Essentials of Biology 5th edition Mader Test Bank

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Chapter 02: Test Bank

Student: _____

1. Which of the following is not one of the most common elements in living things?

   A. oxygen
   B. carbon
   C. calcium
   D. iron
   E. nitrogen

2. 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

3. Elements differ from each other in their

   A. physical properties only.
   B. atomic number only.
   C. type of subatomic particles.
   D. physical properties and atomic number.
   E. type of electrons.

4. Regarding atoms, identify which statement below 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.

5. Isotopes of an element differ in their

   A. proton number.
   B. electron number.
   C. neutron number.
   D. type of bonds.
   E. atomic number.

6. 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.

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

   A. ion.
   B. molecule.
   C. isotope.
   D. element.
   E. proton.

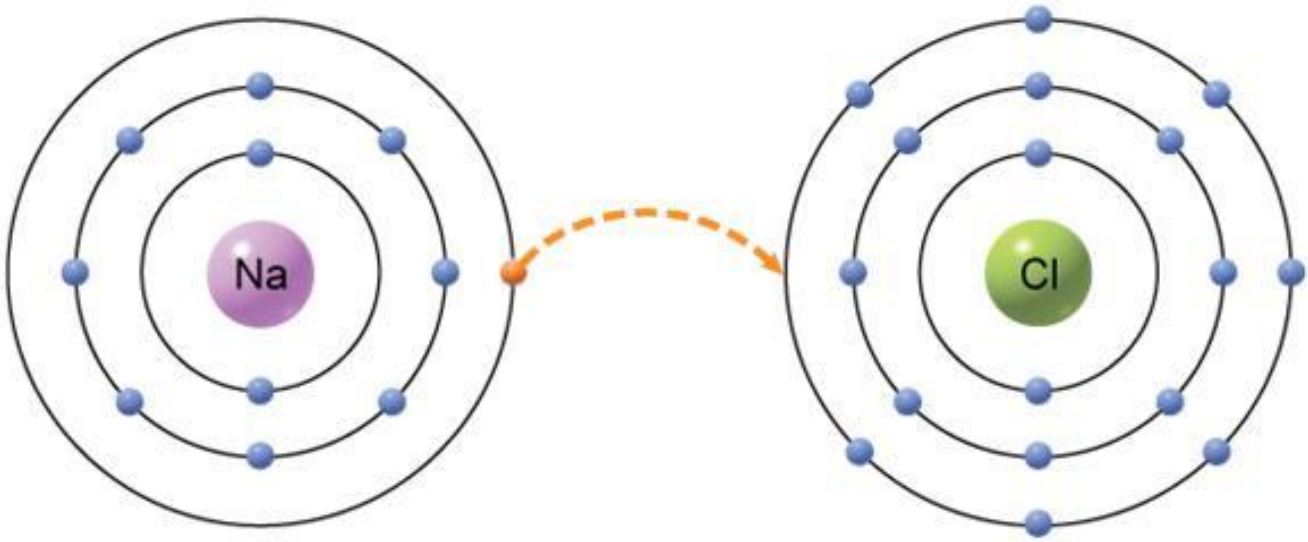
8. A covalent bond occurs when

   A. protons are transferred from one atom to another.

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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.

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



A. covalent
B. ionic
C. hydrogen
D. atomic
E. isotopic

10. Which of these does not occur when a sodium atom transfers an electron to a chlorine atom?

A. The sodium atom becomes a positively charged ion.
B. The positive and negative ions will attract each other, forming a crystal if no water is present.
C. The ions will separate in the presence of water.
D. There is a mutual sharing of the electrons between the sodium and chlorine atoms.
E. The chlorine atom becomes a negatively charged ion.

