1. The part of the atom that determines how the atom behaves chemically is the
   A) proton.
   B) electron.
   C) neutron.
   D) innermost shell.
   E) nucleus.

2. Which components of an atom do *not* add significantly to its mass?
   A) Proton
   B) Neutron
   C) Electron
   D) Nucleus
   E) Both a and b

3. There are _____ natural elements in the universe.
   A) 12
   B) 24
   C) 66
   D) 94
   E) 116

4. The atomic number of an element is the same as the number of _____ in each atom.
   A) neutrons
   B) protons plus electrons
   C) protons
   D) neutrons plus protons
   E) neutrons plus electrons

5. Which element is *not* found in all living systems?
   A) Nitrogen
   B) Phosphorus
   C) Sulfur
   D) Carbon
   E) Helium

6. The mass number of an atom is the total number of _____ in its nucleus.
   A) electrons
   B) protons
   C) protons and electrons
   D) protons and neutrons
   E) charges

7. The number of protons in a neutral atom equals the number of
   A) isotopes.
   B) neutrons.
   C) electrons plus neutrons.
   D) neutrons minus electrons.
   E) electrons.

8. An atom with _____ has an atomic mass of 14.
   A) 14 neutrons
   B) 14 electrons
   C) 7 neutrons and 7 protons
   D) 7 protons and 7 electrons
   E) 6 electrons and 8 neutrons

9. Phosphorus has an atomic number of 15 and an atomic mass of 31. How many neutrons does it have?
   A) 5
   B) 16
   C) 30
   D) 31
   E) 47

10. Which element has the same number of outer-shell (valence) electrons as oxygen?
   A) Calcium
   B) Nitrogen
   C) Fluorine
   D) Sodium
   E) Sulfur

11. Which element requires two additional electrons to fill the outermost electron shell?
    A) Phosphorus
    B) Carbon
    C) Nitrogen
    D) Oxygen
    E) Hydrogen

12. How many hydrogen atoms would bind with one nitrogen atom to create a neutrally charged molecule?
    A) 1
    B) 2
    C) 3
    D) 4
    E) 5

13. You are given a project to devise structural formulas of molecules that will create stable compounds. The most important piece of information about the atoms you will need to consider is
    A) their atomic weight.
    B) the number and distribution of electrons.
    C) their ability to form isomers.
    D) the configuration of their nuclei.
    E) their pH.

14. You are given two identical vials of what you are told are identical molecules. However, one vial weighs more than the other, albeit on a very minute scale. One sample weighs more per molecule because the component elements have
    A) different isotopes.
    B) an integer atomic mass value.
    C) more than one atomic number.
    D) various means of forming chemical bonds.
    E) different isomers.

15. Which element does *not* follow the octet rule?
    A) Sodium
    B) Chlorine
    C) Carbon
    D) Hydrogen
    E) Nitrogen

16. Because atoms can have the same number of protons but a different number of neutrons, elements have
    A) isotopes.
    B) an integer atomic mass value.
    C) more than one atomic number.
    D) various means of forming chemical bonds.
    E) isomers.

17. The element magnesium (Mg) has an atomic number of 12. Therefore, it has _____ electron shells and _____ electrons in the outermost shell.
    A) 2; 6
    B) 2; 10
    C) 3; 2
    D) 3; 4
    E) 4; 6

18. The element silicon (Si) has an atomic number of 14. Therefore, its properties are similar to those of
    A) sulfur.
    B) oxygen.
    C) phosphorus.
    D) carbon.
    E) boron.

19. All of the following molecules are examples of the octet rule *except*
    A) CO_2.
    B) H_2O.
    C) H_2.
    D) C_2H_6.
    E) CH_3.

20. Nitrogen-14 and nitrogen-15 are isotopes, and nitrogen-15 is used to determine protein structure. Based on this information, one can conclude that nitrogen-15 has _____ nitrogen-14.
    A) more protons than
    B) more neutrons than
    C) more electrons than
    D) an electronic configuration that is different from that of
    E) the same number of protons and neutrons as

21. Phosphorus has an atomic number of 15, and on average phosphorus atoms have a total of 30.974 protons and neutrons. From this information one can conclude that this element
    A) has isotopes.
    B) forms isomers.
    C) dissolves in liquid methane.
    D) is an ion.
    E) is radioactive.

22. A compound with the molecular formula C_2H_4 has _____ double bond(s).
    A) one C–H
    B) two C–H
    C) four C–H
    D) one C–C
    E) no

23. Chemical bonds formed by electrical attractions are
    A) covalent bonds.
    B) ionic bonds.
    C) hydrogen bonds.
    D) van der Waals forces.
    E) Both b and c

24. A covalent bond is the sharing of _____ between atoms, whereas an ionic bond is the _____.
    A) neutrons; sharing of electrons
    B) electrons; electrical attraction between two atoms
    C) protons; electrical attraction between two atoms
    D) protons; sharing of electrons
    E) electrons; transfer of electrons from one atom to another

25. In addition to covalent bonds, which interactions are important in biological systems?
    A) van der Waals interactions
    B) Hydrogen bonds
    C) Hydrophobic interactions
    D) Ionic attractions
    E) All of the above

26. Magnesium (Mg) has an atomic number of 12. When it bonds with another element, it will likely
    A) gain two electrons from the other element.
    B) share four electrons with the other element.
    C) lose two electrons to the other element.
    D) form a hydrogen bond.
    E) gain six electrons from the other element.

