

***Human Physiology: An Integrated Approach, 7e (Silverthorn)***  
**Chapter 2 Molecular Interactions**

1) Stanley Miller set out to demonstrate an explanation for the origins of organic molecules using a combination of simple organic molecules, heat and periodic bursts of electricity through the mixture, ultimately producing which kind of molecules?

- A) carbohydrates
- B) amino acids
- C) lipids
- D) glycoproteins
- E) nucleic acids

Answer: B

Section: Molecules and Bonds

Learning Outcome: 2.1

Bloom's Taxonomy: Comprehension

2) Glycosylated molecules are those formed with which group of organic compounds?

- A) lipids
- B) nucleic acids
- C) lysosomes
- D) cholesterol
- E) DNA

Answer: A

Section: Molecules and Bonds

Learning Outcome: 2.1

Bloom's Taxonomy: Comprehension

3) Cells regulate their level of activity by regulating the amount of proteins present in the cell at any given time, so an up regulation of enzymes would be expected to

- A) increase the cell's response that is produced by the reaction catalyzed by the enzyme.
- B) decrease the level of productivity of chemical reactions that rely on them.
- C) have no effect on the rate of reactions catalyzed by the enzymes.
- D) decrease the rate of reactions catalyzed by the enzymes.
- E) both decrease the level of productivity of chemical reactions that rely on them and decrease the rate of reactions catalyzed by the enzymes.

Answer: A

Section: Protein Interactions

Learning Outcome: 2.9

Bloom's Taxonomy: Comprehension

- 4) When an enzyme reaches its saturation point, the amount of
- A) substrate for the enzyme to act upon is very high.
  - B) substrate for the enzyme to act upon is very low.
  - C) product produced continues to increase.
  - D) product produced by the enzyme decreases.
  - E) substrate for the enzyme to act upon is very low and the amount of product produced by the enzyme decreases.

Answer: A

Section: Protein Interactions

Learning Outcome: 2.8

Bloom's Taxonomy: Comprehension

- 5) Which group of elements makes up more than 90% of the body's mass?

- A) O, H, Na
- B) C, Na, K
- C) O, Ca, H
- D) Ca, C, O
- E) O, C, H

Answer: E

Section: Molecules and Bonds

Learning Outcome: 2.1

Bloom's Taxonomy: Comprehension

- 6) The organic molecules known as phospholipids are key components of cell membranes and composed of which molecules?

- A) amino acids
- B) nucleotides
- C) glycerol
- D) fatty acids
- E) both glycerol and fatty acids

Answer: E

Section: Molecules and Bonds

Learning Outcome: 2.1

Bloom's Taxonomy: Knowledge

- 7) Chromium is

- A) not an element in the periodic table.
- B) a protein.
- C) a dietary supplement with no natural role in the body.
- D) an essential element involved in glucose metabolism.

Answer: D

Section: Molecules and Bonds

Learning Outcome: 2.1

Bloom's Taxonomy: Knowledge

8) Which of the following is a way to recognize a carbohydrate by looking at its name only?

- A) It ends in -ase.
- B) It ends in -ose.
- C) It begins with nucleo-.
- D) It begins with proteo-.
- E) It begins with lipo-.

Answer: B

Section: Molecules and Bonds

Learning Outcome: 2.1

Bloom's Taxonomy: Comprehension

9) Which of the following is NOT considered an essential element for a living organism?

- A) carbon
- B) hydrogen
- C) mercury
- D) oxygen
- E) nitrogen

Answer: C

Section: Molecules and Bonds

Learning Outcome: 2.1

Bloom's Taxonomy: Knowledge

10) The largest carbohydrate molecules are called polysaccharides because they are composed of \_\_\_\_\_ molecules bonded together with one another.

- A) amino acid
- B) nucleotide
- C) purine
- D) pyrimidine
- E) simple sugar

Answer: E

Section: Molecules and Bonds

Learning Outcome: 2.1

Bloom's Taxonomy: Comprehension

11) Essential amino acids that are used to build proteins

- A) exist in twenty six different configurations.
- B) are linked together by ionic chemical bonds in proteins.
- C) can be used medically for both diagnosis and treatment of diseases.
- D) are derived from the foods we eat and digest.
- E) can only be made by cells within our bodies.

Answer: D

Section: Molecules and Bonds

Learning Outcome: 2.1

Bloom's Taxonomy: Comprehension

12) Which of the following are examples of cations?

- A)  $\text{SO}_4^{2-}$
- B)  $\text{Ca}^{2+}$
- C)  $\text{HPO}_4^{2-}$
- D)  $\text{HCO}_3^-$
- E)  $\text{Cl}^-$

Answer: B

Section: Molecules and Bonds

Learning Outcome: 2.2

Bloom's Taxonomy: Comprehension

13) A positively-charged ion is called a(n)

- A) electron.
- B) proton.
- C) neutron.
- D) cation.
- E) anion.

Answer: D

Section: Molecules and Bonds

Learning Outcome: 2.2

Bloom's Taxonomy: Knowledge

14) The most important polar molecule is \_\_\_\_\_ because it is practically a universal solvent.

- A) water
- B) bicarbonate
- C) sodium chloride
- D) magnesium sulfate
- E) nucleic acid

Answer: A

Section: Molecules and Bonds

Learning Outcome: 2.3

Bloom's Taxonomy: Knowledge

15) A molecule referred to as highly soluble is

- A) very likely to dissolve in water.
- B) not very likely to dissolve in water.
- C) called aqueous.
- D) very likely to dissolve in water and is called aqueous.
- E) not very likely to dissolve in water and is called aqueous.

Answer: A

Section: Noncovalent Interactions

Learning Outcome: 2.4

Bloom's Taxonomy: Comprehension

- 16) A free radical is a
- A) charged particle.
  - B) molecule with an extra electron.
  - C) molecule with an extra neutron.
  - D) molecule with an extra proton.
  - E) molecule with an unpaired electron.

Answer: E

Section: Molecules and Bonds

Learning Outcome: 2.2

Bloom's Taxonomy: Knowledge

- 17) The chemical bonding behavior of an atom is directly determined by the
- A) number of protons.
  - B) number of neutrons.
  - C) number and arrangement of electrons.
  - D) size of the atom.
  - E) mass of the atom.

Answer: C

Section: Molecules and Bonds

Learning Outcome: 2.2

Bloom's Taxonomy: Comprehension

- 18) Atoms in a covalent molecule
- A) share electrons in single pairs.
  - B) share electrons in double pairs.
  - C) share electrons in triple pairs.
  - D) share electrons singly, never in pairs.
  - E) can share electrons in single pairs, double pairs, or triple pairs.

Answer: E

Section: Molecules and Bonds

Learning Outcome: 2.3

Bloom's Taxonomy: Comprehension

- 19) The weak interactions between atoms that keep atoms near each other are called
- A) hydrogen bonds.
  - B) van der Waals forces.
  - C) ionic bonds.
  - D) hydrogen bonds and van der Waals forces.
  - E) van der Waals forces and ionic bonds.

Answer: D

Section: Molecules and Bonds

Learning Outcome: 2.3

Bloom's Taxonomy: Comprehension

20) All of these statements about carbohydrates are true EXCEPT one. Identify the exception.

- A) Simple sugars include galactose, glucose, and ribose.
- B) Cellulose is the most abundant polysaccharide on earth.
- C) Glycogen is a storage polysaccharide made by animal cells.
- D) Polysaccharides are important both for energy storage and to provide structure to cells.
- E) Glycogen is important both for energy storage and to provide structure for cells.

