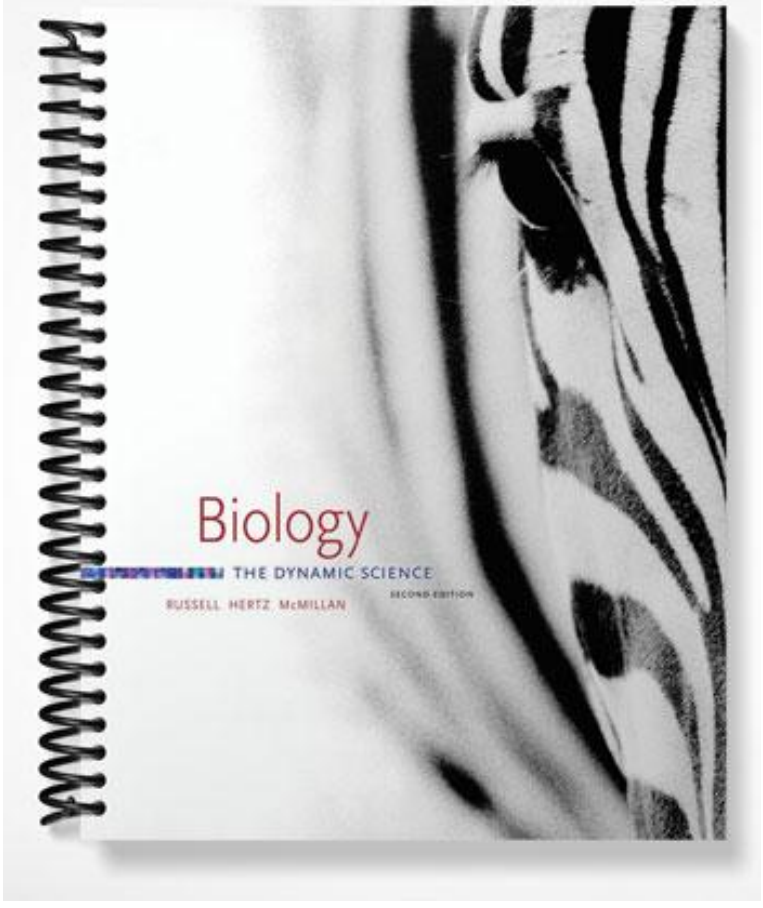
TEST BANK


Biology
THE DYNAMIC SCIENCE
SECOND EDITION
RUSSELL HERTZ McMILLAN

CHAPTER 2--LIFE, CHEMISTRY, AND WATER

Student: _____

1. According to studies by Norman Terry and coworkers, some plants can perform a version of bioremediation of selenium in wastewater by
A. converting selenium to a form that kills waterfowl.
B. using selenium to make a necessary supplement for humans.
C. converting selenium into a relatively nontoxic gas.
D. storing selenium in the soil.
E. increasing the selenium concentration in the water.

2. The laws of chemistry and physics that govern living things are ____ the laws of chemistry and physics that govern nonliving things.
A. different from
B. the same as
C. roughly half the same as and half different from
D. mostly different from
E. mostly the same as

3. A substance that cannot be broken down into simpler substances by ordinary chemical or physical techniques is a(n) ____.
A. molecule
B. chemical
C. compound
D. element
E. all of these

4. Four elements make up more than 96% of the mass of most living organisms. Which of the following is NOT one of those four elements?
A. sodium
B. carbon
C. oxygen
D. nitrogen
E. hydrogen

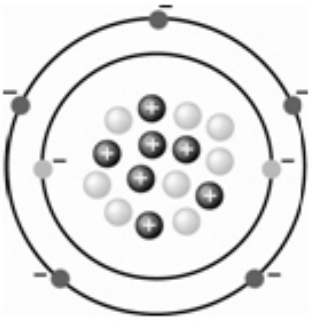
5. A trace element is one found in specific organisms in ____ quantities and is ____ for normal biological functions.
A. moderate; unnecessary
B. moderate; vital
C. small; unnecessary
D. large; unnecessary
E. small; vital

6. The smallest unit that retains the chemical and physical properties of an element is a(n) ____.
A. proton
B. compound
C. molecule
D. neutron
E. atom

7. The substance H_2O is considered to be
A. both a molecule and a compound.
B. a compound but not a molecule.
C. neither a molecule nor a compound.
D. a molecule but not a compound.

8. The substance O_2 is considered to be
A. both a molecule and a compound.
B. a compound but not a molecule.
C. neither a molecule nor a compound.
D. a molecule but not a compound.

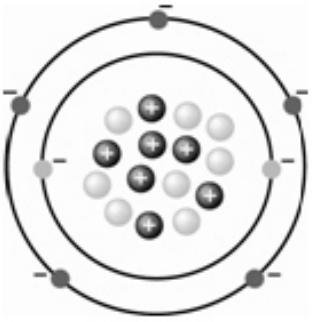
9. An oxygen atom has ____ surrounding a nucleus composed of ____.
A. neutrons; electrons and protons
B. electrons; protons and neutrons
C. protons and electrons; neutrons
D. protons; neutrons and electrons
E. electrons and neutrons; protons

10. 

Use the figure above for the following question(s).

The mass number of the atom depicted in the figure is

A. 5.
B. 7.
C. 8.
D. 15.
E. 22.

11. 

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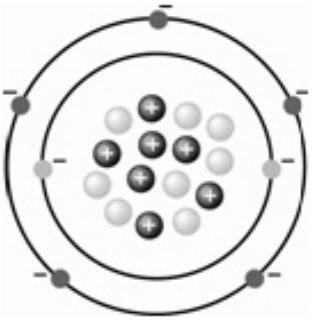
12. 

Use the figure above for the following question(s).

The number of electrons for the atom depicted in the figure is
A. 5.
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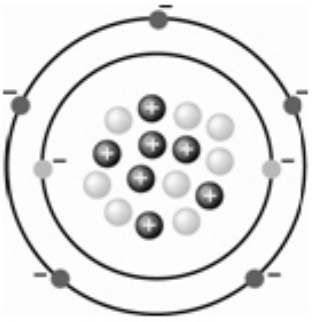
C. 8.
D. 15.
E. 22.

13. 

Use the figure above for the following question(s).

The number of neutrons for the atom depicted in the figure is
A. 5.
B. 7.
C. 8.
D. 15.
E. 22.

14. Which of the following are charged particles?
A. electrons and protons
B. neutrons only
C. protons and neutrons
D. electrons only
E. protons, neutrons, and electrons

15. What is the atomic mass number of an atom with 7 electrons, 7 neutrons, and 7 protons?
A. 7 daltons
B. 10 daltons
C. 14 daltons
D. 21 daltons
E. 28 daltons

16. Isotopes of the same element differ from each other in the number of
A. electrons and protons.
B. neutrons only.
C. protons and neutrons.
D. electrons only.
E. protons, neutrons, and electrons.