27. The two atoms in a hydrogen molecule are held together by
    A) hydrogen bonds.
    B) ionic attractions.
    C) van der Waals forces.
    D) a shared pair of electrons.
    E) gravity.

28. Which statement about the difference between ionic bonds and covalent bonds is true?
    A) An ionic bond is stronger than a covalent bond.
    B) A covalent bond occurs only in nonpolar molecules.
    C) An ionic bond occurs more often in aqueous solutions.
    D) An ionic bond occurs only in liquid methane.
    E) Electron sharing is more equal in the covalent bond.

29. A single covalent chemical bond represents the sharing of how many electrons?
    A) One
    B) Two
    C) Three
    D) Four
    E) Six

30. All of these molecules are considered to be nonpolar *except* for
    A) O_2.
    B) N_2.
    C) CH_4.
    D) NaCl.
    E) H_2.

31. Which statement about hydrogen bonds is true?
    A) They form between two hydrogen atoms.
    B) They form only between hydrogen and oxygen atoms within a molecule.
    C) They form between a highly electronegative atom and hydrogen.
    D) They involve a transfer of electrons.
    E) They are the strongest bonds because of their length.

32. The hydrogen bond between two water molecules forms because water is
    A) polar.
    B) nonpolar.
    C) a liquid.
    D) a small molecule.
    E) hydrophobic.

33. What determines if a molecule is polar, nonpolar, or ionic?
    A) The number of protons
    B) The bond distances
    C) The differences in the electronegativities of the atoms
    D) The ionic charges
    E) The distance of the electrons from the nucleus

34. Two carbon atoms held together in a double covalent bond share _____ electron(s).
    A) one
    B) two
    C) four
    D) six
    E) eight

35. Sweating is a useful cooling device for humans because water
    A) has a high heat of vaporization.
    B) has little cohesion strength.
    C) has little hydrogen bonding.
    D) is an outstanding solvent.
    E) ionizes readily.

36. Ice is used to cool beverages primarily because
    A) it is composed only of water.
    B) it floats.
    C) it dilutes the taste.
    D) people like to chew it.
    E) it absorbs a lot of heat when it melts because of hydrogen bonding.

37. Cholesterol, which is composed primarily of carbon and hydrogen atoms, is therefore
    A) insoluble in water.
    B) a polar molecule.
    C) a base.
    D) an acid.
    E) a buffer.

38. Chlorine (Cl) has an atomic number of 17. When it bonds with another element, it will likely
    A) gain one electron from the other element.
    B) share four electrons with the other element.
    C) lose one electron to the other element.
    D) form a double bond.
    E) gain three electrons from the other element.

39. Which statement regarding the functional groups of carbon-based molecules is *false*?
    A) They determine how the molecule interacts with other molecules in the environment.
    B) They repel each other.
    C) They determine the shape of the molecule.
    D) They determine the specific properties of the molecule.
    E) They may have interactions with specific functional groups on the same molecule.

40. If you place a paper towel in a dish of water, the water will move up the towel by capillary action because water
    A) molecules ionize.
    B) is a good solvent.
    C) molecules have hydrophobic interactions.
    D) can form hydrogen bonds with the surface of the paper towel.
    E) takes up large amounts of heat when it vaporizes.

41. When exposed to extreme heat, the human body relies on _____ to absorb excess heat and maintain normal body temperature.
    A) evaporation
    B) condensation
    C) respiration
    D) transpiration
    E) convection

42. The amino and carboxyl functional groups tend to form bases and acids by attracting or releasing
    A) a neutron.
    B) a proton.
    C) an electron.
    D) a proton and an electron.
    E) a neutron and a proton.

43. Aldehydes and ketones are very similar in that they both contain
    A) phosphorus atoms.
    B) sulfur atoms.
    C) a C=O group.
    D) nitrogen atoms.
    E) two “R” groups.

44. Molecules containing a large number of hydroxyl groups are
    A) basic.
    B) structurally less stable than those with fewer hydroxyls.
    C) complex macromolecules.
    D) nonpolar.
    E) soluble in water.

45. In condensation reactions, the atoms that make up a water molecule are derived from
    A) oxygen.
    B) only one of the reactants.
    C) both of the reactants.
    D) carbohydrates.
    E) enzymes.

46. Which statement about condensation reactions is *false*?
    A) They are used in protein synthesis.
    B) They are used in polysaccharide synthesis.
    C) They involve covalent bonds.
    D) They consume water as a reactant.
    E) Different condensation reactions produce different kinds of macromolecules.

