

Microbiology with Diseases by Body System, 3e (Bauman)
Chapter 2 The Chemistry of Microbiology

2.1 Multiple-Choice Questions

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

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

Answer: B

Bloom's Rank: Knowledge

Section: Atoms

2) An atom of carbon that has six protons and seven neutrons is an example of a(n)

- A) isotope.
- B) radioactive isotope.
- C) molecule.
- D) compound.
- E) dalton.

Answer: A

Bloom's Rank: Application

Section: Atoms

3) An atom is electrically neutral when

- A) the number of electrons equals the number of neutrons.
- B) the numbers of its protons, electrons, and neutrons are all equal.
- C) it has no extra electrons in its valence shell.
- D) the number of protons equals the number of neutrons.
- E) the number of electrons equals the number of protons.

Answer: E

Bloom's Rank: Application

Section: Atoms

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 Rank: Comprehension

Section: Atoms

5) All of the following are associated with atomic structure EXCEPT

- A) valence.
- B) dalton.
- C) monomer.
- D) electron shell.
- E) neutron.

Answer: C

Bloom's Rank: Comprehension

Section: Organic Macromolecules

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 Rank: Comprehension

Section: Atoms

7) The type(s) of bond 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) polar covalent and ionic bonds.

Answer: A

Bloom's Rank: Comprehension

Section: Chemical Bonds

8) The type(s) of bond produced when atoms with significantly 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) nonpolar covalent and ionic bonds.

Answer: B

Bloom's Rank: Comprehension

Section: Chemical Bonds

9) Which of the following types of chemical bonds do carbon atoms generally NOT form?

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

Answer: E

Bloom's Rank: Application

Section: Chemical Bonds

10) All of the following are associated with ionic bonds EXCEPT

- A) cations.
- B) radioactivity.
- C) electrolytes.
- D) salts.
- E) anions.

Answer: B

Bloom's Rank: Comprehension

Section: Chemical Bonds

11) Which of the following is an INCORRECT pairing?

- A) electrolytes: anions
- B) synthesis: endothermic
- C) hydrolysis: hydrogen bonds
- D) catabolism: exothermic
- E) dehydration: anabolism

Answer: C

Bloom's Rank: Application

Section: Chemical Reactions

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 Rank: Comprehension

Section: Water, Acids, Bases, and Salts

- 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 non-polar molecule.

Answer: A

Bloom's Rank: Comprehension

Section: Water, Acids, Bases, and Salts

- 14) An acid dissociates in water to release
- A) hydrogen ion(s).
 - B) cation(s).
 - C) hydroxyl group(s).
 - D) anion(s).
 - E) both anions and hydrogen ions.

Answer: E

Bloom's Rank: Knowledge

Section: Water, Acids, Bases, and Salts

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

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

Answer: C

Bloom's Rank: Knowledge

Section: Chemical Reactions

- 16) Which pH would be alkaline?

- A) 7.0
- B) 8.0
- C) 4.0
- D) 1.5
- E) 6.5

Answer: B

Bloom's Rank: Knowledge

Section: Water, Acids, Bases, and Salts

17) Which of the following is NOT a characteristic of saturated fats?

- A) They are usually solid at room temperature.
- B) They contain at least one double bond.
- C) They are found in animals.
- D) Their fatty acids pack tightly together.
- E) They are a form of stored energy.

Answer: B

Bloom's Rank: Comprehension

Section: Organic Macromolecules

18) Which of the following is NOT a characteristic of phospholipids?

- A) They are found in cellular membranes.
- B) They can form micelles and bilayers.
- C) They contain fatty acids that associate with water.
- D) They contain a hydrophilic phosphate "head."
- E) They contain two fatty acids and a phosphate functional group.

Answer: C

Bloom's Rank: Comprehension

Section: Organic Macromolecules

19) Organisms use carbohydrates in all of the following ways EXCEPT

- A) as a component of cell walls.
- B) as a long-term energy source.
- C) as a short-term energy source.
- D) to keep membranes flexible at low temperatures.
- E) as a building block of DNA and RNA molecules.

Answer: D

Bloom's Rank: Comprehension

Section: Organic Macromolecules

20) Fats, 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 Rank: Application

Section: Organic Macromolecules

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 Rank: Comprehension

Section: Organic Macromolecules

22) Which of the following statements about proteins is FALSE?

- A) They are composed of amino acids.
- B) They have multiple levels of structural organization.
- C) They can be hydrophobic, hydrophilic, or both.
- D) Their primary function is energy storage.
- E) They are formed by dehydration synthesis reactions.

