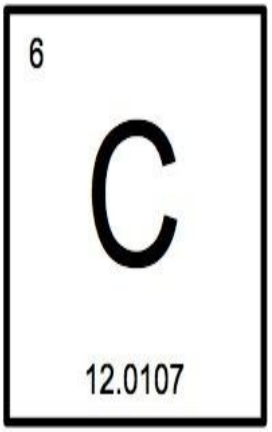
Name: _____ Class: _____ Date: _____

Chapter 2

1. What is the atomic weight of carbon (C)?



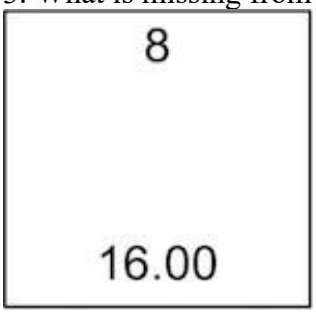
a. 6
b. 11
c. 12
d. 12.0107
e. 18

ANSWER: d

2. The four most abundant elements in living organisms are:
a. carbon, hydrogen, potassium, and oxygen.
b. hydrogen, nitrogen, carbon, and silicon.
c. carbon, nitrogen, hydrogen, and calcium.
d. hydrogen, nitrogen, oxygen, and carbon.
e. carbon, hydrogen, nitrogen, and phosphorus.

ANSWER: d

3. What is missing from this cell of the periodic table?



a. the chemical symbol for oxygen, O
b. the chemical symbol for oxygen, Ox
c. the chemical symbol for nitrogen, N
d. the chemical symbol for nitrogen, Nit
e. the chemical symbol for carbon, C

ANSWER: a

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4. An atom of iron has the atomic number 26. This means that it has:
   a. 52 protons.
   b. 26 protons.
   c. 13 neutrons.
   d. an atomic mass of 26.
   e. 13 electrons.

ANSWER: b

5. Carbon-14 has the same:
   a. number of protons but more neutrons than carbon-12.
   b. atomic number and atomic mass as carbon-12.
   c. atomic number and, therefore, the same number of neutrons as carbon-13.
   d. atomic mass as both carbon-12 and carbon-13.
   e. atomic mass and, therefore, the same number of neutrons as carbon-12.

ANSWER: a

6. All matter on earth, both living and non-living, is made up of:
   a. cells.
   b. DNA.
   c. carbohydrates.
   d. phospholipids.
   e. atoms.

ANSWER: e

7. Of all the elements that occur on earth, how many are found in your body?
   a. 4
   b. 10
   c. 25
   d. 90
   e. 100

ANSWER: c

8. The thing that distinguishes one element, such as chlorine, from another, such as neon, is the number of:
   a. protons in the nucleus.
   b. protons and neutrons in the nucleus.
   c. electrons.
   d. protons, neutrons, and electrons.
   e. neutrons in the nucleus.

ANSWER: a

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9. An atom of sodium (Na) has 11 protons. What is its approximate atomic mass?

a. 5
b. 11
c. 16.5
d. 22
e. 44

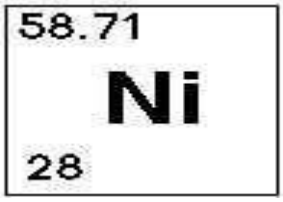
ANSWER: d

10. What would happen if you subdivided an atom of sodium?

a. You would form salt.
b. The pieces would come together in a uniform, crystal structure.
c. The particle of matter would lose its essential properties.
d. You would have two atoms of sodium.
e. You would create an additional electron shell.

ANSWER: c

11. A neutral atom of the most common form of nickel (Ni) has how many protons?



a. 28
b. 36
c. 24
d. 26
e. 52

ANSWER: a

12. Suppose you have an atom composed of 13 protons, 14 neutrons, and 13 electrons. What is the approximate mass of this atom?

a. 27
b. 26.98
c. 40
d. 26
e. 28

ANSWER: a

13. True or False: A piece of silver can be cut indefinitely into pieces and still retain all of the properties of silver.

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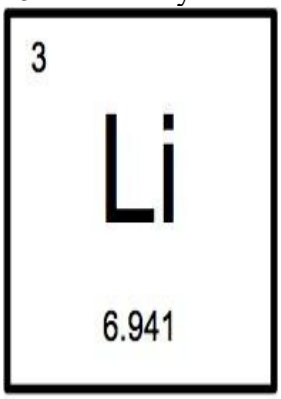
a. True. All particles, including subatomic particles that make up the element, possess the properties of the element.
b. True. Atoms are the smallest units of matter, are indivisible, and possess the properties of their element.
c. False. Once the pieces are smaller than an atom of silver, the pieces no longer retain the properties of silver.
d. False. Silver atoms are too small to possess the properties of silver.
e. False. As a piece of silver is cut into smaller pieces, the atoms begin to take on the properties of smaller elements.

