

Student name: _____

1) Which of the following is a way that isotopes are useful in medicine? Check all that apply.

A) Radioactive isotopes can be used as tracers to detect molecular changes or to destroy abnormal or infectious cells.

B) Radioactive isotopes can be used to regenerate damaged tissues.

C) Radioactive isotopes can be used to detect Alzheimer's disease.

D) Radioactive isotopes can be used to sterilize medical equipment.

E) Radioactive isotopes can be used to protect against dangerous biological agents.

2) Given the chemical equation: $6\text{CO}_2 + 6\text{H}_2\text{O} + \text{light} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$, identify which of the following statements are correct. Check all that apply.

A) CO_2 is a reactant

B) H_2O is a product

C) $\text{C}_6\text{H}_{12}\text{O}_6$ is both a reactant and a product

D) O_2 is a product.

E) There is not enough information to distinguish the reactants from the products.

3) Which of the following properties of water involve hydrogen bonds? Check all that apply

A) cohesion

B) high heat capacity

C) surface tension

D) polarity
E) water expands as it freezes

4) Which of the following would be considered a trace element in living things?

A) oxygen

- B) carbon
- C) hydrogen

- D) nitrogen
- E) zinc

5) Which one of the following is the smallest unit of matter that has all the properties of an element?

- A) molecule
- B) proton

- C) atom
- D) compound
- E) electron

6) Which of the following statements about atoms is correct?

- A) An element may be composed of several types of atoms.
- B) The nucleus of an atom contains protons and electrons.
- C) The number and arrangement of electrons in an atom governs its chemical activity.

- D) The positive charges of an element are carried by the electrons.
- E) The neutral charges of an element are carried by the protons.

7) Isotopes of an element differ in their

- A) proton number.
- B) electron number.
- C) neutron number.

- D) type of bonds.
- E) atomic number.

8) An atom's valence electron shell

- A) is filled when it has three electrons.
- B) determines its chemical reactivity.
- C) determines its atomic mass.

- D) is filled with positively charged particles.
- E) is filled

identically for every element.

9) An atom that has an electrical charge is called a(n)

- A) ion.
- B) molecule.

- C) isotope.
- D) element.
- E) proton.

10) A covalent bond occurs when

- A) protons are transferred from one atom to another.
- B) neutrons are shared between two atoms to form an isotope.
- C) electrons are shared between two atoms to complete their octets.

- D) the hydrogen of one water molecule is attracted to the oxygen of another water molecule.
- E) electrons are transferred from one atom to another.

11) The type of bond that would form from the transfer of an electron from one atom to another is a(n) _____ bond.

- A) covalent
- B) ionic

- C) hydrogen
- D) atomic
- E) isotopic

12) When a sodium atom transfers an electron to a chlorine atom

- A) the sodium atom becomes a positively charged ion.
- B) the chlorine atom becomes a negatively charged ion.
- C) the positive and negative ions will attract each other, forming a crystal if no water is present.

- D) the ions will separate in the presence of water.
- E) All of the above statements are correct.

13) Which of the following is a molecule?

- A) H_2O
- B) O_2

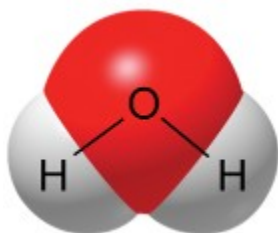
- C) NaCl
- D) CO_2
- E) MgCl_2

14) Glucose, $\text{C}_6\text{H}_{12}\text{O}_6$, is best described as a(n)

- A) element.
- B) isotope.

- C) compound.
- D) ion.
- E) atom.

15) A water molecule, as shown here, is polar because of

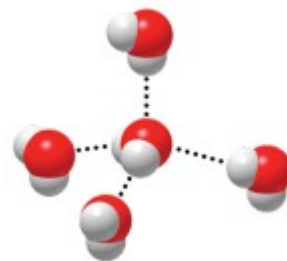


- A) the transfer of electrons.
- B) unequal sharing of electrons.
- C) its ability to freeze.

- D) its hydrogen bonds.
- E) the negative charge of the molecule.

