

Microbiology with Diseases by Body System, 4e (Bauman)
Chapter 2 The Chemistry of Microbiology

2.1 Multiple Choice Questions

1) Which of the following is a particle found in the nucleus of an atom and that has no electrical charge?

- A) electron
- B) neutron
- C) element
- D) proton
- E) isotope

Answer: B

Bloom's Taxonomy: Knowledge

Section: Atoms

Learning Outcome: 2.2

2) Matter composed of a single type of atom is known as a(n)

- A) element.
- B) mineral.
- C) molecule.
- D) compound.
- E) electron.

Answer: A

Bloom's Taxonomy: Knowledge

Section: Atoms

Learning Outcome: 2.1

3) A stable atom has _____ in its valence shell.

- A) 4 electrons
- B) 2 neutrons
- C) 8 electrons
- D) 8 protons
- E) 10 electrons

Answer: C

Bloom's Taxonomy: Comprehension

Section: Chemical Bonds

Learning Outcome: 2.4

4) Which parts of the atoms interact in a chemical reaction?

- A) protons
- B) neutrons
- C) ions
- D) electrons
- E) isotopes

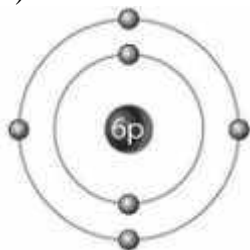
Answer: D

Bloom's Taxonomy: Comprehension

Section: Chemical Bonds

Learning Outcome: 2.4

5)



The outer ring in Figure 2-1 represents

- A) an electron.
- B) the nucleus.
- C) an isotope.
- D) an electron shell.
- E) a neutron.

Answer: D

Bloom's Taxonomy: Comprehension

Section: Atoms

Learning Outcome: 2.2

6) The valence of an atom represents its

- A) ability to interact with other atoms.
- B) electronegativity.
- C) radioactivity.
- D) ability to attract electrons.
- E) ability to interact with water.

Answer: A

Bloom's Taxonomy: Comprehension

Section: Chemical Bonds

Learning Outcome: 2.4

7) The type(s) of bonds produced when atoms share electrons equally is/are

- A) a nonpolar covalent bond.
- B) a hydrogen bond.
- C) an ionic bond.
- D) a polar covalent bond.
- E) both polar covalent and ionic bonds.

Answer: A

Bloom's Taxonomy: Comprehension

Section: Chemical Bonds

Learning Outcome: 2.6

8) The type(s) of bond produced when atoms with somewhat different electronegativities share electrons is/are

- A) a nonpolar covalent bond.
- B) a polar covalent bond.
- C) an ionic bond.
- D) a hydrogen bond.
- E) both nonpolar covalent and ionic bonds.

Answer: B

Bloom's Taxonomy: Comprehension

Section: Chemical Bonds

Learning Outcome: 2.7

9) A research microbiologist wants to determine whether a microbe can metabolize a new synthetic organic molecule composed of carbon, hydrogen and oxygen. Which of the following would be useful in tracing the fate of the compound?

- A) the ^{14}C isotope
- B) the ^2H isotope
- C) the ^{13}C isotope
- D) the ^{12}C isotope
- E) a $^{13}\text{C}^+$ ion.

Answer: A

Bloom's Taxonomy: Application

Section: Atoms

Learning Outcome: 2.3

10) Unstable isotopes can be useful

- A) catalysts.
- B) in medical diagnosis.
- C) in vitamins.
- D) in the formation of hydrogen bonds.
- E) as buffers.

Answer: B

Bloom's Taxonomy: Application

Section: Atoms

Learning Outcome: 2.3

11) Which of the following is a CORRECT pairing of metabolic terms?

- A) dehydration: decomposition
- B) catabolism: endothermic
- C) hydrolysis: decomposition
- D) synthesis: catabolism
- E) synthesis: exothermic

Answer: C

Bloom's Taxonomy: Comprehension

Section: Chemical Reactions

Learning Outcome: 2.10

12) Compounds that readily dissociate in water are

- A) nonpolar.
- B) ionic.
- C) polar.
- D) either polar or ionic.
- E) never polar or ionic.

Answer: D

Bloom's Taxonomy: Comprehension

Section: Chemical Bonds

Learning Outcome: 2.8

13) Which of the following is a property of water?

- A) It has a high capacity for heat.
- B) It is not a common reactant in metabolic reactions.
- C) It is not a good solvent.
- D) It is liquid in a very narrow temperature range.
- E) It is a nonpolar molecule.

