

***Hole's Human Anatomy & Physiology, 15e (Shier)***  
**Chapter 2 Chemical Basis of Life**

- 1) Matter is composed of elements, which are composed of \_\_\_\_\_.
- A) atoms
  - B) inorganic molecules
  - C) organic molecules
  - D) chemicals
- 2) The atomic number of an atom equals the number of \_\_\_\_\_, and the atomic weight equals the \_\_\_\_\_.
- A) neutrons; number of protons
  - B) protons; weight of all the electrons
  - C) neutrons; number of protons plus electrons
  - D) protons; number of protons plus neutrons
- 3) In a covalent bond
- A) one atom loses and another atom gains electrons.
  - B) atoms share a pair or more of electrons.
  - C) oppositely charged atoms attract.
  - D) like-charged atoms repel.
- 4) In an ionic bond
- A) each atom gains electrons.
  - B) atoms share a pair or more of electrons.
  - C) oppositely charged atoms attract.
  - D) like-charged atoms repel.
- 5) Sodium ions and calcium ions are examples of
- A) cations.
  - B) uncharged particles.
  - C) anions.
  - D) salts.
- 6) When  $K^+$  and  $Cl^-$  meet, they will
- A) repel and form no product.
  - B) form KCl with an ionic bond.
  - C) form KCl with a covalent bond.
  - D) form individual molecules.
- 7) When placed into water, the ionic compound NaCl will
- A) bond more strongly to each other.
  - B) dissociate into  $Na^+$  and  $Cl^-$  ions.
  - C) bond covalently with water molecules, forming HCl and NaOH.
  - D) decompose.

8) Considering the number of valence electrons carbon has, what is the maximum number of hydrogen atoms a free carbon atom may bond with?

- A) 1
- B) 2
- C) 4
- D) 8

9) Which of the following isotopes has the longest half-life?

- A) Iodine-131
- B) Iron-59
- C) Phosphorus-32
- D) Cobalt-60

10) The \_\_\_\_\_ uses iodine in a synthesis reaction.

- A) spleen
- B) liver
- C) thymus
- D) thyroid gland

11) The isotope most likely to be used to study the thyroid gland is

- A) iodine-131.
- B) iron-59.
- C) thallium-201.
- D) cobalt-60.

12) Atomic radiation is useful for treating cancer because

- A) radiation affects cancer cells but not normal cells.
- B) radiation protects normal cells against the effects of cancer.
- C) radiation harms cancer cells more readily than it does most non-cancer cells.
- D) normal cells are not affected by radiation.

13) Exposure to ionizing radiation may

- A) cloud the lens of the eye.
- B) cause cancer.
- C) interfere with normal growth.
- D) All of the answer choices are correct.

14) Which of the following is not a source of ionizing radiation?

- A) Cosmic rays from outer space
- B) Cholesterol and triglycerides
- C) Atomic and nuclear weapons
- D) Smoke detectors

- 15) A computerized tomography (CT) scan differs from a conventional X-ray image because it is
- A) two-dimensional.
  - B) three-dimensional.
  - C) four-dimensional.
  - D) safer.
- 16) Positron emission tomography (PET) imaging follows the emission of
- A) positrons.
  - B) electrons.
  - C) neutrons.
  - D) protons.
- 17) Chemistry deals with
- A) the composition of and changes to substances that make up living as well as non-living matter.
  - B) the composition of and changes to substances found in organisms only.
  - C) the composition of and changes to substances that make up non-living matter only.
  - D) the location of organs in body cavities.
- 18) Chemistry is important to the study of physiology because
- A) the foods that we eat are chemicals.
  - B) body functions depend on cellular functions that reflect chemical changes.
  - C) chemical reactions enable our bodies to extract energy from nutrients.
  - D) All of the answer choices are correct.
- 19) Which of the following substances is an element?
- A) Iron
  - B) Water
  - C) Sodium chloride
  - D) Glucose
- 20) Which of the following groups of elements accounts for more than 95% of the human body by weight?
- A) Carbon, hydrogen, oxygen, nitrogen
  - B) Calcium, hydrogen, oxygen, nitrogen
  - C) Carbon, phosphorus, oxygen, hydrogen
  - D) Calcium, phosphorus, hydrogen, nitrogen
- 21) The atoms of different elements have
- A) the same atomic number and same atomic weight.
  - B) the same atomic number but different atomic weights.
  - C) different atomic numbers.
  - D) different atomic numbers but the same number of electrons.

