Chapter 02: Concepts in Biochemistry
Test Bank

MULTIPLE CHOICE

1. Each of the following is a major area of biochemistry except one. Which one is the exception?
   a. Structure
   b. Function
   c. Metabolism
   d. Information

   ANS: B
   Function is not a major area of biochemistry. The three major areas of biochemistry, the study of life at the molecular level, are structure, metabolism, and information.

   REF: p. 35

2. A biomolecule is a substance required by the body that must be supplied by an outside source. During metabolism, energy can be extracted from dietary carbohydrates, proteins, lipids and can be used to create biomolecules required for life.
   a. Both statements are true.
   b. Both statements are false.
   c. The first statement is true; the second is false.
   d. The first statement is false; the second is true.

   ANS: B
   The first statement is incorrect because it defines a nutrient instead of a biomolecule. Note that with a nutrient, the substance must be supplied from an outside source, typically food. A biomolecule is any molecule that is produced by a living cell or organism, which would include carbohydrates, proteins, nucleic acids, and lipids.

   REF: p. 35

3. The biomolecules necessary for life are based on carbon because carbon has the ability to form glycosidic bonds to itself and many other atoms.
   a. Both the statement and the reason are correct and related.
   b. Both the statement and the reason are correct, but are not related.
   c. The statement is correct, but the reason is not correct.
   d. The statement is not correct, but the reason is correct.
   e. Neither the statement nor the reason is correct.

   ANS: C
   Biomolecules are based on carbon because carbon has the ability to form stable covalent bonds with itself and with many other atoms. A covalent bond forms when electrons are shared equally between two nonmetals. A glycosidic bond forms when a disaccharide is formed from two monosaccharides reacting together.

   REF: pp. 35-36

4. The biological function that plants use to make the carbohydrate animals can use for energy and oxygen is called:
   a. oxidation-reduction.
   b. condensation.
   c. hydrolysis.
   d. photosynthesis.

   ANS: D
   Photosynthesis is the biological function that plants use to make the carbohydrate $C_6H_{12}O_6$ (glucose), a carbohydrate that animals can use for energy and storage. Oxidation-reduction, condensation, and hydrolysis are chemical reactions that can convert functional groups into other functional groups.

   REF: p. 36

5. In metabolism, energy is extracted from glucose ($C_6H_{12}O_6$) and converted to carbon dioxide (CO_2) by which chemical reaction?
   a. Oxidation
   b. Reduction
   c. Hydrolysis
   d. Condensation

   ANS: A
   During metabolism, the chemical reaction called *oxidation* extracts energy from glucose and converts it to carbon dioxide. This is termed a *complete oxidation*. Note that oxidation is the loss of electrons, increase in charge, gain of O atoms or loss of H atoms.

   REF: p. 36

6. In general, a condensation reaction creates a new molecule by:
   a. breaking a larger molecule into two smaller molecules.
   b. forming an ionic bond between a metal and a nonmetal ion.
   c. forming a bond between two smaller molecules.
   d. sharing two electrons between two nonmetals.

   ANS: C
   In general, a condensation reaction creates a new molecule by forming a bond between two smaller molecules. Regarding the incorrect selections, a hydrolysis reaction breaks a larger molecule into two smaller molecules. Ionic bonds are formed between a metal and a nonmetal ion. A covalent bond forms when two electrons are equally shared between two nonmetals.

   REF: p. 36

7. Biochemists organize the variety in chemical structure by classifying molecules into functional groups. A functional group is a group of atoms that gives a family of molecules its characteristic chemical and physical properties.
   a. Both statements are true.
   b. Both statements are false.
   c. The first statement is true; the second is false.
   d. The first statement is false; the second is true.

   ANS: A

Molecules that have similar functional groups have similar properties. In addition to carbon, the combination of different atoms like hydrogen (H), oxygen (O), nitrogen (N), sulfur (S), and phosphorus (P) form biomolecules that provide great variety in chemical structure, properties and reactivity in biological systems.

REF: p. 36

8. Each of the following exemplifies glycosidic bonding reactions except one. Which one is the exception?
   a. A condensation reaction can unite two glucose monomers into maltose.
   b. Maltose is a disaccharide that results from degradation of starch.
   c. Maltose is used in brewing and in alcoholic beverages.
   d. The disaccharide lactose is formed from the two monosaccharides: galactose and glucose.
   e. When fructose and sucrose combine, glucose is formed.