Answer: E

Section: Molecules and Bonds

Learning Outcome: 2.1

Bloom's Taxonomy: Comprehension

21) In regard to lipids, the term *unsaturated* refers to

- A) the lack of double bonds between adjacent carbon atoms in a fatty acid.
- B) the presence of double bonds between adjacent carbon atoms in a fatty acid.
- C) the ring structure of steroids.
- D) glycerol, which acts as an anchor for joined fatty acids.
- E) fats, such as butter and lard, which come from animal sources.

Answer: B

Section: Molecules and Bonds

Learning Outcome: 2.1

Bloom's Taxonomy: Comprehension

22) Each amino acid differs from others in the

- A) number of central carbon atoms.
- B) size of the amino group.
- C) number of carboxyl groups.
- D) chemical structure of the R group.
- E) number of peptide bonds in the molecule.

Answer: D

Section: Molecules and Bonds

Learning Outcome: 2.1

Bloom's Taxonomy: Comprehension

23) The alpha-helix and pleated sheet are examples of the \_\_\_\_\_ structure of a protein.

- A) primary
- B) secondary
- C) tertiary
- D) quaternary
- E) pentanary

Answer: B

Section: Noncovalent Interactions

Learning Outcome: 2.5

Bloom's Taxonomy: Comprehension

24) Interactions between different globular or fibrous polypeptide chains result in which type of structure?

- A) primary
- B) secondary
- C) tertiary
- D) quaternary
- E) pentagonal

Answer: D

Section: Noncovalent Interactions

Learning Outcome: 2.5

Bloom's Taxonomy: Comprehension

25) The concentration of a solution expresses the amount of

- A) solvent per volume of solute.
- B) solute per volume of solvent.
- C) solvent per volume of solution.
- D) solute per volume of solution.
- E) None of the answers are correct.

Answer: D

Section: Noncovalent Interactions

Learning Outcome: 2.4

Bloom's Taxonomy: Knowledge

26) Nucleic acids are polymers of units called

- A) amino acids.
- B) fatty acids.
- C) bases.
- D) ribose.
- E) nucleotides.

Answer: E

Section: Molecules and Bonds

Learning Outcome: 2.1

Bloom's Taxonomy: Comprehension

27) A nucleotide consists of a

- A) five-carbon sugar and phosphate group.
- B) five-carbon sugar and a nitrogenous base.
- C) phosphate group and a nitrogenous base.
- D) five-carbon sugar, a nitrogenous base, and a phosphate group.
- E) five-carbon sugar and an amino acid.

Answer: D

Section: Molecules and Bonds

Learning Outcome: 2.1

Bloom's Taxonomy: Knowledge

28) According to the rules of complementary base pairing, a nucleotide containing the base cytosine would only pair with a nucleotide containing the base

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

Answer: E

Section: Molecules and Bonds

Learning Outcome: 2.1

Bloom's Taxonomy: Knowledge

29) The most important energy-transferring compound in cells is a nucleotide known as

- A) glucose.
- B) fructose.
- C) protein.
- D) adenosine triphosphate.
- E) deoxyribonucleic acid.

Answer: D

Section: Molecules and Bonds

Learning Outcome: 2.1

Bloom's Taxonomy: Knowledge

30) Which bases below are purines?

- 1. adenine
  - 2. cytosine
  - 3. guanine
  - 4. thymine
  - 5. uracil
- A) 1 and 2
  - B) 2 and 3
  - C) 1, 3, and 5
  - D) 1 and 3
  - E) 2, 4, and 5

Answer: D

Section: Molecules and Bonds

Learning Outcome: 2.1

Bloom's Taxonomy: Knowledge

31) Polymers are a typical formation of \_\_\_\_\_ molecules.

- A) organic
- B) inorganic
- C) either organic or inorganic

Answer: A

Section: Molecules and Bonds

Learning Outcome: 2.1

Bloom's Taxonomy: Comprehension



32) Cholesterol is a

- A) precursor to steroid hormones.
- B) structural component of cell membranes.
- C) dangerous fat that is absent from a healthy body.
- D) precursor to steroid hormones and a structural component of cell membranes.
- E) precursor to steroid hormones, a structural component of cell membranes, and a dangerous fat that is absent from a healthy body.

Answer: D

Section: Molecules and Bonds

Learning Outcome: 2.1

Bloom's Taxonomy: Comprehension

33) A component of an important buffer in the human body is

- A) NaCl.
- B) H<sup>+</sup>.
- C) HCl.
- D) HCO<sub>3</sub><sup>-</sup>.
- E) H<sub>2</sub>O.

Answer: D

Section: Noncovalent Interactions

Learning Outcome: 2.6

Bloom's Taxonomy: Knowledge

34) Which of the following substances is most alkaline?

- A) lemon juice, pH = 2
- B) urine, pH = 6
- C) tomato juice, pH = 4
- D) white wine, pH = 3
- E) stomach secretions, pH = 1

Answer: B

Section: Noncovalent Interactions

Learning Outcome: 2.6

Bloom's Taxonomy: Comprehension

35) If a substance has a pH that is less than 7, it is considered

- A) neutral.
- B) acidic.
- C) alkaline.
- D) a buffer.
- E) a salt.

Answer: B

Section: Noncovalent Interactions

Learning Outcome: 2.6

Bloom's Taxonomy: Comprehension

36) Protein specificity is the

- A) activation of a specific protein that is needed to perform a particular function.
- B) degree to which a protein is attracted to a ligand.
- C) ability of a protein to bind a certain ligand or a group of related ligands.
- D) degree to which a protein-ligand complex initiates a response.
- E) degree to which a protein is attracted to a ligand and the ability of a protein to bind a certain ligand or a group of related ligands.

Answer: C

Section: Protein Interactions

Learning Outcome: 2.8

Bloom's Taxonomy: Knowledge

37) Which of the following is a common feature of soluble proteins?

- A) structural support
- B) noncovalent interaction
- C) receptor binding
- D) chemical modulation
- E) All of the answers are correct.

Answer: B

Section: Protein Interactions

Learning Outcome: 2.7

Bloom's Taxonomy: Knowledge

38) An ion has gained or lost

- A) a proton(s).
- B) a neutron(s).
- C) an electron(s).
- D) a carbon atom(s).
- E) a double bond.

Answer: C

Section: Molecules and Bonds

Learning Outcome: 2.2

Bloom's Taxonomy: Knowledge

39) Isotopes of the same element differ by having different numbers of

- A) protons.
- B) neutrons.
- C) electrons.
- D) carbon atoms.
- E) double bonds.

Answer: B

Section: Molecules and Bonds

Learning Outcome: 2.1

Bloom's Taxonomy: Comprehension

40) The identity of an element can be determined by the number of

- A) protons.
- B) neutrons.
- C) electrons.
- D) carbon atoms.
- E) double bonds.

Answer: A

Section: Molecules and Bonds

Learning Outcome: 2.1

Bloom's Taxonomy: Comprehension

41) This particle has a charge of +1 and a mass of 1.

- A) proton
- B) neutron
- C) electron
- D) molecular oxygen
- E) sodium chloride

Answer: A

Section: Molecules and Bonds

Learning Outcome: 2.1

Bloom's Taxonomy: Comprehension

42) This particle has a charge of -1 and a negligible mass.

- A) proton
- B) neutron
- C) electron
- D) hydrogen
- E) magnesium

Answer: C

Section: Molecules and Bonds

Learning Outcome: 2.1

Bloom's Taxonomy: Comprehension

43) This particle has a neutral charge and a mass of 1.

