

Chapter 02 The Molecules of Life

Multiple Choice Questions

1. In addition to investigations with bacteria that led to him being considered the Father of Microbiology, Pasteur also
 - A. found that some molecules can exist as stereoisomers.
 - B. created aspartame.
 - C. separated organic acids using a microscope.
 - D. discovered polarized light.
 - E.** found that some molecules can exist as stereoisomers AND separated organic acids using a microscope.

2. The positively charged component of the atom is the
 - A. electron.
 - B. neutron.
 - C.** proton.
 - D. quark.

3. The negatively charged component of the atom is the
 - A. proton.
 - B. nucleus.
 - C. neutron.
 - D.** electron.

4. The uncharged component of the atom is the
 - A. electron.
 - B. proton.
 - C.** neutron.
 - D. muon.

5. The part of the atom that is most involved in chemical reactivity is the

- A. proton.
- B. neutron.
- C. electron.**
- D. nucleus.

6. Which determines the chemical and physical properties of the atom?

- A. electron
- B. neutron
- C. atomic weight
- D. atomic number**

7. Electrons

- A. are found in orbitals.
- B. may gain or lose energy.
- C. may move from one orbital to another.
- D. are located farthest from the nucleus and have the least energy.
- E. are found in orbitals, may gain or lose energy, and may move from one orbital to another.**

8. The atom, as a whole, is uncharged because

- A. the number of protons equals the number of neutrons.
- B. the number of electrons equals the number of neutrons.
- C. neutrons neutralize the charges.
- D. the number of protons equals the number of electrons.**

9. The atomic number is equal to

- A. the number of electrons.
- B. the number of electrons plus neutrons.
- C. the number of protons.**
- D. the number of neutrons and protons.

10. The atomic weight is equal to

- A. the number of electrons.
- B. the number of electrons plus neutrons.
- C. the number of protons.
- D.** the number of neutrons and protons.

11. Sharing of electrons forms a (n)

- A. hydrogen bond.
- B. ionic bond.
- C. covalent bond.
- D. strong bond.
- E.** covalent bond AND strong bond.

12. If electrons are shared unequally, this forms a(n)

- A. weak bond.
- B. nonpolar bond.
- C.** polar bond.
- D. ionic bond.

13. If electrons are gained or lost in the formation of a bond, the bond is termed

- A. covalent.
- B. hydrogen.
- C.** ionic.
- D. nonpolar.

14. Atoms that gain electrons are now

- A. positively charged.
- B.** negatively charged.
- C. neutral.
- D. lighter.

15. Charged atoms are termed

- A. ions.
- B. neutrons.
- C. molecules.
- D. polymers.

16. Which of these bonds are weak individually but are much stronger as a group?

- A. covalent
- B. ionic
- C. neutron
- D. hydrogen
- E. ionic AND hydrogen

17. Water

- A. is a polar molecule.
- B. is referred to as a universal solvent.
- C. makes up over 70% (by wt.) of an organism.
- D. is often a product or reactant in chemical reactions.
- E. All of the choices are correct.

18. The most important molecule(s) in the world is (are)

- A. water.
- B. protein.
- C. carbohydrates.
- D. nucleic acids.

19. pH

- A. is a measure of the hydrogen ion concentration.
- B. utilizes a scale from 5 to 8.
- C. is a geometric scale.
- D. is an abbreviation for, "power of helium".
- E. is a measure of the hydrogen ion concentration, utilizes a scale from 5 to 8 AND is a geometric scale.

20. The energy storage form of ATP

A. contains deoxyribose.

B. contains ribose.

C. contains a pyrimidine base.

D. readily releases energy by breaking the bond between the base and the sugar.

E. contains deoxyribose, contains a pyrimidine base AND readily releases energy by breaking the bond between the base and the sugar.

21. The subunits of proteins are

A. nucleotides.

B. phospholipids.

C. amino acids.

D. carbohydrates.

22. How many different amino acids are there to choose from when assembling a protein?

A. 5

B. 10

C. 20

D. 25

23. If the side chains of amino acids contain carboxyl groups, they

A. contribute a positive charge to the amino acid at pH 10.

B. contribute a negative charge to the amino acid at pH 10.

C. have no effect on the charge of the amino acid at pH 10.

D. are considered acidic amino acids.

E. contribute a negative charge to the amino acid at pH 10 AND are considered acidic amino acids.

24. If the side chains of amino acids contain the ammonium ion, they readily form ions that

- A. are described as acidic amino acids.
- B. give positive electric charges to the amino acid.
- C. are described as basic amino acids.
- D. react with lipids to form lipoproteins.
- E.** give positive electric charges to the amino acid AND are described as basic amino acids.

25. Amino acids that contain many methyl groups

- A. are considered hydrophilic.
- B.** are nonpolar.
- C. carry a positive charge.
- D. carry a negative charge.
- E. are considered hydrophilic AND carry a positive charge.

26. L-amino acids occur in proteins and are designated

- A. unnatural.
- B. natural.
- C. rare.
- D. left handed.
- E.** natural AND left handed.

