil (U).
b. dsDNA has strands oriented in an antiparallel fashion, while ssDNA does not.
c. dsDNA cannot undergo translation while ssDNA can leave the nucleus to undergo translation.

d. dsDNA has 5’ to 3’ polarity while ssDNA does not.
Answer: a
Textbook Reference: The Molecules of Cells
Bloom’s Category: 4. Analyzing
Learning Objective: Contrast the structures of RNA and DNA.

22. A researcher is trying to determine the contents of a viral genome. Upon chemical analysis, the nucleic acid is found to contain 27% cytosine, 27% adenine, 23% uracil, and 23% guanine. Based on this data, the viral genome most likely consists of
a. single-stranded DNA.
b. double-stranded DNA.
c. single-stranded RNA.
d. double-stranded RNA.
Answer: c
Textbook Reference: The Molecules of Cells
Bloom’s Category: 3. Applying
Learning Objective: Contrast the structures of RNA and DNA.

23. Serine, threonine, asparagine, and glutamine are all _____ amino acids.
a. basic
b. acidic
c. polar
d. nonpolar
Answer: c
Textbook Reference: The Molecules of Cells
Bloom’s Category: 1. Remembering
Learning Objective: Summarize the properties of the different groups of amino acids.

24. Which of the following is *not* a basic amino acid?
a. Arginine
b. Glutamine
c. Histidine
e. All of the above are basic amino acids.
Answer: b
Textbook Reference: The Molecules of Cells
Bloom’s Category: 2. Understanding
Learning Objective: Summarize the properties of the different groups of amino acids.

25. Proteins are polymers of how many different amino acids?
a. 16
b. 20
c. 24
d. 36
Answer: b
Textbook Reference: The Molecules of Cells
Bloom’s Category: 2. Understanding

Learning Objective: Summarize the properties of the different groups of amino acids.

26. In the primary structure of a protein, amino acids are joined together by _____ bonds.
a. peptide
b. phosphodiester
c. glycosidic
d. hydrophobic
Answer: a
Textbook Reference: The Molecules of Cells
Bloom's Category: 2. Understanding
Learning Objective: Summarize the properties of the different groups of amino acids.

27. The scientist who first determined the complete amino acid sequence of a protein (insulin) was
a. Christian Anfinsen.
b. Frederick Sanger.
c. Linus Pauling.
d. John Kendrew.
Answer: b
Textbook Reference: The Molecules of Cells
Bloom's Category: 1. Remembering
Learning Objective: Summarize the properties of the different groups of amino acids.

28. Anfinsen's experiments on denatured ribonuclease showed that
a. protein denaturation is irreversible.
b. proteins can renature to regain their activity only with the assistance of specialized enzymes.
c. proteins have unique amino acid sequences.
d. the conformation of the folded protein is determined by its amino acid sequence.
Answer: d
Textbook Reference: The Molecules of Cells
Bloom's Category: 2. Understanding
Learning Objective: Explain the roles of noncovalent bonds in protein folding.

29. Which of the following are involved in forming the tertiary structure of proteins?
a. H bonds
b. Hydrophobic interactions
c. Ionic bonds
d. All of the above
Answer: d
Textbook Reference: The Molecules of Cells
Bloom's Category: 2. Understanding
Learning Objective: Explain the roles of noncovalent bonds in protein folding.

30. The interaction of two α and two β subunits to form a functional hemoglobin molecule is an example of _____ structure.
a. primary
b. secondary
c. tertiary
d. quaternary
Answer: d
Textbook Reference: The Molecules of Cells
Bloom's Category: 2. Understanding
Learning Objective: Explain the roles of noncovalent bonds in protein folding.

31. Fully folded proteins typically have polar side chains on their surfaces, where electrostatic attractions and hydrogen bonds can form between the polar group on the amino acid and the polar molecules in the solvent. In contrast, some proteins have a polar side chain in their hydrophobic interior. Which of the following would not occur to help accommodate an internal, polar side chain?
a. A hydrogen bond forms between two polar side chains.
b. A hydrogen bond forms between a polar side chain and the protein backbone.
c. A hydrogen bond forms between a polar side chain and an aromatic side chain.
d. Hydrogen bonds form between polar side chains and a buried water molecule.
Answer: c
Textbook Reference: The Molecules of Cells
Bloom's Category: 3. Applying
Learning Objective: Explain the roles of noncovalent bonds in protein folding.

32. Like other catalysts, enzymes
a. increase the rate of reactions without being consumed in reactions.
b. shift the chemical equilibrium from more reactants to more products.
c. do not alter the chemical equilibrium between reactants and products.
d. Both a and c
Answer: d
Textbook Reference: Enzymes as Biological Catalysts
Bloom's Category: 2. Understanding
Learning Objective: Explain why enzymes affect the kinetics of chemical reactions without changing the equilibrium between reactants and products.

33. Enzymes act by
a. lowering the overall free energy change of a reaction.
b. decreasing the distance reactants must diffuse to find each other.
c. increasing activation energy.
d. decreasing activation energy.
Answer: d
Textbook Reference: Enzymes as Biological Catalysts
Bloom's Category: 1. Remembering
Learning Objective: Explain why enzymes affect the kinetics of chemical reactions without changing the equilibrium between reactants and products.

34. A reaction in which the substrate glucose binds to the enzyme hexokinase and the configuration of both molecules changes is an example of
a. a lock-and-key mechanism.
b. an induced fit mechanism.
c. competitive inhibition.
d. allosteric inhibition.
Answer: b
Textbook Reference: Enzymes as Biological Catalysts
Bloom's Category: 3. Applying
Learning Objective: Summarize the mechanisms of enzymatic catalysis.

35. Because of the central role that one amino acid plays in the mechanism by which proteins are cleaved by the enzymes trypsin and chymotrypsin, these enzymes are called _____ proteases.
a. histidine
b. lysine
c. arginine
d. serine
Answer: d
Textbook Reference: Enzymes as Biological Catalysts
Bloom's Category: 2. Understanding
Learning Objective: Summarize the mechanisms of enzymatic catalysis.

36. The trypsin substrate binding site contains an aspartate residue, which is able to form an ionic bond with which amino acids in its polypeptide substrates?
a. Lysine or arginine
b. Glutamate or glutamine
c. Leucine or phenylalanine
d. Serine or threonine
Answer: a
Textbook Reference: Enzymes as Biological Catalysts
Bloom's Category: 3. Applying
Learning Objective: Summarize the mechanisms of enzymatic catalysis.

37. Coenzymes are
a. enzymes in the same pathway.
b. proteins that form dimeric enzymes.
c. small molecules that work with an enzyme to enhance reaction rate.
d. small molecules that allosterically regulate enzymes.
Answer: c
Textbook Reference: Enzymes as Biological Catalysts
Bloom's Category: 1. Remembering
Learning Objective: Distinguish between enzymes and coenzymes.

38. Which statement describes the most common relationship of the inhibitor molecule to the allosteric enzyme in feedback inhibition of enzyme activity?
a. The inhibitor is the substrate of the enzyme.
b. The inhibitor is the final product of the metabolic pathway.
c. The inhibitor is the product of the enzyme-catalyzed reaction.
d. The inhibitor is a metabolically unrelated signal molecule.
Answer: b
Textbook Reference: Enzymes as Biological Catalysts
Bloom's Category: 2. Understanding
Learning Objective: Explain why regulating the activity of enzymes is important to cell function.

39. In allosteric regulation, binding of a small regulatory molecule to an enzyme _____ enzyme activity.
a. inhibits
b. stimulates
c. may stimulate or inhibit
d. neither stimulates nor inhibits
Answer: c
Textbook Reference: Enzymes as Biological Catalysts
Bloom's Category: 2. Understanding
Learning Objective: Explain why regulating the activity of enzymes is important to cell function.