ANSWER: c

14. Which statement describes an atom of oxygen?
a. Most naturally occurring atoms of oxygen contain 9 neutrons.
b. All atoms of oxygen include 8 protons.
c. Nitrogen-15 is an isotope of oxygen.
d. Its atomic weight is the same as its atomic mass.
e. Its chemical symbol is Ox.

ANSWER: b

15. How many neutrons does the isotope Lithium-7 have?



a. 3
b. 4
c. 6
d. 7
e. 8

ANSWER: b

16. How many electrons are in a typical aluminum (Al) atom's outermost shell?

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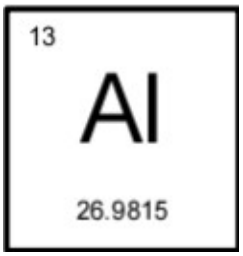

a. 2
b. 3
c. 8
d. 13
e. 14

ANSWER: d

17. Carbon:
a. has no vacancies in its outermost shell.
b. can form up to 4 bonds with other atoms.
c. can't form bonds with other atoms of carbon.
d. can hold 4 electrons in its first electron shell.
e. is the least reactive of all elements.

ANSWER: b

18. Which of these atoms is most likely to be involved in a chemical reaction?
a. helium (atomic number 2)
b. potassium (atomic number 19)
c. neon (atomic number 10)
d. argon (atomic number 18)
e. xenon (atomic number 54)

ANSWER: b

19. Which statement describes how the electron shells of sodium (Na) are filled?
a. 2 electrons in the first shell and 9 electrons in the second shell
b. 2 electrons in the first shell, 8 electrons in the second shell, and 1 electron in the third shell
c. 4 electrons in the first shell, 4 electrons in the second shell, and 3 electrons in the third shell
d. 11 electrons in the first shell
e. 8 electrons in the first shell and 3 electrons in the second shell

ANSWER: b

20. Atoms may gain or lose electrons, becoming ions. Ions:
a. have a neutral charge.
b. tend to be inert.

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c. adjust their number of protons to be the same as the number of electrons.
d. behave differently than their parent atoms.
e. tend to interact with similarly charged ions.

ANSWER: d

21. An atom can be changed into an ion by adding or removing:
a. a neutron.
b. a proton.
c. an electron.
d. either a neutron or a proton.
e. either a proton or an electron.

ANSWER: c

22. Which of these elements has 4 electrons in its outer shell?
a. oxygen
b. nitrogen
c. carbon
d. helium
e. neon

ANSWER: c

23. In an uncharged atom, the number of protons and _____ must be equal.
a. electrons
b. neutrons
c. isotopes
d. ions
e. particles

ANSWER: a

24. Under which condition are atoms most stable and least likely to bond with other atoms?
a. when their outermost electron shell is filled to capacity
b. when their outermost electron shell has four or more vacancies
c. when they have the same number of protons as electrons
d. when they have a positive charge
e. when they have a negative charge

ANSWER: a

25. Which statement is true about atoms that are more stable?
a. They are more likely to interact with other atoms.
b. They tend not to react or combine with other atoms.

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c. They tend to have several electron vacancies in their outermost shell.
d. They have a small number of protons.
e. They have fewer electrons than atoms that are less stable.

ANSWER: b

26. Based on their descriptions, which of these atoms is least likely to interact with other atoms to form molecules?
a. lithium (Li) − 1st shell: 2 electrons; 2nd shell: 1 electron
b. neon (Ne) − 1st shell: 2 electrons; 2nd shell: 8 electrons
c. nitrogen (N) − 1st shell: 2 electrons; 2nd shell: 5 electrons
d. carbon (C) − 1st shell: 2 electrons; 2nd shell: 4 electrons
e. hydrogen (H) − 1st shell: 1 electron

ANSWER: b

27. Choose the best description of a covalent bond from the choices below.
a. Two water molecules interact due to partial charges on the oxygen and hydrogen atoms.
b. A magnesium donates electrons and forms bonds with two chloride ions.
c. A bond forms between a hydrogen from one molecule and a nitrogen from another molecule.
d. A positive potassium ion forms a bond with a negative chloride ion.
e. A nitrogen atom shares electrons with three hydrogen atoms.

