Chapter 1: Principles of Biochemistry

MULTIPLE CHOICE

1. The birth of modern biochemistry can be traced to the
   a. end of the 19th century.
   b. end of the 20th century.
   c. beginning of the 19th century.
   d. beginning of the 21st century.

   ANS: A DIF: Easy REF: 1.1
   OBJ: 1.1.a. List examples where biochemistry has made advancements in the lives of many humans.
   MSC: Remembering

2. The study of biochemistry attempts to explain
   a. chemical processes at the atomic level.
   b. biological processes at the molecular and cellular level.
   c. the nature of life.
   d. physical processes at the macromolecular level.

   ANS: B DIF: Easy REF: 1.1
   OBJ: 1.1.a. List examples where biochemistry has made advancements in the lives of many humans.
   MSC: Remembering

3. Enzymes function as reaction catalysts in cells. If the enzymes were removed from a cell, the rate of biochemical reactions would
   a. increase.
   b. remain the same.
   c. decrease.
   d. It is impossible to know.

   ANS: C DIF: Medium REF: 1.1
   OBJ: 1.1.a. List examples where biochemistry has made advancements in the lives of many humans.
   MSC: Understanding

4. The essential ions calcium, magnesium, potassium, and sodium are all
   a. anions.
   b. cations.
   c. transition metals.
   d. halogens.

   ANS: B DIF: Difficult REF: 1.2
   OBJ: 1.2.a. List the elements that are most abundant in living organisms.
   MSC: Analyzing

5. Look at the bond energies O-H, N-H, and P-H in the table below. O-H is the hardest bond to break because it has the

Table 1.1 BOND ENERGIES AND BOND LENGTHS OF COMMON COVALENT BONDS IN NATURE

Type of bond	Bond energy (kJ/mol)	Bond length (Å)	Type of bond	Bond energy (kJ/mol)	Bond length (Å)
C—C	346	1.54	P—O	335	1.63
C═C	602	1.34	P═O	544	1.50
C—N	305	1.47	N—N	167	1.45
C═N	615	1.29	N═N	418	1.25
C—O	358	1.43	O—H	459	0.96
C═O	799	1.20	N—H	386	1.01
C—H	411	1.09	P—H	322	1.44

Note: 1 angstrom (Å) = 10^{-10} meter.

a. greatest difference in relative affinities of the two atoms for electrons.
b. smallest difference in relative affinities of the two atoms for electrons.
c. smallest difference in atomic size.
d. largest difference in atomic size.

ANS: A DIF: Medium REF: 1.2
OBJ: 1.2.b. Identify the most abundant functional groups found in biomolecules.
MSC: Understanding

6. Given that methane (CH_4) has a bond angle of $109.5°$ and ethylene (C_2H_2) has a bond angle of $120°$, what is the correct bond angle for acetylene (C_2H_2)?
a. $1.5°$
b. $160°$
c. $180°$
d. $360°$

ANS: C DIF: Medium REF: 1.2
OBJ: 1.2.b. Identify the most abundant functional groups found in biomolecules.
MSC: Applying

7. Amino acids are the building blocks for which biomolecule(s)?
a. proteins
b. DNA
c. carbohydrates
d. micelles

ANS: A DIF: Easy REF: 1.2
OBJ: 1.2.c. Name the four major classes of biomolecules and the primary cellular functions associated with each. MSC: Remembering

8. The _____ differentiates amino acids from one another.
a. number of silane groups
b. number of phosphoryl groups
c. side chains attached to the central carbon
d. number of hydroxyl groups

ANS: C DIF: Medium REF: 1.2
OBJ: 1.2.c. Name the four major classes of biomolecules and the primary cellular functions associated with each. MSC: Understanding

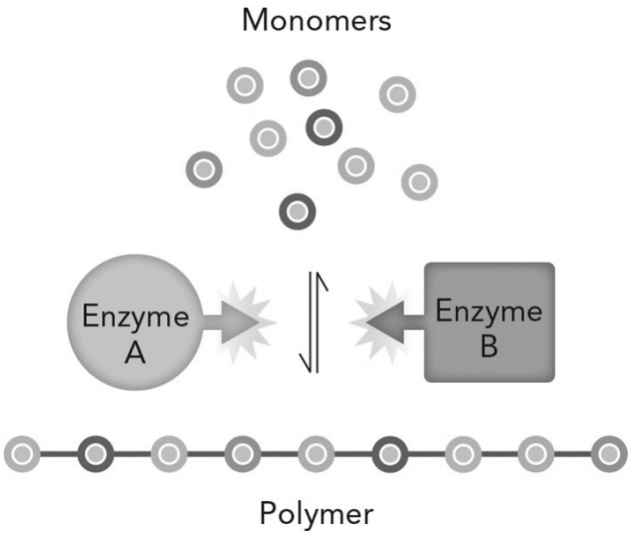
9. A nucleotide consists of which of the following?
   a. nitrogenous base, four-membered sugar and phosphate groups
   b. phosphate base, four-membered sugar and sulfate groups
   c. nitrogenous base, five-membered sugar and phosphate groups
   d. carboxylic acid, four-membered sugar and phosphate groups

   ANS: C DIF: Medium REF: 1.2
   OBJ: 1.2.c. Name the four major classes of biomolecules and the primary cellular functions associated with each. MSC: Remembering

10. Simple sugars are made of which of the following elements?
   a. carbon, sulfur, and hydrogen
   b. carbon, oxygen, and phosphate
   c. carbon, oxygen, and helium
   d. carbon, oxygen, and hydrogen

   ANS: D DIF: Easy REF: 1.2
   OBJ: 1.2.c. Name the four major classes of biomolecules and the primary cellular functions associated with each. MSC: Remembering

11. If energy in the form of ATP is required to make a polymeric macromolecule, which of the following will happen if there is no ATP available?



   a. The rate of polymer increases.
   b. The polymer is broken down to release ATP.
   c. The polymer continues to be made at the same rate.
   d. The enzyme degrades to release ATP.