16) The figure below is depicting the interaction of water molecules with one another. The weak attractions between

water molecules are known as



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

- D) positive and negative ions.
- E) no chemical bonding.

17) Which of the following is a property of water?

- A) water is a good solvent
- B) water is cohesive
- C) water has a high heat capacity
- D) water can be found as a solid, liquid, or gas

- E) All of the above are properties of water.

18) Which of the following statements about basic solutions is true?

- A) Basic solutions have high concentrations of H^+ .
- B) Basic solutions have a pH under 7.
- C) Basic solutions release OH^- .

- D) Basic solutions release both H^+ and OH^- .
- E) Basic solutions have a neutral pH.

19) The pH scale is a mathematical indicator of the

- A) concentration of H^+ present in a solution.
- B) concentration of OH^- present in a solution.
- C) total amount of all ions in a solution.

- D) ability of a

solution to buffer.

E) ability to dissolve in water.

20) After drinking a great deal of coffee (pH 5), a human's blood buffering system would need to _____ as the coffee was digested to lower the level of acid present in the blood stream.

- A) release OH^-
- B) take up H^+
- C) release H^+

- D) take up OH^-
- E) release OH^-
and take up H^+

21) A(n) _____ can be defined as a substance that keeps pH within established limits by taking up excess H^+ or OH^- in a solution.

- A) equalizer
- B) solute

- C) buffer
- D) acid
- E) base

22) Which of the following would be an example of the value of water's heat capacity?

- A) Water is able to travel up a 100-foot tree.
- B) Water expands as it freezes causing ice to float on the surface of a lake.
- C) Living organisms are able to maintain their internal body temperatures because the water in their cells

resists changes in temperature.

- D) Small insects can walk on water.
- E) Water molecules stick together.

23) Which property of water causes sugar to dissolve in coffee?

- A) Water has high heat capacity.
- B) Water is less dense than ice.
- C) Water is a good solvent.
- D) Water is cohesive.

E) Water is able to change from a gas to a solid.

24) When water boils

- A) hydrogen bonds are broken between neighboring water molecules.
- B) covalent bonds are broken between oxygen and hydrogen atoms.
- C) ionic bonds are broken when the minerals in water are heated.
- D) the bond between one water molecule and another

becomes stronger.

E) the hydrogen atoms break away from the oxygen and escape as vapor.

25) Which of the following property of water helps an individual who is exercising vigorously maintain a constant body temperature?

- A) Water has high heat capacity.
- B) Water is less dense than ice.
- C) Water is a good solvent.

D) Water molecules are cohesive.

E) Water molecules are adhesive.

26) Although Oregon and South Dakota are at similar latitudes, winters in Oregon are warmer and summers in Oregon are cooler. Which of the following might explain these differences between the climate of Oregon and the climate of South Dakota?

- A) South Dakota has fewer trees.
- B) The Pacific Ocean makes Oregon temperatures more moderate.

C) Oregon receives more rainfall.

D) South Dakota has fewer lakes and rivers.

E) South Dakota has more prevailing winds from the west.

27) How does a strong acid differ from a weak acid?

- A) A strong acid contains fewer H^+ in solution.
- B) A weak acid dissociates only partially in water.
- C) A strong acid is less likely to remain dissociated.
- D) A weak acid dissociates nearly completely in

water.

E) A strong acid dissociates only partly in water.

28) Heartburn occurs when stomach acid escapes the stomach and burns the tissues of the esophagus. Baking soda is sometimes used as an antacid. How does baking soda help

relieve symptoms of heartburn?

A) The baking soda is serving as a buffer to take up excess H^+ ions from stomach acid.

water into the esophagus thereby diluting the acid.

B) The baking soda is able to coat the lining of the esophagus thereby protecting it from the acid.

E) The baking soda relaxes the stomach muscles.

C) The baking soda increases the acidity of the stomach.

D) The baking soda releases salt which draws more

29) What do lemons, tomatoes, and coffee all have in common chemically?

A) They all produce OH^- ions in solution, making them bases.

D) They are all neutral in pH.

B) They all produce H^+ ions in solution, making them acids.

E) They are all slippery to the touch.

C) They all are fruits.