   ANS: D
   The monosaccharides glucose and fructose react together to form the disaccharide sucrose. Sucrose is table sugar and is one of the sweetest of the carbohydrates.

   REF: p. 36 | p. 38

9. Carbohydrates are classified as each of the following except one. Which one is the exception?
   a. Monosaccharides
   b. Disaccharides
   c. Polysaccharides
   d. Triglycerides

   ANS: D
   Triglycerides, also referred to as *triacylglycerols*, are the storage forms of fatty acids and are considered the metabolic fuel for cells stored in adipose (fat) tissue.

   REF: p. 36 | p. 38

10. Which function has the least priority for protein?
    a. Energy storage
    b. Providing structure
    c. Muscle contraction
    d. Catalyzing reactions
    e. Regulating metabolism

    ANS: A
    Energy storage is a primary function of carbohydrates and fats. Although protein can produce and store energy, this is not a primary role and takes away from other vital roles. The remaining selections are priority functions of protein. Note that catalyzing a reaction involves breaking down of components, such as when more complex molecules are catabolized into smaller molecules.

    REF: p. 38 | p. 39

11. Enzymes perform all the chemical reactions of metabolism involving degradation and biosynthesis of biomolecules required for life. Proteases, amylases, and lipases are coenzymes.
    a. Both statements are true.
    b. Both statements are false.
    c. The first statement is true; the second is false.
    d. The first statement is false; the second is true.

    ANS: C
    Proteases, amylases, and lipases are enzymes that begin the process of digesting dietary proteins, carbohydrates, and lipids, respectively.

    REF: p. 39

12. Coenzymes are protein organic substances that assist enzymes in converting the substrate into a carbohydrate. Many vitamins are converted into biologically active coenzymes.
    a. Both statements are true.
    b. Both statements are false.
    c. The first statement is true; the second is false.
    d. The first statement is false; the second is true.

    ANS: D
    Coenzymes are nonprotein organic substances that assist enzymes in converting the substrate into a product. The product may be a carbohydrate, but not necessarily. Coenzymes are regenerated at the end of the reactions.

    REF: p. 39 | p. 40

13. Each of the following is true of proteins except one. Which one is the exception?
    a. Proteins are composed of building blocks called *amino acids*.
    b. The classification of the 20 common amino acids is based on the structure of their amino group.
    c. The general structure of an amino acid varies considerably.
    d. Amino acids polymerize to form long chains called *polypeptides.*
    e. Amino acids contain strong covalent peptide bonds.

    ANS: B
    The classification of the 20 common amino acids is based on the structure of their side chain. The side chain is one component of the general structure of an amino acid and is also called the *R group*. The other two components are the amino group and the carboxyl group.

    REF: p. 38 | p. 39

14. Each of the following is a component of an amino acid except one. Which one is the exception?
    a. Carbon dioxide group (CO_2)
    b. Amino group ($-NH_3^+$)
    c. Carboxyl group ($-COO^-$)
    d. Side chain (R group)

    ANS: A

Carbon dioxide is not a component of an amino acid. It is a product from the oxidation of glucose. The amino group, the carboxyl group, and the R group form the general structure of an amino acid. Proteins can consist of as few as 50 to as many as millions of amino acid monomers.

REF: p. 38

15. Each of the following is a characteristic or function of lipids except one. Which one is the exception?
    a. Lipids are involved in energy metabolism and storage.
    b. Lipids provide insulation and protection.
    c. Lipids acts as hormones that regulate the body.
    d. Lipids are hydrophilic.

    ANS: D
    Lipids are hydrophobic, water-fearing, compounds that do not combine readily with water. In contrast, carbohydrates and proteins are hydrophilic, or water loving.

    REF: p. 40 | p. 41

16. Fatty acids are structural components that are present in more complex lips, such as triglycerides (TGs). Also referred to as *triacylglycerols*, TGs synthesize fatty acids.
    a. Both statements are true.
    b. Both statements are false.
    c. The first statement is true; the second is false.
    d. The first statement is false; the second is true.

    ANS: C
    Triglycerides, also referred to as *triacylglycerols*, do not synthesize fatty acids. TGs are the storage forms of fatty acids (Fas) and are considered the metabolic fuel for cells stored in adipose (fat) tissue.