   ANS: B DIF: Medium REF: 1.2
   OBJ: 1.2.e. Explain the role of metabolic pathways in living systems.
   MSC: Understanding

12. Why are fewer polypeptide sequences encountered biologically than are theoretically possible?
   a. There is no way to make all the theoretical possibilities.
   b. The phosphodiester linkages don't allow for all the possibilities.
   c. Not all have useful structural and functional properties.
   d. Not all of the possibilities can be broken down.

ANS: C DIF: Medium REF: 1.2
OBJ: 1.2.d. Identify the biomolecules that form polymers. MSC: Applying

13. Humans do not have the enzyme cellulase. Is it likely that a human could survive on a plant-only diet?
    a. No, not enough ATP would be produced to generate energy.
    b. No, not enough DNA would be produced to generate energy.
    c. Yes, cellulase is not necessary to break down plant material.
    d. Yes, ATP is not necessary to maintain life.

    ANS: A DIF: Medium REF: 1.2
    OBJ: 1.2.e. Explain the role of metabolic pathways in living systems.
    MSC: Analyzing

14. Which two functional groups are involved in producing a peptide bond?
    a. alcohol and amino
    b. amino and thiol
    c. methyl and amino
    d. amino and carboxyl

    ANS: D DIF: Medium REF: 1.2
    OBJ: 1.2.b. Identify the most abundant functional groups found in biomolecules.
    MSC: Understanding

15. Even though amylose and cellulose contain the same repeating unit of glucose, they are very different in terms of function. Why?
    a. A glycosidic bond cannot be cleaved.
    b. The orientations of the glycosidic bond are different.
    c. ATP cannot be generated from amylose.
    d. There is no structural difference between the polymers.

    ANS: B DIF: Medium REF: 1.2
    OBJ: 1.2.d. Identify the biomolecules that form polymers. MSC: Applying

16. If the concentration of aspartate in the cell decreased, what would be the predicted outcome?

    a. increased concentration of argininosuccinate
    b. decreased concentration of citrulline
    c. decreased concentration of fumarate
    d. increased concentration of arginine

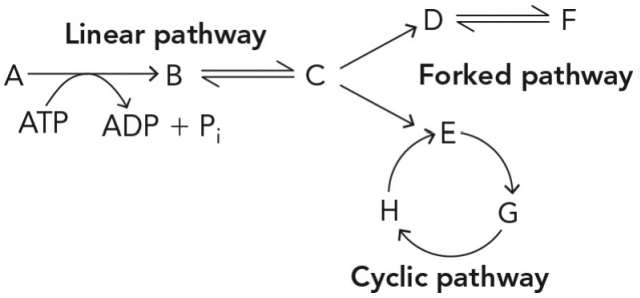
    ANS: C DIF: Difficult REF: 1.2
    OBJ: 1.2.e. Explain the role of metabolic pathways in living systems.
    MSC: Applying

17. The correct definition of a *pathway intermediate* is a molecule that
    a. is both a product and a reactant in a pathway.
    b. lowers the activation energy of a reaction.
    c. increases the rate of a reaction.

d. is only a reactant in a pathway.

ANS: A DIF: Medium REF: 1.2
OBJ: 1.2.e. Explain the role of metabolic pathways in living systems.
MSC: Understanding

18. If the concentration of F is high in a cell, the pathway will MOST likely shift to produce



a. more C.
b. less C.
c. more A.
d. less D.

ANS: D DIF: Difficult REF: 1.2
OBJ: 1.2.e. Explain the role of metabolic pathways in living systems.
MSC: Applying

19. Plasmids are small, circular DNA molecules that are used in which of the following?
a. gene cloning
b. production of chromatin
c. cell movement
d. replication of nucleus

ANS: A DIF: Easy REF: 1.2
OBJ: 1.2.e. Explain the role of metabolic pathways in living systems.
MSC: Remembering

20. What is the function of the chloroplast in a plant cell?
a. detoxification of macromolecules
b. degradation of macromolecules
c. conversion of light energy to chemical energy
d. conversion of glucose to ATP

ANS: C DIF: Medium REF: 1.2
OBJ: 1.2.f. Compare and contrast bacterial and eukaryotic cells.
MSC: Understanding

21. If a plasma membrane is hydrophobic, what kinds of amino acids are MOST likely to be found in the membrane?
a. hydrophilic amino acids
b. hydrophobic amino acids
c. polar amino acids
d. charged amino acids

ANS: B DIF: Medium REF: 1.2
OBJ: 1.2.g. Name the key organelles found in a eukaryotic cell.