11. Which of the following is not a compound?

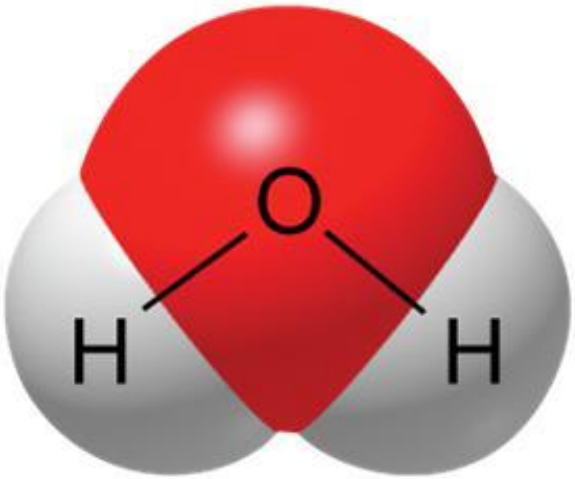
A. H_2O
B. O^{2-}
C. NaCl
D. CO_2
E. $MgCl_2$

12. Glucose, $C_6H_{12}O_6$, is best described as a(n)

A. element.
B. isotope.
C. compound.
D. ion.
E. atom.

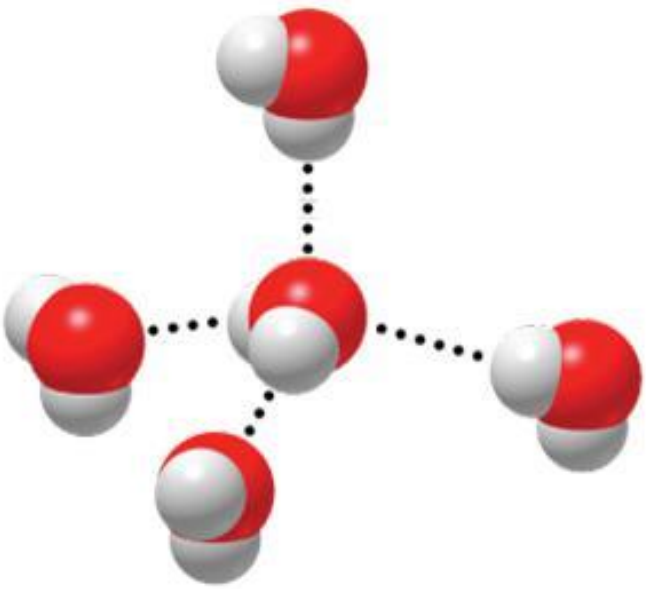
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13. A water molecule, as shown here, is polar because of



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.

14. The figure below is depicting the interaction of water molecules with one another, which involves the use of



A. covalent bonds.
B. hydrogen bonds.
C. ionic bonds.
D. postive and negative ions.
E. no chemical bonding.

15. Which of the following is not a property of water?

A. It is a good solvent.
B. It is denser when frozen than when liquid.
C. It is cohesive.
D. It resists temperature changes.
E. It can be found as a solid, liquid, or gas.

16. Bases can

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A. release only hydrogen ions.
B. take up only hydrogen ions.
C. release only hydroxide ions.
D. both take up hydrogen ions and release hydroxide ions.
E. release hydrogen and release hydroxide.

17. 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.

18. 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^+

19. A(n) _____ can be defined as a substance that prevents the pH of a solution from changing by either releasing or absorbing H^+ in a solution.

A. equalizer
B. solute
C. buffer
D. acid
E. base

20. 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. Ice cubes float.

21. Which property of water causes sugar to dissolve in coffee?

A. Hydrogen bonds are broken between neighboring water molecules.
B. Water is less dense than ice.
C. Water is a good solvent.
D. Water is cohesive.
E. Water is able to change states.

22. Which of the following explains the events occurring 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 is strengthened.
E. The hydrogen atoms break away from the oxygen and escape as vapor.

23. What is the steam being given off when water boils?

A. oxygen molecules
B. hydrogen molecules
C. water molecules
D. hydroxide (OH^-) ions
E. hydrogen (H^+) ions

24. Which property of water would help to account for how an individual who is exercising and producing excessive heat can maintain a constant body temperature?

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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 molecules form by covalent bonding.

25. 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.

26. 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.

27. Baking soda is sometimes used as an antacid. The chemical name for baking soda is sodium bicarbonate. What is the bicarbonate doing to help with stomach upset?

A. It is serving as a buffer to take up excess H^+ ions from stomach acid.
B. It is able to coat the stomach lining.
C. The bicarbonate helps to create more acid in the stomach.
D. The bicarbonate acts as a strong acid quickly dissociating into H^+ ions.
E. It relaxes the stomach muscles.

28. What do lemons, tomatoes, and coffee all have in common chemically?

A. They are all foods that people consume.
B. They all produce H^+ ions in solution, making them acids.
C. They all are fruits.
D. They all taste bitter.
E. They are all slippery to the touch.