- A) Water can move up a 100-foot pine tree, from the roots to the leaves.
- B) A rock skipping across the surface of a lake.
- C) Water requires a great deal of heat to reach the point of vaporizing.
- D) A can of soda bursts when it is placed in the

freezer.

E) A large body of fresh water takes a long time to warm up after the winter season.

31) Cola has a pH of 3.5. This means that it has an excess of _____ ions and would be called a(n) _____.

- A) H^+ ; acid
- B) OH^- ; acid
- C) H^+ ; base

D) OH^- ; base
E) H^+ ; neutral
solution

32) Isotopes of an atom differ in their

- A) atomic number.
- B) atomic mass.
- C) number of electrons.

D) atomic radius.
E) number of
protons.

33) Which of the following is a property of acids?

- A) Acids have a sharp or sour taste.
- B) Acids feel slippery when touched.
- C) Acids taste bitter.
- D) Acids release OH^- when dissolved in a liquid.

E) Acids have a
pH reading above 7.0.

34) An element has an atomic number of 88. The number of protons and electrons in a neutral atom of the element are

- A) 176 protons and 88 electrons.
- B) 44 protons and 44 electrons.

C) 0 protons and
88 electrons.
D) 88 protons and

88 electrons.

E) 88 protons and 44 electrons.

35) All atoms of the same element have the same

A) number of neutrons.

B) atomic number.

C) number of electrons.

D) atomic mass.

E) number of ions.

36) In what ways are radioactive isotopes potentially harmful?

A) Unmonitored release into the environment can make changes in a cell's DNA.

B) They are used to trace molecular changes.

C) They are used to destroy abnormal cells.

D) They are used to determine the age of biological

specimens.

E) They are used to trace the path of materials throughout the body.

37) The number of neutrons present in the nucleus of an average atom of any given element is best estimated by

A) adding the number of electrons and protons together.

B) subtracting the number of electrons from the number of protons.

C) adding the mass number to the number of electrons.

D) subtracting the number of protons from the mass number.

E) adding the atomic number and atomic mass together.

38) An atom with a neutral charge has

A) equal numbers of neutrons and electrons.

B) more neutrons making it more neutral.

C) the same number of protons and neutrons.

- D) equal numbers of protons and electrons.
- E) more protons than it does electrons.

39) The atomic structure of water satisfies the octet rule by having

- A) electrons shared between the two oxygen atoms.
- B) electrons from hydrogen transferred to the oxygen atom.
- C) electrons from oxygen transferred to the hydrogen atoms.

D) oxygen share electrons with two hydrogen atoms.

E) electrons shared between the two hydrogen atoms.

40) In the reaction $6\text{CO}_2 + 6\text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$ carbon dioxide is one of the

- A) reactants.
- B) products.

C) enzymes.

D) elements.

E) ions.

41) Cells need buffering agents in order to

- A) speed up chemical reactions.
- B) carry out life functions in extremely acidic conditions.
- C) minimize the changes in pH of their internal environment.

D) help transfer electrons from one atom to another.

E) increase the amount of OH^- in their surroundings.

42) Which of the following is a way in which chemical bonds can be formed?

- A) sharing electrons
- B) losing electrons
- C) gaining electrons
- D) attracting opposite charges

E) All of the answers describe ways that chemical bonds can be formed.

43) Sulfur has an atomic number of 16. How many valence shell electrons does it have?

- A) One
- B) Two

- C) Three
- D) Four
- E) Six

44) Some insects can stride on the surface of water because water

- A) has a high specific heat.
- B) has lower density when frozen.
- C) is a good solvent.

D) has surface tension.

E) resists temperature changes.

45) The pH of pure water is _____ because _____.

- A) 7.0; water contains an equal number of H^+ ions and OH^- ions
- B) 14.0; water contains more OH^- ions than H^+ ions.
- C) 1.0; water contains more H^+ ions than OH^- ions.

D) 7.0; there are no ions formed in pure water

E) 5; because pure water lacks minerals.

46) Which of the following best describes the structure of how water molecules form?

- A) Hydrogen atoms covalently bond with each other

to create one stable valence shell of electrons. The

hydrogen molecule then forms a hydrogen bond with an oxygen atom to create the water molecule.