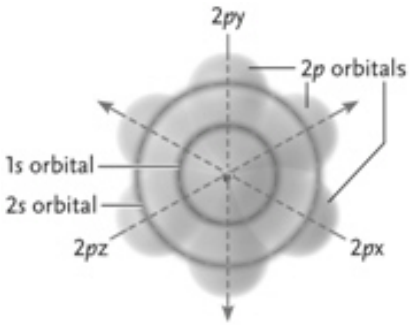
17. A carbon atom with six protons, seven neutrons, and six electrons has a mass number of
A. 6.
B. 7.
C. 12.
D. 13.
E. 19.

18. Which element would the element lithium most likely form an ionic bond with?
A. Aluminum; atomic number = 13
B. Chlorine; atomic number = 17
C. Magnesium; atomic number = 12
D. Nitrogen; atomic number = 7
E. Silicon; atomic number = 14

19. ^{14}C is heavier than ^{12}C because it has _____.
A. two more electrons than ^{12}C
B. two more neutrons than ^{12}C
C. two more protons than ^{12}C
D. one more proton and one more electron than ^{12}C
E. one more proton and one more neutron than ^{12}C

20. The isotope ^{14}C undergoes radioactive decay with a neutron splitting into an electron and a proton. This decay produces an atom of
A. iron.
B. carbon.
C. hydrogen.
D. oxygen.
E. nitrogen.

21. An orbital describes the ____ of an electron.
A. exact location
B. exact path
C. most frequent locations
D. charge
E. chemical bonds

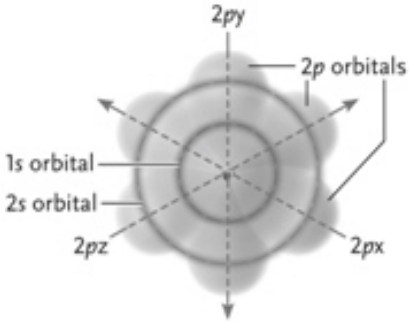


22.

Use the figure above for the following question(s).

The electrons at the lowest energy level in the neon atom depicted in the figure above are found in which orbital?
A. 1*s*
B. 2*s*
C. 2*p*x
D. 2*p*y
E. 2*p*z

23.



Use the figure above for the following question(s).

All of the orbitals shown in the neon atom in the figure are completely filled with electrons. How many electrons does this neon atom have?
A. 5
B. 6
C. 8
D. 10
E. 16

24. Under the right conditions, an electron will
A. move to a lower energy level.
B. enter an orbital shared by two atoms.
C. move to a higher energy level.
D. move from one atom to another atom.
E. all of these

25. Sodium has one valence electron in its third energy level. To reach a stable energy configuration, sodium will tend to
A. take up an electron from another atom.
B. move its valence electron to the second energy shell.
C. give up an electron to another atom.
D. share its valence electron with another atom.
E. move an electron from the second energy level to the valence shell.

26. Which of the following is most likely to share electrons with other atoms in joint orbitals?
A. chlorine (7 valence electrons)
B. calcium (2 valence electrons)
C. argon (8 valence electrons)
D. carbon (4 valence electrons)
E. potassium (1 valence electron)

27. Which of the following is likely to be chemically unreactive?
A. chlorine (7 valence electrons)
B. calcium (2 valence electrons)
C. argon (8 valence electrons)
D. carbon (4 valence electrons)
E. potassium (1 valence electron)

28. Which of the following is most likely to take up an electron from another atom?
A. chlorine (7 valence electrons)
B. calcium (2 valence electrons)
C. neon (8 valence electrons)
D. carbon (4 valence electrons)
E. potassium (1 valence electron)

29. Radioactive ____ is commonly used to treat patients with dangerously overactive thyroid glands.
A. carbon
B. radium
C. iodine
D. thallium
E. cobalt

30. Melvin Calvin and his coworkers used a radioisotope of ____ to trace the reactions of photosynthesis.
A. carbon
B. radium
C. iodine
D. thallium
E. cobalt

31. The chemical bonds that form when atoms that have lost electrons are electrically attracted to atoms that have gained electrons are called ____.
A. polar covalent bonds
B. van der Waals forces
C. ionic bonds
D. hydrogen bonds
E. nonpolar covalent bonds

32. The chemical bonds that are formed when atoms share electrons equally are called ____.
A. polar covalent bonds
B. van der Waals forces
C. ionic bonds
D. hydrogen bonds
E. nonpolar covalent bonds

33. The chemical bonds that are formed when atoms share electrons unequally are called ____.
A. polar covalent bonds
B. van der Waals forces
C. ionic bonds
D. hydrogen bonds
E. nonpolar covalent bonds

34. The chemical bonds that are formed when atoms with temporary zones of positive charge are attracted to other atoms with temporary zones of negative charge are called ____.
A. polar covalent bonds
B. van der Waals forces
C. ionic bonds
D. hydrogen bonds
E. nonpolar covalent bonds

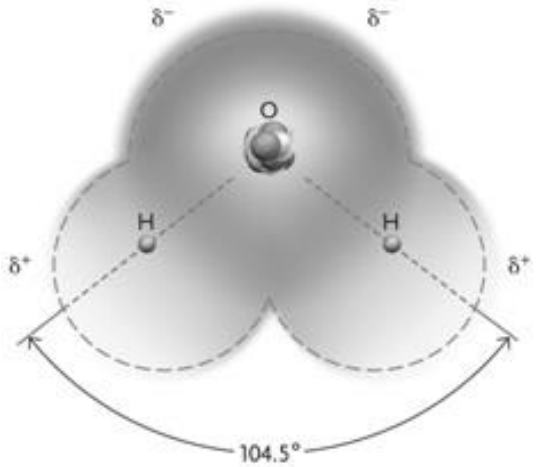
35. Chemical bonds that are formed when one atom with a partial positive charge (created from unequal sharing of electrons) is electrically attracted to another atom with a partial negative charge (also created from unequal sharing of electrons) are called ____.
A. polar covalent bonds
B. van der Waals forces
C. ionic bonds
D. hydrogen bonds
E. nonpolar covalent bonds

36. Which of the following types of chemical linkages is the weakest?
A. polar covalent bonds
B. van der Waals forces
C. ionic bonds
D. hydrogen bonds
E. nonpolar covalent bonds

37. The attraction between Na^+ cations and Cl^- anions forms ____ that hold together the compound NaCl.
A. polar covalent bonds
B. van der Waals forces
C. ionic bonds
D. hydrogen bonds
E. nonpolar covalent bonds

38. Geckos are able to cling to vertical walls due to ____.
A. polar covalent bonds
B. van der Waals forces
C. ionic bonds
D. hydrogen bonds
E. nonpolar covalent bonds

39. Molecules such as H-H and O=O are held together by ____.
A. polar covalent bonds
B. van der Waals forces
C. ionic bonds
D. hydrogen bonds
E. nonpolar covalent bonds



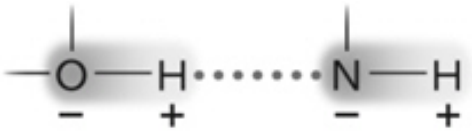
40.