29. Of the following examples, which best demonstrates the property of water cohesion?

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.

30. 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

31. Isotopes of an atom differ in their

A. atomic number.
B. atomic mass.
C. number of electrons.
D. atomic radius.
E. number of protons.

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32. Which of the following is a property of acids?

A. release hydrogen ions when dissolved in a liquid
B. feel slippery when touched
C. taste bitter
D. release hydroxide ions when dissolved in a liquid
E. have a pH reading above 7.0

33. Use the following terms to match the statements provided.

1. The smallest particle of an element that retains the properties of that element	Ion ___
2. Their number in an atom is the atomic number of the element	Atom ___
3. Created when an atom either loses or gains electrons in a reaction, resulting in an overall net charge	Electrons ___
4. Their number and arrangement determine which chemical reactions an element can take part in	Protons ___
5. Their numbers will vary in isotopes of the same element	Neutrons ___

34. An element has an atomic number of 78. The number of protons and electrons in a neutral atom of the element are

A. 156 protons and 78 electrons.
B. 39 protons and 39 electrons.
C. 78 protons and 0 electrons.
D. 78 protons and 78 electrons.
E. 78 protons and 39 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

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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. Which of the following would not be a valuable use for radioactive isotopes?

A. carbon-14 dating
B. destroying abnormal cells as a type of cancer treatment
C. tracing the path of various chemicals in the body for imaging
D. determining the age of biological specimens
E. damaging DNA of healthy cells

41. In the reaction $6CO2 + 6H2OC6H12O6 + 6O2$ carbon dioxide is one of the

A. reactants.
B. products.
C. enzymes.
D. elements.
E. catalysts.

42. Why do cells need buffering agents?

A. to minimize the changes in pH of their internal environment
B. to operate at a constant pH of 2.0
C. to carry out life functions in extremely acidic conditions
D. to help transfer electrons from one atom to another
E. to increase the amount of OH^- in their surroundings

43. Which of the following is not a way in which chemical bonds can be formed?

A. sharing electrons
B. losing electrons
C. splitting electrons
D. gaining electrons
E. attracting opposite charges

44. Sulfur has an atomic number of 16. What would be the valence number of this element?

A. One
B. Two
C. Three
D. Four
E. Six

45. 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.

46. The pH of pure water is _____ because _____.

A. 7.0; water dissociates an equal number of H^+ ions and OH^- ions
B. 14.0; water dissociates and more OH^- ions are formed because there are more hydrogen atoms in water
C. 1.0; water dissociates and more H^+ ions are formed since hydrogen is smaller and can separate from the oxygen easily
D. 7.0; there are no ions formed in pure water
E. acidic; there are more H^+ ions than OH^- ions present

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47. Which of the following best describes the structure of how water molecules form and interact?

A. Hydrogen atoms bond with each other to create a stable outer shell of electrons. Then they form a hydrogen bond to an oxygen atom to create the water molecule.
B. Oxygen atoms transfer one electron to each of the hydrogen atoms, forming an ionic bond that attracts other water molecules to it.
C. The oxygen atom and hydrogen atoms form a covalent bond with one another to create stable outer shells of electrons. The electrons are shared unequally resulting in a polar molecule whose slight charges form weak hydrogen bond attractions with other water molecules.
D. Hydrogen bonds are formed between the two hydrogen atoms and the oxygen atom. This water molecule then forms a covalent bond with adjacent water molecules.
E. The oxygen atom is more electronegative than the two hydrogen atoms. Due to this, it removes the electron from each hydrogen atom. This satisfies the outer shell of oxygen. Then hydrogen bonds form between the two remaining hydrogen atoms to hold them near to the oxygen atom.

48. 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.

49. Radioactive isotopes are useful in biological studies because

A. an organism will take in a molecule with the isotope and use it normally, but the radioactive decay can be detected.
B. an organism will take in a molecule with the isotope but will only use it in a few specific reactions, not the normal ones.
C. an organism will take in the molecule with the isotope and then remove the isotope by sending it through the . excretory system, while replacing the isotope with a normal atom.
D. they are easily visible and normal atoms are not.
E. they are easy and inexpensive to use in studies.