- 22) Isotopes of an element have
- A) the same atomic number and same atomic weight.
  - B) the same atomic number but different atomic weights.
  - C) different atomic numbers but the same atomic weight.
  - D) different atomic numbers and different atomic weights.
- 23) Which of the following is(are) ionizing radiation?
- A) Cosmic radiation only
  - B) Gamma radiation only
  - C) Both cosmic radiation and gamma radiation
  - D) Neither cosmic nor gamma radiation
- 24) The atomic weight of an element whose atoms contain 8 protons, 8 electrons, and 8 neutrons is
- A) 8.
  - B) 16.
  - C) 24.
  - D) 32.
- 25) The atoms of the isotopes of a particular element vary in the number of
- A) electrons.
  - B) protons.
  - C) neutrons.
  - D) nuclei.
- 26) The first electron shell of an atom can hold a maximum of
- A) 1 electron.
  - B) 2 electrons.
  - C) 4 electrons.
  - D) 8 electrons.
- 27) When forming a bond, an atom that has 3 electrons in its second shell and a filled first shell will
- A) lose 3 electrons from its second shell.
  - B) lose all of the electrons from its first shell.
  - C) lose all of the electrons from both its first and second shells.
  - D) gain 5 electrons in its second shell.
- 28) The formula  $H_2O$  refers to
- A) two hydrogen molecules and one oxygen molecule.
  - B) one hydrogen molecule and two oxygen molecules.
  - C) a molecule that contains two hydrogen atoms and one oxygen atom.
  - D) a molecule that contains one hydrogen atom and two oxygen atoms.

29) Which of the following best describes the reaction  $\text{H}_2\text{CO}_3 \rightarrow \text{H}_2\text{O} + \text{CO}_2$ ?

- A) Decomposition reaction
- B) Exchange reaction
- C) Reversible reaction
- D) Synthesis reaction

30) A water solution that contains equal numbers of hydrogen ions and hydroxide ions is

- A) acidic.
- B) basic.
- C) alkaline.
- D) neutral.

31) When placed in a solution,  $\text{HNO}_3$  dissociates into  $\text{H}^+$  and  $\text{NO}_3^-$ . The compound  $\text{HNO}_3$  must be a(n) \_\_\_\_\_.

- A) base.
- B) nucleotide.
- C) acid.
- D) electron.

32) The difference in hydrogen ion concentration between solutions with pH 4 and pH 5 is

- A) twofold.
- B) fivefold.
- C) tenfold.
- D) twentyfold.

33) Which of the following best describes the reaction  $\text{NaNO}_3 + \text{HCl} \rightarrow \text{HNO}_3 + \text{NaCl}$ ?

- A) Decomposition reaction
- B) Exchange reaction
- C) Reversible reaction
- D) Synthesis reaction

34) Consider the following list of commonly found items and their pH values:

Baking Soda (8.3), Battery Acid (1.0), Beer (4.2), Bleach (12.8), Butter (6.1–6.4), Coffee (5.0), Egg Whites (7.6–8.0), Grapes (3.5–4.5), Milk of Magnesia (10.6), Tomato (4.0–4.5), Vinegar (2.2), White Bread (5.0–6.0)

Which of the following choices includes all acids?