The molecule shown in the figure above is held together by ____.
A. polar covalent bonds
B. van der Waals forces
C. ionic bonds
D. hydrogen bonds
E. nonpolar covalent bonds

41. Metallic ions such as Ca^{2+}, Na^{+}, and Fe^{3+} readily form ____.
A. polar covalent bonds
B. van der Waals forces
C. ionic bonds
D. hydrogen bonds
E. nonpolar covalent bonds

42. The chemical linkages that exert an attractive force over the greatest distance are ____.
A. polar covalent bonds
B. van der Waals forces
C. ionic bonds
D. hydrogen bonds
E. nonpolar covalent bonds

43. In contrast to ionic bonds, covalent bonds ____.
A. hold atoms together
B. have distinct, three-dimensional forms
C. transfer electrons from one atom to another
D. are relatively weak
E. are transient

44. 

The dotted line in the figure above indicates ____.
A. a polar covalent bond
B. van der Waals forces
C. an ionic bond
D. a hydrogen bond
E. a nonpolar covalent bond

45. In a molecule of methane, CH_4, each hydrogen atom shares an orbital with the carbon atom. The total number of shared electrons in CH_4 is ____.
A. 4
B. 2
C. 1
D. 8
E. 5

46. A polar covalent bond would be most likely to form between
A. atoms with different electronegativities.
B. cations and anions.
C. atoms with d+ and d- charges.
D. atoms with filled valence shells.
E. atoms of the same element.

47. Which of these types of chemical bonds would you not expect to find in biological molecules?
A. covalent bonds
B. van der Waals forces
C. ionic bonds
D. hydrogen bonds
E. all of these types of bonds are found in biological molecules

48. In the presence of water, nonpolar associations form between molecules or regions of molecules that are ____.
A. partially charged
B. hydrophobic and hydrophilic
C. hydrophobic
D. fully charged
E. hydrophilic

49. A mixture of vegetable oil and water will separate into layers because oil is ____ and forms ____.
A. hydrophobic; nonpolar associations
B. hydrophilic; nonpolar associations
C. hydrophilic; polar associations
D. hydrophobic; polar associations

50. Analyze this chemical reaction:

$6\ CO_2 + 6\ H_2O \rightarrow C_6H_{12}O_6 + 6\ O_2$

Which of the following is FALSE?
A. Water is a reactant.
B. $C_6H_{12}O_6$ is a product.
C. Molecular oxygen is a product.
D. CO_2 is a reactant.
E. Molecular carbon is a reactant.

51. The formation and breaking of bonds between atoms requires
A. a chemical reaction.
B. van der Walls forces.
C. partial charges.
D. an empty valence shell.
E. an enzyme.

52. What do cohesion, surface tension, and specific heat have in common concerning the properites of water?
A. All are produced by covalent bonding.
B. All are properties related to hydrogen bonding.
C. All have to do with nonpolar covalent bonds.
D. All increase when temperature increases.
E. All are produced by covalent bonding and all increase when temperature increases.

53. A molecule of water in the middle of a chunk of ice will usually have ____ hydrogen bonds with other water molecules.
A. 3
B. 3.4
C. 6
D. 4
E. 2

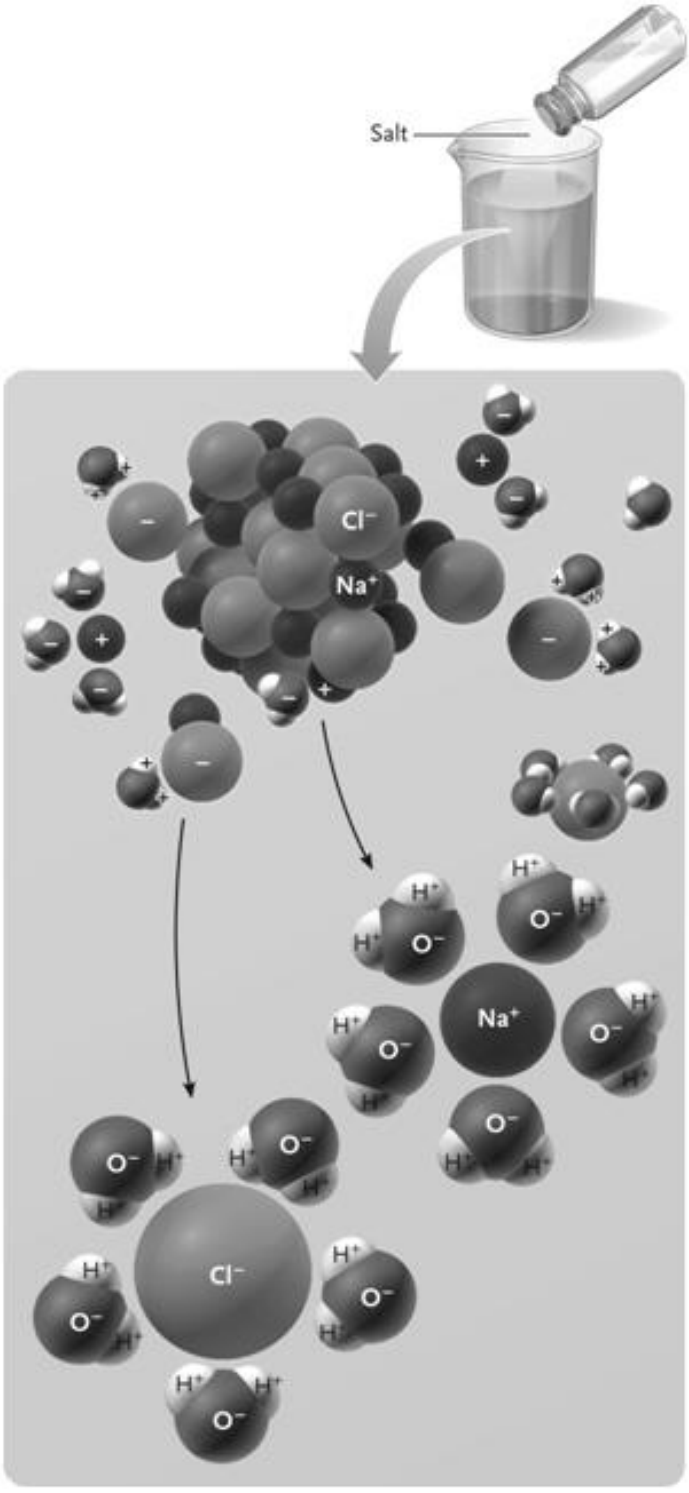
54. Which of the following would have the most difficulty entering a water lattice?
A. table salt (NaCl)
B. a nonpolar molecule
C. a sodium ion
D. a proton (H^+)
E. an electron

55. Ice floats in liquid water because
A. ice forms hydrogen bonds with the surface of liquid water.
B. ice forms hydrogen bonds but liquid water does not.
C. the hydrogen bonds of liquid water are fixed in place.
D. liquid water forms hydrogen bonds but ice does not.
E. the distance between water molecules is maximized due to the hydrogen bonds which are fixed in place.

56. Biological membranes are held together mainly by
A. hydrogen bonds between lipid molecules.
B. hydration layers over lipid molecules.
C. exclusion of the nonpolar regions of lipids by water.
D. hydrogen bonds between water molecules.
E. surface tension at the interface between layers of water molecules.

57. A ____ is formed when a ____ is dissolved in a ____.
A. solution; solute; solvent
B. solute; solvent; solution
C. solution; solvent; solute
D. solvent; solution; solute
E. solvent; solute; solution

58. When sugar dissolves in water, water is acting as a ____ and the sugar molecules are acting as ____.
A. solution; solvents
B. solute; solutions
C. solvent; solutes
D. solute; solvents
E. solvent; solutions

59. 

