

Biology, 12e (Raven)

Chapter 2 The Nature of Molecules and the Properties of Water

1) Matter is composed of:

- A) atoms
- B) energy
- C) mass
- D) molecules

2) All atoms possess the ability to do work. The term that is defined as the ability to do work is:

- A) matter
- B) energy
- C) molecules
- D) space

3) The number of protons in a given atom is equal to its:

- A) atomic number
- B) mass
- C) neutron number
- D) molecular number

4) Isotopes that are unstable and decay when their nucleus breaks up into elements with lower atomic numbers, emitting significant amounts of energy in the process, are called:

- A) energetic
- B) ionic
- C) radioactive
- D) isometric

5) Atoms containing a specific number of protons are called:

- A) minerals
- B) elements
- C) metals
- D) molecules

6) Sugars dissolve well in water because of water's _____.

- A) ionic bonds
- B) cohesiveness
- C) hydrophobic exclusion
- D) polarity

7) The negative logarithm of the hydrogen ion concentration in the solution is referred to as:

- A) pH
- B) atomic mass
- C) -OH concentration
- D) electronegativity
- E) specific heat

8) Bicarbonate ions in the blood can absorb hydrogen ions, keeping pH balanced. Bicarbonate is acting as a _____ in blood.

- A) buffer
- B) acid
- C) base
- D) alkaline

9) Atomic nuclei contain protons and _____.

- A) isomers
- B) ions
- C) moles
- D) neutrons

10) Carbon-12, Carbon-13 and Carbon-14 are examples of:

- A) ions
- B) isotopes
- C) isomers
- D) molecules

11) Organisms are composed of molecules, which are collections of smaller units, termed:

- A) monomers.
- B) atoms.
- C) electrons.
- D) polymers.
- E) ions.

12) Negatively charged subatomic particles that have almost no mass are called:

- A) electrons.
- B) protons.
- C) neutrons.
- D) ions.
- E) polymers.

13) Atoms of a single element that possess different numbers of neutrons are called:

- A) polymers.
- B) ions.
- C) monomers.
- D) isomers.
- E) isotopes.

14) $\text{Cl} + \text{e}^- \rightarrow \text{Cl}^-$ is an example of a:

- A) oxidation.
- B) reduction.
- C) polymerization.
- D) ionization.

15) When atoms gain or lose electrons, they become negatively or positively charged. These negatively or positively charged atoms are known as

- A) isotopes.
- B) ions.
- C) isomers.
- D) unstable atoms.

16) When two atoms share a pair of electrons, the bonding is referred to as:

- A) ionic.
- B) covalent.
- C) unstable.
- D) hydrogen.

17) Water molecules are polar with ends that exhibit partial positive and negative charges. These opposite charges allow water molecules to attract each other through:

- A) ionic bonds.
- B) covalent bonds.
- C) hydrogen bonds.
- D) peptide bonds.

18) An atom has 20 electrons and 20 neutrons. What is the mass of this atom?

- A) 10
- B) 20
- C) 40
- D) 80

19) Sue was monitoring the oil spill into the Gulf of Mexico from an oil tanker. From her observations, she noted that the oil was moving as large patches in the water. It did not appear as though the oil was dissolving into the water. Why did the oil not dissolve into the water?

- A) Hydrophobic interactions
- B) Surface tension
- C) Sea water acts as a solvent
- D) Water forms hydration shells
- E) Water has a high heat of vaporization

20) The atomic number of an element is equal to the number of:

- A) protons only.
- B) neutrons only.
- C) protons plus electrons.
- D) protons plus neutrons.
- E) neutrons plus electrons.

21) Oxygen has an atomic mass of 16 and an atomic number of 8. How many neutrons are present?

- A) 24
- B) 8
- C) 16
- D) 4

22) The pH of your small intestines is around 7.5 and the pH of your large intestine can be 5.5. As substances travel from the small intestines to the large intestine, what would happen to the H^+ ion concentration?

- A) It decreases 100-fold.
- B) It increases by 100-fold.
- C) It increases 10-fold.
- D) It increases 2-fold.
- E) It decreases 10-fold.

23) Oxygen-16 is abundant and has 8 protons and 8 neutrons. Oxygen-18 has two extra neutrons. These two forms are:

- A) oxygen ions.
- B) oxygen isotopes.
- C) oxygen isomers.
- D) oxygen dimers.