27. D-amino acids are associated with

- A. radioactive isotopes.
- B. human proteins.
- C. plant proteins.
- D.** bacterial cell walls.

28. Amino acids in proteins are linked to one another by peptide bonds between the

- A. methyl group of one amino acid and a side group of another amino acid.
- B. carbon atoms of two adjacent amino acids.
- C.** carboxyl group of one amino acid and the amino group of another.
- D. nitrogen atom and carboxyl ion.

29. The most important feature of a protein is its

- A. secondary structure.
- B. side group.
- C.** shape.
- D. electric charge.

30. The primary structure in a protein

- A. refers to the helical folding of a protein.
- B. refers to two or more polypeptides linked to one another.
- C.** refers to the sequence of amino acids.
- D. refers to the initial folding of a protein.

31. The helices and sheets of amino acids form a protein's

- A. primary structure.
- B.** secondary structure.
- C. tertiary structure.
- D. quaternary structure.

32. Side chains are important to proteins because they

- A. help determine protein shape.
- B. help determine the degree of solubility of the protein in water.
- C. are a source of energy for hydration reactions in the cell.
- D. form the peptide bonds which link amino acids to one another.
- E.** help determine protein shape AND help determine the degree of solubility of the protein in water.

33. Acidic or basic amino acids are

- A. readily soluble in water.
- B. readily soluble in lipids.
- C. able to form ions.
- D. considered hydrophilic.
- E.** readily soluble in water, able to form ions AND considered hydrophilic.

34. A protein

A. assumes any number of equally functional shapes.

B. may need help, in the form of chaperones, to assume the correct shape.

C. consists of a string of hydroxyl acids.

D. is always polar.

E. assumes any number of equally functional shapes AND may need help, in the form of chaperones, to assume the correct shape.

35. The N terminal in a protein

A. is the end characterized by a free carboxyl group.

B. is the end characterized by a free amino group.

C. is typically found in the middle of a protein.

D. refers to that area of a protein that is bound to another protein.

36. Weak bonds are important for the _____ structure of proteins.

A. primary

B. secondary

C. tertiary

D. quarternary

E. secondary, tertiary AND quarternary

37. Protein denaturation can

A. occur due to certain chemicals.

B. occur due to pH changes.

C. occur due to high temperature.

D. cause the protein to no longer function.

E. All of the choices are correct.

38. Proteins

- A. are involved in almost every important function performed by a cell.
- B. comprise more than 50% of the dry weight of a cell.
- C. are composed of a string of nucleotides.
- D. are characterized by a 1:2:1 ratio of carbon to hydrogen to oxygen.
- E.** are involved in almost every important function performed by a cell AND comprise more than 50% of the dry weight of a cell.

39. Which is true of carbohydrates?

- A. They may be part of the structure of bacteria.
- B. They may serve as a source of food.
- C. They contain carbon, hydrogen and oxygen in a 1:2:1 ratio.
- D. They may be bonded to proteins to form glycoproteins.
- E.** All of the choices are correct.

40. The carbohydrate(s) found in nucleic acids is/are

- A. ribose.
- B. glucose.
- C. galactose.
- D. deoxyribose.
- E.** ribose AND deoxyribose

41. Carbohydrates

- A. form only ring structures.
- B. form only linear structures.
- C.** may interconvert between ring and linear structures.
- D. contain both ring and linear portions within the same molecule.

42. The -OH group in a carbohydrate

- A. may be found above or below the plane of the ring.
- B. is involved in the formation of stereoisomers.
- C. is involved when linking monosaccharides together.
- D.** All of the choices are true.

43. Structural isomers

- A. contain the same elements in different arrangements.
- B. are exemplified by glucose and galactose.
- C. are formed by different arrangements of the -COOH groups.
- D. may be referred to as the -D and -L forms.
- E.** contain the same elements in different arrangements AND are exemplified by glucose and galactose.

44. Dehydration reactions are involved in

- A. the formation of polypeptides.
- B. the formation of polysaccharides.
- C. the formation of monosaccharides.
- D. the formation of nucleotides.
- E.** the formation of polypeptides AND the formation of polysaccharides.

45. What type of bonding holds one strand of DNA to the complementary strand of DNA?

- A. covalent
- B.** hydrogen
- C. disulfide
- D. ionic

46. Which is true of nucleotides?

- A. They are the building blocks of DNA.
- B. They carry chemical energy in their bonds.
- C. They are part of certain enzymes.
- D. They serve as specific signaling molecules.
- E.** All of the choices are true.

47. The sugars found in nucleic acids consist of

- A. 3 carbon atoms.
- B.** 5 carbon atoms.
- C. 7 carbon atoms.
- D. 9 carbon atoms.

48. The purines of DNA are

- A. adenine and guanine.
- B. thymine and adenine.
- C. serine and threonine.
- D. thymine and uracil.
- E. thymine and adenine AND thymine and uracil.