- A) proton
- B) neutron
- C) electron
- D) hydrogen
- E) magnesium

Answer: B

Section: Molecules and Bonds

Learning Outcome: 2.1

Bloom's Taxonomy: Comprehension

44) A change in pH value of one unit indicates a

- A) 1-fold change in  $[H^+]$ .
- B) change of  $10^{-1}$  in pH.
- C) change of  $10^{-2}$  in pH.
- D) 10 fold change in  $[H^+]$ .
- E) Cannot be determined.

Answer: D

Section: Noncovalent Interactions

Learning Outcome: 2.6

Bloom's Taxonomy: Comprehension

45) A blood pH of less than 7.00 and greater than 7.70 is incompatible with life.

- A) True
- B) False

Answer: A

Section: Noncovalent Interactions

Learning Outcome: 2.6

Bloom's Taxonomy: Knowledge

46) Which of the following statements best describes the relationship between pH and hydrogen ions?

- A) pH and hydrogen ions are equivalent.
- B) pH and hydrogen ions are directly proportional.
- C) pH and hydrogen ions are inversely proportional.
- D) pH is always 100 times more than the number of hydrogen ions.
- E) pH and hydrogen ions are independent and unrelated.

Answer: C

Section: Noncovalent Interactions

Learning Outcome: 2.6

Bloom's Taxonomy: Comprehension

47) HCl (hydrochloric acid) is considered an acid because

- A) in solution it donates its  $H^+$ .
- B) in solution it decreases the concentration of free  $H^+$ .
- C) in solution it increases the pH.
- D) it is similar to ammonia.
- E) it is able to form hydroxide ions.

Answer: A

Section: Noncovalent Interactions

Learning Outcome: 2.6

Bloom's Taxonomy: Comprehension

48) Molecular function and distinctive shapes of large complex biomolecules result from the interactions of which of the following?

- A) van der Waals forces
- B) ionic bonds
- C) hydrogen bonds
- D) covalent bond angles
- E) All of the choices can contribute.

Answer: E

Section: Noncovalent Interactions

Learning Outcome: 2.5

Bloom's Taxonomy: Comprehension

49) Which of the following formulas describes the relationship between pH and hydrogen ions?

- A)  $\text{pH} = \log [\text{H}^+]$
- B)  $\text{pH} = -\log [\text{H}^+]$
- C)  $[\text{H}^+] = -\log \text{pH}$
- D)  $[\text{H}^+] = \log \text{pH}$
- E)  $\text{pH} = [\text{H}^+] + [\text{OH}^-]$

Answer: B

Section: Noncovalent Interactions

Learning Outcome: 2.6

Bloom's Taxonomy: Comprehension

50) All organic molecules contain which of the following?

- A) calcium
- B) carbon
- C) adenosine
- D) oxygen
- E) lipids

Answer: B

Section: Molecules and Bonds

Learning Outcome: 2.1

Bloom's Taxonomy: Knowledge

51) Molecules that contain the element carbon are known as

- A) organic molecules.
- B) essential elements.
- C) nucleic acids.
- D) protons.
- E) vitamins.

Answer: A

Section: Molecules and Bonds

Learning Outcome: 2.1

Bloom's Taxonomy: Knowledge

52) Which of the following combination of elements make up 90% of the body's mass?

- A) oxygen, carbon, and nucleic acids
- B) hydrogen, nitrogen, and oxygen
- C) oxygen, carbon, and hydrogen
- D) carbon dioxide, oxygen, and sodium
- E) sodium, potassium, and calcium

Answer: C

Section: Molecules and Bonds

Learning Outcome: 2.1

Bloom's Taxonomy: Knowledge

53) Which of the following results when an atom has such a strong attraction for electrons that it pulls one or more electrons completely away from another atom?

- A) a Van der Waals attraction
- B) an ionic bond
- C) a hydrogen bond
- D) a covalent bond
- E) a very stable bond

Answer: B

Section: Molecules and Bonds

Learning Outcome: 2.3

Bloom's Taxonomy: Knowledge

54) These are weak attractive forces that are responsible for the surface tension of water.

- A) a Van der Waals attraction
- B) an ionic bond
- C) a hydrogen bond
- D) a covalent bond
- E) a potassium bond

Answer: C

Section: Molecules and Bonds

Learning Outcome: 2.3

Bloom's Taxonomy: Comprehension

55) These result when the carbon atoms in phospholipids share a pair of electrons.

- A) a Van der Waals attraction
- B) an ionic bond
- C) a hydrogen bond
- D) a covalent bond
- E) a potassium bond

Answer: D

Section: Molecules and Bonds

Learning Outcome: 2.3

Bloom's Taxonomy: Comprehension

56) Van der Waals forces are weak attractive forces between the nucleus of one atom and the electrons of another atom close by.

- A) True
- B) False

Answer: A

Section: Molecules and Bonds

Learning Outcome: 2.3

Bloom's Taxonomy: Knowledge

57) Which of the following biological molecules does glycogen belong to?

- A) carbohydrates
- B) lipids
- C) proteins
- D) nucleotides
- E) lipids and proteins

Answer: A

Section: Molecules and Bonds

Learning Outcome: 2.1

Bloom's Taxonomy: Comprehension

58) Nucleotides participate in which of the following functions?

- A) They combine with oxygen to produce energy.
- B) They are the building blocks of proteins like cell receptors.
- C) They form structural elements in the cell membrane.
- D) They transfer energy and are part of genetic material.
- E) They store glucose as fat.

Answer: D

Section: Molecules and Bonds

Learning Outcome: 2.1

Bloom's Taxonomy: Comprehension

59) Which of the following biological molecules exhibit the characteristics of saturation, specificity and competition?

- A) carbohydrates
- B) lipids
- C) receptor proteins
- D) nucleotides
- E) lipids and proteins

Answer: C

Section: Protein Interactions

Learning Outcome: 2.8

Bloom's Taxonomy: Comprehension

60) To which of the following groups of biomolecules do triglycerides and steroids belong?

- A) carbohydrates
- B) lipids
- C) proteins
- D) nucleotides
- E) lipids and proteins

Answer: B

Section: Molecules and Bonds

Learning Outcome: 2.1

Bloom's Taxonomy: Knowledge

61) Potassium channels are usually composed of several subunits. This is an example of which level of protein structure?

- A) primary
- B) secondary
- C) tertiary
- D) quaternary
- E) alpha helix

Answer: D

Section: Molecules and Bonds

Learning Outcome: 2.1

Bloom's Taxonomy: Application

62) The sequence and number of amino acids in the chain is an example of which of the following levels of protein structure?

- A) primary
- B) secondary
- C) tertiary
- D) quaternary
- E) alpha helix

Answer: A

Section: Molecules and Bonds

Learning Outcome: 2.1

Bloom's Taxonomy: Knowledge

63) Hemoglobin molecules are made from four globular protein subunits. The three-dimensional shape of these globular subunits would be an example of which of the following levels of protein structure?

- A) primary
- B) secondary
- C) tertiary
- D) quaternary
- E) alpha helix

Answer: C

Section: Molecules and Bonds

Learning Outcome: 2.1

Bloom's Taxonomy: Knowledge



64) Beta strands are an example of a spatial arrangement of amino acids.

A) True

B) False

Answer: A

Section: Noncovalent Interactions

Learning Outcome: 2.5

Bloom's Taxonomy: Comprehension

65) Which of the following levels of protein structure occurs from spontaneous folding that results from covalent bonds and noncovalent interactions?

A) primary

B) secondary

C) tertiary

D) quaternary

E) triangular

Answer: C

Section: Noncovalent Interactions

Learning Outcome: 2.5

Bloom's Taxonomy: Knowledge

66) The protein keratin which is found in hair and nails and affords nails their rigid structure would be categorized as which of the following protein shapes?