B) One oxygen atom transfers an electron to each of two hydrogen atoms, forming an ionic bond.

C) The oxygen atom and hydrogen atoms form a covalent bond with one another to create stable valence shells of electrons. The electrons are shared unequally resulting in a polar molecule.

D) Hydrogen bonds are formed between the two hydrogen atoms and the oxygen atom.

E) Because of its strong electronegativity,

oxygen removes one electron from two different hydrogen atoms. This satisfies the valence shell of oxygen. Then hydrogen bonds form between the two hydrogen atoms which keeps them in the vicinity of the oxygen atom.

47) The subatomic particles that are found in the nucleus of an atom are the

A) protons and electrons.

B) neutrons and protons.

C) electrons only.

D) protons only.

E) electrons and neutrons.

48) The reactivity of an atom depends on the number of

A) protons.

B) neutrons.

C) protons plus neutrons.

D) valence

electrons.

E) protons and

electrons.

49) Chemical bonds involve

A) the giving and taking of electrons.

B) the giving and taking of protons.

C) the giving, taking, or sharing of electrons.

D) the giving, taking, or sharing of protons.

E) the sharing of electrons.

A) 2 in the inner electron shell, 8 in the second electron shell, and 8 in the outer electron shell.

B) 8 in the inner electron shell, 8 in the second electron shell, and 2 in the outer electron shell.

C) 6 in the inner electron shell, 6 in the second electron shell, and 6 in the outer electron shell.

D) 5 in the inner electron shell, 6 in the second

electron shell, and 7 in the outer electron shell.

E) 7 in the inner electron shell, 6 in the second electron shell, and 5 in the outer electron shell.

51) An ionic bond forms when

A) an atom gives away or takes in an electron.

B) an atom gives away or takes in a proton.

C) a negatively charged ion is attracted to one with a positive charge.

D) two atoms come close enough to share one or

more electrons.

E) two atoms come close enough to share one or more protons.

52) A covalent bond involves the sharing of

A) neutrons.

B) protons.

C) pairs of protons.

D) at least three electrons.

E) pairs of electrons.

53) Positron-emission tomography (PET) is an example of how ions are useful in medicine.

☐ true

☐ false

54) Both radioactive isotopes and stable isotopes contain the same number of electrons and protons.

☐ true

☐ false

55) When a positively charged hydrogen in a water molecule become attracted to thenegatively charged oxygen in a nearby water molecule, this is called a ionic bond.

☐ true

☐ false

Answer Key

Test name: Essentials of Biology Chapter 02

1) [A, C, D, E]

Radioactive isotopes can be used for everything list above except regenerating damaged tissue.

2) [A, D]

In the equation $6\text{CO}_2 + 6\text{H}_2\text{O} + \text{light} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$, everything to the left of the arrow (CO_2 , H_2O) is a reactant and everything to the right of the arrow is a product

($\text{C}_6\text{H}_{12}\text{O}_6$, O_2).

3) [A, B, C, E]

Hydrogen bonds are involved in all the properties of water except polarity. Polarity is due to the unequal sharing of electrons in the

covalent bonds holding the water molecule together.

4) E

Four elements, carbon, hydrogen, nitrogen, and oxygen, make up about 96% of the body weight of most organisms. A number of elements, including minerals such as zinc and

chromium, are found at very low, or trace, levels.

5) C

Elements are comprised of one kind of atom. These atoms all have the same atomic number, which means they all have the same number of protons. Molecules have more than

one atom present and compounds are composed of two or more different types

of elements. Therefore, neither molecules nor compounds are in their simplest form.

6) C

An atom is comprised of subatomic particles. Protons are positively charged, electrons are negatively charged and neutrons have no charge (they are neutral). The neutrons and protons are located in the atomic nucleus and contribute to the majority of an atom's mass.

The electrons, which orbit the nucleus, are negatively charged and govern the element's reactivity.

7) C

Isotopes are atoms of the same element that differ in the number of neutrons. They have the same number of protons, but because they have different numbers of neutrons, they have

different mass numbers.

8) B

Atoms (except for hydrogen) with fewer than eight electrons in the outer shell react with other atoms in such a way that each has a

completed outer shell after the reaction.