Answer: A

Bloom's Taxonomy: Comprehension

Section: Water, Acids, Bases, and Salts

Learning Outcome: 2.15

14) An acid dissociates in water to release

- A) hydrogen ions.
- B) cations.
- C) hydroxyl groups.
- D) anions.
- E) both anions and hydrogen ions.

Answer: E

Bloom's Taxonomy: Knowledge

Section: Water, Acids, Bases, and Salts

Learning Outcome: 2.16

15) The reverse of a dehydration synthesis reaction is a(n) _____ reaction.

- A) anabolic
- B) exchange
- C) hydrolysis
- D) endothermic
- E) metabolic

Answer: C

Bloom's Taxonomy: Knowledge

Section: Chemical Reactions

Learning Outcome: 2.13

16) A hydroxyl _____ acts as a base.

- A) group
- B) anion
- C) atom
- D) cation
- E) salt

Answer: B

Bloom's Taxonomy: Comprehension

Section: Water, Acids, Bases, and Salts

Learning Outcome: 2.16

17) The chemical formula of a solid indicates it contains two groups with different electronegativities. This substance is most likely

- A) a mixture.
- B) a salt.
- C) a nonpolar molecule.
- D) radioactive.
- E) non-ionic.

Answer: B

Bloom's Taxonomy: Application

Section: Chemical Bonds

Learning Outcome: 2.8

18) You are performing an experiment in your chemistry lab class. The directions advise caution because the reaction is exothermic. Which of the following is the hazard the directions warn about?

- A) The reaction will generate radiation.
- B) The reaction will produce a noxious vapor.
- C) The reaction may cause the container to become dangerously hot.
- D) The reaction may cause the container to freeze and break.
- E) The reaction will generate enough light to require eye protection.

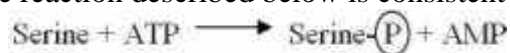
Answer: C

Bloom's Taxonomy: Application

Section: Chemical Reactions

Learning Outcome: 2.12

19) The reaction described below is consistent with



- A) a synthesis reaction.
- B) a catabolic reaction.
- C) a decomposition reaction.
- D) an exchange reaction.
- E) both synthesis and decomposition.

Answer: D

Bloom's Taxonomy: Comprehension

Section: Chemical Reactions

Learning Outcome: 2.14

20) Nucleic acid polymers, proteins, and complex carbohydrates are all produced by

- A) hydrolytic reactions.
- B) dehydration synthesis.
- C) exchange reactions.
- D) hydrogen bonding.
- E) catabolic reactions.

Answer: B

Bloom's Taxonomy: Application

Section: Organic Macromolecules

Learning Outcome: 2.11

21) Which of the following is an example of a polysaccharide?

- A) glycogen
- B) glucose
- C) fructose
- D) deoxyribose
- E) sucrose

Answer: A

Bloom's Taxonomy: Comprehension

Section: Organic Macromolecules

Learning Outcome: 2.20

22) Research suggests taking antacids may make people more susceptible to infection with *Vibrio vulnificus* by making the stomach environment more tolerable to the bacteria. Based on this information and the name "antacid," which of the following are antacids likely to be?

- A) acids
- B) bases
- C) non-polar compounds
- D) buffers
- E) either base or buffer

Answer: E

Bloom's Taxonomy: Application

Section: Water, Acids, Bases, and Salts

Learning Outcome: 2.16

23) All of the following are components of an amino acid EXCEPT a(n)

- A) carboxyl group.
- B) pentose group.
- C) amino group.
- D) α -carbon.
- E) R group.

Answer: B

Bloom's Taxonomy: Comprehension

Section: Organic Macromolecules

Learning Outcome: 2.17

24) Which of the following is found in nucleic acids?

- A) amino groups
- B) carboxylic acid
- C) purines
- D) glycerol
- E) R group

Answer: C

Bloom's Taxonomy: Comprehension

Section: Organic Macromolecules

Learning Outcome: 2.23

25) Hydrogen bonds are found in all of the following EXCEPT

- A) between phosphates in ATP.
- B) in the structure of complex polysaccharides.
- C) between water molecules.
- D) in the DNA double helix between nucleotides.
- E) between the R groups of amino acids in proteins.

Answer: A

Bloom's Taxonomy: Application

Section: Chemical Bonds

Learning Outcome: 2.9

26) Tertiary and quaternary structure of proteins involves _____ bonds.