A) fibrous

B) globular

C) acidic

D) hexavalent

E) triangular

Answer: A

Section: Noncovalent Interactions

Learning Outcome: 2.5

Bloom's Taxonomy: Knowledge

67) Which of the following types of bonds between adjacent amino acids plays an important role in the shape of globular proteins?

A) collagen bonds

B) disulfide bonds

C) sodium bonds

D) metallic bond

E) secondary bonds

Answer: B

Section: Noncovalent Interactions

Learning Outcome: 2.5

Bloom's Taxonomy: Comprehension

68) Which of the following would be disrupted by changes in free hydrogen ions in solution, thus disrupting the molecule's shape and function?

- A) disulfide bonds
- B) hydrogen bonds
- C) sodium bonds
- D) covalent bonds
- E) double bonds

Answer: B

Section: Noncovalent Interactions

Learning Outcome: 2.5

Bloom's Taxonomy: Comprehension

69) During intense exercise our muscles produce lactate and hydrogen ions. Which of the following molecules would be affected by the accumulation of hydrogen ions?

- A) cholesterol in the plasma membrane
- B) glucose molecules in the adipose tissue
- C) DNA in the nucleus
- D) the proteins actin and myosin
- E) phospholipids in the membrane

Answer: D

Section: Noncovalent Interactions

Learning Outcome: 2.5

Bloom's Taxonomy: Application

70) Which of the following best describes an irreversible antagonist?

- A) involved in activation via phosphorylation
- B) cannot be displaced by competition
- C) binds to proteins away from the active site
- D) reversible antagonist
- E) allosteric enhancer

Answer: B

Section: Protein Interactions

Learning Outcome: 2.9

Bloom's Taxonomy: Comprehension

71) When glucose enters a cell it is phosphorylated in order to maintain a low glucose concentration in the cell. The enzyme that phosphorylates glucose would be what kind of modulator?

- A) covalent modulator
- B) competitive inhibitor
- C) allosteric modulator
- D) reversible antagonist
- E) irreversible agonist

Answer: A

Section: Protein Interactions

Learning Outcome: 2.9

Bloom's Taxonomy: Application

72) If a reaction which is stopped by substance X can recover when a lot more of the native activator is supplied, substance X would be considered which of the following?

- A) covalent modulator
- B) competitive inhibitor
- C) allosteric modulator
- D) irreversible antagonist
- E) a phosphatase

Answer: B

Section: Protein Interactions

Learning Outcome: 2.9

Bloom's Taxonomy: Application

73) Which of the following would be considered an allosteric modulator?

- A) A substance involved in activation via phosphorylation.
- B) A substance that can be displaced by competition at the active site.
- C) A substance that binds to proteins away from the active site.
- D) A substance that has no effect on the affinity of the ligand.
- E) A substance that binds irreversibly.

Answer: C

Section: Protein Interactions

Learning Outcome: 2.9

Bloom's Taxonomy: Comprehension

74) The smallest unit of an element is a(n)

- A) atom.
- B) molecule.
- C) element.
- D) nucleus.
- E) tissue.

Answer: A

Section: Molecules and Bonds

Learning Outcome: 2.1

Bloom's Taxonomy: Knowledge

75) When two or more atoms are chemically linked, the smallest unit of the resulting material is referred to as a(n)

- A) atom.
- B) molecule.
- C) element.
- D) nucleus.
- E) tissue.

Answer: B

Section: Molecules and Bonds

Learning Outcome: 2.1

Bloom's Taxonomy: Knowledge

76) A(n) \_\_\_\_\_ is a substance that consists entirely of atoms with the same atomic number.

- A) atom
- B) molecule
- C) element
- D) nucleus
- E) tissue

Answer: C

Section: Molecules and Bonds

Learning Outcome: 2.1

Bloom's Taxonomy: Knowledge

77) The center of an atom is called the

- A) proton.
- B) molecule.
- C) element.
- D) nucleus.
- E) electron.

Answer: D

Section: Molecules and Bonds

Learning Outcome: 2.1

Bloom's Taxonomy: Comprehension

78) Electrons travel around the center of the atom at high speed forming a(n)

- A) atom.
- B) molecule.
- C) element.
- D) nucleus.
- E) shell.

Answer: E

Section: Molecules and Bonds

Learning Outcome: 2.2

Bloom's Taxonomy: Comprehension

79) An element's ability to bind to and with other elements is determined by which of the following?

- A) the arrangement of electrons in the outer shell of an atom
- B) its amino acid composition
- C) its state of glycosylation
- D) the number of enzymes required
- E) the amount of folding in its subunits

Answer: A

Section: Molecules and Bonds

Learning Outcome: 2.2

Bloom's Taxonomy: Knowledge

80) Ions with a positive charge are called

- A) anions.
- B) electrons.
- C) cations.
- D) neurons.
- E) tissues.

Answer: C

Section: Molecules and Bonds

Learning Outcome: 2.3

Bloom's Taxonomy: Knowledge

81) Ions with a negative charge are called

- A) anions.
- B) electrons.
- C) cations.
- D) neurons.
- E) tissues.

Answer: A

Section: Molecules and Bonds

Learning Outcome: 2.3

Bloom's Taxonomy: Knowledge

82) A \_\_\_\_\_ is a homogeneous mixture containing a solvent and a solute.

- A) nucleus
- B) molecule
- C) solution
- D) compound
- E) cocktail

Answer: C

Section: Noncovalent Interactions

Learning Outcome: 2.4

Bloom's Taxonomy: Comprehension

83) Molecules that readily dissolve in water are called

- A) hydrophobic.
- B) hydrophilic.
- C) isotonic.
- D) non-polar.
- E) lipids.

Answer: B

Section: Noncovalent Interactions

Learning Outcome: 2.4

Bloom's Taxonomy: Comprehension

84) Molecules that do not dissolve well in water are called

- A) hydrophobic.
- B) hydrophilic.
- C) isotonic.
- D) polar.
- E) salts.

Answer: A

Section: Noncovalent Interactions

Learning Outcome: 2.4

Bloom's Taxonomy: Knowledge

85) A(n) \_\_\_\_\_ is any molecule or ion that binds to another molecule.

- A) phospholipid
- B) enzyme
- C) vitamin
- D) ligand
- E) cofactor

Answer: D

Section: Protein Interactions

Learning Outcome: 2.7

Bloom's Taxonomy: Knowledge

86) Two methods of protein activation include \_\_\_\_\_ and \_\_\_\_\_.

- A) exergonic, endogonic
- B) enzymatic, glycolytic
- C) homeostatic, osmotic
- D) mechanistic, covalent bonding
- E) proteolytic, cofactor binding

Answer: E

Section: Protein Interactions

Learning Outcome: 2.8

Bloom's Taxonomy: Comprehension

87) The molecule DNA contains the five-carbon sugar

- A) lactose.
- B) ribose.
- C) deoxyribose.
- D) glucose.
- E) uracil.

Answer: C

Section: Molecules and Bonds

Learning Outcome: 2.1

Bloom's Taxonomy: Knowledge

88) The molecule RNA contains the five-carbon sugar

- A) lactose.
- B) ribose.
- C) deoxyribose.
- D) glucose.
- E) uracil.

Answer: B

Section: Molecules and Bonds

Learning Outcome: 2.1

Bloom's Taxonomy: Knowledge

89) The purines found in DNA are \_\_\_\_\_ and \_\_\_\_\_.