When salt dissolves in water as illustrated in the figure above, the water molecules form ____ around the Na^+ and Cl^- ions.

A. covalent bonds
B. hydration layers
C. nonpolar interactions
D. membranes
E. ionic bonds

60. Water has a molecular weight of 18 g per mole, and glucose has a molecular weight of 180 g per mole. Which of the following would have an approximately equal number of water and glucose molecules?
A. 1 g of water and 180 g of glucose
B. 90 g of water and 9 g of glucose
C. 180 g of water and 1 g of glucose
D. 9 g of water and 90 g of glucose
E. 90 g of water and 90 g of glucose

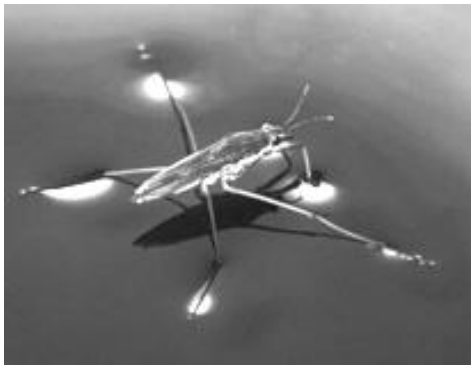
61. Water has a molecular weight of 18 Daltons or amu. Therefore, a mole of water would have a mass of ____.
A. 1 g
B. 6.02×10^{23} g
C. 36 g
D. 1.08×10^{25} g
E. 18 g

62. Water has an unusually high boiling point for its molecular weight because water molecules
A. are very dense.
B. get much heavier as they are heated.
C. are held to each other by hydrogen bonds.
D. are held together by covalent bonds.
E. form hydration layers.

63. The hydrogen-bond lattice causes water to have an unusually ____ specific heat and an unusually ____ heat of vaporization for its molecular weight.
A. high; high
B. low; high
C. high; low
D. low; low

64. Water is useful for cooling organisms mainly due to its
A. hydration layers.
B. specific heat.
C. low calories.
D. surface tension.
E. heat of vaporization.

65. Water has an important stabilizing effect on temperature in living organisms and their environments because as water absorbs heat, much of the energy is used to ____ instead of raising the temperature.
A. create hydrogen bonds
B. create covalent bonds
C. break surface tension
D. break hydrogen bonds
E. create hydration layers

66. 

The water strider shown in the figure above is able to stand on water because of the ____ of water.
A. covalent bonds
B. surface tension
C. van der Waals forces
D. density
E. hydration layer

67. When added to water, a base will act as a ____ and cause the pH of the solution to ____.
A. proton acceptor; rise
B. proton donor; rise
C. proton acceptor; fall
D. proton donor; fall
E. none of these

68. When added to water at neutral pH (7.0), an acid will
A. act as a proton donor, raising the pH of the solution.
B. act as a proton acceptor, raising the pH of the solution.
C. act as a proton donor, lowering the pH of the solution.
D. act as a proton acceptor, lowering the pH of the solution.
E. do nothing since the aqueous solution is neutral.

69. A pH of 6 is ____ times more ____ than a pH of 2.
A. 3; acidic
B. 4; acidic
C. 3; basic
D. 10,000; basic
E. 40; basic

70. For pure water, which has a pH of 7.0, which of the following is true?
A. $[H^+] < [OH^-]$
B. $[H^+] = [OH^-]$
C. $[H^+] = 0$
D. $[OH^-] = 0$
E. $[H^+] > [OH^-]$

71. For acid rainwater, which has a pH as low as 3.0, which of the following is true?
A. $[H^+] < [OH^-]$
B. $[H^+] = [OH^-]$
C. $[H^+] = 0$
D. $[OH^-] = 0$
E. $[H^+] > [OH^-]$

72. Solution A has a pH of 6 and solution B has a pH of 8. Which of the following is true regarding the concentration of hydrogen ions in each solution?
A. A has 100 times greater H^+ concentration than B.
B. B has 100 times greater H^+ concentration than A.
C. A has 7/9 of the H^+ concentration of B.
D. A has 9/7 of the H^+ concentration of B.
E. none of these

73. In water, NaOH almost completely separates into Na^+ and OH^- ions. Thus, NaOH is _____.
A. a strong acid
B. a strong base
C. a weak acid
D. a weak base
E. neutral

74. Seawater typically is
A. highly basic.
B. neutral.
C. somewhat basic.
D. somewhat acidic.
E. highly basic.

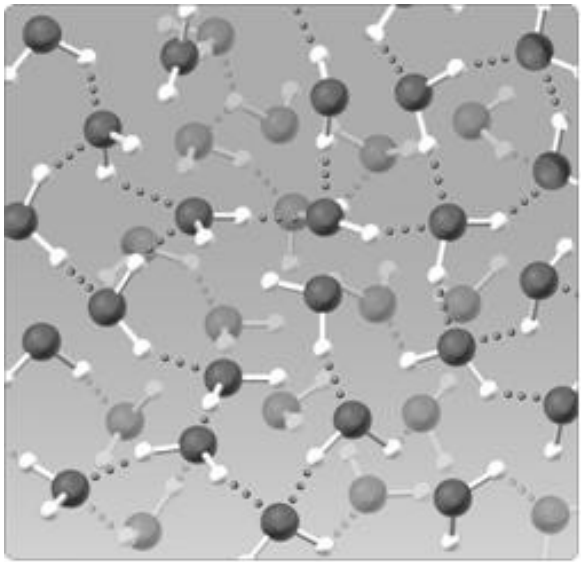
75. Without ____, living organisms would often experience major changes in pH in their cells.
A. buffers
B. acids
C. surface tension
D. nonpolar bonds
E. bases

76. Most pH buffers are
A. strong acids.
B. weak acids or weak bases.
C. weak acids.
D. strong bases.
E. strong acids or strong bases.

77. A research group led by Joanne Santini has found a(n) ____ that potentially can be used in arsenic bioremediation.
A. amoeba
B. plant
C. alga
D. bacterium
E. fungus

78. Which of the following statements about irradiation of food is true?
A. Irradiation does not affect viruses in food.
B. Irradiation kills many bacteria and parasites in food.
C. Studies have shown higher cancer rates in laboratory animals fed irradiated food.
D. Irradiation makes food radioactive.
E. Vitamins are completely destroyed when food is irradiated.

79. The most common isotope of carbon has an atomic number of 6 and a mass number of 12, while the most common isotope of oxygen has an atomic number of 8 and a mass number of 16. A molecule of CO_2 made up of these common isotopes has a molecular weight of ____.
A. 28
B. 44
C. 56
D. 14
E. 22

80. 