- A) Egg whites, baking soda, milk of magnesia, and bleach
- B) Tomatoes, egg whites, and baking soda
- C) Vinegar, grapes, tomatoes, and coffee
- D) Beer, butter, and baking soda

- 35) Electrolytes are substances that
- A) form covalent bonds with water.
  - B) ionize in water.
  - C) cannot conduct electricity in solution.
  - D) form bonds that are stable in water.
- 36) The pH scale measures the
- A) concentration of hydrogen ions in solution.
  - B) number of molecules of salts dissolved in water.
  - C) number of hydroxide ions in water.
  - D) strength of an electrical current that a solution carries.
- 37) Which of the following is the most abundant inorganic substance in the body?
- A) Carbohydrate
  - B) Water
  - C) Lipid
  - D) Protein
- 38) A person has alkalosis if the blood pH
- A) is above 7.0.
  - B) is below 7.0.
  - C) rises above 7.5.
  - D) drops below 7.3.
- 39) A complete atom is electrically neutral because
- A) the number of protons equals the number of neutrons.
  - B) the number of electrons equals the number of neutrons.
  - C) the number of electrons equals the number of protons.
  - D) the number of electrons is greater than the number of protons.
- 40) Synthesis reactions are particularly important in the body for
- A) release of energy.
  - B) digestion of food products.
  - C) growth of body parts.
  - D) neutralization of acids by buffers.
- 41) On the pH scale
- A) a tenfold difference in hydrogen ion concentration separates each whole number.
  - B) the lower the whole number on the scale, the greater the  $H^+$  concentration.
  - C) pH values above 7 are basic (alkaline).
  - D) All of the answer choices are correct.

- 42) An acid reacting with a base is
- A) a synthesis reaction.
  - B) hydrolysis.
  - C) a decomposition reaction.
  - D) an exchange reaction.
- 43) The following reaction occurs:  $\text{HBr} + \text{NaOH} \rightarrow \text{NaBr} + \text{H}_2\text{O}$ . What is the product NaBr considered in this reaction?
- A) A buffer
  - B) A salt
  - C) A solvent
  - D) A protein
- 44) A substance is added to a protein sample that does not alter the composition or amino acid sequence of the protein itself, but changes its three-dimensional structure. Which of the following was altered by the substance?
- A) Oxygen double bonds
  - B) Covalent bonds
  - C) Ionic bonds
  - D) Hydrogen bonds
- 45) In the body, oxygen
- A) reacts with water to form carbonic acid.
  - B) is used during cellular respiration.
  - C) is a major electrolyte.
  - D) is produced by cells.
- 46) Which of the following is characteristic of carbohydrates?
- A) They contain C, H, O, with twice as many hydrogen as oxygen atoms.
  - B) They provide much of the energy that the cell requires.
  - C) They include sugars and starches.
  - D) All of the answer choices are correct.
- 47) A simple carbohydrate
- A) has a molecular formula of  $\text{C}_6\text{H}_{12}\text{O}_6$ .
  - B) is a building block of protein.
  - C) consists of several joined chains.
  - D) has only one nucleotide.
- 48) Lipids
- A) are insoluble in water.
  - B) include phospholipids, cholesterol, and fats.
  - C) contain C, H, and O, but with proportionately less oxygen than in carbohydrates.
  - D) All of the answer choices are correct.

49) Collagen, a helical protein, became straight and flat as the temperature of its environment was changed. Its primary structure was not altered. What happened to cause it to flatten?

- A) Bonds between carbon and oxygen were broken.
- B) Hydrogen bonds were broken.
- C) Peptide bonds were broken.
- D) Peptide bonds were formed.

50) Which of the following is not organic?

- A) Sodium chloride
- B) Lipids
- C) Nucleic acids
- D) Enzymes

51) Lard will \_\_\_\_\_ than peanut oil.

- A) contain more water
- B) have more glycerol
- C) have more single carbon-carbon bonds
- D) have fewer hydrogen atoms bonded to carbon atoms

52) Proteins

- A) are structural materials.
- B) can function as enzymes.
- C) contain C, H, O, and N, and sometimes S.
- D) All of the answer choices are correct.

53) Amylase is an enzyme that promotes the breakdown of starches during digestion. Which of the following describes the method by which amylase functions?

- A) It catalyzes starch breakdown without being changed or depleted.
- B) It functions as a hormone that signals for starch breakdown to begin.
- C) It inhibits chemical reactions by being changed or depleted by the starch.
- D) It changes its composition in order to break starch down itself.