    REF: p. 41

17. Saturated fatty acids are alkenes that contain one or more C=C (double) bond. Unsaturated fatty acids, contain only one C=C bond.
    a. Both statements are true.
    b. Both statements are false.
    c. The first statement is true; the second is false.
    d. The first statement is false; the second is true.

    ANS: B
    Fatty acids can be classified according to the presence or absence of C=C (double) bonds. Saturated fatty acids contain only C-C (single) bonds while unsaturated fatty acids contain one or more C=C bonds. Saturated fatty acids are called *alkenes*. Monounsaturated fatty acids such as oleic acid contain just one C=C bond, whereas polyunsaturated fatty acids such as linoleic acid contain more than one C=C bond.

    REF: p. 41

18. Antioxidants like vitamins C and E are added to unsaturated fats because antioxidants prevent rancidity associated with the oxidation during preparation of vegetable oils and margarines.

a. Both the statement and the reason are correct and related.
b. Both the statement and the reason are correct but are not related.
c. The statement is correct, but the reason is not correct.
d. The statement is not correct, but the reason is correct.
e. Neither the statement nor the reason is correct.

ANS: A
A common but unwanted reaction involving C=C bonds is oxidation. Oxidation of unsaturated fats leads to rancidity; therefore, antioxidants, such as vitamins C and E, are added to vegetable oils as a preventive measure.

REF: p. 44

19. Cholesterol is the most abundant lipoprotein and is important to biological membranes. Cholesterol is also the precursor of steroid hormones, bile acids, and the lipid-soluble vitamin D.
a. Both statements are true.
b. Both statements are false.
c. The first statement is true; the second is false.
d. The first statement is false; the second is true.

ANS: C
Cholesterol is not a lipoprotein; it belongs to a class of lipids known as *steroids*. Cholesterol is the most abundant steroid and is an important stabilizing component of biological membranes. The second statement describes other important functions of cholesterol.

REF: p. 44

20. During the Krebs cycle complete aerobic oxidation of glucose ($C_6H_{12}O_6$) produces each of the following except one. Which one is the exception?
a. CO_2
b. H_2O
c. ATP
d. Amino acids

ANS: D
During the Krebs cycle, also known as the TCA cycle, complete aerobic oxidation of glucose produces carbon dioxide (CO_2), water (H_2O), and adenosine triphosphate (ATP). Glucose is a carbohydrate, whereas amino acids are broken down from proteins. Although amino acids are involved in the Krebs cycle, the production of CO_2, water, and ATP from glucose differs from the production of amino acids from protein. Note that lipids are also catabolized during the Krebs cycle. Ultimately, the end products of catabolism of all nutrients are CO_2, H_2O, and ammonia (NH_3).

REF: p. 47

21. When the body's stores of energy are depleted, the pancreas becomes involved because gluconeogenesis can convert pyruvate into glucose for energy.
a. Both the statement and the reason are correct and related.
b. Both the statement and the reason are correct but are not related.
c. The statement is correct, but the reason is not correct.

d. The statement is not correct, but the reason is correct.
e. Neither the statement nor the reason is correct.

ANS: D
When the body's energy stores are depleted, the liver becomes involved by converting pyruvate and other simple noncarbohydrate precursors, such as lactate and amino acids into glucose for energy. This mechanism of energy production is a last-resort effort. The preferred source of energy is dietary glucose. Excess dietary glucose is stored as the polysaccharide glycogen in muscles and the liver. Later, when blood glucose levels decrease and the body needs energy, glycogen is converted back into glucose. Only when glycogen is depleted does the liver resort to gluconeogenesis.

REF: p. 47

22. Each of the following is true of lipids except one. Which one is the exception?
a. The catabolism of lipids is a major source of energy for the body.
b. Lipids can by oxidized to produce more energy than carbohydrates or proteins.
c. The hydrous nature of lipids make them retain water.
d. Lipids can be stored in adipose tissue in unlimited amounts.

ANS: C
Lipids are not hydrous, meaning that they do not have water content. They are best described as anhydrous, or without water. This characteristic enables lipids to produce more energy per gram than either carbohydrates or proteins. Lipids produce 9 kcal/g, whereas carbohydrates and proteins both produce 4 kcal/g. These characteristics combined with their unlimited storage capacity explain why catabolism (break down) of lipids is a major source of energy for the body.

REF: p. 48