40. Proteins can be covalently modified by the addition of phosphate groups to all but which of the following amino acids?
a. Arginine
b. Threonine
c. Serine
d. All of the above
Answer: a
Textbook Reference: Enzymes as Biological Catalysts
Bloom's Category: 2. Understanding
Learning Objective: Explain why regulating the activity of enzymes is important to cell function.

41. The fundamental building block of cellular membranes is
a. the glycolipid.
b. the phospholipid.
c. cholesterol.
d. protein.
Answer: b
Textbook Reference: Cell Membranes
Bloom's Category: 1. Remembering
Learning Objective: Illustrate the hydrophobic and hydrophilic interactions that lead to the formation of lipid bilayers.

42. Common factors affecting membrane fluidity include
a. length of phospholipid fatty acid chains.
b. temperature.
c. number of double bonds in the fatty acid chains.
d. All of the above
Answer: d
Textbook Reference: Cell Membranes
Bloom's Category: 2. Understanding
Learning Objective: Illustrate the hydrophobic and hydrophilic interactions that lead to the formation of lipid bilayers.

43. Cholesterol affects membrane fluidity by
a. increasing membrane fluidity at all temperatures.
b. decreasing membrane fluidity at all temperatures.
c. decreasing membrane fluidity at high temperatures and increasing membrane fluidity at low temperatures.
d. increasing membrane fluidity at high temperatures and decreasing membrane fluidity at low temperatures.
Answer: c
Textbook Reference: Cell Membranes
Bloom's Category: 2. Understanding
Learning Objective: Illustrate the hydrophobic and hydrophilic interactions that lead to the formation of lipid bilayers.

44. Phospholipids in a membrane commonly
a. move laterally in the plane of the bilayer.
b. rotate within the bilayer.
c. move from one bilayer to the other.
d. Both a and b
Answer: d
Textbook Reference: Cell Membranes
Bloom's Category: 2. Understanding
Learning Objective: Illustrate the hydrophobic and hydrophilic interactions that lead to the formation of lipid bilayers.

45. The role of double bonds in the fatty acid tails of membrane phospholipids is to
a. help stabilize the membrane.
b. react with adjacent double bonds.
c. increase membrane fluidity.
d. interact with membrane proteins.
Answer: c
Textbook Reference: Cell Membranes
Bloom's Category: 1. Remembering
Learning Objective: Illustrate the hydrophobic and hydrophilic interactions that lead to the formation of lipid bilayers.

46. The currently accepted model of membrane structure is called the _____ model.
a. lipid bilayer
b. unit membrane
c. lipid raft
d. fluid mosaic
Answer: d
Textbook Reference: Cell Membranes
Bloom's Category: 1. Remembering
Learning Objective: Illustrate the hydrophobic and hydrophilic interactions that lead to the formation of lipid bilayers.

47. The fluid mosaic model of cell membranes was proposed by
a. Frye and Edidin.
b. Singer and Nicolson.
c. Gorter and Grendel.
d. Watson and Crick.
Answer: b
Textbook Reference: Cell Membranes
Bloom's Category: 1. Remembering
Learning Objective: Illustrate the hydrophobic and hydrophilic interactions that lead to the formation of lipid bilayers.

48. The unique functions of different membranes are primarily due to their
a. proteins.
b. phospholipids.
c. cholesterol molecules.
d. glycolipids.
Answer: a
Textbook Reference: Cell Membranes
Bloom's Category: 2. Understanding
Learning Objective: Explain the difference between integral and peripheral membrane proteins.

49. The mitochondrial inner membrane is about _____ protein.
a. 0%
b. 10%
c. 42%
d. 75%
Answer: d
Textbook Reference: Cell Membranes
Bloom's Category: 1. Remembering
Learning Objective: Explain the difference between integral and peripheral membrane proteins.

50. Integral membrane proteins are those that

a. directly associate with membrane lipids.
b. associate with the membrane indirectly.
c. do not span the lipid bilayer.
d. None of the above
Answer: a
Textbook Reference: Cell Membranes
Bloom's Category: 1. Remembering
Learning Objective: Explain the difference between integral and peripheral membrane proteins.

51. Transmembrane proteins that span the membrane are
a. peripheral membrane proteins.
b. covalently linked to membrane lipids.
c. integral membrane proteins.
d. active transporters.
Answer: c
Textbook Reference: Cell Membranes
Bloom's Category: 1. Remembering
Learning Objective: Explain the difference between integral and peripheral membrane proteins.

52. Transmembrane proteins can span the lipid bilayer as
a. α helices.
b. β turns.
c. unstructured chains.
d. Both a and c
Answer: a
Textbook Reference: Cell Membranes
Bloom's Category: 1. Remembering
Learning Objective: Explain the difference between integral and peripheral membrane proteins.

53. Membrane proteins can be anchored to the cytosolic face of the plasma membrane by
a. sugar groups of glycolipids.
b. prenyl groups.
c. sugar groups of glycoproteins.
d. None of the above
Answer: b
Textbook Reference: Cell Membranes
Bloom's Category: 2. Understanding
Learning Objective: Explain the difference between integral and peripheral membrane proteins.

54. Phospholipid bilayers are permeable only to molecules that are _____ and _____.
a. large; uncharged

b. large; charged
c. small; uncharged
d. small; charged
Answer: c
Textbook Reference: Cell Membranes
Bloom's Category: 1. Remembering
Learning Objective: Distinguish molecules that can diffuse through a lipid bilayer from those that require transporters to cross a membrane.

55. Passive transport molecules
a. allow small molecules across membranes.
b. are peripheral proteins.
c. can transport against a concentration gradient.
d. use the energy of ATP to transport molecules.
Answer: a
Textbook Reference: Cell Membranes
Bloom's Category: 1. Remembering
Learning Objective: Distinguish molecules that can diffuse through a lipid bilayer from those that require transporters to cross a membrane.

56. Molecules that traverse a membrane against their concentration gradient do so by _____ transport.
a. active
b. passive
c. carrier-mediated
d. channel-mediated
Answer: a
Textbook Reference: Cell Membranes
Bloom's Category: 1. Remembering
Learning Objective: Distinguish molecules that can diffuse through a lipid bilayer from those that require transporters to cross a membrane.

57. Channels form pores through which molecules of appropriate size and charge can cross a membrane. By contrast, carrier proteins
a. actively transport molecules.
b. selectively bind the molecule to be transported, change configuration, and release it on the other side.
c. require ATP.
d. transport a molecule against its concentration gradient.
Answer: b
Textbook Reference: Cell Membranes
Bloom's Category: 2. Understanding
Learning Objective: Distinguish molecules that can diffuse through a lipid bilayer from those that require transporters to cross a membrane.

Fill in the Blank

1. Plants store glucose in the form of _____, and animals store glucose in the form of _____.
Answer: starch; glycogen
Textbook Reference: The Molecules of Cells
Bloom's Category: 1. Remembering
Learning Objective: Diagram the structure of a simple carbohydrate.

2. Because phospholipids consist of hydrophobic hydrocarbon chains and hydrophilic head groups, they are _____ molecules.
Answer: amphipathic
Textbook Reference: The Molecules of Cells
Bloom's Category: 2. Understanding
Learning Objective: Compare the structures of fatty acids, phospholipids, and steroid hormones.

3. Steroid hormones are derivatives of the membrane lipid _____.
Answer: cholesterol
Textbook Reference: The Molecules of Cells
Bloom's Category: 1. Remembering
Learning Objective: Compare the structures of fatty acids, phospholipids, and steroid hormones.

4. RNA contains uracil in place of the _____ found in DNA.
Answer: thymine
Textbook Reference: The Molecules of Cells
Bloom's Category: 1. Remembering
Learning Objective: Contrast the structures of RNA and DNA.