The water lattice illustrated in the figure above forms as a result of ____ between water molecules.
A. covalent bonds
B. hydrogen bonds
C. nonpolar interactions
D. ionic bonds
E. van der Walls forces

81. The isotope of hydrogen most commonly found in water is protium, which has no neutrons. However, the form of hydrogen with one neutron, deuterium, can also be found in water. If you were to compare water that only has protium (protium water) with water that only has deuterium (deuterium water) you would find that
A. a mole of protium water weighs the same as a mole of deuterium water.
B. a mole of deuterium water weighs considerably less than half as much as a mole of protium water.
C. a mole of protium water weighs about twice as much as a mole of deuterium water.
D. a mole of deuterium water weighs about twice as much as a mole of protium water.
E. a mole of protium water weighs considerably less than half as much as a mole of deuterium water.

82. *Match each of the following terms with its correct definition.*

1. isotope	A pure substance that cannot be broken down into simpler substances by ordinary chemical or physical techniques	____
2. orbital	A molecule whose component atoms are different from each other	____
3. compound	Anything that occupies space and has mass	____
4. matter	The locations around an atomic nucleus where an electron occurs most frequently	____
5. element	An atom with the same number of protons as another atom but a different number of neutrons	____

83. Place a large amount of hydrogen gas and oxygen gas in the presence of a fire and you will get an explosion. In light of this, explain how it is possible that water, which is composed of hydrogen and oxygen, is often used to put out fires.

84. Oxygen generally forms two covalent bonds, while carbon generally forms four covalent bonds. In contrast, helium is inert (generally does not form any bonds). Explain the reason for the differences in chemical behavior between these three elements.

85. Describe how the interaction of water with dual polarity lipid molecules establishes biological membranes.

CHAPTER 2--LIFE, CHEMISTRY, AND WATER Key

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7. The substance H_2O is considered to be
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8. The substance O_2 is considered to be
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B. a compound but not a molecule.
C. neither a molecule nor a compound.
D. a molecule but not a compound.

9. An oxygen atom has ____ surrounding a nucleus composed of ____.
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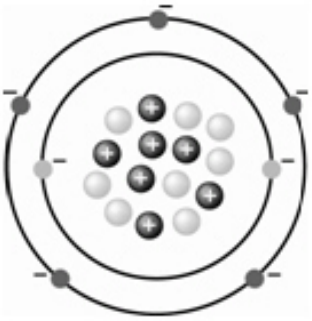
B. electrons; protons and neutrons
C. protons and electrons; neutrons
D. protons; neutrons and electrons
E. electrons and neutrons; protons

10. 

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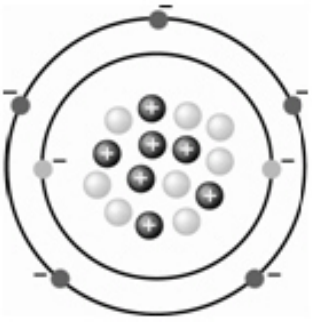
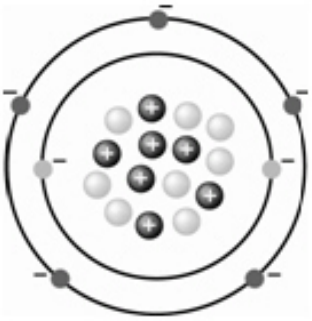
D. 15.
E. 22.

11. 

Use the figure above for the following question(s).

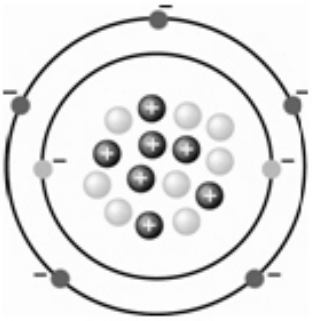
The atomic number of the atom depicted in the figure is

A. 5.
B. 7.
C. 8.
D. 15.
E. 22.

12. 

Use the figure above for the following question(s).

The number of electrons for the atom depicted in the figure is
A. 5.
B. 7.
C. 8.
D. 15.
E. 22.

13. 

Use the figure above for the following question(s).

The number of neutrons for the atom depicted in the figure is
A. 5.
B. 7.
C. 8.
D. 15.
E. 22.

14. Which of the following are charged particles?
A. electrons and protons
B. neutrons only
C. protons and neutrons
D. electrons only
E. protons, neutrons, and electrons

15. What is the atomic mass number of an atom with 7 electrons, 7 neutrons, and 7 protons?
A. 7 daltons
B. 10 daltons
C. 14 daltons
D. 21 daltons
E. 28 daltons

16. Isotopes of the same element differ from each other in the number of
A. electrons and protons.
B. neutrons only.
C. protons and neutrons.
D. electrons only.
E. protons, neutrons, and electrons.

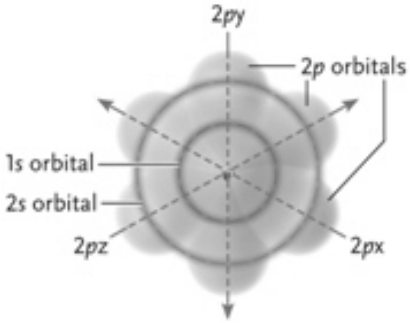
17. A carbon atom with six protons, seven neutrons, and six electrons has a mass number of
A. 6.
B. 7.
C. 12.
D. 13.
E. 19.

18. Which element would the element lithium most likely form an ionic bond with?
A. Aluminum; atomic number = 13
B. Chlorine; atomic number = 17
C. Magnesium; atomic number = 12
D. Nitrogen; atomic number = 7
E. Silicon; atomic number = 14

19. ^{14}C is heavier than ^{12}C because it has _____.
A. two more electrons than ^{12}C
B. two more neutrons than ^{12}C
C. two more protons than ^{12}C
D. one more proton and one more electron than ^{12}C
E. one more proton and one more neutron than ^{12}C

20. The isotope ^{14}C undergoes radioactive decay with a neutron splitting into an electron and a proton. This decay produces an atom of
A. iron.
B. carbon.
C. hydrogen.
D. oxygen.
E. nitrogen.

21. An orbital describes the ____ of an electron.
A. exact location
B. exact path
C. most frequent locations
D. charge
E. chemical bonds

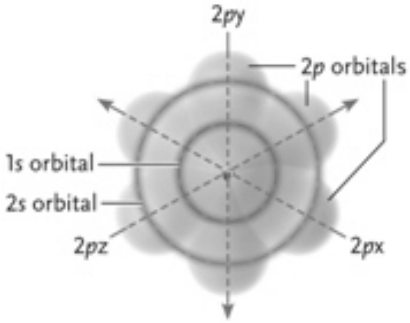


22.

Use the figure above for the following question(s).

The electrons at the lowest energy level in the neon atom depicted in the figure above are found in which orbital?
A. 1*s*
B. 2*s*
C. 2*p*x
D. 2*p*y
E. 2*p*z

23.



Use the figure above for the following question(s).

All of the orbitals shown in the neon atom in the figure are completely filled with electrons. How many electrons does this neon atom have?
A. 5
B. 6
C. 8
D. 10
E. 16

24. Under the right conditions, an electron will
A. move to a lower energy level.
B. enter an orbital shared by two atoms.
C. move to a higher energy level.
D. move from one atom to another atom.
E. all of these

25. Sodium has one valence electron in its third energy level. To reach a stable energy configuration, sodium will tend to
A. take up an electron from another atom.
B. move its valence electron to the second energy shell.
C. give up an electron to another atom.
D. share its valence electron with another atom.
E. move an electron from the second energy level to the valence shell.