- A) hydrogen
- B) ionic
- C) polar covalent
- D) nonpolar covalent
- E) hydrogen, ionic, polar, and nonpolar covalent

Answer: E

Bloom's Taxonomy: Application

Section: Organic Macromolecules

Learning Outcome: 2.22

27) Which of the following are examples of pyrimidines?

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

Answer: E

Bloom's Taxonomy: Comprehension

Section: Organic Macromolecules

Learning Outcome: 2.23

28) A macromolecule containing two fatty acids and a phosphate group is a

- A) wax.
- B) phospholipid.
- C) steroid.
- D) saturated fatty acid.
- E) glycerol.

Answer: B

Bloom's Taxonomy: Knowledge

Section: Organic Macromolecules

Learning Outcome: 2.18

29) The "backbone" of the DNA molecule is composed of

- A) amino acids.
- B) pentoses.
- C) phosphates.
- D) nitrogenous bases.
- E) alternating phosphates and pentoses.

Answer: E

Bloom's Taxonomy: Application

Section: Organic Macromolecules

Learning Outcome: 2.24

30) Which of the following would NOT normally be found as a component of a cell's nucleic acids?

- A) adenine deoxyribonucleotides
- B) thymine deoxyribonucleotides
- C) uracil deoxyribonucleotides
- D) cytosine ribonucleotides
- E) adenine ribonucleotides

Answer: C

Bloom's Taxonomy: Application

Section: Organic Macromolecules

Learning Outcome: 2.24

31) All of the following are associated with ATP molecules EXCEPT

- A) a long-term energy supply.
- B) high-energy bonds.
- C) a recyclable energy supply.
- D) formation of coenzymes.
- E) three phosphate groups.

Answer: A

Bloom's Taxonomy: Knowledge

Section: Organic Macromolecules

Learning Outcome: 2.25

32) Which of the following is TRUE of both DNA and RNA?

- A) The "backbone" is composed of riboses and phosphates.
- B) They contain adenine, cytosine, guanine and thymine.
- C) They are usually double-stranded helices.
- D) The purines and pyrimidines form hydrogen-bonded pairs.
- E) They are highly hydrophobic macromolecules.

Answer: D

Bloom's Taxonomy: Application

Section: Organic Macromolecules

Learning Outcome: 2.24

33) Which of the following is an INCORRECT pairing?

- A) primary structure; amino acid sequence
- B) secondary structure; disulfide bridges
- C) tertiary structure; covalent bonds
- D) quaternary structure; two or more polypeptides
- E) secondary structure; β -pleated sheets

Answer: B

Bloom's Taxonomy: Application

Section: Organic Macromolecules

Learning Outcome: 2.22

34) Proteins contain both acidic and basic R groups, and can therefore function as

- A) energy storage macromolecules.
- B) structural macromolecules.
- C) buffers.
- D) catalysts.
- E) genetic material.

Answer: C

Bloom's Taxonomy: Application

Section: Organic Macromolecules

Learning Outcome: 2.16, 2.21

35) Which of the following is characteristic of proteins?

- A) They are composed of carbohydrate.
- B) They have multiple layers of structural organization.
- C) They are composed of nucleic acids.
- D) Their secondary structure is composed of β -helices.
- E) They are primarily hydrophobic.

Answer: B

Bloom's Taxonomy: Comprehension

Section: Proteins

Learning Outcome: 2.22

36) Plant cell walls are composed of _____ held together by _____.

- A) polysaccharides; hydrogen bonds
- B) amino acids; peptide bonds
- C) disaccharides; hydrophobic interactions
- D) fatty acids; polar covalent bonds
- E) peptidoglycan; ionic bonds

Answer: A

Bloom's Taxonomy: Application

Section: Organic Macromolecules

Learning Outcome: 2.9, 2.20

37) A(n) _____ is an arrangement of atoms found in a variety of macromolecules.

- A) buffer
- B) isotope
- C) salt
- D) stereoisomer
- E) functional group

Answer: E

Bloom's Taxonomy: Comprehension

Section: Organic Macromolecules

Learning Outcome: 2.17

38) Decomposition reactions are commonly _____ reactions.

- A) endothermic
- B) exchange
- C) exothermic
- D) anabolic
- E) dehydration

Answer: C

Bloom's Taxonomy: Knowledge

Section: Organic Macromolecules

Learning Outcome: 2.12

39) Lipids found in the membranes of most eukaryotic cells are

- A) polyunsaturated fats.
- B) phospholipids.
- C) steroids.
- D) waxes.
- E) triglycerides.