5. Polymerization of DNA and RNA always occurs in the _____ direction.
Answer: 5′ to 3′
Textbook Reference: The Molecules of Cells
Bloom's Category: 1. Remembering
Learning Objective: Contrast the structures of RNA and DNA.

6. The purine base adenine is found in DNA and in the principal form of chemical energy in cells, _____.
Answer: adenosine 5′-triphosphate (ATP)
Textbook Reference: The Molecules of Cells
Bloom's Category: 2. Understanding
Learning Objective: Contrast the structures of RNA and DNA.

7. The side chains of basic amino acids such as lysine and arginine are _____ charged while those of acidic amino acids such as aspartic acid and glutamic acid are _____ charged at normal cellular pH.

Answer: positively (+); negatively (–)
Textbook Reference: The Molecules of Cells
Bloom's Category: 2. Understanding
Learning Objective: Summarize the properties of the different groups of amino acids.

8. In most proteins, α helices and β sheets fold into globular domains with _____ on the inside.
Answer: hydrophobic amino acids
Textbook Reference: The Molecules of Cells
Bloom's Category: 1. Remembering
Learning Objective: Explain the roles of noncovalent bonds in protein folding.

9. The two polypeptide chains in insulin are held together by _____ bonds.
Answer: disulfide
Textbook Reference: The Molecules of Cells
Bloom's Category: 2. Understanding
Learning Objective: Explain the roles of noncovalent bonds in protein folding.

10. Proteins associated with a membrane by protein-protein interactions are called _____.
Answer: peripheral membrane proteins
Textbook Reference: The Molecules of Cells
Bloom's Category: 1. Remembering
Learning Objective: Explain the difference between integral and peripheral membrane proteins.

11. Under the mild conditions of temperature and pressure that are compatible with life, most biological reactions are so slow that they would not occur in the absence of _____.
Answer: enzymes (enzymatic catalysis)
Textbook Reference: Enzymes as Biological Catalysts
Bloom's Category: 1. Remembering
Learning Objective: Explain why enzymes affect the kinetics of chemical reactions without changing the equilibrium between reactants and products.

12. Enzymes increase reaction rates without either being _____ themselves or altering the _____ of the reaction.
Answer: consumed (altered permanently, used up); equilibrium
Textbook Reference: Enzymes as Biological Catalysts
Bloom's Category: 1. Remembering
Learning Objective: Explain why enzymes affect the kinetics of chemical reactions without changing the equilibrium between reactants and products.

13. Enzymes reduce the _____ energy required to reach the _____ state in a chemical reaction.
Answer: activation; transition

Textbook Reference: Enzymes as Biological Catalysts
Bloom's Category: 1. Remembering
Learning Objective: Explain why enzymes affect the kinetics of chemical reactions without changing the equilibrium between reactants and products.

14. Coenzymes serve as _____ of several types of chemical groups.
Answer: carriers
Textbook Reference: Enzymes as Biological Catalysts
Bloom's Category: 1. Remembering
Learning Objective: Distinguish between enzymes and coenzymes.

15. In allosteric regulation of enzyme activity, the regulatory molecules bind to a site that is _____ from the active site of the protein, producing a _____ change in the protein that affects substrate binding to the active site.
Answer: distal (distant, far); conformational (shape)
Textbook Reference: Enzymes as Biological Catalysts
Bloom's Category: 1. Remembering
Learning Objective: Explain why regulating the activity of enzymes is important to cell function.

16. The formation of cell membranes is based on the capacity of _____ to form a _____.
Answer: lipids (phospholipids, amphipathic lipids); bilayer (phospholipid bilayer)
Textbook Reference: Cell Membranes
Bloom's Category: 1. Remembering
Learning Objective: Illustrate the hydrophobic and hydrophilic interactions that lead to the formation of lipid bilayers.

17. Integral membrane proteins typically possess _____ segments of 20−25 amino acids that traverse the membrane and are rich in _____ amino acids.
Answer: alpha-helical; hydrophobic
Textbook Reference: Cell Membranes
Bloom's Category: 2. Understanding
Learning Objective: Explain the difference between integral and peripheral membrane proteins.

18. Cell membranes are _____ permeable to small, uncharged molecules, while transport of larger polar or charged substances through membranes occurs via _____ or _____ proteins.
Answer: selectively; channel (carrier); carrier (channel)
Textbook Reference: Cell Membranes
Bloom's Category: 2. Understanding
Learning Objective: Distinguish molecules that can diffuse through a lipid bilayer from those that require transporters to cross a membrane.

True/False

1. Most proteins interact with other proteins through covalent protein–protein interactions.
Answer: F
Textbook Reference: The Molecules of Cells
Bloom's Category: 3. Applying
Learning Objective: Explain the properties of different types of chemical bonds.

2. The function of glycogen, starch, and cellulose is to store glucose.
Answer: F
Textbook Reference: The Molecules of Cells
Bloom's Category: 2. Understanding
Learning Objective: Diagram the structure of a simple carbohydrate.

3. The glucose molecules in cellulose are joined by $\beta(1\rightarrow4)$ bonds.
Answer: T
Textbook Reference: The Molecules of Cells
Bloom's Category: 1. Remembering
Learning Objective: Diagram the structure of a simple carbohydrate.

4. Cholesterol is an amphipathic molecule.
Answer: T
Textbook Reference: The Molecules of Cells
Bloom's Category: 1. Remembering
Learning Objective: Compare the structures of fatty acids, phospholipids, and steroid hormones.

5. Each membrane phospholipid contains 3 fatty acid chains.
Answer: F
Textbook Reference: The Molecules of Cells
Bloom's Category: 1. Remembering
Learning Objective: Compare the structures of fatty acids, phospholipids, and steroid hormones.

6. Sphingomyelin is a serine-based phospholipid.
Answer: T
Textbook Reference: The Molecules of Cells.
Bloom's Category: 1. Remembering
Learning Objective: Compare the structures of fatty acids, phospholipids, and steroid hormones

7. RNAs can be enzymes.
Answer: T
Textbook Reference: The Molecules of Cells
Bloom's Category: 1. Remembering
Learning Objective: Contrast the structures of RNA and DNA.

8. Christian Anfinsen and colleagues showed in the 1950s that proteins contain all the information to spontaneous fold into an active enzyme. Yet sixty years later, we can still not predict the three-dimension shape of a protein from its amino acid sequence.
Answer: T
Textbook Reference: The Molecules of Cells
Bloom's Category: 2. Understanding
Learning Objective: Explain the roles of noncovalent bonds in protein folding.

9. Enzymes accelerate reactions and affect the end equilibrium concentration of reactants and products.
Answer: F
Textbook Reference: Enzymes as Biological Catalysts
Bloom's Category: 4. Analyzing
Learning Objective: Explain why enzymes affect the kinetics of chemical reactions without changing the equilibrium between reactants and products.

10. Some enzymes participate directly in the chemical reactions they catalyze.
Answer: T
Textbook Reference: Enzymes as Biological Catalysts
Bloom's Category: 2. Understanding
Learning Objective: Summarize the mechanisms of enzymatic catalysis.

11. Coenzymes function in conjunction with enzymes to carry chemical groups between substrates.
Answer: T
Textbook Reference: Enzymes as Biological Catalysts
Bloom's Category: 1. Remembering
Learning Objective: Distinguish between enzymes and coenzymes.

12. Approximately 50% of the chemical reactions in cells are catalyzed by enzymes.
Answer: F
Textbook Reference: Enzymes as Biological Catalysts
Bloom's Category: 1. Remembering
Learning Objective: Explain why regulating the activity of enzymes is important to cell function.