47. During the formation of a polymer from monomers, a(n) _____ is formed.
    A) molecule of water
    B) disulfide bridge
    C) hydrophobic bond
    D) hydrophilic bond
    E) ionic bond

48. The general chemical formula for carbohydrates includes the atoms
    A) C, H, and N.
    B) C and H.
    C) C, H, and P.
    D) C, H, and O.
    E) C, H, O, and N.

49. A molecule with the formula $C_{16}H_{30}O_{15}$ is a
    A) hydrocarbon.
    B) carbohydrate.
    C) lipid.
    D) protein.
    E) nucleic acid.

50. The monomers that make up polymeric carbohydrates like starch are called
    A) nucleotides.
    B) trisaccharides.
    C) monosaccharides.
    D) nucleosides.
    E) fatty acids.

51. A simple sugar with the formula $C_5H_{10}O_5$ can be classified as a
    A) hexose.
    B) polysaccharide.
    C) disaccharide.
    D) pentose.
    E) lipid.

52. A type of molecule very often drawn with a single six-sided ring structure is
    A) sucrose.
    B) an amino acid.
    C) a steroid.
    D) a fatty acid.
    E) glucose.

53. Which statement about the hydrolysis of the disaccharide maltose to two glucose units is true?
    A) The reaction is energy neutral.
    B) The potential energy contained within glucose is larger than that of maltose.
    C) The hydrolysis reaction involves the breaking of a single covalent bond.
    D) The hydrolysis reaction involves the breaking of two covalent bonds.
    E) At completion, the concentration of maltose is higher than the concentration of glucose.

54. Maltose, which is composed of two glucose units, can be classified as a
    A) disaccharide.
    B) hexose.
    C) pentose.
    D) polysaccharide.
    E) monosaccharide.

55. Sucrose, known as common table sugar, is a
    A) hexose.
    B) lipid.
    C) simple sugar.
    D) glucose.
    E) disaccharide.

56. Starch and glycogen, which are both polysaccharides, differ in their functions in that starch is _____, whereas glycogen _____.
    A) the main component for plant structural support; is an energy source for animals
    B) a structural material found in plants and animals; forms external skeletons in animals
    C) a temporary compound used to store glucose; is a highly stable compound that stores complex lipids
    D) the principal energy storage compound of plants; is the main energy storage of animals
    E) the main energy storage of animals; is a temporary compound used to store glucose

57. The main function of cellulose, the most abundant organic compound on Earth, is
    A) as a storage compound for genetic information.
    B) as a storage compound for energy in plant cells.
    C) as a storage compound for energy in animal cells.
    D) as a component of biological membranes.
    E) as an excellent structural material that can withstand harsh environmental conditions without substantial change.

58. Starch and glycogen, which are both polysaccharides, differ structurally in that glycogen _____, whereas starch _____.
    A) is highly branched; is moderately branched
    B) consists of parallel strands; is highly branched
    C) consists of a combination of branching and parallel strands; is moderately branched
    D) is moderately branched; consists of parallel strands
    E) is highly branched; consists of parallel strands

59. Seeds contain dense aggregates of starch. What role does water play in how the seeds use the stored starch?
    A) Water is needed to break the hydrogen bonds in the starch aggregates, allowing ready access to stored energy.
    B) Water is needed to break the peptide bonds in the starch polymers, releasing more water for the plant's use.
    C) Water is needed to activate enzymes that will dissolve the starch into its disaccharide monomers that are used for growth.
    D) Water is needed to dissolve the starch so that it can mix with fats and create new energy compounds utilized by the growing plant.
    E) Water is needed to help transport starch across membranes, allowing communication between the newly growing plant cells.

60. Starch and glycogen are different in that only one of them
    A) is a polymer of glucose.
    B) contains ribose.
    C) is made in plants.
    D) is an energy storage molecule.
    E) can be digested by humans.

61. The arrangement of glycosidic linkages in _____ makes it a much more stable molecule than _____.
    A) guanine; cytosine
    B) RNA; DNA
    C) sucrose; lactose
    D) cellulose; starch
    E) testosterone; cortisone

62. Why does a starchy food, like bread, become hard and stale when it dries out?
    A) Cellulose molecules aggregate in the absence of water.
    B) In the absence of water, starch forms hydrogen bonds between polysaccharides, which then aggregate.
    C) The release of carbon dioxide causes the bread to harden.
    D) Water and heat cause the polysaccharide chains to bind together.
    E) Mold growth interferes with glycosidic linkages, causing the bread to harden.

63. Lipids form the barriers surrounding various compartments within an organism. Which property of lipids makes them a good barrier?
    A) Many biologically important molecules and ions are not soluble in lipids.
    B) Lipids are polymers.
    C) Lipids store energy.
    D) Lipids are triglycerides.
    E) Lipids release large amounts of energy when broken down.