ANSWER: e

28. A lithium atom contains 3 electrons, whereas a fluorine atom contains 9 electrons. Which correctly describes the formation of a bond between lithium and fluorine atoms?
a. Lithium and fluorine will share one pair of electrons.
b. A hydrogen bond will form between the partially positive lithium and the partially negative fluorine.
c. Lithium will donate an electron to fluorine, making a positive lithium ion and a negative fluoride ion that are attracted to each other.
d. Lithium will take an electron from fluorine, making a negative lithium ion and a positive fluoride ion that are attracted to each other.
e. Lithium and fluorine share two pairs of electrons.

ANSWER: c

29. Multiple atoms linked together are called a(n):
a. reactant.
b. isotope.
c. molecule.
d. substrate.
e. element.

ANSWER: c

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30. A covalent bond is formed when:
    a. two atoms share electrons.
    b. one atom gives up electrons to another atom.
    c. two nonpolar molecules associate with each other in a polar environment.
    d. two polar molecules associate with each other in a nonpolar environment.
    e. a positively charged particle is attracted to a negatively charged particle.

ANSWER: a

31. Hydrogen bonds are:
    a. the sharing of electrons between a hydrogen atom and another atom.
    b. the electrostatic interaction between an atom that has lost an electron and an atom that has gained an electron.
    c. the interaction between a hydrogen atom covalently bonded to an electronegative atom and another electronegative atom.
    d. the strongest kind of bonds.
    e. only found in water.

ANSWER: c

32. How is the reaction $2H_2 + O_2 \rightarrow 2H_2O$ described in words?
    a. Two molecules of hydrogen combine with two atoms of oxygen to form two molecules of water.
    b. Two molecules of hydrogen combine with two molecules of oxygen to form two molecules of water.
    c. Two molecules of hydrogen combine with one molecule of oxygen to form two molecules of water.
    d. Two atoms of hydrogen combine with one atom of oxygen to form two atoms of water.
    e. Two atoms of hydrogen combine with two atoms of oxygen to form two molecules of water.

ANSWER: c

33. How many total electrons are involved in a double bond, such as that found in a molecule of oxygen (O_2)?
    a. 1
    b. 2
    c. 3
    d. 4
    e. 6

ANSWER: d

34. Three principal types of bonds hold multiple atoms together. These are:
    a. phosphate bonds, disulfide bonds, and hydrogen bonds.
    b. hydrogen bonds, ionic bonds, and glycosidic linkages.
    c. covalent bonds, ionic bonds, and hydrogen bonds.
    d. covalent bonds, ionic bonds, and disulfide bonds.

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e. ionic bonds, hydrogen bonds, and ester bonds.

ANSWER: c

35. Which statement about chemical bonds is false?
    a. Covalent bonds are formed through electron sharing and are quite strong.
    b. Ionic bonds result from the attraction between two oppositely charged atoms.
    c. Methane (CH_4) is the result of an ionic bond between two oppositely charged atoms of carbon and hydrogen.
    d. O_2 is the result of a covalent bond where two oxygen atoms share two pairs of electrons.
    e. Hydrogen bonds are formed from the attraction between a hydrogen atom and another atom with a slight negative charge.

ANSWER: c

36. Which molecule is not formed by covalent bonding?
    a. H_2O
    b. CH_4
    c. O_2
    d. NaCl
    e. H_2

ANSWER: d

37. One important difference between covalent and ionic bonds is that:
    a. ionic bonds are much stronger than covalent bonds.
    b. in ionic bonds, two atoms share electrons, whereas in covalent bonds, one atom gives one or more electrons to the other atom.
    c. in covalent bonds, two atoms share electrons, whereas in ionic bonds, one atom gives one or more electrons to the other atom.
    d. in ionic bonds, both protons and electrons can be shared, whereas in covalent bonds, only electrons can be shared.
    e. ionic bonds only occur among water-soluble elements.

ANSWER: c

38. When two hydrogen atoms share electrons, what is the result?
    a. A stable H_2 molecule is formed.
    b. The nuclei repel each other and destabilize the molecule.
    c. An H_2 molecule is formed, which is highly likely to bond with other atoms.
    d. One of the hydrogen atoms is stable, whereas the other remains unstable.
    e. A positively charged H_2 molecule is formed.