26. Which of the following is most likely to share electrons with other atoms in joint orbitals?
A. chlorine (7 valence electrons)
B. calcium (2 valence electrons)
C. argon (8 valence electrons)
D. carbon (4 valence electrons)
E. potassium (1 valence electron)

27. Which of the following is likely to be chemically unreactive?
A. chlorine (7 valence electrons)
B. calcium (2 valence electrons)
C. argon (8 valence electrons)
D. carbon (4 valence electrons)
E. potassium (1 valence electron)

28. Which of the following is most likely to take up an electron from another atom?
A. chlorine (7 valence electrons)
B. calcium (2 valence electrons)
C. neon (8 valence electrons)
D. carbon (4 valence electrons)
E. potassium (1 valence electron)

29. Radioactive ____ is commonly used to treat patients with dangerously overactive thyroid glands.
A. carbon
B. radium
C. iodine
D. thallium
E. cobalt

30. Melvin Calvin and his coworkers used a radioisotope of ____ to trace the reactions of photosynthesis.
A. carbon
B. radium
C. iodine
D. thallium
E. cobalt

31. The chemical bonds that form when atoms that have lost electrons are electrically attracted to atoms that have gained electrons are called ____.
A. polar covalent bonds
B. van der Waals forces
C. ionic bonds
D. hydrogen bonds
E. nonpolar covalent bonds

32. The chemical bonds that are formed when atoms share electrons equally are called ____.
A. polar covalent bonds
B. van der Waals forces
C. ionic bonds
D. hydrogen bonds
E. nonpolar covalent bonds

33. The chemical bonds that are formed when atoms share electrons unequally are called ____.
A. polar covalent bonds
B. van der Waals forces
C. ionic bonds
D. hydrogen bonds
E. nonpolar covalent bonds

34. The chemical bonds that are formed when atoms with temporary zones of positive charge are attracted to other atoms with temporary zones of negative charge are called ____.
A. polar covalent bonds
B. van der Waals forces
C. ionic bonds
D. hydrogen bonds
E. nonpolar covalent bonds

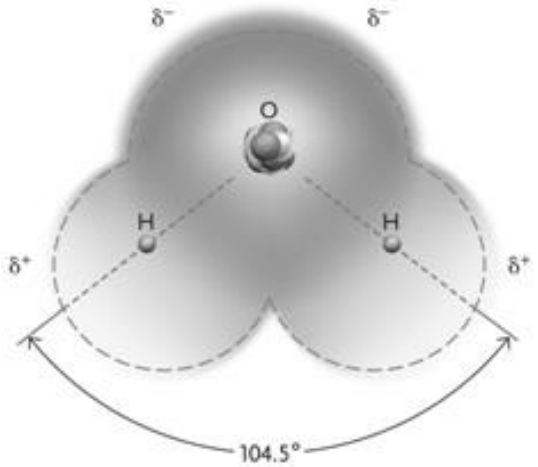
35. Chemical bonds that are formed when one atom with a partial positive charge (created from unequal sharing of electrons) is electrically attracted to another atom with a partial negative charge (also created from unequal sharing of electrons) are called ____.
A. polar covalent bonds
B. van der Waals forces
C. ionic bonds
D. hydrogen bonds
E. nonpolar covalent bonds

36. Which of the following types of chemical linkages is the weakest?
A. polar covalent bonds
B. van der Waals forces
C. ionic bonds
D. hydrogen bonds
E. nonpolar covalent bonds

37. The attraction between Na^+ cations and Cl^- anions forms ____ that hold together the compound NaCl.
A. polar covalent bonds
B. van der Waals forces
C. ionic bonds
D. hydrogen bonds
E. nonpolar covalent bonds

38. Geckos are able to cling to vertical walls due to ____.
A. polar covalent bonds
B. van der Waals forces
C. ionic bonds
D. hydrogen bonds
E. nonpolar covalent bonds

39. Molecules such as H-H and O=O are held together by ____.
A. polar covalent bonds
B. van der Waals forces
C. ionic bonds
D. hydrogen bonds
E. nonpolar covalent bonds



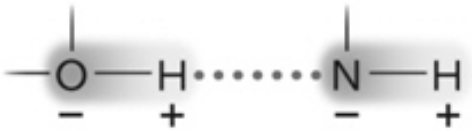
40.

The molecule shown in the figure above is held together by ____.
A. polar covalent bonds
B. van der Waals forces
C. ionic bonds
D. hydrogen bonds
E. nonpolar covalent bonds

41. Metallic ions such as Ca^{2+}, Na^{+}, and Fe^{3+} readily form ____.
A. polar covalent bonds
B. van der Waals forces
C. ionic bonds
D. hydrogen bonds
E. nonpolar covalent bonds

42. The chemical linkages that exert an attractive force over the greatest distance are ____.
A. polar covalent bonds
B. van der Waals forces
C. ionic bonds
D. hydrogen bonds
E. nonpolar covalent bonds

43. In contrast to ionic bonds, covalent bonds ____.
A. hold atoms together
B. have distinct, three-dimensional forms
C. transfer electrons from one atom to another
D. are relatively weak
E. are transient

44. 

The dotted line in the figure above indicates ____.
A. a polar covalent bond
B. van der Waals forces
C. an ionic bond
D. a hydrogen bond
E. a nonpolar covalent bond

45. In a molecule of methane, CH_4, each hydrogen atom shares an orbital with the carbon atom. The total number of shared electrons in CH_4 is ____.
A. 4
B. 2
C. 1
D. 8
E. 5

46. A polar covalent bond would be most likely to form between
A. atoms with different electronegativities.
B. cations and anions.
C. atoms with d+ and d- charges.
D. atoms with filled valence shells.
E. atoms of the same element.

47. Which of these types of chemical bonds would you not expect to find in biological molecules?
A. covalent bonds
B. van der Waals forces
C. ionic bonds
D. hydrogen bonds
E. all of these types of bonds are found in biological molecules

48. In the presence of water, nonpolar associations form between molecules or regions of molecules that are ____.
A. partially charged
B. hydrophobic and hydrophilic
C. hydrophobic
D. fully charged
E. hydrophilic

49. A mixture of vegetable oil and water will separate into layers because oil is ____ and forms ____.
A. hydrophobic; nonpolar associations
B. hydrophilic; nonpolar associations
C. hydrophilic; polar associations
D. hydrophobic; polar associations

50. Analyze this chemical reaction:

$6\ CO_2 + 6\ H_2O \rightarrow C_6H_{12}O_6 + 6\ O_2$

Which of the following is FALSE?
A. Water is a reactant.
B. $C_6H_{12}O_6$ is a product.
C. Molecular oxygen is a product.
D. CO_2 is a reactant.
E. Molecular carbon is a reactant.

51. The formation and breaking of bonds between atoms requires
A. a chemical reaction.
B. van der Walls forces.
C. partial charges.
D. an empty valence shell.
E. an enzyme.

52. What do cohesion, surface tension, and specific heat have in common concerning the properites of water?
A. All are produced by covalent bonding.
B. All are properties related to hydrogen bonding.
C. All have to do with nonpolar covalent bonds.
D. All increase when temperature increases.
E. All are produced by covalent bonding and all increase when temperature increases.