MSC: Applying

22. When a ligand binds to a receptor, it causes the receptor to
    a. degrade.
    b. activate.
    c. deactivate.
    d. rapidly grow.

    ANS: B DIF: Easy REF: 1.2
    OBJ: 1.2.g. Name the key organelles found in a eukaryotic cell.
    MSC: Understanding

23. How does the molecule adenosine monophosphate fit into the seven hierarchical levels that define the chemical basis of life?
    a. element/functional group
    b. biomolecule
    c. metabolism
    d. organism

    ANS: B DIF: Medium REF: 1.2
    OBJ: 1.2.f. Compare and contrast bacterial and eukaryotic cells.
    MSC: Understanding

24. The main difference between deoxyribonucleotides and ribonucleotides is that they have a different
    a. number of carbons in the sugar ring.
    b. functional group on the 2′ carbon.
    c. number of phosphates on the 5′ carbon.
    d. functional group on the 3′ carbon.

    ANS: B DIF: Medium REF: 1.3
    OBJ: 1.3.b. Compare and contrast DNA and RNA. MSC: Understanding

25. A *hydrogen bond* can best be described as a
    a. strong covalent interaction.
    b. strong ionic interaction.
    c. weak noncovalent interaction.
    d. weak covalent interaction.

    ANS: C DIF: Easy REF: 1.3
    OBJ: 1.3.a. Identify the three components of a nucleotide. MSC: Remembering

26. Why can a guanine not be paired with adenine?
    a. Guanine is only found in RNA and adenine is found only in DNA.
    b. Guanine can form three hydrogen bonds and adenine can form two.
    c. Guanine can form only two hydrogen bonds and adenine can form three.
    d. Guanine can only pair with thymine.

    ANS: B DIF: Medium REF: 1.3
    OBJ: 1.3.b. Compare and contrast DNA and RNA. MSC: Analyzing

27. What structural feature of DNA is attributed to the fact that the two DNA strands are antiparallel?
    a. DNA is a left-handed helix.
    b. DNA has the phosphate groups on the interior.
    c. DNA is a right-handed helix.

d. DNA forms a pleated sheet.

ANS: C DIF: Medium REF: 1.3
OBJ: 1.3.b. Compare and contrast DNA and RNA. MSC: Applying

28. The "central dogma of molecular biology" can best be described as the transfer of information between
a. nucleic acids and proteins.
b. fatty acids and proteins.
c. carboxylic acids and proteins.
d. nucleic acids and DNA.

ANS: A DIF: Easy REF: 1.3
OBJ: 1.3.c. Define the central dogma of molecular biology. MSC: Remembering

29. A segment of DNA containing 20 base pairs includes 8 adenine residues. How many uracil residues are present?
a. 12
b. 8
c. 0
d. 28

ANS: C DIF: Difficult REF: 1.3
OBJ: 1.3.b. Compare and contrast DNA and RNA. MSC: Analyzing

30. A genome is a set of
a. proteins.
b. transcripts.
c. genes.
d. genetic code.

ANS: C DIF: Medium REF: 1.3
OBJ: 1.3.b. Compare and contrast DNA and RNA. MSC: Remembering

31. Given a DNA sequence of 3′-CAT-5′, what is the complementary sequence in mRNA?
a. 5′-GUA-3′
b. 5′-AUG-3′
c. 3′-GUA-5′
d. 5′-GTA-3′

ANS: A DIF: Difficult REF: 1.3
OBJ: 1.3.b. Compare and contrast DNA and RNA. MSC: Applying

32. Who received the Nobel Prize in 1962 for elucidating the molecular structure of DNA?
a. Albert Einstein
b. Linus Pauling
c. John Kendrew and Max Perutz
d. Maurice Wilkins, James Watson, and Francis Crick

ANS: D DIF: Easy REF: 1.3
OBJ: 1.3.c. Define the central dogma of molecular biology. MSC: Remembering

33. A single nucleotide base substitution in a wild-type DNA is an example of
a. random mutation.
b. transcription.

c. translation.
d. cloning.

ANS: A DIF: Easy REF: 1.4
OBJ: 1.4.a. Differentiate between germ-line cell mutations and somatic cell mutations.
MSC: Remembering

34. An inherited disease comes from the mutation of DNA in a _____ cell.
a. somatic
b. germ-line
c. adipose
d. blood

ANS: B DIF: Easy REF: 1.4
OBJ: 1.4.a. Differentiate between germ-line cell mutations and somatic cell mutations.
MSC: Understanding

35. The RNA world model is based on the hypothesis that _____ is stable.
a. RNA
b. DNA
c. uracil
d. adenine

ANS: B DIF: Medium REF: 1.2
OBJ: 1.4.a. Differentiate between germ-line cell mutations and somatic cell mutations.
MSC: Understanding

36. Bioinformatics shows that 98% of human DNA is identical to that of chimpanzees. If human DNA contains 3.2 billion nucleotides, how many nucleotides are different between the two species?
a. 3.1 billion
b. 64 million
c. 3.1 million
d. 640 million

ANS: B DIF: Medium REF: 1.2
OBJ: 1.4.c. Identify the relationship between protein structure and function.
MSC: Applying

37. Highly conserved gene sequences that encode proteins with the same function in different organisms are called _____ genes.
a. orthologous
b. conserved
c. parallel
d. antiparallel

ANS: A DIF: Easy REF: 1.4
OBJ: 1.4.b. Differentiate between orthologous genes and paralogous genes.
MSC: Understanding

38. If a mutation was made to the gene for glucose–6–phosphate dehydrogenase that prevented it from functioning, a possible outcome would be the production of
a. more NADPH.
b. less NADPH.
c. more ATP.
d. less ATP.