50. The reactivity of an atom depends on the number of

A. protons.
B. neutrons.
C. electrons.
D. valence electrons.
E. protons and neutrons in the nucleus.

51. 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.

52. The electron arrangement for argon, which has 18 electrons, is

A. 2 in the inner energy shell, 8 in the second energy shell, and 8 in the outer energy shell.
B. 8 in the inner energy shell, 8 in the second energy shell, and 2 in the outer energy shell.
C. 6 in the inner energy shell, 6 in the second energy shell, and 6 in the outer energy shell.
D. 5 in the inner energy shell, 6 in the second energy shell, and 7 in the outer energy shell.
E. 7 in the inner energy shell, 6 in the second energy shell, and 5 in the outer energy shell.

53. Inside a living cell, which type of bond would be the most stable?

A. hydrogen
B. ionic
C. covalent
D. polar

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E. all bonds are equally stable in a living system

54. 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.

55. A covalent bond involves the sharing of

A. electrons.
B. protons.
C. pairs of protons.
D. at least three electrons.
E. pairs of electrons.

56. Which of the following describes how an acid disrupts the chemical bonds of molecules in a cell?

A. The H^+ ions can disrupt hydrogen bonds as the slightly negative portion of the molecule is more attracted to H^+ ions than to the hydrogen that was part of the bond.
B. The H^+ ions can disrupt hydrogen bonds as the slightly positive portion of the molecule is more attracted to H^+ ions than to the hydrogen that was part of the bond.
C. The OH^- ions can disrupt hydrogen bonds as the slightly positive portion of the molecule is more attracted to H^+ ions than to the hydrogen that was part of the bond.
D. The OH^- ions can disrupt hydrogen bonds as the slightly negative portion of the molecule is more attracted to H^+ ions than to the hydrogen that was part of the bond.
E. The H^+ ions disrupt the covalent bonds that hold the molecule together.

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Chapter 02: Test Bank Key

1. Which of the following is not one of the most common elements in living things?

   A. oxygen
   B. carbon
   C. calcium
   D. iron
   E. nitrogen

   Six elements of matter make up the majority of body weight of most organisms. Their presence and properties are essential to the uniqueness of living things.

   Blooms Level: 1. Remember
   Learning Outcome: 02.01.01 Distinguish among the types, locations, and charges of subatomic particles.
   Section: 02.01
   Topic: Atomic Structure

2. 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

   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.

   Blooms Level: 1. Remember
   Learning Outcome: 02.01.01 Distinguish among the types, locations, and charges of subatomic particles.
   Section: 02.01
   Topic: Atomic Structure

3. Elements differ from each other in their

   A. physical properties only.
   B. atomic number only.
   C. type of subatomic particles.
   D. physical properties and atomic number.
   E. type of electrons.

   The number of protons in an element creates its atomic number. Different elements will have different numbers of these particles and thus different atomic numbers. However, all elements have the same type of subatomic particles— protons, neutrons, and electrons.

   Blooms Level: 2. Understand
   Learning Outcome: 02.01.01 Distinguish among the types, locations, and charges of subatomic particles.
   Section: 02.01
   Topic: Atomic Structure

4. Regarding atoms, identify which statement below 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.

   An atom is comprised of subatomic particles. The protons bear a positive charge and are found in the nucleus; their number creates the atomic number assigned to that element. The neutrons are found in the nucleus as well and with the protons create the majority of an atom's mass. The electrons bear a negative charge and govern the element's reactivity.

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Blooms Level: 2. Understand
Learning Outcome: 02.01.01 Distinguish among the types, locations, and charges of subatomic particles.
Section: 02.01
Topic: Atomic Structure

5. Isotopes of an element differ in their

A. proton number.
B. electron number.
C. neutron number.
D. type of bonds.
E. atomic number.

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.

Blooms Level: 1. Remember
Learning Outcome: 02.01.01 Distinguish among the types, locations, and charges of subatomic particles.
Section: 02.01
Topic: Atomic Structure

6. 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.

Atoms 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.

Blooms Level: 2. Understand
Learning Outcome: 02.01.02 Relate how the arrangement of electrons determines an element's reactivity.
Section: 02.01
Topic: Atomic Structure
Topic: Chemical Reactions

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

A. ion.
B. molecule.
C. isotope.
D. element.
E. proton.

When an atom either loses or gains electrons in a reaction, the resulting atom now bears an overall net charge. This state is called an ion.