53. A molecule of water in the middle of a chunk of ice will usually have ____ hydrogen bonds with other water molecules.
A. 3
B. 3.4
C. 6
D. 4
E. 2

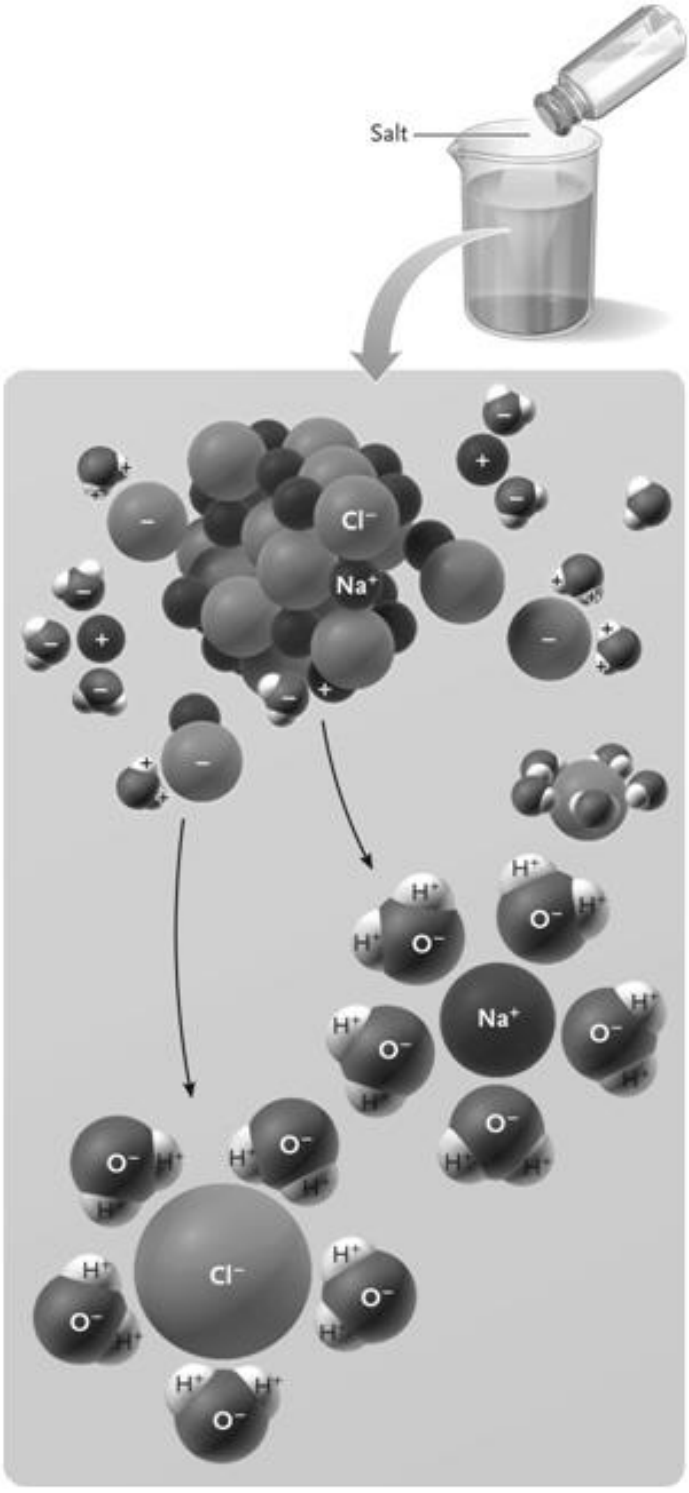
54. Which of the following would have the most difficulty entering a water lattice?
A. table salt (NaCl)
B. a nonpolar molecule
C. a sodium ion
D. a proton (H^+)
E. an electron

55. Ice floats in liquid water because
A. ice forms hydrogen bonds with the surface of liquid water.
B. ice forms hydrogen bonds but liquid water does not.
C. the hydrogen bonds of liquid water are fixed in place.
D. liquid water forms hydrogen bonds but ice does not.
E. the distance between water molecules is maximized due to the hydrogen bonds which are fixed in place.

56. Biological membranes are held together mainly by
A. hydrogen bonds between lipid molecules.
B. hydration layers over lipid molecules.
C. exclusion of the nonpolar regions of lipids by water.
D. hydrogen bonds between water molecules.
E. surface tension at the interface between layers of water molecules.

57. A ____ is formed when a ____ is dissolved in a ____.
A. solution; solute; solvent
B. solute; solvent; solution
C. solution; solvent; solute
D. solvent; solution; solute
E. solvent; solute; solution

58. When sugar dissolves in water, water is acting as a ____ and the sugar molecules are acting as ____.
A. solution; solvents
B. solute; solutions
C. solvent; solutes
D. solute; solvents
E. solvent; solutions

59. 

When salt dissolves in water as illustrated in the figure above, the water molecules form ____ around the Na^+ and Cl^- ions.

A. covalent bonds
B. hydration layers
C. nonpolar interactions
D. membranes
E. ionic bonds

60. Water has a molecular weight of 18 g per mole, and glucose has a molecular weight of 180 g per mole. Which of the following would have an approximately equal number of water and glucose molecules?
A. 1 g of water and 180 g of glucose
B. 90 g of water and 9 g of glucose
C. 180 g of water and 1 g of glucose
D. 9 g of water and 90 g of glucose
E. 90 g of water and 90 g of glucose

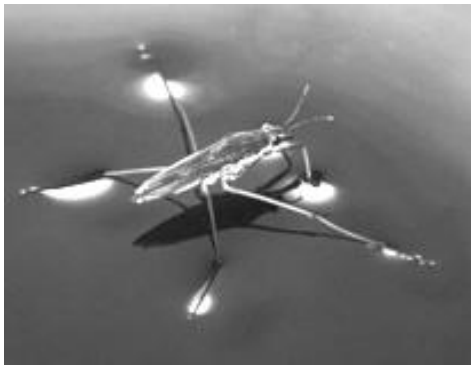
61. Water has a molecular weight of 18 Daltons or amu. Therefore, a mole of water would have a mass of ____.
A. 1 g
B. 6.02×10^{23} g
C. 36 g
D. 1.08×10^{25} g
E. 18 g

62. Water has an unusually high boiling point for its molecular weight because water molecules
A. are very dense.
B. get much heavier as they are heated.
C. are held to each other by hydrogen bonds.
D. are held together by covalent bonds.
E. form hydration layers.

63. The hydrogen-bond lattice causes water to have an unusually ____ specific heat and an unusually ____ heat of vaporization for its molecular weight.
A. high; high
B. low; high
C. high; low
D. low; low

64. Water is useful for cooling organisms mainly due to its
A. hydration layers.
B. specific heat.
C. low calories.
D. surface tension.
E. heat of vaporization.

65. Water has an important stabilizing effect on temperature in living organisms and their environments because as water absorbs heat, much of the energy is used to ____ instead of raising the temperature.
A. create hydrogen bonds
B. create covalent bonds
C. break surface tension
D. break hydrogen bonds
E. create hydration layers

66. 