ANS: B DIF: Medium REF: 1.4
OBJ: 1.4.a. Differentiate between germ-line cell mutations and somatic cell mutations.
MSC: Applying

39. The appearance of new gene speciation is an example of
    a. gene multiplication.
    b. gene singulation.
    c. gene duplication.
    d. random mutation.

    ANS: B DIF: Easy REF: 1.4
    OBJ: 1.4.a. Differentiate between germ-line cell mutations and somatic cell mutations.
    MSC: Understanding

40. The amino acid sequence of a protein determines its structure. Which of the following statements is true?
    a. Two proteins with similar amino acid sequence should have similar structures.
    b. Two proteins with different amino acid sequences will have identical structures.
    c. Two proteins with similar amino acid sequences will always have the same function in a cell.
    d. It is impossible to determine how proteins will fold based on the amino acid sequence alone.

    ANS: A DIF: Medium REF: 1.4
    OBJ: 1.4.c. Identify the relationship between protein structure and function.
    MSC: Analyzing

41. Which of the following is NOT a common functional group?
    a. COOH
    b. CH_3
    c. SH
    d. CHO

    ANS: D DIF: Easy REF: 1.2
    OBJ: 1.2.b. Identify the most abundant functional groups found in biomolecules.
    MSC: Understanding

42. By convention, nucleic acid chains are written starting at the _____ end.
    a. amino
    b. carboxyl
    c. 3′
    d. 5′

    ANS: D DIF: Easy REF: 1.2
    OBJ: 1.2.b. Identify the most abundant functional groups found in biomolecules.
    MSC: Understanding

43. The proposal that DNA is a double helix was based on what experimental evidence?
    a. NMR
    b. IR
    c. HPLC
    d. x-ray crystallography

    ANS: D DIF: Medium REF: 1.4
    OBJ: 1.4.c. Identify the relationship between protein structure and function.

MSC: Understanding

44. mRNA is used for what process in the cell?
    a. as a template for protein synthesis
    b. regulation of gene expression
    c. regulation of RNA
    d. replication of DNA

    ANS: A DIF: Easy REF: 1.3
    OBJ: 1.3.d. Define the terms transcriptome and proteome. MSC: Understanding

45. In DNA the phosphate groups are on the outside of the helix. Why does this stabilize the structure?
    a. ionic interactions with the solvent
    b. hydrogen bonding with itself
    c. covalent binding to the solvent
    d. It does not stabilize the structure.

    ANS: A DIF: Difficult REF: 1.3
    OBJ: 1.3.b. Compare and contrast DNA and RNA. MSC: Applying

46. What is the cause of the overall negative charge of a molecule of DNA?
    a. hydrogen bonding between base pairs
    b. the phosphate backbone
    c. the sugars
    d. the antiparallel orientation of the DNA

    ANS: B DIF: Difficult REF: 1.3
    OBJ: 1.3.b. Compare and contrast DNA and RNA. MSC: Evaluating

47. Mutations to proteins typically occur starting
    a. at the protein itself.
    b. with mRNA.
    c. with tRNA.
    d. with DNA.

    ANS: D DIF: Medium REF: 1.3
    OBJ: 1.3.c. Define the central dogma of molecular biology. MSC: Analyzing

48. Hydrogen bonds form between hydrogen and
    a. oxygen.
    b. helium.
    c. carbon.
    d. hydrogen.

    ANS: A DIF: Medium REF: 1.3
    OBJ: 1.3.b. Compare and contrast DNA and RNA. MSC: Applying

49. The DNA double helix is stabilized by the interactions between nucleotides because of _____ between nucleotides.
    a. hydrogen bonding
    b. pi–pi stacking
    c. sigma bonds
    d. ionic interactions

    ANS: B DIF: Medium REF: 1.3
    OBJ: 1.3.b. Compare and contrast DNA and RNA. MSC: Analyzing

50. In structures of tRNA, base pairs form between
    a. the same strand.
    b. another strand of RNA.
    c. a strand of DNA.
    d. Base pairs do not form.

    ANS: A DIF: Medium REF: 1.3
    OBJ: 1.3.b. Compare and contrast DNA and RNA. MSC: Analyzing

51. Ribose is a
    a. four-carbon sugar.
    b. five-carbon sugar.
    c. six-carbon sugar.
    d. five-carbon acid.

    ANS: B DIF: Easy REF: 1.3
    OBJ: 1.3.b. Compare and contrast DNA and RNA. MSC: Remembering

52. The process of fermentation uses sugar to produce which molecules?
    a. alcohol and carbon monoxide
    b. alcohol and carbon dioxide
    c. acid and carbon monoxide
    d. acid and carbon dioxide

    ANS: B DIF: Medium REF: 1.1
    OBJ: 1.1.a. List examples where biochemistry has made advancements in the lives of many humans.
    MSC: Understanding

53. An example of experimental biochemistry is trying an experiment and
    a. quitting after it fails to prove your hypothesis.
    b. continuing to try with no changes to protocol.
    c. optimizing experimental design.
    d. successfully proving your hypothesis after the first attempt.