Blooms Level: 1. Remember
Learning Outcome: 02.01.01 Distinguish among the types, locations, and charges of subatomic particles.
Section: 02.01
Topic: Atomic Structure
Topic: Chemical Reactions

8. A covalent bond occurs when

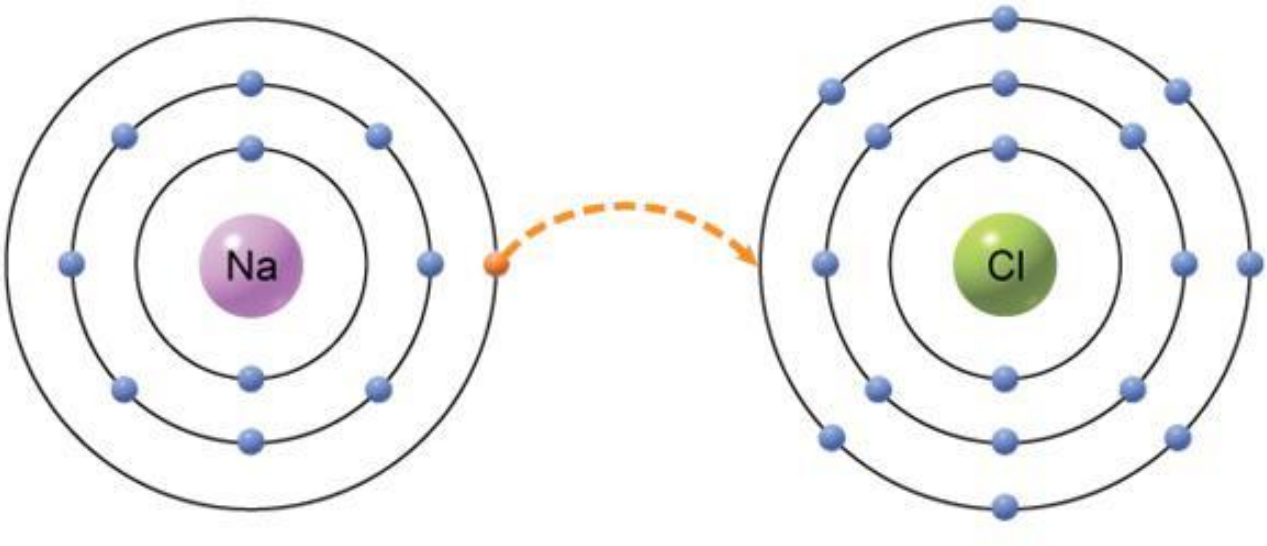
A. protons are transferred from one atom to another.
B. neutrons are shared between two atoms to form an isotope.
C. electrons are shared between two atoms to complete their octets.
D. the hydrogen of one water molecule is attracted to the oxygen of another water molecule.
E. electrons are transferred from one atom to another.

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

Blooms Level: 2. Understand
Learning Outcome: 02.01.04 Contrast ionic and covalent bonds.
Section: 02.01
Topic: Chemical Bonds

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



A. covalent
B. ionic
C. hydrogen
D. atomic
E. isotopic

Ionic bonds are formed when two atoms are held together by an attraction between opposite charges. In this diagram, sodium is transferring 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.

Blooms Level: 2. Understand
Figure: 02.07a
Learning Outcome: 02.01.04 Contrast ionic and covalent bonds.
Section: 02.01
Topic: Chemical Bonds

10. Which of these does not occur when a sodium atom transfers an electron to a chlorine atom?

A. The sodium atom becomes a positively charged ion.
B. The positive and negative ions will attract each other, forming a crystal if no water is present.
C. The ions will separate in the presence of water.
D. There is a mutual sharing of the electrons between the sodium and chlorine atoms.
E. The chlorine atom becomes a negatively charged ion.

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.

Blooms Level: 2. Understand
Learning Outcome: 02.01.04 Contrast ionic and covalent bonds.
Section: 02.01
Topic: Chemical Bonds

11. Which of the following is not a compound?

A. H_2O
B. O^{-2}
C. NaCl
D. CO_2

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E. $MgCl_2$

Only when a molecule contains atoms of more than one element can it be called a compound.