- A) adenine, guanine
- B) ribose, thymine
- C) deoxyribose, guanine
- D) guanine, cytosine
- E) uracil, adenine

Answer: A

Section: Molecules and Bonds

Learning Outcome: 2.1

Bloom's Taxonomy: Knowledge

90) The pyrimidines found in DNA are \_\_\_\_\_ and \_\_\_\_\_.

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

Answer: B

Section: Molecules and Bonds

Learning Outcome: 2.1

Bloom's Taxonomy: Knowledge

91) In a chemical reaction, \_\_\_\_\_ between atoms are broken as atoms are rearranged in new combinations to form different chemical substances.

- A) electron shells
- B) nuclei
- C) chemical bonds
- D) homeostatic interactions
- E) protons

Answer: C

Section: Molecules and Bonds

Learning Outcome: 2.3

Bloom's Taxonomy: Knowledge

92) The reaction rates of many chemical reactions that occur in the body are controlled by special protein molecules called

- A) neurotransmitters.
- B) purines.
- C) nucleic acids.
- D) enzymes.
- E) intermediates.

Answer: D

Section: Protein Interactions

Learning Outcome: 2.7

Bloom's Taxonomy: Comprehension

93) List the following in order of increasing mass: atom, molecule, proton, neutron, electron.

- A) electron < proton < neutron < atom < molecule
- B) neutron < proton < electron < atom < molecule
- C) electron < proton < atom < neutron < molecule
- D) proton < neutron < electron < atom < molecule
- E) atom < electron < proton < neutron < molecule

Answer: A

Section: Molecules and Bonds

Learning Outcome: 2.1

Bloom's Taxonomy: Comprehension

94) How many milliequivalents are represented by a mole of bicarbonate ions ( $\text{HCO}_3^-$ )?

Answer: 1000 milliequivalents. This is calculated by taking the equivalent value of the molecule, which equals the molarity of the molecule (1 in this case) times the number of charges the molecule carries (in this case, the minus symbol indicates a charge of negative one, i.e., -1), so  $1 \times 1 = 1$  equivalent. 1 equivalent = 1000 milliequivalents.

Section: Noncovalent Interactions

Learning Outcome: 2.4

Bloom's Taxonomy: Application

95) List and briefly describe the seven categories of soluble proteins.

Answer: The seven categories: enzymes, membrane transporters, signal molecules, receptors, binding proteins, regulatory proteins, and immunoglobulins. See the "Protein Interactions" section of the chapter.

Section: Protein Interactions

Learning Outcome: 2.7

Bloom's Taxonomy: Comprehension



96) Which of the following elements combine to form nonpolar covalent bonds?

- A) carbon and hydrogen
- B) nitrogen and hydrogen
- C) sodium and chlorine
- D) hydrogen and oxygen
- E) carbon and chlorine

Answer: A

Section: Molecules and Bonds

Learning Outcome: 2.3

Bloom's Taxonomy: Comprehension

97) The designation  $\text{Ca}^{2+}$  means calcium has

- A) space for two more electrons.
- B) gained two more electrons.
- C) space for two more protons.
- D) gained two more protons.

Answer: A

Section: Molecules and Bonds

Learning Outcome: 2.2

Bloom's Taxonomy: Comprehension

98) In a 5% NaCl solution,

- A) there are 5 grams of sodium chloride for every 100 mL of water.
- B) there are 5 grams of sodium chloride for every 100 mL of total solution.
- C) the solute is water.
- D) there are 5 grams of sodium chloride for every 100 mL of water and there are 5 grams of sodium chloride for every 100 mL of total solution.
- E) there are 5 grams of sodium chloride for every 100 mL of total solution and the solute is water.

Answer: B

Section: Noncovalent Interactions

Learning Outcome: 2.4

Bloom's Taxonomy: Application

99) A molecule of sucrose has a molecular weight of 342 Daltons. How many grams of sucrose would be required to make one liter of a 2.5 Molar solution of sucrose?

Answer: 805 grams (per liter). This is calculated by multiplying the amount of sucrose in one liter of a

1 molar solution (342 grams) times the molar concentration (2.5).  $342 \times 2.5 = 805$  grams

Section: Noncovalent Interactions

Learning Outcome: 2.4

Bloom's Taxonomy: Application

- 100) A double covalent bond is formed when atoms
- A) share one pair of electrons (a total of two).
  - B) share two pairs of electrons (a total of four).
  - C) swap two pairs of electrons.
  - D) transfer a pair of electrons from one atom to the other.
  - E) transfer two pairs of electrons from one atom to the other.

Answer: B

Section: Molecules and Bonds

Learning Outcome: 2.3

Bloom's Taxonomy: Comprehension

- 101) The term *polar* is used to describe molecules because
- A) polar covalent molecules are found in colder climates.
  - B) polar covalent molecules were first discovered in polar bears.
  - C) there are at least two distinct ends of the molecule regarding electron position and the resulting charge.
  - D) there are at least two distinct ends of the molecule regarding hydrogen placement.
  - E) such molecules are always linear in shape.

Answer: C

Section: Molecules and Bonds

Learning Outcome: 2.4

Bloom's Taxonomy: Comprehension

102) What makes fats solid at room temperature? The more likely a fat is to be solid at room temperature the more it potentially can contribute to cardiovascular disease. With this in mind which fats will be the most dangerous?

Answer: The more saturated or the higher the number of hydrogens a fat contains, the more likely it will be solid at room temperature. Therefore, saturated animal fats are the most associated with cardiovascular disease.

Section: Molecules and Bonds

Learning Outcome: 2.1

Bloom's Taxonomy: Application

103) Lipids are hydrophobic, and do not usually dissolve in water. Because blood is water-based, the lipid cholesterol is combined with \_\_\_\_\_ so that it can be transported by blood.

- A) hydrophilic molecules
- B) hydrophobic molecules
- C) nothing; cholesterol is not transported in blood
- D) cations
- E) anions

Answer: A

Section: Noncovalent Interactions

Learning Outcome: 2.4

Bloom's Taxonomy: Application

104) Only free  $H^+$  contributes to the hydrogen ion concentration.

- A) True
- B) False

Answer: A

Section: Noncovalent Interactions

Learning Outcome: 2.6

Bloom's Taxonomy: Comprehension

105) In the equation  $CO_2 + H_2O \leftrightarrow H_2CO_3 \leftrightarrow H^+ + HCO_3^-$ , which of these is an acid?

- A)  $HCO_3^-$
- B)  $H_2CO_3$
- C)  $H_2O$
- D)  $CO_2$
- E)  $H^+$

Answer: B

Section: Noncovalent Interactions

Learning Outcome: 2.6

Bloom's Taxonomy: Comprehension

106) Chemical reactions that occur in the human body proceed at a faster rate due to special catalytic molecules called

- A) enzymes.
- B) cytozymes.
- C) proteins.
- D) antibodies.
- E) antagonists.

Answer: A

Section: Protein Interactions

Learning Outcome: 2.7

Bloom's Taxonomy: Comprehension

107) The fuel molecule cells use to run all their activities is

- A) sucrose.
- B) starch.
- C) protein.
- D) vitamins.
- E) glucose.

Answer: E

Section: Molecules and Bonds

Learning Outcome: 2.1

Bloom's Taxonomy: Knowledge

108) A fatty acid that contains three double bonds in its carbon chain is said to be

- A) saturated.
- B) monounsaturated.
- C) polyunsaturated.
- D) hydrogenated.
- E) carboxylated.

Answer: C

Section: Molecules and Bonds

Learning Outcome: 2.1

Bloom's Taxonomy: Comprehension

109) Most of the lipid found in the human body is in the form of

- A) steroids.
- B) phospholipids.
- C) triglycerides.
- D) prostaglandins.
- E) monoglycerides.