24) Which element's isotope is commonly used to determine when biological samples such as fossils, were formed?

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

25) Atoms in which the number of electrons does not equal the number of protons are known as:

- A) valences.
- B) ions.
- C) isotopes.
- D) isomers.

26) The area around a nucleus where an electron is most likely to be found is the:

- A) electrical space.
- B) energy level.
- C) polar space.
- D) orbital.

27) Regardless of its shape, a given orbital may contain no more than:

- A) 1 electron.
- B) 4 electrons.
- C) 8 electrons.
- D) 2 electrons.

28) All atoms tend to fill their outer energy levels with the maximum number of electrons, usually eight. Depending on whether atoms satisfy the octet rule will predict:

- A) the chemical behavior of the atoms.
- B) whether they will be found in nature.
- C) whether they will dissolve in water.
- D) their radioactive energy.

29) Mendeleev found that when he arranged the known elements according to their atomic mass, the entries in the table exhibited a pattern of chemical properties that repeated itself in groups of eight elements. This led to the generalization now known as:

- A) an atomic model.
- B) valance electrons.
- C) the periodic table.
- D) the octet rule.

30) Sodium has 11 electrons arranged in three energy levels. In order to become stable, sodium forms an ion with:

- A) no charge.
- B) -1 charge.
- C) -8 charge.
- D) +1 charge.
- E) +8 charge.

31) In the crystal matrix of ordinary salt, the sodium and chlorine are held together by:

- A) peptide bonds.
- B) covalent bonds.
- C) ionic bonds.
- D) hydrogen bonds.
- E) nonpolar bonds.

32) Two oxygen atoms joined to each other by the sharing of two pairs of electrons form a(n):

- A) single bond.
- B) ionic bond.
- C) hydrogen bond.
- D) double covalent bond.

- 33) In a chemical analysis of an animal tissue sample, which element would be in the least quantity?
- A) carbon
 - B) hydrogen
 - C) nitrogen
 - D) oxygen
 - E) iodine
- 34) Life is thought to have evolved from complex molecules formed by the interaction of smaller molecules in oceans and the atmosphere. The substance which brought these molecules together to interact is
- A) hydrogen.
 - B) acids.
 - C) water.
 - D) buffers.
 - E) salts.
- 35) Because oxygen is more electronegative than hydrogen, the water molecule is:
- A) hydrophobic.
 - B) hydrophilic.
 - C) nonpolar.
 - D) ionic.
 - E) polar.
- 36) Water molecules are attracted to each other due to the opposite charges created by partial charge separations within the molecules. These attractions are called:
- A) peptide bonds.
 - B) covalent bonds.
 - C) ionic bonds.
 - D) hydrogen bonds.
 - E) double bonds.
- 37) How many hydrogen bonds can a water molecule form?
- A) 1
 - B) 2
 - C) 3
 - D) 4
 - E) 5
- 38) Nitrogen has a higher electronegativity than hydrogen. As a result you would expect that ammonia (NH_3) molecules can form _____ with each other.
- A) hydrogen bonds
 - B) hydrophilic bonds
 - C) ionic bonds
 - D) covalent bonds
 - E) cohesive bonds

39) When water ionizes, it produces equal amounts of hydrogen and hydroxide ions that can reassociate with each other. The pH of water is:

- A) 3
- B) 4
- C) 5
- D) 6
- E) 7

40) A scientist conducts a procedure that causes nitrogen atoms to gain neutrons. The resulting atoms will be:

- A) ions of nitrogen.
- B) positively charged.
- C) negatively charged.
- D) isotopes of nitrogen.
- E) new elements with higher atomic numbers.

41) The half-life of Carbon-14 is approximately 5,700 years. Using this information scientists have been able to determine the age of some artifacts left by humans. A scientist wants to know approximately how old a piece of wood was that she found on the floor in an old cave that had recently been discovered. She removed the wood (with permission) to her laboratory. Her wood sample contained 2 grams of Carbon-14. If the age of the wood was determined to be 22,800 years old, how much Carbon-14 originally existed in this piece of wood?