13. The activity of enzymes can be controlled by the binding of small molecules, by interaction with other proteins, and by covalent modifications.
Answer: T
Textbook Reference: Enzymes as Biological Catalysts
Bloom's Category: 2. Understanding
Learning Objective: Explain why regulating the activity of enzymes is important to cell function.

14. One conclusion derived from the Singer and Nicolson fluid mosaic model of membrane structure is that integral membrane proteins are freely soluble in water.
Answer: F
Textbook Reference: Cell Membranes
Bloom's Category: 2. Understanding
Learning Objective: Explain the difference between integral and peripheral membrane proteins.

15. The sugar groups of glycolipids and glycoproteins are found on the outer surface of the plasma membrane.
Answer: T
Textbook Reference: Cell Membranes
Bloom's Category: 1. Remembering
Learning Objective: Explain the difference between integral and peripheral membrane proteins.

Short Answer

1. How is the information in DNA or RNA conveyed?
Answer: By the order of the bases in the polynucleotide chain
Textbook Reference: The Molecules of Cells
Bloom's Category: 1. Remembering
Learning Objective: Contrast the structures of RNA and DNA.

2. Provide the name or three-letter code of one amino acid to fit each of the following descriptions:
a) It is normally positively charged at pH 7.0.
b) Its R group can form ionic bonds with lysine in a protein.
c) It has a hydrophobic R group.
d) It commonly forms covalent bonds between its R group and another identical R group.
Answer: a) Arginine (Arg), histidine (His), or lysine (Lys); b) Aspartic acid (Asp) or glutamic acid (Glu); c) Alanine (Ala), valine (Val), isoleucine (Ile), leucine (Leu), methionine (Met), phenylalanine (Phe), tyrosine (Tyr), or tryptophan (Trp); d) Cysteine (Cys)
Textbook Reference: The Molecules of Cells
Bloom's Category: 1. Remembering
Learning Objective: Summarize the properties of the different groups of amino acids.

3. Identify the amino acids below as positively (+) charged, negatively (–) charged, able to form disulfide bonds (SS), and/or having OH groups that can be phosphorylated (P) by protein kinases at pH 7.0. Place the appropriate symbols (+, –, SS, or P) in the blanks beside the three-letter codes. (*Hint:* Some amino acids have none of these properties.)

Ala	_____	Leu	_____
Arg	_____	Lys	_____
Asn	_____	Met	_____

Asp	_____	Phe	_____
Cys	_____	Pro	_____
Glu	_____	Ser	_____
Gln	_____	Thr	_____
Gly	_____	Trp	_____
His	_____	Tyr	_____
Ile	_____	Val	_____

Answer:

Ala	_____	Leu	_____
Arg	+	Lys	+
Asn	_____	Met	_____
Asp	–	Phe	_____
Cys	SS	Pro	_____
Glu	–	Ser	P
Gln	_____	Thr	P
Gly	_____	Trp	_____
His	+	Tyr	P
Ile	_____	Val	_____

Textbook Reference: The Molecules of Cells
Bloom's Category: 2. Understanding
Learning Objective: Summarize the properties of the different groups of amino acids.

4. What kind of bonds hold together the two chains of insulin?
Answer: Disulfide bonds
Textbook Reference: The Molecules of Cells
Bloom's Category: 1. Remembering
Learning Objective: Summarize the properties of the different groups of amino acids.

5. What is the name of the technique commonly used to determine the three-dimensional structure of proteins?
Answer: X-ray crystallography
Textbook Reference: The Molecules of Cells
Bloom's Category: 1. Remembering
Learning Objective: Explain the roles of noncovalent bonds in protein folding.

6. How is it possible for serine proteases, which all have different substrates, to share a similar chemical mechanism?
Answer: The enzymes of the serine protease family each have a differently sized and shaped substrate binding pocket near their active site that accepts a specific type of amino acid. Their active sites all hydrolyze peptide bonds using the amino acid that fits in their active site.
Textbook Reference: Enzymes as Biological Catalysts
Bloom's Category: 2. Understanding
Learning Objective: Summarize the mechanisms of enzymatic catalysis.

7. How does NAD^+ act as a chemical carrier?
Answer: NAD^+ can accept a hydrogen ion and two electrons from one substrate, forming NADH, which can then donate these electrons to a second substrate, re-forming NAD^+ Thus, NAD^+ transfers electrons from the first substrate (which becomes oxidized) to the second substrate (which becomes reduced).
Textbook Reference: Enzymes as Biological Catalysts
Bloom's Category: 2. Understanding
Learning Objective: Distinguish between enzymes and coenzymes.

8. What is the relationship between feedback inhibition and allosteric inhibition of enzyme activity?
Answer: Feedback inhibition is one example of allosteric inhibition. In the example given in the text, isoleucine, the end product of a metabolic pathway, inhibits threonine deaminase, the first enzyme in the pathway. Isoleucine is different in size and shape from the other substrate of threonine deaminase. Rather than binding to the active site as a competitor, it binds to a distal site as an allosteric regulator.
Textbook Reference: Enzymes as Biological Catalysts
Bloom's Category: 2. Understanding
Learning Objective: Explain why regulating the activity of enzymes is important to cell function.

9. State the two main ways that cells regulate the activity of their enzymes and provide one example of each.
Answer: (1) Allosteric or feedback inhibition or activation of enzyme activity (e.g., amino acids such as isoleucine feedback and inhibit the first enzyme in their pathway of synthesis); (2) Phosphorylation or other covalent modification of an enzyme (e.g., phosphorylation of glycogen phosphorylase takes place); or proteolytic activation, a variation on covalent modification (e.g., a pro-enzyme or zymogen like chymotrypsin or trypsin is activated by proteolysis).
Textbook Reference: Enzymes as Biological Catalysts
Bloom's Category: 3. Applying
Learning Objective: Explain why regulating the activity of enzymes is important to cell function.

10. On which face of the plasma membrane are glycolipids and glycoproteins found?
Answer: The extracellular face (or outside face)
Textbook Reference: Cell Membranes
Bloom's Category: 1. Remembering
Learning Objective: Explain the difference between integral and peripheral membrane proteins.

DASHBOARD QUIZ QUESTIONS

Multiple Choice

1. The most abundant molecule in cells is
a. aspartic acid.
b. DNA.
c. sucrose.
d. water.
Answer: d
Textbook Reference: The Molecules of Cells
Bloom's Category: 1. Remembering
Learning Objective: Explain the properties of different types of chemical bonds.
Feedback A: Incorrect. Aspartic acid is a very important amino acid, but is a very small portion of the total molecules in cells.
Feedback B: Incorrect. DNA is the essential genetic material in cells, but it is only a small portion of cellular mass and an even smaller fraction of the total molecules in cells.
Feedback C: Incorrect. Sucrose is stored in some plants and can sometimes be abundant. However, sucrose is not a normal cell constituent in animals.
Feedback D: Correct! Water is the most abundant molecule in cells, accounting for 70% of cellular mass, and considering its small size, an even higher fraction of the total molecules in cells.

2. Which of the following is *not* one of the four major classes of organic molecules in the cell?
a. Carbohydrates
b. Lipids
c. Water
d. Proteins
Answer: c
Textbook Reference: The Molecules of Cells
Bloom's Category: 1. Remembering
Learning Objective: Explain the properties of different types of chemical bonds.
Feedback A: Incorrect. Carbohydrates, including simple sugars and polysaccharides, are one of the major classes.
Feedback B: Incorrect. Lipids are important organic components of the cell, not only for their structural role in membranes, but also as signaling molecules and in energy storage.
Feedback C: Correct! Although water is a major cell constituent, accounting for 70% of the cell's mass, it is not an organic molecule. Nucleic acids are the fourth major class of organic molecules in the cell.
Feedback D: Incorrect. Proteins are critical components of cells, carrying out a variety of functions.