9) A

When an atom either loses or gains electrons in a reaction, the resulting atom now bears an overall net charge. An atom with an positive

or negative charge is called an ion.

10) C

A covalent bond results when two atoms share electrons in order to have a completed outer shell (octet).

11) B

An ionic bond forms when two atoms are held together by the attraction between opposite charges. An ionic bond occurs when one atom gives up electrons (and becomes positively

charged) and another atom gains the electrons (and becomes positively charged).

12) E

Ionic bonds are formed when two atoms are held together by an attraction between ions. Sodium transfers a negatively charged electron over to chlorine. The result is sodium having a positive charge (Na^+) and chlorine now having a negative charge (Cl^-). These ions have an attraction that creates the ionic bond that holds them together. Ionic

compounds are often found as salts, solid substances that usually separate and exist as individual ions in water.

13) B

A group of atoms bonded together is called a molecule. When a molecule contains atoms of

more than one element, it can be called a compound.

14) C

The glucose molecule is a compound made up of three different elements.

15) B

Atoms differ in their affinity for electrons in a covalent bond (electronegativity). Oxygen is more electronegative than hydrogen. Consequently, the shared electrons spend more time near the oxygen nucleus than the hydrogen nuclei. This gives the oxygen a slight negative charge and the hydrogen

atom a slight positive charge. This unequal sharing of electrons makes it a polar molecule.

16) B

The positive hydrogen forms a hydrogen bond with the negative oxygen from a nearby molecule. No electron transfer or sharing is occurring in this type of bond. It is a weak

attraction between polar molecules.

17) E

Water has four key properties that support life: solvency, cohesion, surface tension, high heat

capacity, and varying density.

18) C

Basic solutions either take up hydrogen ions (H^+) or release hydroxide ions (OH^-) and

have a pH higher than 7.

19) A

pH indicates the number of hydrogen ions in a solution. It is used to indicate the acidity or

basicity of a solution.

20) B

Human physiologic pH should be 7.4. Coffee acidifies the blood. To maintain homeostasis, buffers would take up the excess H^+ returning

the blood pH to normal.

21) C

A buffer is a chemical that serves to neutralize an acid or a base in solution. Buffers help to resist pH changes because they can take up

excess hydrogen ions (H^+) or hydroxide ions (OH^-).

22) C

Water has the ability to absorb heat without greatly changing in temperature. Because the temperature of water rises and falls slowly,

organisms are better able to maintain their normal internal

temperatures and are also protected from rapid temperature changes.

23) C

The polarity of water makes it a good solvent. The water forms hydrogen bonds with the

sugar promoting its ability to dissolve in the coffee.

24) A

Hydrogen bonds link water molecules together. As they absorb heat, the bonds begin to break causing water to enter into a gaseous

state and evaporate into the environment.

25) A

Water has a high heat capacity. Blood plasma is primarily comprised of water, which provides the ability to moderate temperature changes even under rigorous exercise. This feature of water allows organisms to better

maintain their internal temperatures.

26) B

Because of water's high heat capacity and high heat of vaporization, temperatures along the Earth's coasts are moderate. During the summer, the ocean absorbs and stores solar

heat, and during the winter, the ocean releases it slowly.

27) B

A strong acid, such as HCL, dissociates nearly completely in water. A weak acid dissociates only partially.

28) A

Baking soda acts as a buffer and takes up the excess hydrogen ions (H^+) in the esophagus and stomach. This helps to relieve the

symptoms of heartburn.

29) B

Acidic solutions have a sour taste and are often associated with indigestion. Lemons, tomatoes and coffee are all acidic substances

that dissociate in water, releasing hydrogen ions (H^+).

30) A

Cohesion refers to the ability of water molecules to cling to each other due to hydrogen bonding. Within the long narrow vessels of a plant, water molecules cling to each other and form a long chain that stretches from the roots to the leaves. When one water

evaporates from the leaves, is immediately replaced with the water molecules below it.

31) A

A pH below 7 is acidic. In this case the acid from the cola dissociates in water, releasing

hydrogen ions to the solution.