64. Cholesterol is soluble in ether, an organic solvent, but it is not soluble in water. Based on this information, to which class of biological molecules does cholesterol belong?
    A) Nucleic acids
    B) Carbohydrates
    C) Proteins
    D) Lipids
    E) Sugars

65. You have isolated an unidentified liquid from a sample of beans. You add the liquid to a beaker of water and shake vigorously. After a few minutes, the water and the other liquid separate into two layers. To which class of biological molecules does the unknown liquid most likely belong?
    A) Carbohydrates
    B) Lipids
    C) Proteins
    D) Enzymes
    E) Nucleic acids

66. Lipids are
    A) insoluble in water.
    B) important for energy storage.
    C) hydrophobic.
    D) important constituents of biological membranes.
    E) All of the above

67. Fatty acids are molecules that
    A) contain fats bonded to a glycerol.
    B) are composed of a hydrocarbon chain and a carboxyl group.
    C) are carbohydrates linked to a hydrocarbon chain.
    D) contain glycerol and a carboxyl group.
    E) are always saturated.

68. A fat contains fatty acids and
    A) glycerol.
    B) a base.
    C) an amino acid.
    D) a phosphate.
    E) None of the above

69. You look at the label on a container of shortening and see the words “hydrogenated vegetable oil.” This means that during processing, the number of carbon–carbon double bonds in the oil was decreased. What is the result of decreasing the number of double bonds?
    A) The oil now has a lower melting point.
    B) The oil is now solid at room temperature.
    C) There are more “kinks” in the fatty acid chains.
    D) The oil is now a derivative carbohydrate.
    E) The fatty acid is now a triglyceride.

70. Molecules that are both attracted to water and repel water are called
    A) hydrophilic.
    B) hydrophobic.
    C) amphipathic.
    D) amphoric.
    E) glycosidic.

71. Triglycerides are _____; phospholipids are _____.
    A) hydrophobic; amphipathic
    B) hydrophobic; hydrophilic
    C) amphipathic; hydrophobic
    D) hydrophilic; amphipathic
    E) hydrophilic; hydrophobic

72. The portion of a phospholipid that contains the phosphorous group has one or more electric charges, which make this region of the molecule
    A) hydrophobic.
    B) hydrophilic.
    C) nonpolar.
    D) unsaturated.
    E) saturated.

73. In a biological membrane, the phospholipids are arranged with the fatty acid chains facing the interior of the membrane. As a result, the interior of the membrane is
    A) hydrophobic.
    B) hydrophilic.
    C) charged.
    D) polar.
    E) filled with water.

74. Oil and water do not mix easily because the fat molecules aggregate in water as a result of
    A) van der Waals forces.
    B) covalent bonds.
    C) disulfide bonds.
    D) hydrogen bonds.
    E) glycosidic linkages.

75. You are given two fat-like solid substances and upon analysis you determine that Sample A has a higher melting point than sample B. You thus come to the conclusion that sample A
    A) has a higher number of carbon–carbon double bonds than sample B.
    B) has a lower number of carbon–carbon double bonds than sample B.
    C) is a saturated fat and sample B is an unsaturated fat.
    D) is an unsaturated fat and sample B is a saturated fat.
    E) is a triglyceride and sample B is a simple lipid.

76. Water held back by a dam represents what kind of energy?
    A) Hydroelectric
    B) Irrigation
    C) Potential
    D) Kinetic
    E) Metabolic

77. The sum total of all the chemical reactions in a living structure is called
    A) energetics.
    B) activity.
    C) digestive power.
    D) entropy.
    E) metabolism.

78. Phosphorylation of ADP to ATP is endergonic, whereas the hydrolysis of ATP to ADP is exergonic. Therefore, the two reactions can be
    A) substrates.
    B) endothermic.
    C) kinetic.
    D) activated.
    E) linked.

79. What can *never* be created or destroyed?
    A) Entropy
    B) Energy
    C) Free energy only
    D) Thermal energy only
    E) Potential energy only

80. Which statement about the exergonic hydrolysis of maltose to glucose is true?
    A) The reaction requires the input of free energy.
    B) The free energy of glucose is larger than the free energy of maltose.
    C) The reaction is not spontaneous.
    D) The reaction releases free energy.
    E) At equilibrium, the concentration of maltose is higher than the concentration of glucose.

81. Which statement about thermodynamics is true?
    A) Free energy is used up in an exergonic reaction.
    B) Free energy cannot be used to do work.
    C) The total amount of energy can change after a chemical transformation.
    D) Free energy, but not potential energy, can be kinetic.
    E) Entropy has a tendency to increase.

82. How does the second law of thermodynamics apply to organisms?
    A) As energy transformations occur, free energy increases and unusable energy decreases.
    B) To maintain order, life requires a constant input of energy.
    C) The potential energy of chemical bonds can be converted to kinetic energy.
    D) Reactions occur only with an input of energy.
    E) It does not apply to organisms; the complexity of organisms contradicts the second law.

83. A conclusion of the first law of thermodynamics is that the total energy in the universe is
    A) decreasing.
    B) increasing.
    C) constant.
    D) being converted to free energy.
    E) being converted to matter.