3. What is the major carbohydrate-storage molecule in plants?
a. Starch
b. Cellulose

c. Glycogen
d. Deoxyribonucleic acid
Answer: a
Textbook Reference: The Molecules of Cells
Bloom's Category: 1. Remembering
Learning Objective: Diagram the structure of a simple carbohydrate.
Feedback A: Correct! Starch is a polysaccharide composed of glucose residues in the α configuration. The principal linkage is between carbon 1 of one glucose and carbon 4 of a second glucose.
Feedback B: Incorrect. Cellulose is a plant polysaccharide, but it has a structural role rather than a role in energy storage.
Feedback C: Incorrect. Glycogen is the major carbohydrate-storage molecule in animals.
Feedback D: Incorrect. The structure of deoxyribonucleic acid (DNA) includes sugars, but it is a nucleic acid, not a carbohydrate, and its role is in the storage of genetic information.

4. Molecules that are partly water-soluble and partly water-insoluble are
a. hydrophilic.
b. amphipathic.
c. hydrophobic.
d. allosteric.
Answer: b
Textbook Reference: The Molecules of Cells
Bloom's Category: 1. Remembering
Learning Objective: Compare the structures of fatty acids, phospholipids, and steroid hormones.
Feedback A: Incorrect. Hydrophilic molecules are either charged or polar and are water-soluble.
Feedback B: Correct! An example of an amphipathic molecule is a phospholipid, which has a long hydrocarbon chain (the water-insoluble part) attached to a polar head group (the water-soluble part).
Feedback C: Incorrect. Hydrophobic molecules, such as triacylglycerols, do not mix with water and form insoluble droplets in aqueous medium.
Feedback D: Incorrect. This is a type of regulation used to control a protein's activity.

5. Cholesterol, a membrane lipid in animals, has a chemical structure similar to
a. estradiol.
b. phosphatidylinositol.
c. thymine.
d. triacylglycerol.
Answer: a
Textbook Reference: The Molecules of Cells
Bloom's Category: 1. Remembering
Learning Objective: Compare the structures of fatty acids, phospholipids, and steroid hormones.
Feedback A: Correct! Cholesterol is a steroid and a precursor to steroid hormones such as

estradiol.
Feedback B: Incorrect. Phosphatidylinositol is a glycerol phospholipid.
Feedback C: Incorrect. Thymine is a pyrimidine base found in DNA molecules.
Feedback D: Incorrect. Triacylglycerol is a fat—three fatty acids linked to a glycerol molecule.

6. Which of the following bases is *not* found in DNA?
a. Adenine
b. Cytosine
c. Thymine
d. Uracil
Answer: d
Textbook Reference: The Molecules of Cells
Bloom's Category: 1. Remembering
Learning Objective: Contrast the structures of RNA and DNA.
Feedback A: Incorrect. Adenine is a purine base found both in DNA and RNA.
Feedback B: Incorrect. Cytosine is a pyrimidine base found both in DNA and RNA.
Feedback C: Incorrect. Thymine is a pyrimidine base found in DNA, but not in RNA.
Feedback D: Correct! Uracil is a pyrimidine base found in RNA, but not in DNA.

7. How many amino acids are commonly incorporated into proteins?
a. 5
b. 10
c. 20
d. 25
Answer: c
Textbook Reference: The Molecules of Cells
Bloom's Category: 1. Remembering
Learning Objective: Summarize the properties of the different groups of amino acids.
Feedback A: Incorrect. Twenty amino acids are commonly found in proteins.
Feedback B: Incorrect. Twenty amino acids are commonly found in proteins.
Feedback C: Correct!
Feedback D: Incorrect. Twenty amino acids are commonly found in proteins.

8. A disulfide bond is formed between _____ residues.
a. cysteine
b. glycine
c. methionine
d. tyrosine
Answer: a
Textbook Reference: The Molecules of Cells
Bloom's Category: 1. Remembering
Learning Objective: Summarize the properties of the different groups of amino acids.
Feedback A: Correct! Each cysteine (Cys, C) has an SH (sulfhydryl) group. Following oxidation, two cysteine residues are then linked to form a disulfide bond.
Feedback B: Incorrect. Glycine (Gly, G) is the shortest amino acid. Its side chain consists

of a hydrogen (H) atom.
Feedback C: Incorrect. Methionine (Met, M) also contains a sulfur (S) atom. However, the sulfur is internal in the side chain and cannot form a disulfide bond.
Feedback D: Incorrect. Tyrosine (Tyr, Y) has an aromatic, hydrophobic side chain that contains no sulfur.

9. Which of the following classes of amino acids is buried within the folded structure of the protein?
a. Acidic
b. Basic
c. Nonpolar
d. Polar
Answer: c
Textbook Reference: The Molecules of Cells
Bloom's Category: 2. Understanding
Learning Objective: Summarize the properties of the different groups of amino acids.
Feedback A: Incorrect. Acidic amino acids are hydrophilic and hence are on the surface of proteins, where they can interact with water.
Feedback B: Incorrect. Basic amino acids are hydrophilic and hence are on the surface of proteins, where they can interact with water.
Feedback C: Correct! Nonpolar amino acids are hydrophobic and are in the interior of proteins.
Feedback D: Incorrect. Polar amino acids are hydrophilic and hence are on the surface of proteins, where they can interact with water.

10. The three-dimensional structure of a protein is analyzed most definitively by
a. electron microscopy.
b. light microscopy.
c. subcellular fractionation.
d. X-ray crystallography.
Answer: d
Textbook Reference: The Molecules of Cells
Bloom's Category: 2. Understanding
Learning Objective: Explain the roles of noncovalent bonds in protein folding.
Feedback A: Incorrect. Electron microscopy does not have the resolution to provide information on the arrangement of atoms in a protein.
Feedback B: Incorrect. The resolution of light microscopy is about 0.2 μm and hence is insufficient to detect even the overall shape of a protein.
Feedback C: Incorrect. Subcellular fractionation is an approach for separating organelles, membranes, and soluble molecules, either in individual molecules or in molecular complexes.
Feedback D: Correct! X-ray crystallography is a high-resolution technique that is capable of defining the position of atoms within a protein.

11. The α (alpha) helix is an example of which level of protein structure?
a. Primary

b. Quaternary
c. Secondary
d. Tertiary
Answer: c
Textbook Reference: The Molecules of Cells
Bloom's Category: 1. Remembering
Learning Objective: Explain the roles of noncovalent bonds in protein folding.
Feedback A: Incorrect. Primary structure refers simply to the amino acid sequence of a protein.
Feedback B: Incorrect. Quaternary structure refers to interactions between different polypeptide chains.
Feedback C: Correct! Secondary structure refers to the arrangement of amino acids within a localized region, and an α helix is a coiled structure of often relatively limited length.
Feedback D: Incorrect. Tertiary structure refers to the overall structure of a relatively large portion of a protein.

12. Proteins must have more than one _____ to have a quaternary structure.
a. α helix
b. β sheet
c. polypeptide chain
d. transmembrane segment
Answer: c
Textbook Reference: The Molecules of Cells
Bloom's Category: 2. Understanding
Learning Objective: Explain the roles of noncovalent bonds in protein folding.
Feedback A: Incorrect. The α helix is a feature of the secondary structure of a protein.
Feedback B: Incorrect. The β sheet is a feature of the secondary structure of a protein.
Feedback C: Correct! The quaternary structure of a protein is the association of multiple polypeptide chains with one another.
Feedback D: Incorrect. A transmembrane segment of a protein is typically an α helix, a secondary feature of the protein.