Blooms Level: 3. Apply
Learning Outcome: 02.01.04 Contrast ionic and covalent bonds.
Section: 02.01
Topic: Chemical Bonds

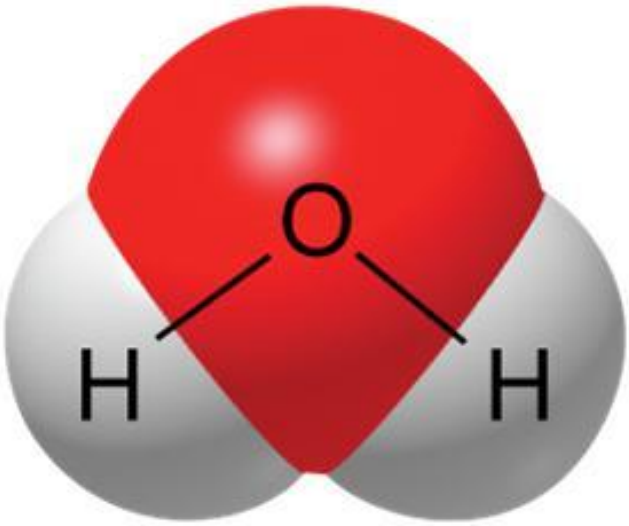
12. Glucose, $C_6H_{12}O_6$, is best described as a(n)

A. element.
B. isotope.
C. compound.
D. ion.
E. atom.

The presence of three different kinds of elements— carbon, hydrogen, and oxygen— determine that it is not an element. An isotope is a unique type of single element that has a varied number of neutrons. An ion is a charged atom. The glucose molecule is a compound made up of more than one element.

Blooms Level: 2. Understand
Learning Outcome: 02.01.04 Contrast ionic and covalent bonds.
Section: 02.01
Topic: Chemical Bonds

13. A water molecule, as shown here, is polar because of



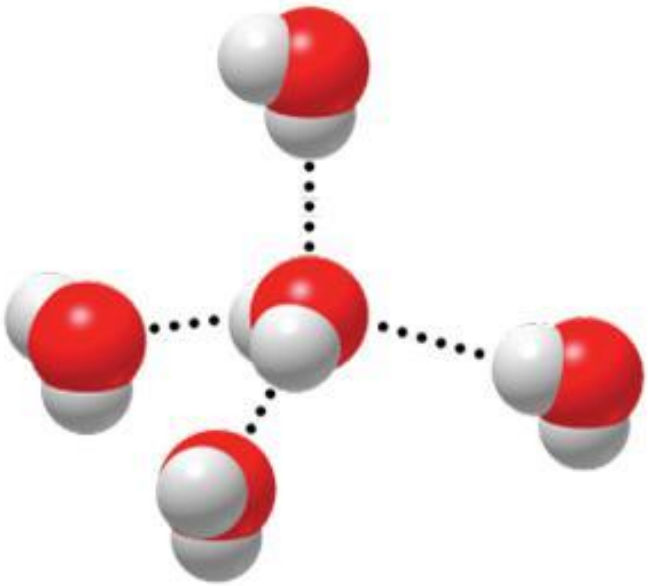
A. the transfer of electrons.
B. unequal sharing of electrons.
C. its ability to freeze.
D. its hydrogen bonds.
E. the negative charge of the molecule.

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 unequal sharing of electrons makes it a polar molecule.

Blooms Level: 2. Understand
Figure: 02.09a
Learning Outcome: 02.02.01 Describe the general structure of a water molecule.
Section: 02.02
Topic: Properties of Water

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14. The figure below is depicting the interaction of water molecules with one another, which involves the use of



A. covalent bonds.
B. hydrogen bonds.
C. ionic bonds.
D. postive and negative ions.
E. no chemical bonding.

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.

Blooms Level: 2. Understand
Figure: 02.09b
Learning Outcome: 02.02.01 Describe the general structure of a water molecule.
Section: 02.02
Topic: Properties of Water

15. Which of the following is not a property of water?

A. It is a good solvent.
B. It is denser when frozen than when liquid.
C. It is cohesive.
D. It resists temperature changes.
E. It can be found as a solid, liquid, or gas.

Water has four key properties that support life: solvency, cohesion, surface tension, high heat capacity, and varying density.