54) The parts of a protein that change when it denatures are

- A) the primary and secondary structures.
- B) the secondary and tertiary structures.
- C) the amino acid sequence and the secondary structure.
- D) the tertiary and quaternary structures.

55) DNA

- A) is a protein.
- B) plays no role in the synthesis of fats.
- C) stores genetic information, including instructions for enzymes that synthesize fats and carbohydrates.
- D) is routinely broken down to provide cellular energy.



- 56) Nucleic acids are
- A) very small, simple molecules.
  - B) structural molecules that have no function other than support.
  - C) composed of building blocks called nucleotides.
  - D) primary sources of cellular energy.
- 57) The nitrogenous bases of DNA and RNA provide informational content because
- A) the bases are of several types and therefore can form a code sequence.
  - B) they all contain nitrogen.
  - C) their sugars and phosphates vary.
  - D) the bases are also parts of amino acids.
- 58) In phenylketonuria, an individual cannot break down the amino acid phenylalanine. Molecules that include phenylalanine build up in the blood, which causes intellectual disability and other symptoms. This inherited disease can be controlled by following a diet that is very low in
- A) carbohydrates.
  - B) cholesterol.
  - C) protein.
  - D) nucleic acids.
- 59) The breakdown of table sugar into glucose and fructose is an example of a(n) \_\_\_\_\_ reaction.
- A) synthesis
  - B) hydrolysis
  - C) acid-base
  - D) exchange
- 60) Nucleic acids include
- A) proteins and DNA.
  - B) RNA and DNA.
  - C) enzymes and RNA.
  - D) steroids and triglycerides.
- 61) DNA and RNA differ in that
- A) RNA has deoxyribose and DNA has ribose.
  - B) RNA is double-stranded and DNA is single-stranded.
  - C) DNA holds genetic information and RNA uses that information to synthesize protein.
  - D) RNA is found only in the nucleus and DNA is found only in the cytoplasm.
- 62) The type of organic molecule that can replicate is a
- A) protein.
  - B) lipid.
  - C) carbohydrate.
  - D) nucleic acid.

63) The term conformation refers to:  
A) the three-dimensional shape of a molecule, such as a protein.  
B) the energy held in the bonds of an organic molecule, such as a protein.  
C) the ability of DNA to copy itself.  
D) the amino acid sequence (primary structure) of a protein.

64) An organic compound always contains  
A) carbon and hydrogen.  
B) oxygen and nitrogen.  
C) carbon and oxygen.  
D) nitrogen and hydrogen.

65) Which of these is not a monosaccharide?  
A) Glucose  
B) Ribose  
C) 6-carbon sugar  
D) Sucrose

66) Glycogen is stored in the liver and \_\_\_\_\_.  
A) spleen  
B) skeletal muscles  
C) pancreas  
D) heart

67) A triglyceride consists of  
A) 3 glycerols and 1 fatty acid.  
B) 3 glucose molecules.  
C) 3 fatty acids and 3 phosphate groups.  
D) 3 fatty acids and 1 glycerol.

68) Which of the following is the least likely to dissolve in water?  
A) Albumin  
B) A triglyceride  
C) Table sugar (sucrose)  
D) Nucleotides

69) Which of the following molecules does not have a polar region?  
A) Water  
B) Triglyceride  
C) Water-soluble amino acid  
D) Glucose

70) If helium (He) were to gain a proton, it would become

- A) He<sup>+</sup>.
- B) He<sup>-</sup>.
- C) Helium-3.
- D) Lithium.

71) A patient's blood test shows that their blood pH is 7.29. They are most likely experiencing

- A) alkalosis.
- B) acidosis.
- C) blood clots.
- D) nothing, their blood pH is normal.

72) A ribosome exists as an association between different ribosomal protein subunits. The entire structure of the ribosome with its associations between subunits is considered the

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

73) Consider the following list of commonly found items and their pH values:

Battery acid (1.0), vinegar (2.2), grapes (3.5–4.5), tomato (4.0–4.5), beer (4.2), coffee (5.0), white bread (5.0–6.0), butter (6.1–6.4), egg whites (7.6–8.0), baking soda (8.3), milk of magnesia (10.6), bleach (12.8)

Which of the following is closest to the pH of water?