84. In any system, some of the energy is unusable for work. The unusable energy is a measure of the disorder of the system and is referred to as
    A) free energy.
    B) entropy.
    C) enthalpy.
    D) thermodynamics.
    E) equilibrium.

85. If ΔG of a chemical reaction is negative, that reaction will
    A) release energy in the process.
    B) require the input of energy.
    C) not be spontaneous.
    D) not proceed.
    E) decrease the disorder in the system.

86. Which condition or component was *not* likely to have been present on Earth during the formation of the first biologically relevant molecules?
    A) High atmospheric oxygen levels
    B) Rain
    C) Electrical activity in the atmosphere
    D) Ammonia gas
    E) Hydrogen gas

87. During photosynthesis, plants use light energy to synthesize sugars from carbon dioxide. Plants do not make new energy; they merely convert it from light energy to chemical energy. This process is an illustration of
    A) entropy.
    B) chemical equilibrium.
    C) the first law of thermodynamics.
    D) the second law of thermodynamics.
    E) a spontaneous reaction.

88. One _____ or _____ has the mass of about one dalton.

89. Oxygen and carbon are defined as different elements because they have atoms with a different number of _____.

90. Every atom except for _____ has one or more neutrons in its nucleus.

91. The sum of the protons and neutrons in the nucleus of any given atom is called its _____.

92. The tendency of atoms in stable molecules to have eight electrons in their outermost shells is known as the _____.

93. The chemical properties of an element are determined by the number of _____ in its _____ shell.

94. Of the different types of chemical bonds, the strongest bond in biological systems is the _____ bond.

95. The attraction between a slight positive charge on a hydrogen atom and the slight negative charge of a nearby electronegative atom is the basis for a _____.

96. To create methane, one carbon atom shares electrons with four hydrogen atoms, forming _____ covalent bonds.

97. The electronegativity of an atom depends upon the number of its _____ and how far the _____ are from the nucleus.

98. Covalent bonds in which electrons are shared unequally are called _____ bonds.

99. The functional group written as —COOH is called the _____ group.

100. Proteins are polymers composed of _____ acids.

101. Starch is a polymer of glucose subunits. The subunits of any polymer are called _____.

102. The reaction H—A—OH + H—B—OH $\rightarrow$ H—A—B—OH + H_2O represents a(n) _____ reaction.

103. Carbohydrates made up of two simple sugars are called _____.

104. The bonds that link sugar monomers in a starch molecule are _____ linkages.

105. The highly branched polysaccharide that is the major energy storage molecule in mammals is _____, which is water-_____.

106. The fluidity and melting point of fatty acids are determined partially by the number of _____ bonds.

107. A lipid that is liquid at room temperature is called a(n) _____.

108. A lipid with a phosphate group is called a(n) _____.

109. The basic structure of a biological membrane consists of a phospholipid _____, with a(n) _____ interior and _____ exterior.

110. Cells cannot create _____, which in general cannot be created or destroyed.

111. Heat is an example of _____ energy.

112. The energy in a system that exists due to state or position is called _____ energy.

113. Potential energy can be converted into _____ energy, which does work.

114. The linking of molecules in a living system is known as _____; the breaking down of molecules in a living system is known as _____.

115. Energy derived from an exergonic reaction can be used to drive an endergonic reaction if the two reactions are _____.

116. The second law of thermodynamics states that disorder in the universe is constantly _____.

117. When a drop of ink is added to a beaker of water, the dye molecules become randomly dispersed throughout the water. This is an example of an increase in _____.

118. If the ΔG of a reaction is negative, the reaction will occur _____.

119. The generation of order in one place will be accompanied by an increase in the _____ in the total system, which is also called _____.

Use the following to answer questions 120-122:

Refer to the figure below showing part of the periodic table.

					2 He 4.003
5 B 10.81	6 C 12.011	7 N 14.007	8 O 15.999	9 F 18.998	10 Ne 20.179
13 Al 26.982	14 Si 28.086	15 P 30.974	16 S 32.06	17 Cl 35.453	18 Ar 39.948