Answer: C

Section: Molecules and Bonds

Learning Outcome: 2.1

Bloom's Taxonomy: Comprehension

110) Each of the following is a function of proteins EXCEPT one. Identify the exception.

- A) binding to ligands
- B) transport
- C) catalyst
- D) storage of genetic information
- E) carrying of messages

Answer: D

Section: Protein Interactions

Learning Outcome: 2.7

Bloom's Taxonomy: Comprehension

111) If a polypeptide contains 10 peptide bonds, how many amino acids does it contain?

- A) 0
- B) 5
- C) 10
- D) 11
- E) 12

Answer: D

Section: Molecules and Bonds

Learning Outcome: 2.1

Bloom's Taxonomy: Comprehension

112) Glycoprotein molecules

A) act as buffers in body fluids.

B) increase the solubility of lipids.

C) allow atoms to pack closely together and occupy minimum space.

D) aid in the formation of chemical bonds between carbon atoms.

E) create a coat on the cell surface that assists in cell aggregation and adhesion.

Answer: E

Section: Protein Interactions

Learning Outcome: 2.7

Bloom's Taxonomy: Knowledge

113) Compare and contrast the role of up-regulation and down-regulation of proteins.

Answer: These terms refer to the net change in the amount of a functional protein present in a cell in response to a signal. Up-regulation is an increase in the amount of the protein, whereas down-regulation is a decrease.

Section: Protein Interactions

Learning Outcome: 2.9

Bloom's Taxonomy: Analysis

114) What is the induced-fit model? List the types of bonds involved and classify them as strong or weak.

Answer: The interaction between a protein binding site and a ligand that are in close proximity results in a conformational change of the protein to fit more closely to the ligand. The bonds involved are hydrogen (weak), ionic (strong), and van der Waals (weak).

Section: Protein Interactions

Learning Outcome: 2.8

Bloom's Taxonomy: Comprehension

115) The \_\_\_\_\_ of a solution is the negative logarithm of the hydrogen ion concentration, expressed in moles per liter of solution.

Answer: pH

Section: Noncovalent Interactions

Learning Outcome: 2.6

Bloom's Taxonomy: Comprehension

116) When a nitrogenous base is bonded to a pentose sugar and a phosphate, a \_\_\_\_\_ is formed.

Answer: nucleotide

Section: Molecules and Bonds

Learning Outcome: 2.1

Bloom's Taxonomy: Comprehension

117) Solutions are formed with water and \_\_\_\_\_ solutes which dissolve in them.

Answer: hydrophilic

Section: Noncovalent Interactions

Learning Outcome: 2.4

Bloom's Taxonomy: Comprehension

118) The \_\_\_\_\_ molecules which form the bilayer region of the cell membrane exhibit hydrophilic properties on the outer surface and hydrophobic properties on the inner surface.

Answer: phospholipid

Section: Noncovalent Interactions

Learning Outcome: 2.4

Bloom's Taxonomy: Comprehension

119) Compare and contrast the chemical bonds between adjacent monomers in DNA, and between two strands of DNA.

Answer: The bonds holding monomers together are covalent bonds, between sugar and phosphate molecules. The bonds holding neighboring strands together at the complementary bases are hydrogen bonds.

Section: Molecules and Bonds

Learning Outcome: 2.3

Bloom's Taxonomy: Analysis

120) Compare and contrast the general chemical structures of monosaccharides and amino acids.

Answer: Monosaccharides consist of carbon, hydrogen, and oxygen, in the ratio C:H:O of 1:2:1. Amino acids consist of a central carbon (CH), a carboxylic acid (COOH), an amine (NH<sub>2</sub>), and an organic side chain of variable structure (mainly a hydrocarbon chain, designated as R).

Section: Molecules and Bonds

Learning Outcome: 2.1

Bloom's Taxonomy: Analysis

121) What are functional groups? List the most common functional groups found in biological molecules.

Answer: Several combinations of atoms that occur repeatedly in biological molecules. See Table 2.1 in the main text.

Section: Molecules and Bonds

Learning Outcome: 2.1

Bloom's Taxonomy: Knowledge

122) True or False? Lipids are considered hydrophobic because they easily dissolve in water. If true what allows them to dissolve in water or if not, what is it about their molecular structure that makes them less likely to dissolve in water?

Answer: False. Lipids are considered hydrophobic because they have an even distribution of electrons and no positive or negative poles. Thus, nonpolar molecules have no regions of partial charge, and therefore tend to repel water molecules.

Section: Noncovalent Interactions

Learning Outcome: 2.4

Bloom's Taxonomy: Application

123) Explain the polar character of an ammonia molecule ( $\text{NH}_3$ ). What is the cause of the partial charges? What is the overall charge for  $\text{NH}_3$ ?

Answer: When chemically bonded with each other, the nitrogen atom is partially negative whereas the hydrogen atoms are partially positive. The nitrogen atom in a molecule of ammonia has a stronger attraction for the electrons participating in the covalent bonds than the hydrogen atoms. The net charge on the molecule is still zero, however.

Section: Noncovalent Interactions

Learning Outcome: 2.4

Bloom's Taxonomy: Application

124) Water striders are insects that literally walk on water. These insects are frequently found living on ponds. If hydrogen bonds did not exist, how would this affect the life of water striders?

Answer: Hydrogen bonds are responsible for the surface tension of water, the attractive force between water molecules that can make it difficult to separate them. The surface tension is strong enough to support the weight of water striders, thus allowing them to walk on water. If water molecules could not form hydrogen bonds, the water striders would not be able to walk on water because there would be no surface tension to support their weight. Therefore, these insects would have to adapt to terrestrial conditions near ponds or lakes rather than living on them.

Section: Molecules and Bonds

Learning Outcome: 2.3

Bloom's Taxonomy: Application

125) If the dissociation constant of a protein is less than one ( $K_d < 1$ ), what can you conclude about the affinity of the protein for the ligand?

Answer: Since  $K_d < 1$ , you know that  $[\text{P}][\text{L}] < [\text{PL}]$ . Therefore, at equilibrium, there is a higher concentration of protein-ligand complex suggesting that the protein has a relatively high binding affinity for the ligand.

Section: Protein Interactions

Learning Outcome: 2.8

Bloom's Taxonomy: Analysis

126) Noncovalent molecular interactions occur between many different biomolecules and often involve proteins. Give an example of such an interaction and what the function might be.

Answer: Examples of such interactions would be the interactions between carbohydrates, proteins, and lipids. These interactions form molecules like glycolipids and glycoproteins. These molecules are usually used as signaling molecules on the surfaces of cells.

Section: Protein Interactions

Learning Outcome: 2.7

Bloom's Taxonomy: Analysis

127) Sally does not understand the differences between ions, isotopes, and free radicals. Assuming she has learned and understood some basic chemistry, what is the likely source of her confusion? Review the definitions of these terms, then make a table or flow chart to help her sort this out.

Answer: Her confusion may arise from the fact that all of these terms describe a structure that has either gained or lost *something*. An *ion* is an *atom* that has gained or lost one or more *electrons* and thus bears an electrical *charge*. Ions form when salts dissolve in water and are required for normal cell function. An ion's charge affects both its behavior in solution and its chemical reactivity. An *isotope* is an *atom* that has gained or lost one or more *neutrons*; as neutrons lack a charge, isotopes remain *neutral*. Some isotopes emit *radiation*, a type of energy, rendering them both useful and dangerous; compared to ions, they are rare in nature. A *free radical* is an *atom* or *molecule* that has at least one *unpaired* electron (an electron is more stable if paired with another electron). Free radicals can be either electrically *charged* (e.g., superoxide) or *neutral* (e.g., hydroxy), depending upon the total number of protons and electrons present. Because free radicals are unstable, they are highly reactive and disruptive to cell function; compared to ions, they are rare in the body. Neither isotopes nor free radicals are known to be required for normal cell function.