13. Enzymes act by
a. lowering the overall change in free energy of a reaction.
b. decreasing the distance that reactants must diffuse to find one another.
c. increasing activation energy.
d. decreasing activation energy.
Answer: d
Textbook Reference: Enzymes as Biological Catalysts
Bloom's Category: 1. Remembering
Learning Objective: Explain why enzymes affect the kinetics of chemical reactions without changing the equilibrium between reactants and products.
Feedback A: Incorrect. The total change in free energy for a reaction is not altered by an enzyme.

Feedback B: Incorrect. Enzymes do not affect the distance that reactants must diffuse toward one another.
Feedback C: Incorrect. Increasing activation energy would slow down the reaction.
Feedback D: Correct! Enzymes decrease the energy required to reach the transition state (the activation energy), thus speeding up a reaction.

14. Enzymes affect the transition state of a chemical reaction by
a. binding to substrate(s).
b. providing a surface on which reactions converting substrate to product can occur more rapidly.
c. altering the conformation of substrate(s) to approach that of the transition state.
d. All of the above
Answer: d
Textbook Reference: Enzymes as Biological Catalysts
Bloom's Category: 1. Remembering
Learning Objective: Summarize the mechanisms of enzymatic catalysis.
Feedback A: Incorrect. Enzymes do bind to substrates, but the other answer choices are correct as well.
Feedback B: Incorrect. Enzymes do provide a surface on which the reactions can occur more rapidly, but the other answer choices are correct as well.
Feedback C: Incorrect. Enzymes do alter the conformation of the substrate to approach that of the transition state, but the other answer choices are correct as well.
Feedback D: Correct! Because A, B, and C are true, D is the best and therefore the correct answer.

15. Chymotrypsin, trypsin, elastase, and thrombin are all members of the serine protease family because each
a. has similar charge and shape properties in its substrate insertion pockets.
b. can form a heptahedral complex with its substrate.
c. uses the same catalytic mechanism involving the same key amino acids.
d. can be modified by the cell-wall degrading enzyme chitinase.
Answer: c
Textbook Reference: Enzymes as Biological Catalysts
Bloom's Category: 2. Understanding
Learning Objective: Summarize the mechanisms of enzymatic catalysis.
Feedback A: Incorrect. If each had similar substrate binding properties, then each would cleave proteins at the same sequence. This is not the case. For example, chymotrypsin cleaves next to a hydrophobic amino acid and trypsin cleaves next to a basic amino acid. The insertion pocket of chymotrypsin is hydrophobic, while that of trypsin is negatively charged.
Feedback B: Incorrect. Carbon atoms form tetrahedral complexes, not heptahedral complexes.
Feedback C: Correct! A similar tetrahedral transition complex is formed between a serine residue in the active site of the enzyme and the substrate amino acid N-terminal of the cleavage site, hence the name serine protease. A carbon atom forms a tetrahedral

complex. A proton is transferred from the serine to a histidine as a part of the overall catalytic mechanism.
Feedback D: Incorrect. All four examples are enzymes found in mammals. Mammals do not have cell walls.

16. The coenzymes NAD^+ and $NADP^+$ are structurally related to the vitamin
a. riboflavin (B2).
b. niacin.
c. pantothenate.
d. pyridoxal (B6).
Answer: b
Textbook Reference: Enzymes as Biological Catalysts
Bloom's Category: 1. Remembering
Learning Objective: Distinguish between enzymes and coenzymes
Feedback A: Incorrect. Riboflavin (B2) is structurally related to the coenzyme FAD.
Feedback B: Correct!
Feedback C: Incorrect. Pantothenate is structurally related to Coenzyme A
Feedback D: Incorrect. Pyridoxal (B6) is structurally related to the coenzyme pyridoxal phosphate

17. Which of the following is *not* true of coenzymes?
a. They are branched amino acids.
b. They serve as carriers of chemical groups.
c. They transfer specific chemical groups among a wide range of substrates.
d. They work together with enzymes to enhance chemical reactions without being irreversibly altered.
Answer: a
Textbook Reference: Enzymes as Biological Catalysts
Bloom's Category: 2. Understanding
Learning Objective: Distinguish between enzymes and coenzymes.
Feedback A: Correct! Coenzymes are not amino acids but are small molecules related to a number of vitamins.
Feedback B: Incorrect. Coenzymes do act as carriers for several different types of chemical groups.
Feedback C: Incorrect. The enzyme, not the coenzyme, determines the specificity of the substrate.
Feedback D: Incorrect. Coenzymes are regenerated in a cyclical manner.

18. Coenzymes are chemically related to
a. amino acids.
b. inorganic phosphate.
c. glucose.
d. vitamins.
Answer: d
Textbook Reference: Enzymes as Biological Catalysts
Bloom's Category: 1. Remembering

Learning Objective: Distinguish between enzymes and coenzymes.
Feedback A: Incorrect. Coenzymes are not derived metabolically from amino acids, so they have little chemical similarity to amino acids.
Feedback B: Incorrect. Coenzymes are organic compounds. Some, such as NADH, are dinucleotides that include phosphate within their overall structure, but this is not as free inorganic phosphate.
Feedback C: Incorrect. Glucose is a very important metabolic sugar, but the overall structure of coenzymes is that of a sugar.
Feedback D: Correct! Many coenzymes are closely related to vitamins that contribute part or all of the structure of the coenzyme.

19. All of the following are ways in which enzyme activity can be regulated *except*
a. by binding to an allosteric site.
b. through feedback inhibition.
c. by modulation of intracellular sucrose concentrations.
d. through phosphorylation.
Answer: c
Textbook Reference: Enzymes as Biological Catalysts
Bloom's Category: 2. Understanding
Learning Objective: Explain why regulating the activity of enzymes is important to cell function.
Feedback A: Incorrect. Allosteric regulation, the outcome of binding to an allosteric site, can regulate enzyme activity.
Feedback B: Incorrect. Feedback inhibition by the end product of an early step in a metabolic pathway can regulate enzyme activity.
Feedback C: Correct! Typically, sucrose is not an intracellular metabolite; hence, this cannot regulate enzyme activity.
Feedback D: Incorrect. Phosphorylation is a common regulator of enzyme activity.

20. About 50% of the mass of most biological membranes consists of lipids and about 50% consists of proteins. Therefore,
a. the membranes contain fewer molecules of lipid than of protein.
b. the membranes contain equal numbers of lipid and protein molecules.
c. the membranes contain more molecules of lipid than of protein.
d. only a few membrane proteins are exposed at the cell surface.
Answer: c
Textbook Reference: Cell Membranes
Bloom's Category: 3. Applying
Learning Objective: Illustrate the hydrophobic and hydrophilic interactions that lead to the formation of lipid bilayers.
Feedback A: Incorrect. Lipids are much lower in molecular weight than membrane proteins are, and hence in terms of molecular abundance there are many more molecules of lipid than of protein.
Feedback B: Incorrect. Lipids are much lower in molecular weight than membrane proteins are, and hence in terms of molecular abundance there are many more molecules of lipid than of protein.

Feedback C: Correct! Lipids are much lower in molecular weight than membrane proteins are, and hence in terms of molecular abundance there are many more molecules of lipid than of protein.
Feedback D: Incorrect. Many of these proteins are transmembrane proteins and hence are exposed at the cell surface.

21. Introducing a double bond into a fatty acid puts a(n) _____ into the conformation of the molecule.
a. amino acid bulge
b. kink
c. reverse spiral
d. branch
Answer: b
Textbook Reference: The Molecules of Cells
Bloom's Category: 2. Understanding
Learning Objective: Illustrate the hydrophobic and hydrophilic interactions that lead to the formation of lipid bilayers.
Feedback A: Incorrect. There are no amino acids in fatty acids.
Feedback B: Correct! The double bond introduces a kink in the hydrocarbon chain.
Feedback C: Incorrect. In the absence of a double bond, the hydrocarbon chain of a fatty acid is fairly straight.
Feedback D: Incorrect. The hydrocarbon chain of a fatty acid has either single or double carbon-carbon bonds holding it together.