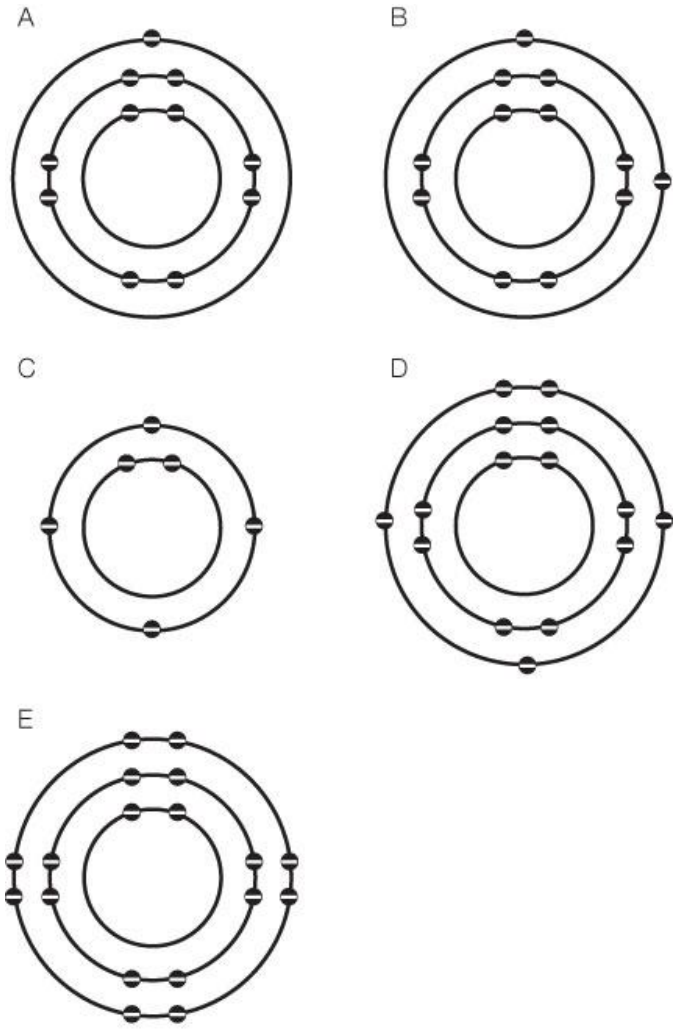
120. Which element has an atomic number of 15?

121. Which element has the same number of electrons in its outer shell as silicon (Si)?

122. Which elements have complete outer shells?

Use the following to answer questions 123-126:

Refer to the figure below showing Bohr models of five elements.



123. Which of the diagrams is the Bohr model for magnesium (Mg), atomic number 12?

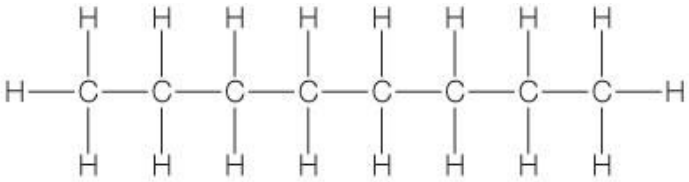
124. Which of the diagrams represents a stable atom, and which element is it?

125. Which of the diagrams show(s) an atom that will lose electrons to form a stable ion?

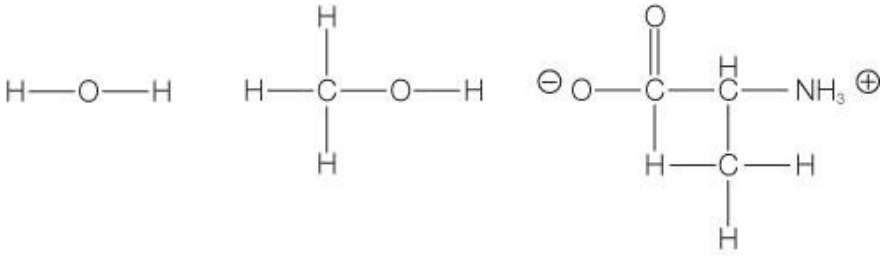
126. Place the atoms in order from lowest electronegativity to highest electronegativity.

Use the following to answer questions 127-128:

Refer to the formulas of the organic molecules below.



Octane



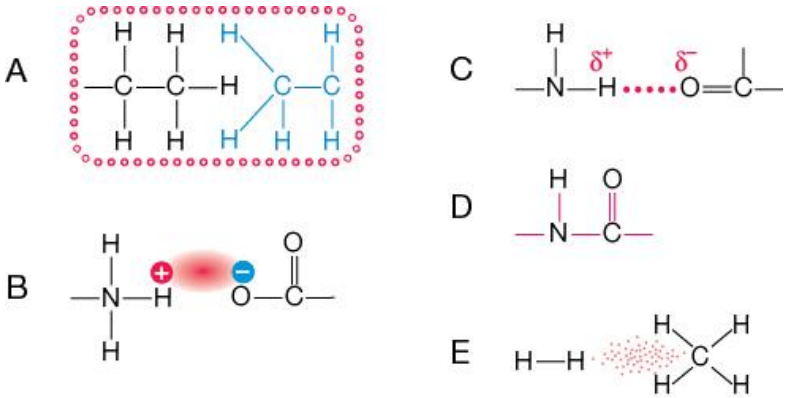
Water Methanol Amino acid

127. Which are most likely to be miscible (soluble in each other) and why?

128. Which molecule is a hydrocarbon?

Use the following to answer questions 129-131:

Refer to the figure below showing various chemical bonds and interactions. The bonds and interactions are colored red.