32) B

Isotopes are atoms of the same element that differ in the number of neutrons. They have the same number of protons, but they have

different mass numbers.

33) A

Acids have a sharp sour taste, a pH below 7.0,

and release

hydrogen ions in water. Bases have a bitter taste, feel slippery, a pH above 7.0, and

release hydroxide ions when dissolved in water.

34) D

The number of protons an element has is called the atomic number. In a neutral atom, there are the same number of protons and electrons. Protons carry a positive charge. Because neutral atoms have no charge, there

must be an equal number of negative charges (electrons).

35) B

The number of protons an element has is called the atomic number and is constant for all atoms of an element. In a neutral atom, there are the same number of protons and electrons, while the number of neutrons can vary creating what are known as isotopes and

consequently producing varying atomic mass.

36) A

Radioactive isotopes are important in biology and medicine. They can be used to trace molecular changes, destroy abnormal cells, and play a significant role in the ability to determine the age of biological specimens. Their danger comes in their unmonitored release into the environment, where they can

make changes in cells, damage DNA, cause cancer, or at their worst be lethal.

37) D

To determine the usual number of neutrons,

subtract the number

of protons from the mass number.

38) D

The number of protons an element has is called the atomic number. In a neutral atom, there are the same number of protons and electrons, while the number of neutrons can

vary creating what are known as isotopes.

39) D

Two hydrogen atoms share their lone electrons by way of a covalent bond with an oxygen atom. By this sharing, oxygen completes its octet, and hydrogen atoms' outer

shell is complete with two electrons.

40) A

The reactants are the molecules that participate in the reaction and are shown on the left side of the reaction arrow. The products are the molecules that are formed by

the reaction and are shown on the right.

41) C

Living organisms need to be kept within narrow pH ranges in order to maintain homeostasis. A buffer is able to keep pH within their normal limits by taking up excess

hydrogen ions (H^+) or hydroxide ions (OH^-) in solution.

42) E

Compounds and molecules are formed when atoms form either ionic or covalent bonds. These two result from either the sharing of outer shell electrons or the transfer of the

electrons from one atom to another.

43) E

Sulfur has two electrons in the first shell, eight electrons in the second shell, leaving six

electrons in its outer valence shell.

44) D

Because the water molecules at the surface are more strongly attracted to each other than to the air above, water molecules at the surface cling so tightly to each other (surface tension)

that some insects (and even one type of lizard) can walk on water.

45) A

A pH of 7 represents a neutral state in which the hydrogen ion and hydroxide ion concentrations are equal, as in pure water.

46) C

In a water molecule, the oxygen atom and hydrogen atoms form a covalent bond with one another to create stable valence shells of electrons. The oxygen is more electronegative than hydrogen. Consequently the shared electrons spend more time near the oxygen

nucleus than the hydrogen nuclei. This unequal sharing of electrons make it a polar molecule.

47) B

An atom is comprised of subatomic particles. Protons and neutrons are located in the nucleus of the atom while the electrons orbit around the nucleus.

48) D

The bonds between different atoms arise from the giving, taking, or sharing of the electrons in the outer energy level (valence electrons).

49) C

As atoms give, take, or share electrons so that the valence level of the atom is full, they form

bonds with the other atom(s) involved in the exchange.

50) A

With 18 electrons, argon has all three electron levels filled. The most that the one closest to the nucleus can hold is 2, the most that the

second one can hold is 8, and the final one can also hold 8 at most.

51) C

Ions form when an atom gives away or takes in an electron. An ionic bond forms when two

oppositely charged ions attract.

52) E

In order to form covalent bonds each atom must contribute an equal number of electrons.

Therefore, electrons are shared in pairs.

53) FALSE

Positron-emission tomography (PET) is an example of how isotopes are useful in medicine. Isotopes are atoms of the same element that differ in the number of neutrons while ions are electrically charged atoms that

have gained or lost electrons.

54) TRUE

It is true that both radioactive isotopes and stable isotopes contain the same number of electrons and protons. They differ however, in

their numbers of neutrons.

55) FALSE

When a positively charged hydrogen in a water molecule become attracted to thenegatively charged oxygen in a nearby

water molecule, this is called a hydrogen bond.