22. Phospholipids consist of a 3-carbon core to which two fatty acids and a phosphate group are linked. The most common 3-carbon core is
a. dihydroxyacetone.
b. glyceraldehyde.
c. glycerol.
d. serine.
Answer: c
Textbook Reference: The Molecules of Cells
Bloom's Category: 1. Remembering
Learning Objective: Illustrate the hydrophobic and hydrophilic interactions that lead to the formation of lipid bilayers.
Feedback A: Incorrect. Dihydroxyacetone is a 3-carbon simple sugar.
Feedback B: Incorrect. Glyceraldehyde is a 3-carbon simple sugar.
Feedback C: Correct! Glycerol has three hydroxyl groups and is the 3-carbon core to which phosphate and two fatty acids are added in the four most common phospholipids.
Feedback D: Incorrect. Serine is an amino acid and is the 3-carbon core to which phosphate and two fatty acids are added in one class of phospholipids—sphingomyelin. Serine is also a core component of glycolipids.

23. Lipids with unsaturated fatty acids
a. decrease fluidity of membranes.
b. increase the charge associated with the inner face of a membrane.

c. increase fluidity of membranes.
d. are present only on the inner side of the plasma membrane.
Answer: c
Textbook Reference: Cell Membranes
Bloom's Category: 2. Understanding
Learning Objective: Illustrate the hydrophobic and hydrophilic interactions that lead to the formation of lipid bilayers.
Feedback A: Incorrect. However, cholesterol can decrease the fluidity of membranes.
Feedback B: Incorrect. Unsaturated fatty acids do not affect the charge associated with a membrane.
Feedback C: Correct! Double bonds produce kinks in fatty-acid chains, causing them to pack irregularly, which increases the fluidity of membranes.
Feedback D: Incorrect. Unsaturated fatty acids can be located on either side of the membrane.

24. In the fluid mosaic model of biological membrane structure, transmembrane proteins are
a. embedded nearly randomly in the lipid bilayer.
b. almost completely surrounded by membrane lipid.
c. segregated into large protein clusters or rafts.
d. weakly held in place on the surface of the lipid bilayer.
Answer: a
Textbook Reference: Cell Membranes
Bloom's Category: 1. Remembering
Learning Objective: Explain the difference between integral and peripheral membrane proteins.
Feedback A: Correct! Typically, only small, α-helical portions of the protein are embedded in the membrane, and individual proteins are distributed fairly randomly within the membrane bilayer.
Feedback B: Incorrect. Typically, only small, α-helical portions of the protein are embedded in the membrane.
Feedback C: Incorrect. Typically, transmembrane proteins form at most small polypeptide clusters (e.g., dimers).
Feedback D: Incorrect. This is a characteristic of peripheral membrane proteins.

25. What is the effect of a β barrel on the permeability of a membrane?
a. It decreases permeability.
b. It increases permeability.
c. It has no effect.
d. β barrels are peripheral membrane proteins.
Answer: b
Textbook Reference: Cell Membranes
Bloom's Category: 1. Remembering
Learning Objective: Explain the difference between integral and peripheral membrane proteins.
Feedback A: Incorrect. A β barrel is a protein structural feature that spans a membrane,

creating a pore-like opening and increasing permeability.
Feedback B: Correct! A β barrel is a protein structural feature that spans a membrane, creating a pore-like opening. The presence of this feature therefore increases the permeability of a membrane.
Feedback C: Incorrect. A β barrel is a protein structural feature that spans a membrane, creating a pore-like opening and increasing permeability.
Feedback D: Incorrect. A β barrel is a protein structural feature that spans a membrane, creating a pore-like opening.

26. Which class of molecule accelerates transport across biological membranes?
a. Carbohydrates
b. Lipids
c. Nucleic acids
d. Proteins
Answer: d
Textbook Reference: Cell Membranes
Bloom's Category: 1. Remembering
Learning Objective: Distinguish molecules that can diffuse through a lipid bilayer from those that require transporters to cross a membrane.
Feedback A: Incorrect. Carbohydrates can be part of proteins, but it is the polypeptide chain that forms the transporter.
Feedback B: Incorrect. Lipids form the permeability barrier of biological membranes.
Feedback C: Incorrect. Nucleic acids encode the proteins that form transporters in membranes.
Feedback D: Correct! Transporters in membranes are proteins of either the channel or carrier protein class.

27. While small, uncharged molecules can diffuse through the hydrophobic core of a phospholipid bilayer, larger polar molecules such as glucose must enter cells by binding to
a. a nonphospholipid such as cholesterol.
b. the carbohydrate portion of glycolipids.
c. peripheral membrane proteins located on the inner side of the membrane.
d. carrier proteins that facilitate the passage of specific molecules across membranes.
Answer: d
Textbook Reference: Cell Membranes
Bloom's Category: 2. Understanding
Learning Objective: Distinguish molecules that can diffuse through a lipid bilayer from those that require transporters to cross a membrane.
Feedback A: Incorrect. Cholesterol is a minor portion of membrane lipids. Binding of a polar glucose to the hydrophobic portions of cholesterol would be energetically unfavorable.
Feedback B: Incorrect. The carbohydrate portions of glycolipids are exposed at the cell surface. Therefore, binding to these would not cause the glucose to be transported into the cell.
Feedback C: Incorrect. Peripheral membrane proteins located on the inner side of the

membrane are inaccessible from the outside of the cell. Binding of glucose to these proteins is physically impossible.
Feedback D: Correct! Through binding to a carrier protein, a transporter, glucose is placed in a hydrophilic environment and not exposed to the hydrophobic membrane lipids.

28. Passive transport across a membrane refers to
a. transport into the interior of a cell.
b. transport out of a cell.
c. transport in the energetically favorable direction.
d. simple diffusion across membranes, without the help of proteins such as channels or carriers.
Answer: c
Textbook Reference: Cell Membranes
Bloom's Category: 2. Understanding
Learning Objective: Distinguish molecules that can diffuse through a lipid bilayer from those that require transporters to cross a membrane.
Feedback A: Incorrect. Passive transport can be directed toward either the inside or the outside of a cell.
Feedback B: Incorrect. Passive transport can be directed toward either the inside or the outside of a cell.
Feedback C: Correct! Passive transport refers to the transport of a molecule in the energetically favorable direction, taking into consideration concentration and electrochemical gradients via membrane channels or carrier proteins.
Feedback D: Incorrect. The term "passive transport," by convention, is restricted to energetically favorable transport across membranes via membrane channels and carrier proteins. Hence, the term does not include simple diffusion.

Essay

1. Can RNA be considered a polysaccharide?
Answer: Ribose is a five-carbon sugar, and RNA has many riboses linked together through phosphodiester bonds. Hence, both RNA and polysaccharides are polysugars. In the case of polysaccharides, however, the sugars are linked by glycosidic bonds rather than by phosphodiester bonds. Because of this difference, RNA is not considered a polysaccharide.
Textbook Reference: The Molecules of Cells
Bloom's Category: 3. Applying
Learning Objective: Explain the properties of different types of chemical bonds.