- A) 32 grams
- B) 16 grams
- C) 12 grams
- D) 8 grams
- E) 4 grams

42) Plants transport water to their leaves through the xylem when water evaporates from the leaves. The evaporating water pulls other water molecules up the xylem through _____.

- A) Hydrogen bonds
- B) Ionic bonds
- C) Covalent bonds
- D) Hydrophobic interactions

43) Water is most dense and thus heaviest at 4°C. At 0°C, ice forms and can float on liquid water. Suppose ice were most dense at 0°C. What would happen in a lake at this temperature?

- A) The ice would cover the surface of the aquatic system and would never melt.
- B) The ice would cover the bottom of the aquatic system and would build up in layers over time.
- C) Ice would not form because solids are always less dense than liquids.
- D) The cold temperatures and the subsequent ice formation would prevent hydrogen bonds from forming between the water molecules, thus causing the existing ice crystals to become disassociated from each other.

44) Your dog becomes ill and you rush him to the veterinarian's office. A technician draws blood from your dog's leg for a vet-ordered lab test. After a few minutes the lab results are given to the vet, who immediately grabs a bottle from a shelf and begins to fill a syringe with an unknown fluid. You inquire about the fluid, and the vet informs you that the fluid is necessary to manage your dog's metabolic acidosis. Based on the information provided, what is acidosis, and what is the likely effect of the veterinarian's injection?

- A) Acidosis means that your dog's blood pH has dropped from its normal level, and an injection of saline is required to reverse the condition.
- B) Acidosis means that your dog's blood pH has increased from its normal level, and an injection of saline is required to reverse the condition.
- C) Acidosis means that your dog's blood pH has decreased from its normal level, and an injection of buffering solution is required to reverse the condition.
- D) Acidosis means that your dog's blood pH has increased from its normal level, and an injection of buffering solution is required to reverse the condition.

45) As you and a friend are entering a chemistry laboratory at your university, you see a sign that states: DANGER—RADIOACTIVE ISOTOPES IN USE. Your friend is an accounting major and has not had any science courses yet. She asks you what a radioactive isotope is and you respond correctly with:

- A) Radioactive isotopes are atoms that are unstable and as a result emit energy in a process called radioactive decay.
- B) Radioactive isotopes are atoms that are stable and as a result emit energy in a process called radioactive decay.
- C) Radioactive isotopes are atoms that are stable and as a result only emit energy if they are exposed to higher temperatures.
- D) Radioactive isotopes are atoms that are unstable but unless actively disturbed by some chemical process will remain intact and pose no problems.

46) To increase the rate of a reaction you could:

- A) Add more products.
- B) Decrease the temperature.
- C) Add more reactants.
- D) remove a catalyst

47) The two nitrogen atoms in nitrogen gas (N_2) share six electrons forming a _____.

- A) triple covalent bond
- B) double covalent bond
- C) single covalent bond
- D) hydrogen bond
- E) double bond

48) Capillary action is one of the forces that aids water's upward movement in plants. The narrower the diameter of the tube, the farther the water column will rise. Capillary action is a result of water molecules:

- A) storing heat and thus moving faster because of heat of vaporization.
- B) producing sufficient surface tension to overcome the pull of gravity.
- C) having a strong cohesive force and attaching to the surrounding vessel walls.
- D) having an adhesive force, which allows them to attach to the vessel walls.
- E) being associated with hydrophobic molecules, which can result in upward movement.

49) Which atomic particle has no charge and is located in the nucleus?

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

50) The sub-atomic particle with a positive charge is _____.

- A) an electron
- B) an ion
- C) a neutron
- D) a proton
- E) an isotope

51) The smallest subatomic particle is the _____.

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

52) An atom that is negatively charged because it has accepted an electron is a(n):

- A) isomer.
- B) ion.
- C) isotope.
- D) monomer.

53) One mole of a substance contains 6.02×10^{23} molecules. The atomic number of Li is 3 and the atomic mass is approximately 7. If you have three moles of Li, how many grams does it weigh?

- A) 9
- B) 21
- C) $7 \times 6.02 \times 10^{23}$
- D) $3 \times 6.02 \times 10^{23}$

54) After taking your biology exam, you return to your car only to find that you had left the lights on and now the car battery is dead. Your friend offers to jump-start your car, but when you go to hook up the jumper cables you find that the battery terminals are covered with corrosion due to battery acid condensation. Based off your knowledge, what substance could be used to clean the corrosion?