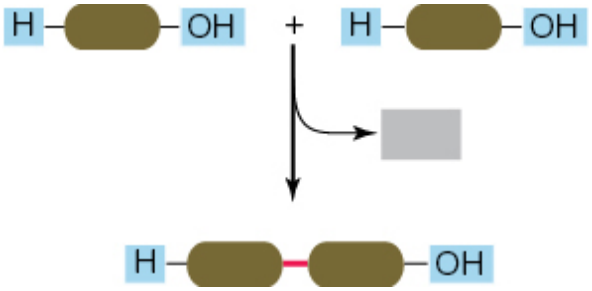
129. What is the correct order of relative strengths, from weakest to strongest, of the bonds and interactions shown in the figure?

130. Nonpolar molecules would likely exhibit which type of bond(s) or interaction(s)?

131. Name each of the bonds or interactions in the figure.

Use the following to answer questions 132-133:

Refer to the diagram below showing a reaction.

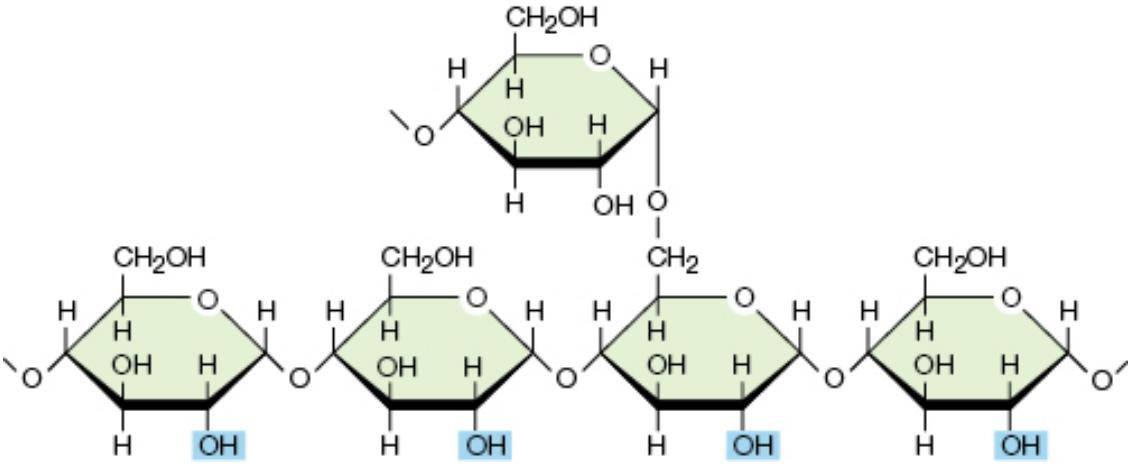


132. Fill in the gray box with the correct molecule.

133. What is the above reaction, and what is the opposite reaction?

Use the following to answer questions 134-136:

Refer to the diagram below of a polysaccharide.



134. What is the monosaccharide component of the above molecule?

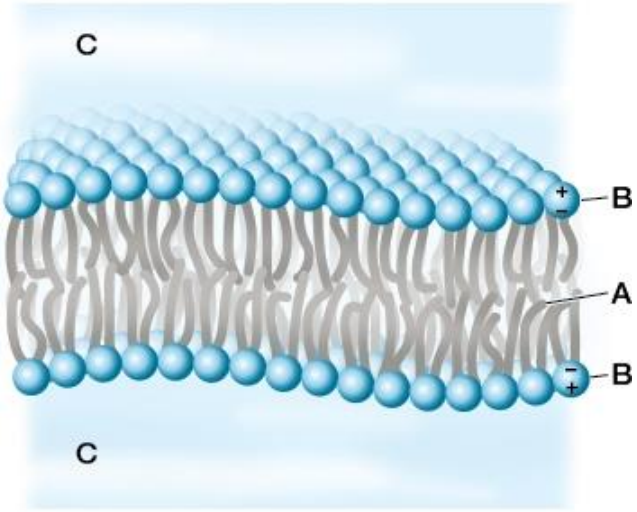
135. What types of linkages connect the monomers?

136. What type of polysaccharide is this, based on the types of linkages and arrangement of the monomers?

137. Although cellulose, starch, and glycogen are all polymers of glucose, paper is made from cellulose, but not of starch or glycogen. Why?

Use the following to answer questions 138-139:

Refer to the diagram below of a phospholipid bilayer.



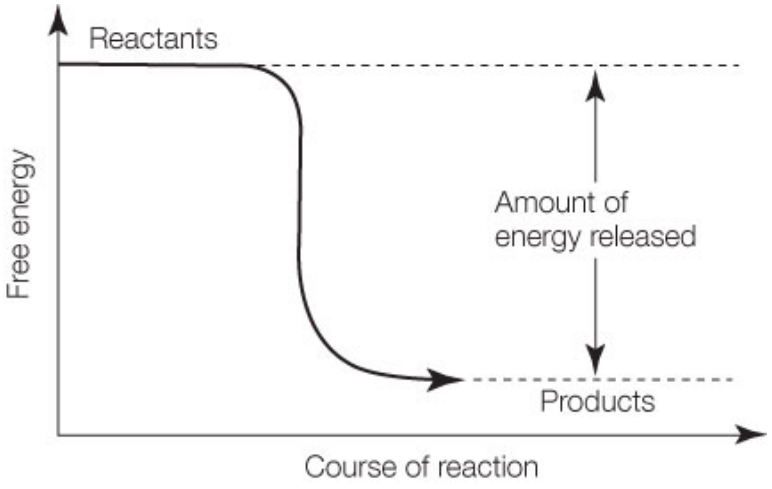
138. Describe why the membrane structure shown in the diagram forms in water.