2. Why is phosphatidylethanolamine considered a neutral phospholipid, while phosphatidylinositol is considered an acidic phospholipid?
Answer: Both phosphatidylethanolamine and phosphatidylinositol are glycerol-based phospholipids. At physiological pH (approximately 7), each has one negative charge contribution from the phosphate group. In addition, phosphatidylethanolamine has a

positive charge contribution from the amino group of ethanolamine. Since the sum of –1 and +1 is 0, phosphatidylethanolamine is a neutral phospholipid. The inositol of phosphatidylinositol is a sugar alcohol and carries no charge contribution. Since the sum of –1 and 0 is –1, phosphatidylinositol is an acidic phospholipid (i.e., it has a net negative charge).
Textbook Reference: The Molecules of Cells
Bloom's Category: 4. Analyzing
Learning Objective: Compare the structures of fatty acids, phospholipids, and steroid hormones.

3. Water is a polar molecule and can form hydrogen bonds. How is this property of water an important factor in determining protein structure?
Answer: Hydrophilic amino acids tend to be exposed on the surface of proteins, where their hydrophilic side chains can both form hydrogen bonds and have charged interactions with water.
Textbook Reference: The Molecules of Cells
Bloom's Category: 2. Understanding
Learning Objective: Explain the roles of noncovalent bonds in protein folding.

4. Like ribonuclease, insulin is a small protein. However, upon renaturation, insulin is much less efficient in resuming its native conformation. Why is this?
Answer: Insulin is composed of two polypeptide chains that are joined by disulfide bonds. When completely denatured, the two polypeptide chains are separated. Upon renaturation, chain A might bond to chain B or to chain A, and the efficiency of correct renaturation is quite low. During the normal biosynthesis of insulin, the protein is synthesized as a single larger polypeptide that is subsequently cleaved to give two polypeptide chains. The correct disulfide bonds are formed before the cleavage.
Textbook Reference: The Molecules of Cells
Bloom's Category: 3. Applying
Learning Objective: Explain the roles of noncovalent bonds in protein folding.

5. Suppose you have completed a series of polyacrylamide gel electrophoresis experiments and found that under both denaturing and non-denaturing conditions, purified hemoglobin migrates as one molecular species. However, the apparent mass of the observed species under denaturing conditions is approximately one-quarter of that observed under non-denaturing conditions. What is the most likely explanation for these results?
Answer: If native hemoglobin had a quaternary structure consisting of four polypeptide chains of near identical mass, then the observed experimental outcomes would be exactly the expected outcomes. Hemoglobin is a protein consisting of four very similar polypeptide chains; two α and two β chains. The α and β chains of hemoglobin arose from gene duplication.
Textbook Reference: The Molecules of Cells
Bloom's Category: 3. Applying
Learning Objective: Explain the roles of noncovalent bonds in protein folding.

6. Suppose you are studying the change in reaction rate for lactate dehydrogenase as the concentration of lactate is increased. You find that initially the reaction rate increases linearly with lactate concentration, but as you continue to increase lactate concentration, there is less and less increase in the reaction rate. Eventually there is almost no increase. Why?
Answer: Lactate, as the substrate of lactate dehydrogenase, forms a complex with the enzyme. In any reaction mixture there is a limited amount of enzyme. As the concentration of substrate, in this case lactate, is increased, more and more of the binding sites of the enzyme molecules are occupied by substrate. The increase in reaction rate becomes less tightly linked to substrate concentration. At a sufficiently high substrate concentration, the enzyme is saturated with substrate and there is no further increase in reaction rate.
Textbook Reference: Enzymes as Biological Catalysts
Bloom's Category: 3. Applying
Learning Objective: Summarize the mechanisms of enzymatic catalysis.

7. A rat's liver is respiring actively, and you supply the liver with glucose labeled with carbon-14. Which of the following will rapidly become radioactively labeled: water, carbon dioxide, or NADH?
Answer: One must consider here the inputs to, and the outputs from, glycolysis, the citric acid cycle, and the electron transport chain, as well as the chemical structures of the compounds named in the question. Water does not become labeled, as it consists of only hydrogen and oxygen atoms, with no carbons. NADH does not become labeled, since it is formed by the addition of hydrogen, not carbon, to NAD+. The carbon dioxide does become labeled, since the carbons of glucose are all released as carbon dioxide.
Textbook Reference: Enzymes as Biological Catalysts
Bloom's Category: 4. Analyzing
Learning Objective: Distinguish between enzymes and coenzymes.

8. Cells can both make cholesterol and utilize cholesterol from the diet. High levels of cholesterol depress cholesterol biosynthesis by cells. What is the biochemical term applied to this type of enzyme regulation, and what are the implications of lowered dietary cholesterol for the rate of cellular cholesterol biosynthesis?
Answer: The inhibition of product biosynthesis by the binding of the end product of a metabolic pathway to an early enzyme is termed feedback inhibition. In the case of cholesterol biosynthesis, reduction of dietary cholesterol could affect the level of cellular cholesterol such that feedback inhibition of the biosynthetic pathway is decreased and the rate of cellular cholesterol biosynthesis is increased.
Textbook Reference: Enzymes as Biological Catalysts
Bloom's Category: 3. Applying
Learning Objective: Explain why regulating the activity of enzymes is important to cell function.

9. Suppose that an organic chemist wishes to synthesize an inhibitor of an important enzyme in pyrimidine biosynthesis. What two different kinds of molecules should be considered the most effective inhibitors?

Answer: Pyrimidines are heterocyclic bases found as part of DNA and RNA. Biosynthesis of pyrimidines is essential for cell multiplication. One chemical approach to inhibiting an enzyme in pyrimidine biosynthesis would be to synthesize a chemical analog of the enzyme substrate that might bind more tightly to the enzyme's active site or be unable to be reacted on by the enzyme. A second chemical approach would be to synthesize a chemical analog of an allosteric effector of the enzyme. Some enzymes are regulated by metabolic products of the enzyme pathway that bind to a second site on the enzyme that is distant from the active site of the enzyme. A tight binding allosteric effector analog would also inhibit enzyme activity.
Textbook Reference: Enzymes as Biological Catalysts
Bloom's Category: 3. Applying
Learning Objective: Explain why regulating the activity of enzymes is important to cell function.

10. Transmembrane proteins are water-insoluble. Why?
Answer: Hydrophobic portions of transmembrane proteins are "dissolved" in the lipid bilayer of the membrane. These portions are not water-soluble; hence the whole protein is water-insoluble. To solubilize a transmembrane protein, detergent must be used. The binding of detergent with the transmembrane domains of the protein solubilizes the protein.
Textbook Reference: Cell Membranes
Bloom's Category: 2. Understanding
Learning Objective: Explain the difference between integral and peripheral membrane proteins.

11. The only protein structure known to span a biological membrane, other than α helix, is the β barrel, formed by the folding of β sheets into a barrel-like structure. Why does the presence of β barrel proteins in the outer membrane of chloroplasts and mitochondria make lipid bilayers permeable to small molecules and ions?
Answer: A β-barrel structure in a membrane creates a porous opening in the lipid bilayer. Therefore, the lipid bilayer, in this case the outer membrane of a chloroplast or mitochondrion, will be permeable to small molecules and ions.
Textbook Reference: Cell Membranes
Bloom's Category: 2. Understanding
Learning Objective: Explain the difference between integral and peripheral membrane proteins.

12. Suppose you are studying the transport of glucose into red blood cells and find that as you increase the concentration of glucose outside of the cells, a concentration is reached at which there is no further increase in the rate of accumulation of glucose in the cells. What is the explanation for this?
Answer: Glucose is too polar a molecule to diffuse through a biological membrane by simple diffusion. Instead, glucose is transported into cells by glucose transporters. The red blood cell membrane has a fixed number of transporters. At a certain concentration of extracellular glucose, glucose is bound to all of the transporters and no further increase in

the rate of accumulation with increased concentration is possible. The number of transporter molecules limits the rate of passive transport.
Textbook Reference: Cell Membranes
Bloom's Category: 4. Analyzing
Learning Objective: Distinguish molecules that can diffuse through a lipid bilayer from those that require transporters to cross a membrane.