ANSWER: a

39. Why is a molecule of H_2 more stable than an atom of hydrogen?

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a. The H_2 molecule shares the 2 electrons in the outermost shell.
b. The H_2 molecule has 4 electrons instead of 2.
c. The H_2 molecule has a vacancy in the outermost electron shell.
d. Two pairs of electrons are shared in a strong double bond.
e. The innermost shell is more stable when it has 1 electron in it.

ANSWER: a

40. Identify the mismatched pairing.
a. H_2: covalent molecule
b. NaCl: ionic compound
c. CH_4: ionic compound
d. H_2O: covalent molecule
e. O_2: covalent molecule

ANSWER: c

41. Calcium has the atomic number 20 and forms an ion with a +2 charge. With which atom(s) would a single calcium ion likely form an ionic bond?
a. one helium (He) atom (atomic number 2)
b. one hydrogen (atom (atomic number 1)
c. two chlorine (Cl) atoms (atomic number 17)
d. two carbon (atoms (atomic number 6)
e. four neon (Ne) atoms (atomic number 10)

ANSWER: c

42. Water molecules form which type of bond with other water molecules?
a. covalent bonds
b. water bonds
c. oxygen bonds
d. hydrogen bonds
e. ionic bonds

ANSWER: d

43. Identify the statement that correctly describes hydrogen bonds.
a. any bond with a hydrogen
b. the attraction between a slightly positive, covalently bonded hydrogen atom and a slightly negative atom of another molecule
c. a bond between two hydrogen atoms to form H_2
d. attraction between hydrogen and oxygen to form a water molecule
e. attraction between oppositely charged ions

ANSWER: b

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44. When transporting water up to the top of giant trees, which feature allows water molecules to pull up adjacent water molecules to which they have bonded?

a. low density as a solid
b. adhesion
c. ionic bonding
d. cohesion
e. high specific heat

ANSWER: d

45. The tendency of molecules to stick together, called cohesion, is stronger in water than in other liquids because the polarity of water allows a(n):

a. hydrogen atom from one water molecule to form an ionic bond with the oxygen atom of another water molecule.
b. hydrogen atom from one water molecule to form a hydrogen bond with the hydrogen atom of another water molecule.
c. hydrogen atom from one water molecule to form a covalent bond with the oxygen atom of another water molecule.
d. oxygen atom from one water molecule to form a hydrogen bond with the oxygen atom of another water molecule.
e. hydrogen atom from one water molecule to form a hydrogen bond with the oxygen atom of another water molecule.

ANSWER: e

46. The distribution of most biological molecules throughout a cell or organismal body is greatly facilitated by their ability to dissolve in:

a. carbohydrate.
b. lipid.
c. nucleic acid.
d. water.
e. protein.

ANSWER: d

47. Most substances become denser when frozen, but water becomes less dense. As a consequence, ice floats. What is responsible for this unusual property?

a. As the temperature drops and water molecules slow down, there is increasing opportunity for hydrogen bonds to form. These bonds hold the numerous V-shaped molecules slightly farther apart than when no hydrogen bonds exist, causing the water to be less dense.
b. Oxygen is able to covalently bond with additional hydrogen molecules when the temperature drops and molecular motion slows down. Because hydrogen floats, the greater the number of hydrogen atoms bound to an oxygen molecule, the more buoyant it becomes.
c. Because covalent bonds are broken by the process of freezing, ice molecules have fewer electrons

than water, and so they are less dense and float.

d. Most water molecules have some sodium and chloride ions bound to them. Upon freezing, the sodium and chloride ions are lost, making the ice less dense.

e. Molecular motion is slower in solid substances than liquids; therefore, more of the molecules can evaporate. As a consequence, when water freezes, it stays in close contact with air.

ANSWER: a

48. The fact that water is less dense as a solid than as a liquid explains why:

a. water is such a good solvent.

b. water can resist temperature changes.

c. ice floats on top of liquid water.

d. ice cubes sink when placed in a glass of water.

e. oil never dissolves in water.

ANSWER: c

49. Evaporation from the leaves of a tree will pull water up through the roots as an unbroken column throughout the entire height of the tree. This feat is possible because of which characteristic of water?

a. surface tension

b. cohesion

c. absorption

d. kinetic energy

e. vaporization

ANSWER: b

50. Why do coastal areas have milder, less variable climates than inland areas?

a. Large bodies of water have high salt concentrations, and salt absorbs a large proportion of the light energy that would have warmed the land.

b. Coastal areas are concentrated near the equator, which varies less than other parts of the globe in the angle at which the sun's light hits it.

c. Because water is a good solvent, it is able to dissolve the photons in light, reducing their ability to heat or cool the land.

d. Large bodies of water, especially oceans, can absorb huge amounts of heat from the sun during warm times of the year, reducing temperature increases on the land. Similarly, during cold times of year the ocean slowly cools, giving off heat that reduces the temperature drop on shore.

e. There is no known reason why coastal areas have milder, less variable climates than inland areas.