Section: Molecules and Bonds

Learning Outcome: 2.1

Bloom's Taxonomy: Analysis

128) Ahmed is trying to memorize chemical structures of every compound his professor has indicated are important to the human body. Explain to him that an easier way is to memorize a few rules of chemical bonding and then figure out the structure of the important compounds, especially the simpler compounds.

Answer: Elements combine to form molecules in predictable ways because of how the outer shell electrons combine between atoms. In most cases, the outer shell will be most stable with a total of eight electrons. This information is easily discernible from the periodic table. Therefore an atom with seven outer shell electrons, such as K, combines very readily with an atom with one outer shell electron, such as Cl; an atom with six outer shell electrons, such as Ca will combine with an atom with two outer shell electrons or with two atoms with one outer shell electron each, and so on. Examples: KCl, CaCl<sub>2</sub>, CH<sub>4</sub>.

Section: Molecules and Bonds

Learning Outcome: 2.2

Bloom's Taxonomy: Application



129) Your roommate is not a science major but is interested in science and asks you to verify a rumor he has heard: it is theoretically possible for two people to walk *through* each other without causing harm. Confirm or refute what he has heard, and explain.

Answer: People are composed of molecules, which are in turn composed of atoms. Each atom is mostly empty space, because the protons, neutrons, and electrons are extremely tiny, and the electrons are relatively distant from each other and from the nucleus. A scientist acknowledges that there is often a finite probability, however small, that a very unlikely event could happen. If all of each person's subatomic particles were aligned just right, they could move through the other person's empty atomic space. This is so unlikely as to be practically impossible, however.

Section: Molecules and Bonds

Learning Outcome: 2.1

Bloom's Taxonomy: Analysis

130) Define polar covalent, nonpolar covalent, ionic, and hydrogen bonding. Which of these bonds involves more than one molecule? Which of these bonds is/are important in determining the properties of water? Explain.

Answer: Polar covalent bonds occur *within a single molecule* that shares electrons unequally; i.e., the constantly orbiting electrons spend more time at some locations and less at others.

Nonpolar covalent bonds occur *within a single molecule* that shares electrons equally; i.e., the probability of an electron occupying a particular location is the same at all locations. Ionic bonds occur *within a single molecule* in which one atom completely loses an electron to another, causing each to develop an opposite charge; it is this electrical attraction that holds the molecule together. Hydrogen bonding occurs *between separate molecules* that contain polar covalent bonds; where electrons spend more time the molecule is partially negative, and where electrons spend less time the molecule is partially positive. The ends of different molecules are thus electrically attracted to each other. Water is a polar covalent molecule, with the oxygen end being partially negative and attracted to the partially positive hydrogen portions of other water molecules. Hydrogen-bonding between water molecules is responsible for surface tension and the crystalline structure of ice.

Section: Molecules and Bonds

Learning Outcome: 2.3

Bloom's Taxonomy: Comprehension

131) Ionic bonds are considered to be strong chemical bonds. Yet, ions dissociate in water. Explain this apparent contradiction.

Answer: Molecules such as sodium chloride are bonded by ionic bonds. So much energy would be required to separate a molecule of NaCl into Na<sup>+</sup> and Cl<sup>-</sup> that it is practically impossible. That is, if the sodium chloride is *dry*. Because water molecules have partial charges resulting from their polar covalent bonds, sodium chloride dissociates in water. This means that the ions separate and function relatively independently. An attraction between sodium and chloride still exists, however, and the dissociation can be described as an increase in bond length rather than a loss of the bond. Evaporate the water, though, and the sodium chloride crystals reform.

Section: Noncovalent Interactions

Learning Outcome: 2.4

Bloom's Taxonomy: Comprehension

132) Your swimming buddy, Mario, jumped into a pool parallel to the water surface. When he stood up, he yelled "ouch," and you noticed that the skin on his chest and belly looked red and irritated. How would you describe the properties of water to explain to Mario why this happened? Why doesn't it hurt when pool water is penetrated perpendicular to the surface, as with a hands-first or feet-first dive?

Answer: Because Mario was parallel to the water surface, the force of his mass was spread out over a relatively large area of the water, making the force per unit water lower than in a typical dive. The surface tension of water, while not strong enough to keep Mario from penetrating the water surface, was strong enough to momentarily resist him. The force of the water pushing back on Mario, however briefly, was enough to cause pain. In a typical dive position, the force of Mario's entire mass is spread only over a tiny area of the water, and thus the force per unit water surface is greater. This higher force is sufficient to immediately break the hydrogen bonds and overcome the surface tension.

Section: Molecules and Bonds

Learning Outcome: 2.3

Bloom's Taxonomy: Application

133) You are helping your dad prepare food in the kitchen. Dad has a tablespoon of water in one hand and a tablespoon of vegetable oil in the other, when he trips over the rug and spills both spoons on the countertop. Dad notices that the oil forms a thin film on the countertop, whereas spilled water forms smaller, taller beads. How should you explain the different behavior of these liquids to your dad?

Answer: Water forms beads when it strikes a nonabsorptive surface because of surface tension resulting from the hydrogen bonds between neighboring water molecules. Vegetable oil molecules are nonpolar covalent, therefore there is no hydrogen bonding between the lipid molecules and no bead formation.

Section: Molecules and Bonds

Learning Outcome: 2.3

Bloom's Taxonomy: Analysis

134) Stanley is confused on the similarities and differences between proteins and nucleic acids. Assuming he has learned and understood the basic chemistry, what is the likely source of his confusion? To help him sort this out, make a table or flow chart to explain the structure of these molecules and their relationship to each other.

Answer: His confusion probably stems from the fact that both proteins and nucleic acids are classified as macromolecules, and both are assembled by covalently bonding certain monomers in a particular order. Also, nucleic acids contain the information necessary for manufacturing proteins, the term *acid* is used in describing the structure of both nucleic acids and proteins, and both nucleic acids and proteins must contain nitrogen. The monomer of protein is the amino acid, which has a central carbon, a variable chain denoted as R, and a nitrogen-containing amino group. There are 20 naturally occurring amino acids. The monomer of the nucleic acid is the nucleotide, which has a sugar attached to a nitrogen-containing base, and a phosphate. There are five different bases and two different sugars. The sequence of bases in a DNA or RNA molecule determines the sequence of amino acids in the protein.

Section: Molecules and Bonds

Learning Outcome: 2.1

Bloom's Taxonomy: Analysis

135) Proteins are described as having different levels of structure. List and distinguish between the level(s) that produce a linear shape vs. a globular shape, and explain why one of those levels can result in either a linear or globular shape.

Answer: Linear shapes: primary, secondary, quaternary. Primary structure is simply the sequence of covalently bonded amino acids in a peptide chain. Secondary structure is further bonding between nearby amino acids in a peptide chain, with the molecule still retaining a strand-like shape. Quaternary structure can involve separate linear polypeptide chains held together in a strand. Globular shapes: tertiary and quaternary. Tertiary structure involves bonding between distant amino acids, which causes the molecule to be wadded. Quaternary structure occurs when more than one globular peptide chain bonds together.

Section: Noncovalent Interactions

Learning Outcome: 2.5

Bloom's Taxonomy: Comprehension

136) While every level of a protein's structure is important to the function of that protein, which level of structure is most important to the function of enzymes, and why?