49. Which of the following is found in RNA but not in DNA?

- A. adenine
- B. ribose
- C. thymine
- D. uracil
- E. ribose AND uracil

50. The end of the nucleic acid chain that grows by adding more nucleotides is always the

- A. 5 prime end.
- B. C terminal.
- C. N terminal.
- D. 3 prime end.

51. Which shows the incorrect complementary base pairing?

- A. A:T
- B. G:C
- C. G:T
- D. A:U
- E. A:T, G:C AND A:U

52. The characteristic common to all lipids is their

- A. solubility in organic solvents.
- B. hydrophilic nature.
- C. large size.
- D. hydrophobic nature.
- E. solubility in organic solvents AND hydrophobic nature.

53. The components of fats are fatty acids and

- A. amino acids.
- B. nucleotides.
- C. phosphate.
- D.** glycerol.
- E. All of the choices are correct.

54. Which is (are) true of lipids?

- A. They are a major structural element of all cell membranes.
- B. They act as gatekeepers of the cell.
- C. They demark the inside vs. the outside of the cell.
- D. They are a heterogeneous group of molecules.
- E.** All of the choices are correct.

55. In general, when saturated fats are compared to unsaturated fats (assuming the same number of carbon atoms in the molecule)

- A. they have about the same melting temperature.
- B. saturated fats have a lower melting temperature.
- C.** unsaturated fats have a lower melting temperature.
- D. No generalizations can be made since melting temperature is strongly influenced by other factors.

Matching Questions

56. Which of the following best matches the description:

- | | |
|-----------------------|------------------------------|
| 1. Tertiary structure | protein <u>1</u> |
| 2. Enzyme | lipid <u>6</u> |
| 3. 1:2:1 of C:H:O | protein <u>7</u> |
| 4. 5 prime, 3 prime | carbohydrate <u>3</u> |
| 5. Membrane | nucleic acid <u>4</u> |
| 6. Monounsaturated | lipid <u>5</u> |
| 7. L-amino acids | protein <u>2</u> |

True / False Questions

57. From top to bottom, the two strands of DNA both go in the same, 5' to 3', direction.

FALSE

58. As DNA is always double-stranded, RNA is always single-stranded.

FALSE

59. RNA is a long double-stranded helix containing ribose and uracil.

FALSE

60. Lipids are polar, hydrophilic molecules.

FALSE

61. Lipids, like nucleic acids and proteins, are made of strings of similar subunits.

FALSE

62. Simple lipids contain carbon, hydrogen, and oxygen in a 1:2:1 ratio.

FALSE

63. Steroids are simple lipids.

TRUE

64. Phospholipids are nonpolar molecules.

FALSE

65. Water soluble substances easily pass through the phospholipid bilayer of a cell membrane.

FALSE

66. Unsaturated fats have lower melting points than saturated fats.

TRUE

Essay Questions

67. *In analyzing DNA, Chargoff found that the number of adenines equaled the number of thymines and the number of guanines equaled the number of cytosines. Explain what these data imply.*

This finding is explained by the double stranded nature of DNA. Each strand is a chain of nucleotides with hydrogen bonds between complementary base pairs holding the strands together. For every thymine found on one strand there would be a complementary adenine found on the other strand. Likewise for every guanine there would be a corresponding cytosine. Therefore $A=T$ and $G=C$.

68. *What would be the simplest way to separate DNA strands?*

The two strands of a DNA molecule are held together by the relatively weak hydrogen bond between complementary base pairs. Heat would be a simple and effective means of breaking the hydrogen bonds and separating the strands.

69. *A saturated fat is made into a polyunsaturated fat. What chemical change in the fat makes it polyunsaturated? Will it be easier or harder to spread on bread?*

Polyunsaturation involves the removal of two or more hydrogens from the long fatty acid tails; thereby, introducing a number of double bonds between the carbon atoms. The double bonds would physically put a kink in the long chain of carbons. This kink would not allow the molecules to associate in a manner necessary to produce a solid. In essence, the molecules would not pack together as nicely and would be more likely to be able to slide by one another and be more liquid-like.

70. *Cellulose and glycogen have very different properties yet both are made of strings of glucose. Explain.*

Yes, these molecules are just strings of glucose, but it is how the glucose units are actually connected to one another that gives each molecule its particular properties. In particular, they differ in length of the chains and degree of branching, but the major difference lies in which particular carbons are used to link the glucose sub units together. Animals have the enzymes that recognize and are able to break the bonds forming glycogen but do not have enzymes that recognize the bonds holding cellulose together. Therefore, animals may digest glycogen (and starch) but not cellulose (and chitin).

71. *How is the ultimate shape of a protein determined?*

The shape of a protein is ultimately determined by its amino acid sequence and manifested through hydrogen bonds and disulfide bonds. For some proteins, there is only one energetically favorable form that it will assume. However, for other proteins, a particular sequence may have several forms that are just as energetically favorable as another. These proteins require a helper molecule, known as a chaperone, to help it fold correctly.