ANSWER: d

51. Which of these is not the result of hydrogen bonding between water molecules?

a. high surface tension

b. ability to dissolve polar substances

c. high specific heat

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d. low density when frozen
e. lack of color, odor, or flavor

ANSWER: e

52. A substance similar to table salt, called magnesium chloride, separates into positively charged magnesium ions and negatively charged chloride ions when placed in water. If you were to look at the magnesium ions dissolved in the water, what would you see?

a. The magnesium ions would be surrounded by chloride ions.
b. The magnesium ions would be surrounded by water molecules with their hydrogen atoms facing the magnesium ions.
c. The magnesium ions would be surrounded by water molecules with their oxygen atoms facing the magnesium ions.
d. The magnesium ions would be drifting by themselves, without any water molecules nearby.
e. The magnesium ions would be covalently bonded to water molecules.

ANSWER: c

53. A balance between which two ions in aqueous solutions within organisms is critical for the proper functioning of the chemical processes of life?

a. H^+ and OH^-
b. Na^+ and Cl^-
c. Na^+ and OH^-
d. H^+ and Cl^-
e. H^+ and H^-

ANSWER: a

54. The pH scale is a direct measure of the concentration of:

a. hydrogen ions in a solution.
b. hydroxide ions in a solution.
c. hydrogen atoms in a solution.
d. salt in a solution.
e. buffers in a solution.

ANSWER: a

55. Certain molecules act like bank accounts for H^+ ions because they can absorb excess H^+ ions to keep a solution from becoming too acidic and release H^+ ions to keep the solution from becoming too basic. Such molecules are called:

a. enzymes.
b. buffers.
c. reducing agents.
d. isotopes.
e. oxidizing agents.

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ANSWER: b

56. A chemical compound that releases OH^- into a solution is called a(n):
    a. hydroxide ion.
    b. solvent.
    c. acid.
    d. salt.
    e. base.

ANSWER: e

57. Which statement is true about acids and bases?
    a. Acids and bases do not react with each other.
    b. Acids mixed with bases neutralize each other.
    c. Acids mixed with bases make stronger acids.
    d. Acids mixed with bases make stronger bases.
    e. Acids are stronger than bases.

ANSWER: b

58. What would you expect to happen to the pH of an unbuffered solution if a few drops of acid were added?
    a. The pH would increase.
    b. The pH would remain the same.
    c. The pH would decrease.
    d. The pH would become neutral.
    e. The pH would increase and then rapidly decrease.

ANSWER: c

59. Bleach has an approximate pH of 13, and pure water has a pH of 7. How much more basic is bleach than pure water?
    a. 100×
    b. 1,000×
    c. 10,000×
    d. 100,000×
    e. 1,000,000×

ANSWER: e

60. Which of these is a correct statement about pH?
    a. The pH of a solution increases as its acidity increases.
    b. The pH of a basic or alkaline solution is less than that of an acidic solution.
    c. As the concentration of H^+ increases in a solution, the pH decreases.
    d. A solution to which HCl has been added will have a greater pH than a solution to which NaOH has

been added.

e. Each number on the pH scale represents an increase of 10^8.

ANSWER: c

61. Increased atmospheric CO_2 has led to drastic changes in ocean water because CO_2 is soluble in water. Which statement is false?

a. The carbonic acid (H_2CO_3) formed due to the interaction between water (H_2O) and CO_2 increases the acidity of the water.

b. The pH of ocean water has decreased from 8.25 to 8.14 over the past 250 years.

c. The ratio of H^+:OH^- has decreased since the 18th century.

d. The carbonic acid (H_2CO_3) formed due to the interaction between water (H_2O) and CO_2 releases H^+ into the ocean water.

e. Ocean water is less acidic than pure water.

ANSWER: c

62. Describe the three types of particles that comprise all atoms in terms of charge, mass, and location within the atom.

ANSWER: The nucleus of an atom contains the positively charged protons and the neutrally charged neutrons, both of which have significant mass. The negatively charged electrons are present outside of the nucleus. Electrons have almost no mass.