Answer: Enzymes and other globular proteins depend upon the three-dimensional shape resulting from the globular folding. Under conditions in which this shape is altered by denaturing agents such as heat, the protein ceases to function, though the primary and secondary structure may be unchanged.

Section: Noncovalent Interactions

Learning Outcome: 2.5

Bloom's Taxonomy: Analysis

137) You are a student intern in the research and development department of a pharmaceutical company. You have discovered a compound that destroys the common cold virus in cultured human cells. Chemical characterization reveals that carbon, hydrogen, and oxygen are present, in a 20:40:4 ratio of C:H:O. Which chemical class is this compound? Experiments in rats show that neither oral nor injectable treatment with the compound was effective in destroying the virus. Discuss some possible reasons for this lack of effectiveness.

Answer: The relatively low amount of oxygen and high carbon and hydrogen indicate that this compound is probably a lipid. Oral administration may result in digestion of the compound so that none is absorbed into the blood. Lipids are not highly soluble in water, and because blood is a watery medium, the injected lipid may not transport well in the blood. Also, human cells as well as the viruses may behave differently in culture compared to in a real patient.

Section: Molecules and Bonds, Noncovalent Interactions

Learning Outcome: 2.1, 2.4

Bloom's Taxonomy: Analysis

138) Describe what happens to NaCl when placed in water.

Answer: Water molecules break the ionic bonds holding Na<sup>+</sup> and Cl<sup>-</sup> together. Each sodium ion becomes surrounded by polar water molecules, with the electronegative ends of water molecules interacting with the ion. Each chloride ion also becomes surrounded by polar water molecules, but in this case it is the electropositive ends of the water molecules that bind to the ion. A consequence is that sodium and chloride ions can function relatively independently of each other when in solution.

Section: Noncovalent Interactions

Learning Outcome: 2.4

Bloom's Taxonomy: Application

139) How many grams of glucose, molecular mass = 180 Daltons, is necessary to make 1 liter of a 1.0 molar solution?

A) 180

B) 360

C) 90

D)  $6.02 \times 10^{23}$

E) 1.0

Answer: A

Section: Noncovalent Interactions

Learning Outcome: 2.4

Bloom's Taxonomy: Application

140) A 5 M solution of 100 mL of glucose contains how many grams of glucose, molecular mass = 180 Daltons?

A) 180

B) 360

C) 90

D)  $6.02 \times 10^{23}$

E) 1.0

Answer: C

Section: Noncovalent Interactions

Learning Outcome: 2.4

Bloom's Taxonomy: Application

141) If 100 mL of water contains 5 grams of NaCl, molecular mass = 58.5 Daltons, what is the molarity of the solution in moles/L?

A) 0.05

B) 0.85

C) 2.92

D) 0.085

E) 0.25

Answer: B

Section: Noncovalent Interactions

Learning Outcome: 2.4

Bloom's Taxonomy: Application

142) How many grams of NaCl, molecular mass = 58.5 Daltons, are the molar equivalent to 90 g of glucose (molecular mass = 180 daltons)?

- A) 0.25
- B) 0.5
- C) 29.25
- D) 117
- E) 14.6

Answer: C

Section: Noncovalent Interactions

Learning Outcome: 2.4

Bloom's Taxonomy: Application

143) How many grams of NaCl, molecular mass = 58.5 Daltons, are necessary to make 1 liter of 5% saline?

- A) 58.5
- B) 1
- C) 50
- D)  $6.02 \times 10^{23}$
- E) 2.9

Answer: C

Section: Noncovalent Interactions

Learning Outcome: 2.4

Bloom's Taxonomy: Application

144) A typical blood concentration of glucose is 100 mg/dL. The molecular weight of glucose is approximately 180 Daltons. What is the molarity of this solution in millimoles?

- A) 100
- B) 10
- C) 0.56
- D) 18
- E) 5.6

Answer: E

Section: Noncovalent Interactions

Learning Outcome: 2.4

Bloom's Taxonomy: Application

145) If in an acid-base reaction  $\text{H}_2\text{SO}_4^{2-}$  donates two  $\text{H}^+$ , one mole of  $\text{H}_2\text{SO}_4^{2-}$  would equal how many equivalents?

- A) 0.75
- B) 1
- C) 4
- D) 0.5
- E) 2

Answer: E

Section: Noncovalent Interactions

Learning Outcome: 2.4

Bloom's Taxonomy: Application

146) What is the difference between atomic mass and molecular mass.

Answer: The atomic mass is the actual mass of an atom, expressed in atomic mass units (amu) or Daltons (Da), where  $1 \text{ amu} = 1.6 \times 10^{-27} \text{ kg}$ . However, molecular mass is the sum of the atomic mass of each element  $\times$  the number of atoms of each atom that make up the molecule.

Section: Noncovalent Interactions

Learning Outcome: 2.4

Bloom's Taxonomy: Application

147) A. Distinguish between the mass of a molecule and the mass of a mole, using NaCl in your example.

B. Calculate the mass of a mole of NaCl in g, using the mass of one Da (amu).

C. Calculate the mass of a dozen NaCl molecules, a dozen donuts, and a mole of donuts, assuming a 30 gram donut.

Answer:

A. The mass of a molecule is determined by the mass of its component atoms. From the periodic table, the mass of Na is 23 amu and of Cl is nearly 36 amu, so the mass of one molecule of NaCl is 59 Da. A mole is like a dozen, i.e., it is a particular number of items, specifically  $6.02 \times 10^{23}$ .

B. A mole of NaCl =  $59 \text{ Da} \times 6.02 \times 10^{23} = 3.55 \times 10^{25} \text{ Da}$ .

$1 \text{ Da} = 1.66 \times 10^{-27} \text{ kg}$ , so  $3.55 \times 10^{25} \text{ Da} \times 1.66 \times 10^{-27} \text{ kg/Da} \times 1000 \text{ g/kg} = 59 \text{ g}$ .

C. A dozen NaCl molecules:  $12 \times 59 \text{ Da} \times 1.66 \times 10^{-27} \text{ kg/Da} \times 1000 \text{ g/kg} = 1.2 \times 10^{-21} \text{ g}$ .

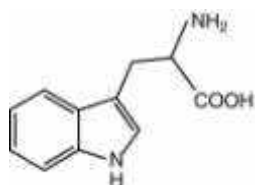
A dozen donuts:  $12 \times 30 \text{ g} = 360 \text{ g}$ . A mole of donuts:  $6.02 \times 10^{23} \times 30 \text{ g} = 1.8 \times 10^{25} \text{ g}$ .

Section: Noncovalent Interactions

Learning Outcome: 2.4

Bloom's Taxonomy: Application

148) Write the chemical formula for the molecule drawn below. Which class of organic molecule does it belong to? Is it most likely polar or nonpolar?



Answer:  $\text{C}_{11}\text{H}_{12}\text{N}_2\text{O}_2$ . The presence of the carboxylic acid (COOH) and amine ( $\text{NH}_2$ ) indicates this is an amino acid. Because of the R group structure, it is relatively nonpolar (this amino acid is tryptophan).

Section: Noncovalent Interactions

Learning Outcome: 2.4

Bloom's Taxonomy: Analysis

149) What is the pH of a 0.005 M HCl solution? Assume complete dissociation.

Answer:  $\text{pH} = 2.3$ . If  $\text{pH} = -\log [\text{H}^+]$  and HCl is a strong acid, we can assume complete dissociation will occur in solution.

Section: Noncovalent Interactions

Learning Outcome: 2.6

Bloom's Taxonomy: Application