139. Why are phospholipids amphipathic, when most lipids are completely hydrophobic?

140. Olive oil is fluid at room temperature, whereas shortening is a solid. Based on these characteristics, what can you infer about the chemical differences between the lipids in the two substances?

Use the following to answer questions 141-142:

Refer to the energy diagram below.



141. Is the reaction exergonic or endergonic? Explain your answer.

142. Is this reaction spontaneous? Why or why not?

143. Alternative sources of energy currently in use include solar panels, hydroelectric dams, and ocean turbines. Your friend tells you that an ocean turbine, which spins perpetually to provide power, must be in violation of the second law of thermodynamics. Why is your friend mistaken?

Answer Key

1. B
2. C
3. D
4. C
5. E
6. D
7. E
8. C
9. B
10. E
11. D
12. C
13. B
14. A
15. D
16. A
17. C
18. D
19. E
20. B
21. A
22. D
23. E
24. E
25. E
26. C
27. D
28. E
29. B
30. D
31. C
32. A
33. C
34. C
35. A
36. E
37. A
38. A
39. B
40. D
41. A
42. B
43. C
44. E

45. C
46. D
47. A
48. D
49. B
50. C
51. D
52. E
53. C
54. A
55. E
56. D
57. E
58. A
59. A
60. C
61. D
62. B
63. A
64. D
65. B
66. E
67. B
68. A
69. B
70. C
71. A
72. B
73. A
74. A
75. B
76. C
77. E
78. E
79. B
80. D
81. E
82. B
83. C
84. B
85. A
86. A
87. C

88A. proton

88B. neutron

89. protons

90. hydrogen
91. mass number
92. octet rule
93A. electrons
93B. outermost
94. covalent
95. hydrogen bond
96. four
97A. protons
97B. electrons
98. polar
99. carboxyl
100. amino
101. monomers
102. condensation
103. disaccharides
104. glycosidic
105A. glycogen
105B. insoluble
106. unsaturated
107. oil
108. phospholipid
109A. bilayer
109B. hydrophobic
109C. hydrophilic
110. energy
111. kinetic
112. potential
113. kinetic
114A. anabolism
114B. catabolism
115. linked
116. increasing
117. entropy
118. spontaneously
119A. disorder
119B. entropy
120. Phosphorus (P)
121. Carbon (C)
122. Helium (He), neon (Ne), and argon (Ar)
123. B
124. E; argon (Ar)
125. Both A and B
126. A < B < D < C < E
127. Water and methanol are most likely to be miscible, because they both have polar groups and will thus form hydrogen bonds.

128. Octane
129. E < A < C = B < D
130. A or E
131. A = hydrophobic; B = ionic; C = hydrogen bond; D = covalent; E = van der Waals
132. Water (or H_2O)
133. Condensation; hydrolysis
134. Glucose
135. Glycosidic linkages
136. Because the structure is a branched polymer of glucose monomers, this is either starch or glycogen.
137. The most likely reason is that cellulose is composed of unbranched molecules that can form thin fibrils, while both starch and glycogen are branched molecules. The thin fibers pack together tightly, making a sturdy structure that we use for paper.
138. The phospholipid molecules shown are amphipathic, meaning that they have both hydrophilic and hydrophobic regions. The hydrophobic tail regions will tend to aggregate, and are thus found on the interior of the structure, leaving the hydrophilic heads on the outside in contact with water.
139. Phospholipids differ from most lipids because they have an extra phosphate group attached to the glycerol "head" of the molecule. This phosphate group is polar, and thus hydrophilic. The fatty acid tails of the phospholipid are hydrophobic, and so the entire molecule is amphipathic.
140. The fatty acid components of the lipids in olive oil and shortening must be different. Fatty acids that are saturated have no carbon–carbon double bonds and thus can pack tightly together due to their relatively linear shape. Unsaturated fatty acids, such as those found in olive oil, have one or more carbon–carbon double bonds and thus have kinks. These kinks prevent the fatty acid tails from packing tightly, increasing fluidity of the lipids.
141. This is an exergonic reaction, since the free energy of the products is lower than the free energy of the reactants and energy is released. The ΔG of the reaction is negative.
142. This reaction could occur spontaneously, since the ΔG of the reaction is negative and the reaction can occur without any extra input of energy.
143. Although the machine moves "perpetually," ocean waves are the source of kinetic energy. Since there is a constant input of energy from the ocean to the system of the turbine, there is no conflict with the second law of thermodynamics. The turbine is not "making" energy; it is merely converting the energy of the ocean waves to electricity for human use.