    ANS: C DIF: Medium REF: 1.1
    OBJ: 1.1.a. List examples where biochemistry has made advancements in the lives of many humans.
    MSC: Applying

54. What side products of pyruvate are being converted into alcohol and carbon dioxide by yeast?
    a. CO and NADH
    b. CO_2 and NADH
    c. CO_2 and NAD^+
    d. CO and NAD^+

    ANS: C DIF: Difficult REF: 1.2
    OBJ: 1.2.e. Explain the role of metabolic pathways in living systems.
    MSC: Applying

55. Pyruvate decarboxylase converts pyruvate into
    a. carbon dioxide and acetaldehyde.
    b. carbon monoxide and acetaldehyde.
    c. water and glucose.

d. ethanol and carbon dioxide.

ANS: A DIF: Medium REF: 1.1
OBJ: 1.1.a. List examples where biochemistry has made advancements in the lives of many humans.
MSC: Understanding

56. Which of the following is an example of a metabolic pathway?
a. mitochondria
b. organelles
c. glycolysis
d. plasma membrane

ANS: C DIF: Medium REF: 1.2
OBJ: 1.2.e. Explain the role of metabolic pathways in living systems.
MSC: Understanding

57. Which of the following is an example of an ecosystem?
a. mammals
b. plasma membrane
c. insects
d. forest

ANS: D DIF: Medium REF: 1.2
OBJ: 1.2.e. Explain the role of metabolic pathways in living systems.
MSC: Understanding

58. A requirement for a covalent bond to form between two atoms is that
a. there are unpaired electrons on each atom.
b. the atoms are ions.
c. both the atoms must be metals.
d. one of the atoms must be a halogen.

ANS: A DIF: Medium REF: 1.2
OBJ: 1.2.a. List the elements that are most abundant in living organisms.
MSC: Applying

59. What is the maximum number of covalent bonds a carbon atom can make?
a. 2
b. 4
c. 6
d. 8

ANS: B DIF: Easy REF: 1.2
OBJ: 1.2.a. List the elements that are most abundant in living organisms.
MSC: Applying

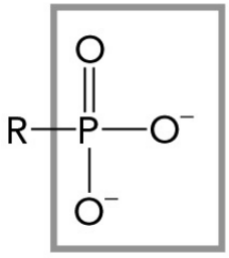
60. The correct name for the VSEPR arrangement around a carbon in methane is
a. linear.
b. trigonal bipyrimidal.
c. tetrahedral.
d. octahedral.

ANS: C DIF: Difficult REF: 1.2
OBJ: 1.2.a. List the elements that are most abundant in living organisms.
MSC: Analyzing

61. Cell signaling and cell membranes are examples of functions performed by which biomolecule?
    a. amino acid
    b. nucleotide
    c. simple sugar
    d. fatty acid

    ANS: D DIF: Medium REF: 1.2
    OBJ: 1.2.c. Name the four major classes of biomolecules and the primary cellular functions associated with each. MSC: Applying

62. The figure below shows an example of which functional group?



    a. amino
    b. hydroxyl
    c. phosphoryl
    d. methyl

    ANS: C DIF: Easy REF: 1.2
    OBJ: 1.2.c. Name the four major classes of biomolecules and the primary cellular functions associated with each. MSC: Understanding

63. ATP is an abbreviation for which *energy currency* molecule?
    a. adenosine triphosphate
    b. adenosine thymine
    c. adenosine dinucleotide
    d. amino triphosphate

    ANS: A DIF: Easy REF: 1.2
    OBJ: 1.2.c. Name the four major classes of biomolecules and the primary cellular functions associated with each. MSC: Understanding

64. Which of the following is the correct formula for glucose?
    a. $C_5H_{10}O_5$
    b. $C_6H_{12}O_6$
    c. $C_5H_{12}O_6$
    d. $C_6H_{10}O_6$

    ANS: B DIF: Easy REF: 1.2
    OBJ: 1.2.c. Name the four major classes of biomolecules and the primary cellular functions associated with each. MSC: Remembering

65. What is another way to describe the amphipathic nature of a fatty acid?
    a. polar head and nonpolar tail
    b. nonpolar head and polar tail
    c. polar head and double bonds in tail

d. nonpolar head and double bonds in tail

ANS: A DIF: Easy REF: 1.2
OBJ: 1.2.c. Name the four major classes of biomolecules and the primary cellular functions associated with each. MSC: Remembering

66. Triacylglycerols are neutral molecules made of
a. three fatty acid esters covalently linked to glycine.
b. three fatty acid esters covalently linked to glycerol.
c. two fatty acid esters covalently linked to glycine.
d. three acyls covalently linked to glycerol.

ANS: B DIF: Medium REF: 1.2
OBJ: 1.2.c. Name the four major classes of biomolecules and the primary cellular functions associated with each. MSC: Remembering

67. Proteins are a polymer of _____, whereas nucleic acids are polymers of _____.
a. nucleotides; fatty acid esters
b. nucleotides; amino acids
c. amino acids; nucleotides
d. sugars; nucleotides

ANS: C DIF: Medium REF: 1.2
OBJ: 1.2.d. Identify the biomolecules that form polymers. MSC: Understanding

68. Vitamin B_2 is a metabolite. Lack of vitamin B_2 can lead to blurred vision and a swollen tongue. Vitamin B_2 has such a strong effect on health because metabolites
a. are the catalysts that drive biochemical reactions necessary for life-sustaining processes.
b. are complex chemical reactions in cells.
c. process essential genetic information needed for life.
d. are needed for construction of microtubules.