Answer: D

Bloom's Rank: Application

Section: Organic Macromolecules

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

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

Answer: B

Bloom's Rank: Comprehension

Section: Organic Macromolecules

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

- A) ionic bonds
- B) peptide bonds
- C) purines
- D) β -sheets
- E) disulfide bridges

Answer: C

Bloom's Rank: Comprehension

Section: Organic Macromolecules

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

- A) between phosphates in ATP.
- B) in α -helices.
- 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 Rank: Application

Section: Organic Macromolecules

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

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

Answer: E

Bloom's Rank: Application

Section: Organic Macromolecules

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 Rank: Comprehension

Section: Organic Macromolecules

28) All of the following bases are found in RNA molecules EXCEPT

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

Answer: B

Bloom's Rank: Knowledge

Section: Organic Macromolecules

29) The "spine" 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 Rank: Application

Section: Organic Macromolecules

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 Rank: Application

Section: Organic Macromolecules

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 Rank: Knowledge

Section: Organic Macromolecules

32) Which of the following statements concerning nucleic acids is FALSE?

- A) Nucleic acid strands are held together by hydrogen bonds between complementary bases.
- B) Not all DNA is double stranded.
- C) Some viruses have DNA as their genomes.
- D) The nucleic acid polymer is composed of peptide bonds.
- E) Cytosine is found in all nucleic acid molecules.

Answer: D

Bloom's Rank: Application

Section: Organic Macromolecules

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 Rank: Application

Section: Organic Macromolecules

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 Rank: Application

Section: Organic Macromolecules

35) An increase in the pH of a solution by 2 whole numbers represents a change in the number of hydrogen ions by what factor?

- A) 2
- B) 20
- C) 1000
- D) 10
- E) 100

Answer: E

Bloom's Rank: Comprehension

Section: Water, Acids, Bases, and Salts

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 Rank: Application

Section: Organic Macromolecules

37) The presence of _____ in the cell wall of a microbe causes it to be resistant to drying.

- A) fats
- B) phospholipids
- C) sterols
- D) glycolipids
- E) waxes

Answer: E

Bloom's Rank: Comprehension

Section: Organic Macromolecules

38) Some _____ are used as hormones.

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

Answer: C

Bloom's Rank: Knowledge

Section: Organic Macromolecules

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

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

Answer: B

Bloom's Rank: Knowledge

Section: Organic Macromolecules

40) A protein is a _____ of amino acids.

- A) monomer
- B) polymer
- C) bilayer
- D) solution
- E) decomposition product

Answer: B

Bloom's Rank: Knowledge

Section: Organic Macromolecules

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 Rank: Knowledge

Section: Organic Macromolecules

42) A polymer composed of simple sugars is a(n)

- A) protein.
- B) triglyceride.
- C) starch.
- D) glycoprotein.
- E) amino acid.

Answer: C

Bloom's Rank: Knowledge

Section: Organic Macromolecules

43) An amino acid is an example of a

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

Answer: A

Bloom's Rank: Knowledge

Section: Organic Macromolecules

44) Glucose is an example of what type of carbohydrate?

- A) a disaccharide
- B) a monomer
- C) a pentose
- D) a pentose polymer
- E) a hexose monomer

Answer: E

Bloom's Rank: Comprehension

Section: Organic Macromolecules

45) Adenosine triphosphate (ATP) is a

- A) monomer.
- B) polymer.
- C) simple carbohydrate.
- D) lipid.
- E) bilayer.

Answer: A

Bloom's Rank: Knowledge

Section: Organic Macromolecules

46) Amylose is a(n) _____ carbohydrate.

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

Answer: C

Bloom's Rank: Knowledge

Section: Organic Macromolecules

2.2 True/False Questions

1) The smallest chemical units of matter are elements.

Answer: FALSE

Bloom's Rank: Knowledge

Section: Atoms

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

Answer: TRUE

Bloom's Rank: Comprehension

Section: Organic Molecules

3) Monosaccharides are usually found in cyclic forms.

Answer: TRUE

Bloom's Rank: Comprehension

Section: Organic Molecules

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

Answer: FALSE

Bloom's Rank: Knowledge

Section: Atoms

5) Hydrogen bonds are stronger than covalent bonds.

Answer: FALSE

Bloom's Rank: Comprehension

Section: Atoms

6) Carbohydrates are composed of carbon, hydrogen, and oxygen.