The water strider shown in the figure above is able to stand on water because of the ____ of water.
A. covalent bonds
B. surface tension
C. van der Waals forces
D. density
E. hydration layer

67. When added to water, a base will act as a ____ and cause the pH of the solution to ____.
A. proton acceptor; rise
B. proton donor; rise
C. proton acceptor; fall
D. proton donor; fall
E. none of these

68. When added to water at neutral pH (7.0), an acid will
A. act as a proton donor, raising the pH of the solution.
B. act as a proton acceptor, raising the pH of the solution.
C. act as a proton donor, lowering the pH of the solution.
D. act as a proton acceptor, lowering the pH of the solution.
E. do nothing since the aqueous solution is neutral.

69. A pH of 6 is ____ times more ____ than a pH of 2.
A. 3; acidic
B. 4; acidic
C. 3; basic
D. 10,000; basic
E. 40; basic

70. For pure water, which has a pH of 7.0, which of the following is true?
A. $[H^+] < [OH^-]$
B. $[H^+] = [OH^-]$
C. $[H^+] = 0$
D. $[OH^-] = 0$
E. $[H^+] > [OH^-]$

71. For acid rainwater, which has a pH as low as 3.0, which of the following is true?
A. $[H^+] < [OH^-]$
B. $[H^+] = [OH^-]$
C. $[H^+] = 0$
D. $[OH^-] = 0$
E. $[H^+] > [OH^-]$

72. Solution A has a pH of 6 and solution B has a pH of 8. Which of the following is true regarding the concentration of hydrogen ions in each solution?
A. A has 100 times greater H^+ concentration than B.
B. B has 100 times greater H^+ concentration than A.
C. A has 7/9 of the H^+ concentration of B.
D. A has 9/7 of the H^+ concentration of B.
E. none of these

73. In water, NaOH almost completely separates into Na^+ and OH^- ions. Thus, NaOH is _____.
A. a strong acid
B. a strong base
C. a weak acid
D. a weak base
E. neutral

74. Seawater typically is
A. highly basic.
B. neutral.
C. somewhat basic.
D. somewhat acidic.
E. highly basic.

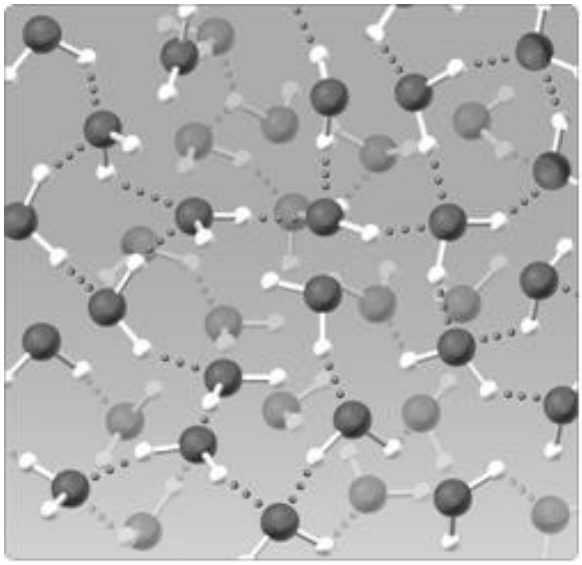
75. Without ____, living organisms would often experience major changes in pH in their cells.
A. buffers
B. acids
C. surface tension
D. nonpolar bonds
E. bases

76. Most pH buffers are
A. strong acids.
B. weak acids or weak bases.
C. weak acids.
D. strong bases.
E. strong acids or strong bases.

77. A research group led by Joanne Santini has found a(n) ____ that potentially can be used in arsenic bioremediation.
A. amoeba
B. plant
C. alga
D. bacterium
E. fungus

78. Which of the following statements about irradiation of food is true?
A. Irradiation does not affect viruses in food.
B. Irradiation kills many bacteria and parasites in food.
C. Studies have shown higher cancer rates in laboratory animals fed irradiated food.
D. Irradiation makes food radioactive.
E. Vitamins are completely destroyed when food is irradiated.

79. The most common isotope of carbon has an atomic number of 6 and a mass number of 12, while the most common isotope of oxygen has an atomic number of 8 and a mass number of 16. A molecule of CO_2 made up of these common isotopes has a molecular weight of ____.
A. 28
B. 44
C. 56
D. 14
E. 22

80. 

The water lattice illustrated in the figure above forms as a result of ____ between water molecules.
A. covalent bonds
B. hydrogen bonds
C. nonpolar interactions
D. ionic bonds
E. van der Walls forces

81. The isotope of hydrogen most commonly found in water is protium, which has no neutrons. However, the form of hydrogen with one neutron, deuterium, can also be found in water. If you were to compare water that only has protium (protium water) with water that only has deuterium (deuterium water) you would find that
A. a mole of protium water weighs the same as a mole of deuterium water.
B. a mole of deuterium water weighs considerably less than half as much as a mole of protium water.
C. a mole of protium water weighs about twice as much as a mole of deuterium water.
D. a mole of deuterium water weighs about twice as much as a mole of protium water.
E. a mole of protium water weighs considerably less than half as much as a mole of deuterium water.

82. *Match each of the following terms with its correct definition.*

1. isotope	A pure substance that cannot be broken down into simpler substances by ordinary chemical or physical techniques	**5**
2. orbital	A molecule whose component atoms are different from each other	**3**
3. compound	Anything that occupies space and has mass	**4**
4. matter	The locations around an atomic nucleus where an electron occurs most frequently	**2**
5. element	An atom with the same number of protons as another atom but a different number of neutrons	**1**

83. Place a large amount of hydrogen gas and oxygen gas in the presence of a fire and you will get an explosion. In light of this, explain how it is possible that water, which is composed of hydrogen and oxygen, is often used to put out fires.

Water is a compound, and compounds typically have chemical and physical properties that are distinct from the atoms that make them up. So, water had different properties than the hydrogen and oxygen that it is made of and thus behaves differently from them in the presence of fire.

84. Oxygen generally forms two covalent bonds, while carbon generally forms four covalent bonds. In contrast, helium is inert (generally does not form any bonds). Explain the reason for the differences in chemical behavior between these three elements.

The number of valence electrons in the outermost energy level, or valence shell, determines chemical reactivity. Atoms of an element with a filled valence shell, such as helium, are nonreactive. In contrast, atoms with an unfilled valence shell are reactive; they will tend to gain, lose, or share electrons so that they wind up with a filled valence shell. Oxygen needs two electrons to fill its valence shell, so it tends to form two covalent bonds. Carbon needs four electrons to fill its valence shell so it tends to form four covalent bonds.

85. Describe how the interaction of water with dual polarity lipid molecules establishes biological membranes.

The hydrogen bonding between water molecules forms a lattice that resists invasion by nonpolar molecules. However, polar molecules can interact with the hydrogen-bond lattice. Lipid molecules with both polar and nonpolar regions can align in a bilayer, with the lipid molecules oriented so that their polar regions are on either side of the bilayer and their nonpolar regions are buried in the middle of the bilayer. In this arrangement only the polar ends are exposed to the water. This creates a membrane of lipid molecules that separates the watery solution on one side of the bilayer from the watery solution on the other side of the bilayer.