ANS: A DIF: Difficult REF: 1.2
OBJ: 1.2.e. Explain the role of metabolic pathways in living systems.
MSC: Analyzing

69. Cyclic pathways contain several metabolites that regenerate during each turn of the cycle. Another way to describe a metabolite is that it functions as a
a. reactant or product.
b. catalysis.
c. transition state.
d. enzyme.

ANS: A DIF: Medium REF: 1.2
OBJ: 1.2.e. Explain the role of metabolic pathways in living systems.
MSC: Applying

70. Enzymes and chromosome are found where in the bacterial cell?
a. nucleoid
b. pili
c. cytoplasm
d. capsule

ANS: C DIF: Easy REF: 1.2
OBJ: 1.2.g. Name the key organelles found in a eukaryotic cell.
MSC: Understanding

71. What does chromatin in eukaryotic nucleus contain?
    a. DNA packaged with proteins.
    b. RNA packaged with proteins.
    c. ATP packaged with proteins.
    d. DNA packaged with ATP.

    ANS: A DIF: Medium REF: 1.2
    OBJ: 1.2.g. Name the key organelles found in a eukaryotic cell.
    MSC: Understanding

72. The function of chloroplasts in plant cells is to convert
    a. heat energy to light energy.
    b. heat energy to chemical energy.
    c. light energy to chemical energy.
    d. chemical energy to heat energy.

    ANS: C DIF: Easy REF: 1.2
    OBJ: 1.2.g. Name the key organelles found in a eukaryotic cell.
    MSC: Applying

73. What process replicates DNA to make more DNA?
    a. DNA transcription
    b. DNA replication
    c. DNA translation
    d. RNA transcription

    ANS: B DIF: Easy REF: 1.3
    OBJ: 1.3.c. Define the central dogma of molecular biology. MSC: Understanding

74. What process converts DNA to RNA?
    a. DNA transcription
    b. DNA replication
    c. DNA translation
    d. RNA transcription

    ANS: A DIF: Easy REF: 1.3
    OBJ: 1.3.c. Define the central dogma of molecular biology. MSC: Understanding

75. What process describes using mRNA templates to produce proteins?
    a. DNA transcription
    b. DNA replication
    c. DNA translation
    d. mRNA translation

    ANS: D DIF: Easy REF: 1.3
    OBJ: 1.3.c. Define the central dogma of molecular biology. MSC: Understanding

SHORT ANSWER

1. What are the three biochemical principles that together provide a framework for understanding life at the molecular level? How are they interrelated?

    ANS:

Hierarchical organization of biochemical processes within cells, organisms, and ecosystems underlies the chemical basis of life on Earth. DNA is the chemical basis for heredity and encodes the structural information for RNA and protein molecules, which mediate biochemical processes in cells. The function of a biomolecule is determined by its molecular structure, which is fine-tuned by evolution through random DNA mutations and natural selection. These processes cannot function without each other.

DIF: Easy REF: Introduction
OBJ: 1.1.a. List examples where biochemistry has made advancements in the lives of many humans.
MSC: Understanding

2. List three examples of how biochemistry has made advancements in the lives of many humans.

ANS:
A list can be found in Section 1.1 of the text. Examples include developing new pharmaceutical drugs, diagnostic tests, improved detergents, and faster ripening of fruit and vegetables.

DIF: Easy REF: 1.1
OBJ: 1.1.a. List examples where biochemistry has made advancements in the lives of many humans.
MSC: Remembering

3. Which six elements make up 97% of the weight of most organisms?

ANS:
Hydrogen, oxygen, carbon, nitrogen, phosphorus, and sulfur

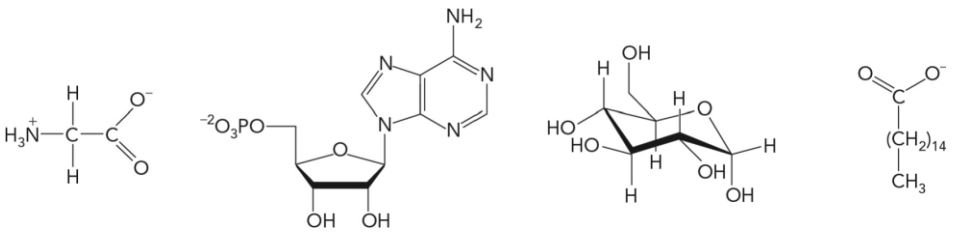
DIF: Easy REF: 1.2
OBJ: 1.2.a. List the elements that are most abundant in living organisms.
MSC: Remembering

4. Identify the following functional groups.

ANS:
Amino, hydroxyl, sulfhydryl, phosphoryl, carboxyl, methyl

DIF: Easy REF: 1.2
OBJ: 1.2.b. Identify the most abundant functional groups found in biomolecules.
MSC: Understanding

5. Identify the following biomolecules.



ANS:
Amino acid, nucleotide, sugar, fatty acid

DIF: Easy REF: 1.2
OBJ: 1.2.c. Name the four major classes of biomolecules and the primary cellular functions associated with each. MSC: Understanding

6. What functions can polysaccharides perform?

ANS:
They provide structural support to cells and energy storage.