Answer: B

Bloom's Taxonomy: Knowledge

Section: Organic Macromolecules

Learning Outcome: 2.18

40) Which of the following lipids has the lowest ratio of hydrogens to carbons?

- A) saturated fats
- B) polyunsaturated fats
- C) monounsaturated fats
- D) both saturated and monounsaturated fats
- E) Saturated, unsaturated, and polyunsaturated fats have equal ratios of hydrogens to carbons.

Answer: B

Bloom's Taxonomy: Comprehension

Section: Organic Macromolecules

Learning Outcome: 2.19

41) DNA is composed of repeating units of sugars, phosphates, and nucleic acids. This is an example of a

- A) polymer.
- B) monomer.
- C) salt.
- D) micelle.
- E) lipid.

Answer: A

Bloom's Taxonomy: Knowledge

Section: Organic Macromolecules

Learning Outcome: 2.24

42) Bacterial cell walls are composed of

- A) peptides.
- B) polysaccharides.
- C) waxes.
- D) carbohydrates and waxes.
- E) peptides and polysaccharides.

Answer: E

Bloom's Taxonomy: Comprehension

Section: Organic Macromolecules

Learning Outcome: 2.20

43) Anna is conducting an experiment using a pH indicator that is red at low pH, green at neutral pH, and purple at high pH. She starts with a green solution. When she adds compound X to her solution it turns purple. Then she adds compound Z to the solution and it turns green. She adds more Z and the solution remains green. These observations suggest X is _____ and Z is _____.

- A) a base; a buffer
- B) an acid; a base
- C) a base; a strong acid
- D) an acid; a buffer
- E) a buffer; a base

Answer: A

Bloom's Taxonomy: Analysis

Section: Water, Acids, Bases, and Salts

Learning Outcome: 2.16

44) A reaction requires water as a reactant and produces heat. What type of reaction is likely to be involved?

- A) a decomposition reaction
- B) a hydrolysis reaction
- C) an exchange reaction
- D) a synthesis reaction
- E) The answer cannot be determined with the available information.

Answer: A

Bloom's Taxonomy: Comprehension

Section: Chemical Reactions

Learning Outcome: 2.14

45) What functional groups are present in ALL amino acids?

- A) amino groups
- B) carboxyl groups
- C) hydroxyl groups.
- D) amino and carboxyl groups
- E) amino and sulfhydryl groups.

Answer: D

Bloom's Taxonomy: Comprehension

Section: Organic Macromolecules

Learning Outcome: 2.17

46) Amylose is a(n) _____ carbohydrate.

- A) simple
- B) monomer
- C) polymer
- D) nucleotide
- E) ionic

Answer: C

Bloom's Taxonomy: Knowledge

Section: Organic Macromolecules

Learning Outcome: 2.20

2.2 True/False Questions

1) The smallest chemical units of matter are elements.

Answer: FALSE

Bloom's Taxonomy: Knowledge

Section: Atoms

Learning Outcome: 2.1

2) The side groups of amino acids can interact with each other and with other molecules.

Answer: TRUE

Bloom's Taxonomy: Comprehension

Section: Organic Molecules

Learning Outcome: 2.17

3) A molecule composed of carbon and hydrogen is a compound.

Answer: TRUE

Bloom's Taxonomy: Knowledge

Section: Chemical Bonds

Learning Outcome: 2.5

4) The electron shells of atoms hold eight electrons each.

Answer: FALSE

Bloom's Taxonomy: Knowledge

Section: Atoms

Learning Outcome: 2.4

5) Carbon atoms have four valence electrons and typically form polar covalent bonds.

Answer: FALSE

Bloom's Taxonomy: Comprehension

Section: Atoms

Learning Outcome: 2.6

6) An organic molecule with the chemical formula $C_4H_5O_1N_3$ is probably a pyrimidine.

Answer: TRUE

Bloom's Taxonomy: Application

Section: Organic Macromolecules

Learning Outcome: 2.23

7) Denaturation of a protein is always permanent.

Answer: FALSE

Bloom's Taxonomy: Comprehension

Section: Organic Macromolecules

Learning Outcome: 2.22

8) Glycolipids are an example of a mixture.

Answer: FALSE

Bloom's Taxonomy: Comprehension

Section: Organic Macromolecules

Learning Outcome: 2.20

9) One of the products of dehydration synthesis reactions is water.