- A) coffee (pH of 5)
- B) water (pH of 7)
- C) vinegar (pH of 3)
- D) baking soda (pH of 9)

55) The amino acid glycine ($C_3NO_2H_6$) is a(an):

- A) organic molecule
- B) inorganic molecule
- C) element
- D) vitamin

56) Consider the following electronegativity values:

Boron (B) = 1.8

Carbon (C) = 2.5

Chlorine (Cl) = 3.2

Selenium (Se) = 2.6

Which of the following bonds is the most polar?

- A) B-Cl
- B) C-Cl
- C) Se-Cl
- D) It cannot be determined from the information provided.

57) The reaction ($H_2 + F_2 \rightarrow 2HF$) is an example of a redox reaction. In reality, two half reactions are occurring. The half reaction ($H_2 \rightarrow 2H^+ + 2e^-$) is a(n):

- A) reduction reaction
- B) oxidation reaction
- C) redox reaction
- D) potential energy reaction

58) The electronic configuration of the noble gas Neon, which has an atomic number of 10, can be written as follows: $1s^2 2s^2 2p^6$. What is the electronic configuration of the noble gas Argon, which has an atomic number of 18?

- A) $1s^2 2s^2 3p^6 4s^2 5p^6$
- B) $1s^2 2s^6 2p^2 3s^6 3p^2$
- C) $1s^2 2s^2 2p^6 3s^2 3p^6$
- D) $1s^2 2s^8 3p^8$

59) You identify an enzyme involved in a cellular reaction. How does the enzyme affect the reaction equilibrium between reactants and products and the time needed to reach equilibrium?

- A) It alters the reaction equilibrium and shortens the time needed to reach equilibrium.
- B) The reaction equilibrium is unaffected, but it shortens the time needed to reach equilibrium.
- C) It alters the reaction equilibrium and lengthens the time needed to reach equilibrium.
- D) The reaction equilibrium is unaffected, but it lengthens the time needed to reach equilibrium.

60) You walk down into your basement to find that the carpeting on the floor is damp. Concerned, you look around for large puddles of water or broken pipes, but find none. In fact, only the basement floor and carpeting is damp. You realize that water must have wicked into the carpet from the floor by _____.

- A) adhesion and cohesion
- B) adhesion and solubility
- C) adhesion, cohesion, and solubility
- D) cohesion and solubility

61) You recently discovered a new element, and find that this particular element has one electron in its outer energy level. What would you expect will happen to an atom of this element if placed in water?

- A) It will lose an electron forming a positive ion.
- B) It will lose an electron forming a negative ion.
- C) It will gain an electron forming a positive ion.
- D) It will gain an electron forming a negative ion.

62) In the Hershey-Chase experiment, bacterial viruses, called phage, were used to demonstrate that DNA is the genetic material. The phage that were used for this experiment consisted of DNA surrounded by a protein coat. Phage will attach to specific types of bacteria and inject their DNA into the bacterial cell. To scientifically determine whether DNA is the genetic material, Hershey and Chase made phage in a medium containing radioactive sulfur-35 (S^{35}). Why was S^{35} used in this experiment?

- A) Only amino acids contain sulfur.
- B) Only nucleic acids contain sulfur.
- C) Both nucleic acids and amino acids contain sulfur.
- D) The radioactive sulfur labels peptide bonds.

63) Why is it necessary to take special safety precautions when using radioactivity?

- A) Radioactive substances will ionize cells.
- B) Radioactive substances have the potential to cause damage to living cells.
- C) Radioactive substances decay.
- D) Radioactive substances will perforate plasma membranes.

64) The high heat of vaporization of water helps you to feel cooler when you sweat because the transition of water from a liquid to a gas requires a _____ of energy to break hydrogen bonds. The energy is _____ from heat produced by your body, thus helping to lower the surface temperature of your body.

- A) release; released
- B) release; obtained
- C) input; obtained
- D) input; released

65) Salt is often used to melt ice on roads during the winter because it lowers the freezing/melting point of water. When salt dissolves in water, individual Na^+ and Cl^- ions break away from the salt lattice and become surrounded by water molecules. Why would this cause ice to melt?