DIF: Difficult REF: 1.2
OBJ: 1.2.c. Name the four major classes of biomolecules and the primary cellular functions associated with each. MSC: Applying

7. What is an advantage of using polypeptides for storage and information transmission?

ANS:
The complexity of monomeric units forms a stable arrangement that is perfect for information storage and transmission.

DIF: Difficult REF: 1.2
OBJ: 1.2.d. Identify the biomolecules that form polymers. MSC: Evaluating

8. Explain how a linear pathway is different from a forked pathway.

ANS:
In a linear pathway, a reaction generates only one product that is then used in the next reaction. In a forked pathway, two products are produced that each enter a different metabolic pathway.

DIF: Difficult REF: 1.2
OBJ: 1.2.e. Explain the role of metabolic pathways in living systems.
MSC: Analyzing

9. Compare and contrast at least three different characteristics of prokaryotic and eukaryotic cells.

ANS:
Prokaryotes are often 1 μm in diameter, their cytoplasm contains all the enzymes and chromosomes, and they have flagella and pili. Eukaryotic cells are 10 to 100 μm in diameter, chromatin is contained in the nucleus, and they have a cytoskeleton.

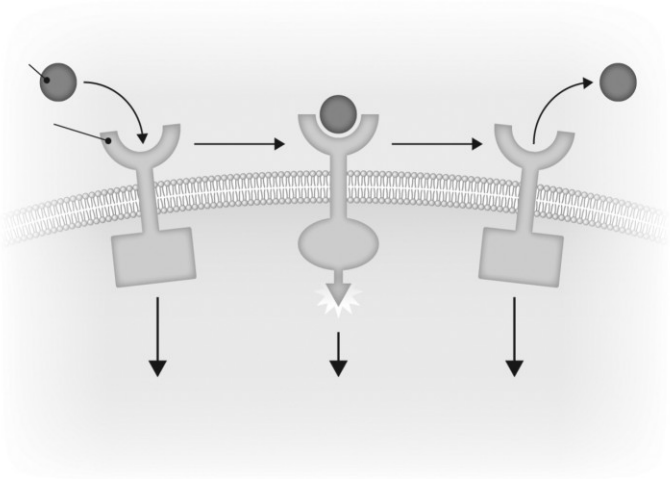
DIF: Difficult REF: 1.2
OBJ: 1.2.f. Compare and contrast bacterial and eukaryotic cells.
MSC: Analyzing

10. Name four organelles found in a eukaryotic cell.

ANS:
Many answers are correct including the following: lysosome, smooth endoplasmic reticulum, rough endoplasmic reticulum, ribosomes, peroxisome, mitochondria, nucleus, Golgi apparatus, and cytoskeleton.

DIF: Easy REF: 1.2
OBJ: 1.2.g. Name the key organelles found in a eukaryotic cell.
MSC: Remembering

11. Describe how a receptor is activated and inactivated by a ligand in the figure below.



ANS:
The receptor ligand is bound to the receptor, which causes a conformation change to the active site on the protein. The ligand is then released and returns the receptor to an inactive conformation.

DIF: Difficult REF: 1.2
OBJ: 1.2.h. Explain the role of receptors in multicellular organisms.
MSC: Analyzing

12. Name the three components of a nucleotide.

ANS:
Nucleotide base, five-carbon ribose, and one or more phosphate groups

DIF: Easy REF: 1.3
OBJ: 1.3.a. Identify the three components of a nucleotide. MSC: Remembering

13. Compare and contrast the bases found in DNA and RNA.

ANS:
DNA is composed of the deoxyribonucleotides (lacking an hydroxyl group on the $2'$ position of ribose) guanine, cytosine, adenine, and thymine. RNA is composed of ribonucleotides (containing an hydroxyl group on the $2'$ position of ribose) guanine, cytosine, adenine, and uracil.

DIF: Medium REF: 1.3 OBJ: 1.3.b. Compare and contrast DNA and RNA.
MSC: Analyzing

14. Define the central dogma of molecular biology.

ANS:

The central dogma of molecular biology describes how genetic information stored in DNA is used to direct the biological processes in cells.

DIF: Medium REF: 1.3
OBJ: 1.3.c. Define the central dogma of molecular biology. MSC: Remembering

15. Compare and contrast a transcriptome and a proteome.

ANS:
Although both transcriptomes and proteomes are collections of genetic material, a collection of DNA transcripts (RNA products) generated by DNA transcription is called a transcriptome, whereas a proteome is the collection of proteins produced by mRNA translation.

DIF: Difficult REF: 1.3
OBJ: 1.3.d. Define the terms transcriptome and proteome. MSC: Analyzing

16. Differentiate between germ-line cell mutations and somatic cell mutations.

ANS:
Although both are mutations in DNA, if the mutation is passed from the parent to the offspring, then the mutation is contained within the DNA of a germ-line cell. If the DNA mutation occurs during the lifetime of the organism in a somatic cell, then this disease is limited to that individual organism.