63. How many electrons can an atom potentially hold in its first two shells? Describe how the number of electrons in each shell can affect an atom's stability.

ANSWER: The first shell has a capacity of two electrons. The second shell can hold up to eight electrons. An atom becomes less reactive and more stable when its outermost shell is filled with electrons; it will neither react nor combine with other atoms. If there are vacancies in the outermost shell, however, the atom is likely to interact with other atoms, giving, taking, or sharing electrons.

64. How is a hydrogen bond like an ionic bond? How are they different?

ANSWER: Both hydrogen bonds and ionic bonds involve an interaction between a positively charged atom and a negatively charged atom. However, in the case of an ionic bond, these atoms have full electrical charges, and in the case of a hydrogen bond, they have only partial electrical charges. As a result, hydrogen bonds are weaker and more easily broken than ionic bonds.

65. How is a fishing spider able to walk on water?

ANSWER: Water has the unique property of cohesion, and the V-shaped molecules are held together by hydrogen bonds. The bonds are just strong enough to give water a surface tension with net-like properties. This allows the fishing spider to walk on water.

66. Why does table salt quickly dissolve when placed in water?

ANSWER: Table salt dissolves in water, meaning that the sodium and chloride ions that were ionically bound together become separated from one another. This occurs because water is able to pull them apart due to its charge and polarity. The positively charged sodium ions are attracted to the negatively

charged side of the water molecule, and the negatively charged chloride ions are attracted to the positively charged side. Water surrounds each ion, dissolving the table salt.

67. What is the normal pH of blood? What happens when blood gets too acidic or too basic?

ANSWER: The normal pH of blood is 7.4. When blood becomes too acidic or too basic, buffers in the body stabilize the pH by absorbing or releasing hydrogen ions. When the blood is too acidic, a buffer absorbs excess hydrogen ions, and when the blood becomes too basic, a buffer releases hydrogen ions to return the pH to normal.

68. What is radioactivity? Outline what happens when uranium-238 breaks down.

ANSWER: Radioactivity refers to the fact that in the process of decomposition, certain atoms release, at a constant rate, a tiny, high-speed particle that carries a lot of energy. The particle can be a proton, neutron, or electron, or just energy may be released. For instance, when uranium-238 breaks down, it spontaneously loses a particle containing 2 protons and 2 neutrons, turning it into thorium-234. Thorium is also radioactive and decays into another radioactive element, until finally producing the stable element lead.

69. Explain the differences among ionic, covalent, and hydrogen bonds, and give an example of each type.

ANSWER: The student should explain the properties of each type of bond, giving the key characteristics of each. For ionic, some key elements would be that the bond occurs because atoms gain or lose electrons, forming negative or positive ions, and because opposites attract, the ions stay together. For covalent, key elements include that this bond is stronger than the ionic bond because the atoms share a pair of electrons and those electrons orbit around both nuclei. Covalent bonds also can occur with atoms sharing two pairs or even three pairs of electrons, and additional shared pairs of electrons make the bond between the atoms even stronger. For hydrogen bonds, key elements include that this type of bond occurs as a result of an unequal sharing of electrons in a covalently bonded molecule. These molecules are said to be “polar.” Because the electrons are shared unequally, the molecule itself has a slight negative charge at one end and a slight positive charge at the other, thus causing adjacent molecules to line up positive to negative. A good example of this type of bond occurs in water and, even though this is by far the weakest of the three types of bonds, it is responsible for most of the structure and function of organic molecules.

70. Explain the properties of H_2O and how these properties make H_2O important for living systems.

ANSWER: In answering this question, the student should list and describe the following properties of water: cohesion, large heat capacity, low density as a solid, and good solvent. After each description, the student can give an example to illustrate how this property of water makes it important in living systems. For example, cohesion of water molecules to each other because of hydrogen bonds allows trees to draw water up from the ground to great heights because the adjacent water molecules in effect pull each other up. Water has a large heat capacity because, as you heat it, the hydrogen bonds first break and re-form before the actual movement of the molecules increases, so the temperature of the water takes a long time to increase. This is important for the absorption of heat from metabolic processes. The low density of water is also due to hydrogen bonding and causes water molecules to pack closer together as they get colder, which is why ice floats and lakes don’t freeze all the way to the bottom, which would kill the occupants. The good-solvent property of water enables it to dissolve important ionic compounds because of its own polar charges and

carry them to cells where they are needed.