- A) White bread
- B) Baking soda
- C) Egg whites
- D) Grapes

74) Consider the following list of commonly found items and their pH values:

Battery acid (1.0), vinegar (2.2), grapes (3.5–4.5), tomato (4.0–4.5), beer (4.2), coffee (5.0), white bread (5.0–6.0), butter (6.1–6.4), egg whites (7.6–8.0), baking soda (8.3), milk of magnesia (10.6), bleach (12.8)

Based on your knowledge of acid and base reactions, which of the following would be most likely to react with a base to form a salt?

- A) Bleach
- B) Battery acid
- C) Coffee
- D) Egg whites

- 75) The number of protons in an atom of an element always equals its atomic weight.
- 76) Radioactive isotopes have stable nuclei.
- 77) Sodium and chloride atoms combine readily because they both lose electrons.
- 78) The symbol  $\text{Na}^+$  represents a sodium atom that has lost an electron.
- 79) Water is an example of a compound.
- 80) If  $\text{Ca}^{+2}$  were to gain 2 electrons, it would become  $\text{Ca}^0$  and become neutral.
- 81) Two negatively charged bromide ( $\text{Br}^-$ ) ions exist in solution. They will be attracted to each other and form an ionic bond.
- 82) Chemistry is the study of the composition of matter and how matter changes.
- 83)  $\text{CaCl}_2$  is dissolved in water. The chlorine that is released will be in the form of anions.
- 84) The compound  $\text{H}_2\text{SO}_4$  will dissociate in water to create  $\text{HSO}_4^-$  and  $\text{H}^+$ . The product  $\text{HSO}_4^-$  is a base.
- 85) In the reaction between  $\text{HCl}$  and  $\text{Ca}(\text{OH})_2$ , the product  $\text{CaCl}_2$  will be a salt.
- 86) Chemically inert atoms always have their outermost electron shell full.
- 87) An acid is an electrolyte that releases hydroxide ions ( $\text{OH}^-$ ) in water.
- 88) A base is an electrolyte that releases ions that combine with hydrogen ions.
- 89) An electrolyte ionizes in water.
- 90) A person with alkalosis has a blood pH less than 7.3.
- 91) A complex carbohydrate consists of a phosphate group attached to a sugar molecule.
- 92) Cholesterol, a type of lipid, is composed of three fatty acid chains attached to glycerol.
- 93) Glycogen is a complex carbohydrate that is obtained by eating plants.
- 94) A phospholipid differs structurally from a triglyceride in that it has three phosphate groups attached to the glycerol molecule rather than three fatty acid chains.
- 95) Nucleic acids are composed of building blocks called amino acids.
- 96) A protein is formed from a sequence of amino acids.

- 97) Proteins encode nucleic acids.
- 98) DNA and RNA are nucleic acids.
- 99) When atoms form chemical bonds, the subatomic particles that directly interact are the \_\_\_\_\_.
- 100) The opposite of a decomposition reaction is a \_\_\_\_\_ reaction.
- 101) The midpoint of the pH scale is pH \_\_\_\_\_.
- 102) Apricots have a pH of 3.8. Therefore, they are \_\_\_\_\_.
- 103) Amino acids are building blocks of \_\_\_\_\_.
- 104) The amino acid sequence of a protein is its \_\_\_\_\_ structure.
- 105) \_\_\_\_\_ are building blocks of nucleic acids.
- 106) \_\_\_\_\_ has the unique ability among types of organic molecules to replicate.
- 107) A change from  $\text{Fe}^{2+}$  to  $\text{Fe}^{3+}$  would require a change in the number of \_\_\_\_\_.
- 108) The difference between carbon-13 and carbon-14 is their number of \_\_\_\_\_.
- 109) The type of chemical bond formed when ions with opposite electrical charges attract is a(n) \_\_\_\_\_ bond.
- 110) Two or more atoms bonding form a \_\_\_\_\_.