DIF: Difficult REF: 1.4
OBJ: 1.4.a. Differentiate between germ-line cell mutations and somatic cell mutations.
MSC: Analyzing

17. Differentiate between orthologous genes and paralogous genes.

ANS:
Orthologous genes are highly conserved gene sequences that encode proteins with the same function in different organisms and are believed to have arisen from a common ancestral gene. Paralogous genes are related genes within a species. Paralogous genes have orthologous genes in other species.

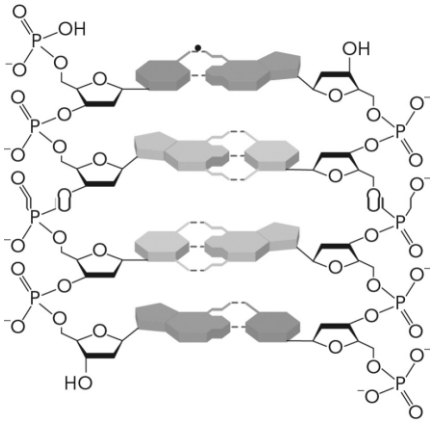
DIF: Difficult REF: 1.4
OBJ: 1.4.b. Differentiate between orthologous genes and paralogous genes.
MSC: Analyzing

18. Evaluate the following statement: Two amino acid sequences with high sequence conservation must have the same function in an organism.

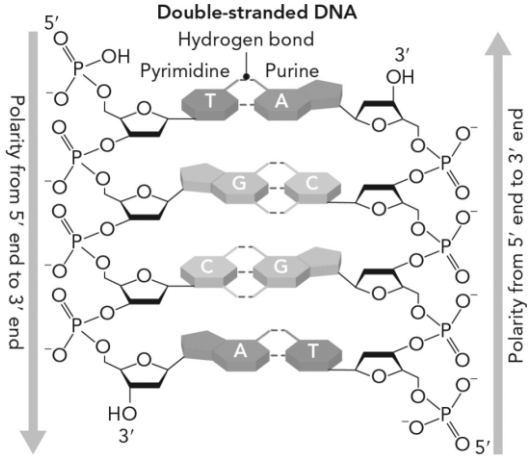
ANS:
Although two amino acid sequences with high sequence conservation may have the same structure, it does not mean that those two proteins will perform the same function in a body. As is shown in Figure 1.30, similar structures may have different function.

DIF: Difficult REF: 1.4
OBJ: 1.4.c. Identify the relationship between protein structure and function.
MSC: Evaluating

19. For the figure below, label the 5′ and 3′ ends for each strand, the hydrogen bonds, and the pyrimidine and purine molecules, as well as the direction of polarity.



ANS:



DIF: Medium REF: 1.2 OBJ: 1.3.b. Compare and contrast DNA and RNA.
MSC: Remembering

20. Describe the difference between a deoxyribonucleotide and a ribonucleotide.

ANS:
Deoxyribonucleotides are monomeric units of DNA and lack a hydroxyl group on the carbon on the 2′ position, whereas a ribonucleotide does have a hydroxyl group on the carbon on the on the 2′ position.

DIF: Medium REF: 1.2 OBJ: 1.3.b. Compare and contrast DNA and RNA.
MSC: Applying

21. Give an example of each of the following: element, biomolecule, macromolecule, metabolism, cell, organism, and ecosystem.

ANS:
Any element from the periodic table is acceptable;
Biomolecules: amino acids, nucleotides, simple sugars, fatty acids;
Macromolecules: DNA/RNA, proteins, carbohydrates;
Metabolism: glycolysis, citrate cycle, urea cycle;

Cells: cell wall, plasma membrane, organelles;
Organisms: trees, mammals, fish, bird, insects;
Ecosystems: rivers, islands, forest, desert.

DIF: Medium REF: 1.2
OBJ: 1.2.a. List the elements that are most abundant in living organisms.
MSC: Remembering

22. Amino acids are the building blocks of proteins. There are 20 amino acids; how do these amino acids differ from one another?

ANS:
Amino acids differ from one another in the side chain attached to the central carbon.

DIF: Easy REF: 1.2
OBJ: 1.2.c. Name the four major classes of biomolecules and the primary cellular functions associated with each. MSC: Applying

23. Describe the differences between the structures of pyrimidine and a purine.

ANS:
A pyrimidine is an aromatic molecule with nitrogen at positions 1 and 3 on the ring, along with a carbonyl at position 4. Examples of pyrimidines are cytosine, thymine, and uracil. A purine is a heterocyclic aromatic molecule with nitrogen at positions 1, 3, 7, and 9. Examples of purines are guanine and adenine.

DIF: Difficult REF: 1.3
OBJ: 1.3.a. Identify the three components of a nucleotide. MSC: Analyzing

24. What is the function of mRNA in the cell?

ANS:
mRNA is used as templates for protein synthesis in a process referred to as mRNA translation.

DIF: Easy REF: 1.3 OBJ: 1.3.b. Compare and contrast DNA and RNA.
MSC: Analyzing

25. If you were a biochemist who just discovered a new protein, how would you gain insight into the function of the protein?

ANS:
One way to gain insight into the function of a protein is to compare its amino acid sequence to those of other proteins to see if conserved regions appear that might suggest an important function. This is done using the genetic code to convert the DNA sequence in the coding stand of a gene into the inferred amino acid sequence of the encoded protein.

DIF: Difficult REF: 1.4
OBJ: 1.4.c. Identify the relationship between protein structure and function.
MSC: Evaluating