Answer: TRUE

Bloom's Rank: Knowledge

Section: Organic Macromolecules

7) Denaturation of a protein is always permanent.

Answer: FALSE

Bloom's Rank: Comprehension

Section: Organic Macromolecules

8) The long-term chemical energy storage molecules in plants are triglycerides.

Answer: FALSE

Bloom's Rank: Knowledge

Section: Organic Macromolecules

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

Answer: TRUE

Bloom's Rank: Knowledge

Section: Chemical Reactions

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

Answer: TRUE

Bloom's Rank: Comprehension

Section: Water, Acids, Bases, and Salts

2.3 Short Answer Questions

1) Another name for a unit of atomic mass is a(n) _____.

Answer: dalton

Bloom's Rank: Knowledge

Section: Atoms

2) Prokaryotes that grow best under acidic conditions are called _____.

Answer: acidophiles

Bloom's Rank: Knowledge

Section: Water, Acids, Bases, and Salts

3) Cell surface markers composed of both carbohydrate and lipid molecules are known as _____.

Answer: glycolipids

Bloom's Rank: Knowledge

Section: Organic Macromolecules

4) Molecules such as amino acids that have identical atoms and functional groups, but are mirror images of each other, are _____.

Answer: stereoisomers

Bloom's Rank: Comprehension

Section: Organic Macromolecules

5) A chemical reaction in which a water molecule is a reactant is known as a(n) _____ reaction.

Answer: hydrolysis

Bloom's Rank: Comprehension

Section: Chemical Reactions

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

Answer: base

Bloom's Rank: Knowledge

Section: Water, Acids, Bases, and Salts

7) The folding of a polypeptide into a three-dimensional shape is its _____ structure.

Answer: tertiary

Bloom's Rank: Comprehension

Section: Organic Macromolecules

8) The DNA double helix is held together by _____ bonds.

Answer: hydrogen

Bloom's Rank: Knowledge

Section: Chemical Bonds

9) A six-carbon sugar is called a(n) _____.

Answer: hexose

Bloom's Rank: Knowledge

Section: Organic Macromolecules

10) A(n) _____ is any molecule that speeds up a chemical reaction.

Answer: catalyst

Bloom's Rank: Comprehension

Section: Organic Macromolecules

11) The monomer of a nucleic acid is called a(n) _____.

Answer: nucleotide

Bloom's Rank: Knowledge

Section: Organic Macromolecules

12) A chemical reaction that traps energy within newly formed chemical bonds is a(n) _____ reaction.

Answer: endothermic

Bloom's Rank: Knowledge

Section: Chemical Reactions

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

Answer: buffer

Bloom's Rank: Comprehension

Section: Water, Acids, Bases, and Salts

14) The sum of all the chemical reactions within an organism is referred to as its _____.

Answer: metabolism

Bloom's Rank: Knowledge

Section: Chemical Reactions

15) The _____ of an element vary in the number of neutrons in the nucleus.

Answer: isotopes

Bloom's Rank: Knowledge

Section: Atoms

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 Rank: Application

Section: Chemical Reactions

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 Rank: Application

Section: Chemical Bonds

3) Define and discuss the importance and impact of pH on living organisms.

Answer: pH is the measurement of the hydrogen ion concentration of a solution or within a cell. The relationship between pH and hydrogen ions is an inverse one: as the number of hydrogen ions increases, the pH drops (acid), and as the number of ions decreases, the pH rises (basic). Changes in pH can have drastic consequences for important cellular molecules such as proteins, which in turn can have a disastrous effect on the metabolism and structure of the cell; for this reason, organisms can exist only in a fairly narrow range of pH. Although the range of pH that is compatible with life is narrow, that range can vary widely among organisms: some organisms prefer highly acidic pH levels, whereas others can function only at alkaline pH levels.

Bloom's Rank: Application

Section: Water, Acids, Bases, and Salts

4) Describe the chemical properties of phospholipids that account for their behavior in water.

Answer: Phospholipids have polar phosphate "heads" and nonpolar fatty acid "tails," which interact in different ways with water molecules. The phospholipid heads are attracted to polar water molecules, but the nonpolar tails of the phospholipid are repelled by water. As the tails are driven away from the water molecules, they congregate together, either in the interior of a ball of lipid (called a micelle) or within the interior of a double layer of phospholipids (called a bilayer). This leaves the phosphate heads "outside," where they can easily interact with the water molecules.

Bloom's Rank: Application

Section: Organic Macromolecules

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 Rank: Application

Section: Organic Macromolecules