- A) Hydrogen bonds are broken, and the salt ions interfere with interactions between H and O. As a result, it is more difficult for water molecules to bond and form ice.
- B) Hydrogen bonds are formed, and the salt ions bond with O. As a result, it is more difficult for water molecules to bond and form ice.
- C) Hydrogen bonds are broken, and the salt ions bond with O and H respectively. As a result, it is more difficult for water molecules to bond and form ice.

66) A chemist adds a chemical to pure water and there is a 100-fold increase in the concentration of hydrogen ions. What is the best approximation of the new pH value?

- A) 0
- B) 5
- C) 7
- D) 9
- E) 14

67) The electronegativity of nitrogen (N) is 3.0, while the electronegativity of hydrogen (H) is 2.1. Knowing this, consider how the electrons will be shared in ammonia (NH_3). What do you predict about the polarity of ammonia?

- A) Each H atom has a partial positive charge
- B) The N atom has a partial positive charge
- C) Each H atom has a partial negative charge
- D) The N atom has a strong positive charge

68) Magnesium chloride is a salt formed with ionic bonds between one magnesium ion and two chloride ions. Magnesium has two electrons in its outer shell and chlorine has seven electrons in its outer shell. How are the electrons transferred between these atoms?

- A) Both magnesium and chlorine are reduced.
- B) Both magnesium and chlorine are oxidized.
- C) Chlorine is oxidized and magnesium is reduced.
- D) Magnesium is oxidized and chlorine is reduced.

- 69) The carbonic acid and bicarbonate buffer in blood is extremely important to help maintain homeostasis. What would happen to the pH of the blood if bicarbonate were removed?
- A) Removing bicarbonate from the blood would increase the pH
 - B) Removing bicarbonate from the blood would decrease the pH
 - C) Removing bicarbonate from the blood would not affect the pH
- 70) The common basilisk lizard will run across water on its hind legs in an erect position when startled by predators. This lizard has large feet and flaps of skin along its toes. What properties of water allow this lizard to walk on water?
- A) Hydrogen bonds absorb heat when they break and release heat when they form. This helps to minimize temperature changes.
 - B) The surface tension created by hydrogen bonds is greater than the weight of the lizard initially.
 - C) Polar molecules are attracted to ions and polar compounds, making these compounds soluble.
 - D) Hydrogen bonds hold water molecules together; many hydrogen bonds must be broken for water to evaporate.
- 71) How is the bond in F_2 different from the bond in KCl ?
- A) F_2 is covalent and KCl is ionic
 - B) F_2 and KCl are both ionic
 - C) F_2 is ionic and KCl is covalent
- 72) Carbon has 4 valence electrons and oxygen has 6. Carbon dioxide would contain _____.
- A) one single covalent bond
 - B) four hydrogen bonds
 - C) two double covalent bonds
 - D) two single covalent bonds
- 73) If water were nonpolar it would not form hydrogen bonds. At normal room temperatures this nonpolar water would be _____.
- A) a gas
 - B) a liquid
 - C) a solid
- 74) Proteins are three dimensional molecules made of strands of amino acids (imagine a ball of string). There are 20 different amino acids used in proteins found in living organisms. Some of these amino acids are polar and others are nonpolar. Where would a series of nonpolar amino acids most likely be located in a protein that is found in the cytosol of an animal cell?
- A) On the surface of the protein
 - B) In the interior of the protein
 - C) At the very top of the protein
 - D) At the very bottom of the protein

75) According to most car mechanics, plain water is the best coolant to use in an engine provided the engine is not being exposed to freezing temperatures. If the car is subject to freezing temperatures then a mixture of water and ethylene glycol (antifreeze) is recommended but it does not cool as efficiently as plain water. Why would ethylene glycol reduce the cooling efficiency of water?

- A) Ethylene glycol has a lower heat capacity than water.
- B) Ethylene glycol has a higher heat capacity than water.
- C) Hydrogen bonds in water allow high levels of heat absorption and a large increase in temperature.
- D) Ethylene glycol raises the freezing point of water.

76) Dennis had a history of heart disease in his family and was reducing his intake of saturated fats. Saturated means each carbon atom is bonded to as many hydrogen atoms as it can accept. If a carbon were bonded to two carbons, how many hydrogens could it accept?

- A) 0
- B) 1
- C) 2
- D) 3
- E) 4