Answer: TRUE

Bloom's Taxonomy: Knowledge

Section: Chemical Reactions

Learning Outcome: 2.11

10) Salts are produced from exchange reactions in which acids and bases neutralize each other.

Answer: TRUE

Bloom's Taxonomy: Comprehension

Section: Water, Acids, Bases, and Salts

Learning Outcome: 2.16

2.3 Short Answer Questions

1) Radioactive iodine is sometimes used to treat thyroid cancer. This is an example of the use of (isotopes/elements/radiation) in medical treatment.

Answer: isotopes

Bloom's Taxonomy: Knowledge

Section: Atoms

Learning Outcome: 2.3

2) The phosphorylation of a protein by ATP is a(n) (exchange/transfer/group) reaction

Answer: exchange

Bloom's Taxonomy: Comprehension

Section: Chemical Reactions

Learning Outcome: 2.14

3) Neon generally does not react with other atoms because it has (2/4/6/8) electrons in its outer shell.

Answer: 8

Bloom's Taxonomy: Comprehension

Section: Chemical Bonds

Learning Outcome: 2.4

4) An atom or molecule becomes a(n) (anion/ion/cation) when it loses an electron to a more electronegative molecule.

Answer: cation

Bloom's Taxonomy: Comprehension

Section: Chemical Bonds

Learning Outcome: 2.8

5) A chemical reaction in which a water molecule is a reactant is known as a (dehydration/hydrolysis) reaction.

Answer: hydrolysis

Bloom's Taxonomy: Comprehension

Section: Chemical Reactions

Learning Outcome: 2.13

6) A(n) (base/acid) is a molecule that binds with hydrogen ions when it is dissolved in water.

Answer: base

Bloom's Taxonomy: Knowledge

Section: Water, Acids, Bases, and Salts

Learning Outcome: 2.16

7) The folding of a polypeptide into a three-dimensional shape is its (secondary/tertiary/quaternary) structure.

Answer: tertiary

Bloom's Taxonomy: Comprehension

Section: Organic Macromolecules

Learning Outcome: 2.22

8) The "double helix" of DNA is the result of (covalent/ionic/hydrogen) bonds.

Answer: hydrogen

Bloom's Taxonomy: Knowledge

Section: Chemical Bonds

Learning Outcome: 2.9

9)



Figure 2-2 depicts the (primary/secondary/tertiary) structure of a protein.

Answer: primary

Bloom's Taxonomy: Knowledge

Section: Organic Macromolecules

Learning Outcome: 2.22

10) A(n) (catalyst/enzyme/protein) is any molecule that speeds up a chemical reaction.

Answer: catalyst

Bloom's Taxonomy: Comprehension

Section: Organic Macromolecules

Learning Outcome: 2.21

11) A fatty acid with two double bonds is a (saturated/monounsaturated/polyunsaturated) fat.

Answer: polyunsaturated

Bloom's Taxonomy: Knowledge

Section: Organic Macromolecules

Learning Outcome: 2.19

12) A chemical reaction that traps energy within newly formed chemical bonds is an (exothermic/endergonic) reaction.

Answer: endothermic

Bloom's Taxonomy: Knowledge

Section: Chemical Reactions

Learning Outcome: 2.12

13) A(n) (indicator/base/buffer) is a substance that maintains the pH even when the amounts of acid and/or base are changing.

Answer: buffer

Bloom's Taxonomy: Comprehension

Section: Water, Acids, Bases, and Salts

Learning Outcome: 2.16

14) The functional group of a monosaccharide is a(n) (amino/carboxyl/hydroxyl/carbonyl)

Answer: hydroxyl

Bloom's Taxonomy: Comprehension

Section: Organic Macromolecules

Learning Outcome: 2.17

15) The (atoms/isotopes/stereoisomers) of an element vary in the number of neutrons in the nucleus.

Answer: isotopes

Bloom's Taxonomy: Knowledge

Section: Atoms

Learning Outcome: 2.3

2.4 Essay Questions

1) Compare and contrast synthesis reactions with decomposition reactions.

Answer: Synthesis and decomposition reactions are often the reverse of each other. Synthesis reactions consume energy (are endothermic), whereas decomposition reactions release energy (are exothermic). Synthesis reactions often release water molecules in a process called dehydration synthesis, whereas decomposition reactions often consume water molecules in a process called hydrolysis. Finally, decomposition reactions break large macromolecules into their component monomers, which can then be used in synthesis reactions to build new macromolecules for use by the cell, whereas synthesis reactions utilize component monomers to build larger molecules.

Bloom's Taxonomy: Application

Section: Chemical Reactions

Learning Outcome: 2.10

2) Discuss the importance of hydrogen bonds in the chemistry of the cell.

Answer: The chemistry of the cell would basically be impossible without hydrogen bonds. Water, which is required by all cellular reactions, would not have its unique properties of cohesiveness and polarity without hydrogen bonds. Hydrogen bonds hold the double helix of DNA together and contribute to the overall shape of protein molecules. However, unlike covalent bonds, hydrogen bonds are not permanent bonds, so they can easily and temporarily be broken, a characteristic that is important at certain points in the cell's life cycle (such as during DNA replication).

Bloom's Taxonomy: Application

Section: Chemical Bonds

Learning Outcome: 2.9, 2.22, 2.24

3) Max is exploring the properties of various compounds. Some of his explorations involve the use of a pH indicator that is red at low pH, yellow-green at neutral pH, and blue to purple at high pH. He sets up several tubes containing water and the pH indicator and then begins to add some of the compounds he is characterizing in various combinations. His results are shown on the Figure 2.3.

| | | | | | | | | | |
|-----------------|-------|-------|-------|-------|--------|-------|------------------|------------------|-----------------------------|
| | | | | | | | 1 × L + 1 × M | 1 × L + 5 × M | 1 × L + 1 × M + 1 × N |
| Compound | None | 1 × L | 1 × M | 2 × M | 5 × M | 1 × N | 1 × L + 1 × M | 1 × L + 5 × M | 1 × L + 1 × M + 1 × N |
| Color | Green | Red | Green | Blue | Purple | Green | Red | Green | Green |

What can Max conclude about his compounds based on these results? Describe the likely events in terms of hydrogen and hydroxyl ions.

Answer: Max's results are consistent with L being an acid and M being a weak base. Compound N appears to be a buffer. The green color of the indicator is seen when the concentrations of hydroxyl and hydrogen ions are equal. The red color of the solution indicates the concentration of hydrogen ions is greater than the hydroxyl ion concentration. The data does not provide information for calculating the concentrations. Blue and purple indicator colors show the hydroxyl ion concentrations exceed the hydrogen ion concentrations. The results with the mixes of L and M suggest that L dissolves to release 5 times more hydrogen ions than the concentration of hydroxyl ions produced by the ionization of M. Compound N accepts or releases ions with changing hydrogen ion concentrations to maintain equal concentrations of cations and anions.

Bloom's Taxonomy: Analysis

Section: Water, Acids, Bases, and Salts

Learning Outcome: 2.16

4) A student is given a compound to identify in an organic chemistry class. The first thing she notices is that it is not soluble in pure water or saline. Analysis of the ratios of atoms indicates the ratio of carbon to hydrogen to oxygen is 1:1.5:0.05. There is no nitrogen. Based on this information, what class of biological macromolecule is the student working with? Justify your answer.

Answer: The macromolecule is a sterol. The lack of nitrogen eliminates amino acids and nucleic acids. The ratio eliminates carbohydrates, which have a C:H:O ratio of 1:2:1. Thus the compound is a lipid. Fatty acids and waxes have a C:H ratio of about 1:2 with only one (wax) or two (fatty acid) oxygens per molecule (C:O ranging from 12:1 to 24:1). The low ratio of H to C suggests many carbons are bonded to three other carbons, consistent with steroids. The presence of some oxygen indicates there are hydroxyl groups, found in sterols.

Bloom's Taxonomy: Analysis

Section: Organic Macromolecules

Learning Outcome: 2.18, 2.19

5) Nitrogen is an essential element for living things, as demonstrated by the fact that nearly all fertilizers contain nitrogenous compounds. Discuss why nitrogen is essential.

Answer: Nitrogen is a component in the structure of two of the four types of organic macromolecules. The amino group of an amino acid is a key reactant in the formation of peptide bonds, or primary structure, of proteins. Nitrogen also participates in hydrogen bonding and thereby contributes to the secondary, tertiary, and quaternary structure of proteins. Nitrogen is a key structural component of the bases in nucleic acids, and its participation in hydrogen bonding results in the formation of the base pairs and therefore the double helix of DNA.

Bloom's Taxonomy: Application

Section: Organic Macromolecules

Learning Outcome: 2.22, 2.23