Blooms Level: 1. Remember
Learning Outcome: 02.02.02 List the properties of water that are important to life.
Section: 02.02
Topic: Properties of Water

16. Bases can

A. release only hydrogen ions.
B. take up only hydrogen ions.
C. release only hydroxide ions.
D. both take up hydrogen ions and release hydroxide ions.
E. release hydrogen and release hydroxide.

Bases are substances that either take up hydrogen ions (H^+) or release hydroxide ions (OH^-).

Blooms Level: 2. Understand
Learning Outcome: 02.03.01 Distinguish between an acid and a base.
Section: 02.03
Topic: Acids and Bases

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17. 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.

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

Blooms Level: 2. Understand
Learning Outcome: 02.03.02 Interpret the pH scale.
Section: 02.03
Topic: Acids and Bases

18. 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^+

A pH below 7 is acidic. In this case the acid dissociates in water, releasing hydrogen ions to the solution.

Blooms Level: 3. Apply
Learning Outcome: 02.03.03 Explain the purpose of a buffer.
Section: 02.03
Topic: Acids and Bases

19. A(n) _____ can be defined as a substance that prevents the pH of a solution from changing by either releasing or absorbing H^+ in a solution.

A. equalizer
B. solute
C. buffer
D. acid
E. base

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 ion (H^+) or hydroxide ion (OH^-).

Blooms Level: 1. Remember
Learning Outcome: 02.03.03 Explain the purpose of a buffer.
Section: 02.03
Topic: Acids and Bases

20. 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. Ice cubes float.

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.

Blooms Level: 4. Analyze
Learning Outcome: 02.02.02 List the properties of water that are important to life.
Section: 02.02
Topic: Properties of Water

21. Which property of water causes sugar to dissolve in coffee?

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A. Hydrogen bonds are broken between neighboring water molecules.
B. Water is less dense than ice.
C. Water is a good solvent.
D. Water is cohesive.
E. Water is able to change states.

The polarity of water makes it a good solvent. The water forms H bonds with the sugar promoting its ability to dissolve in the coffee.

Blooms Level: 1. Remember
Learning Outcome: 02.02.02 List the properties of water that are important to life.
Section: 02.02
Topic: Properties of Water

22. Which of the following explains the events occurring 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 is strengthened.
E. The hydrogen atoms break away from the oxygen and escape as vapor.

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.

Blooms Level: 2. Understand
Learning Outcome: 02.02.02 List the properties of water that are important to life.
Section: 02.02
Topic: Chemical Bonds
Topic: Properties of Water

23. What is the steam being given off when water boils?

A. oxygen molecules
B. hydrogen molecules
C. water molecules
D. hydroxide (OH^-) ions
E. hydrogen (H^+) ions

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.

Blooms Level: 2. Understand
Learning Outcome: 02.02.01 Describe the general structure of a water molecule.
Section: 02.02
Topic: Properties of Water

24. Which property of water would help to account for how an individual who is exercising and producing excessive heat can 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 is cohesive.
E. Water molecules form by covalent bonding.

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.

Blooms Level: 2. Understand
Learning Outcome: 02.02.02 List the properties of water that are important to life.
Section: 02.02
Topic: Properties of Water

25. 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?

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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.

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.

Blooms Level: 3. Apply
Learning Outcome: 02.02.02 List the properties of water that are important to life.
Section: 02.02
Topic: Properties of Water

26. 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.

A strong acid dissociates nearly completely in water. A weak acid dissociates only partially. Since a strong acid dissociates nearly completely, the concentration of hydrogen (H^+) is said to have a higher acidity.

Blooms Level: 3. Apply
Learning Outcome: 02.03.01 Distinguish between an acid and a base.
Section: 02.03
Topic: Acids and Bases

27. Baking soda is sometimes used as an antacid. The chemical name for baking soda is sodium bicarbonate. What is the bicarbonate doing to help with stomach upset?

A. It is serving as a buffer to take up excess H^+ ions from stomach acid.
B. It is able to coat the stomach lining.
C. The bicarbonate helps to create more acid in the stomach.
D. The bicarbonate acts as a strong acid quickly dissociating into H^+ ions.
E. It relaxes the stomach muscles.

Bicarbonate acts as a buffer reforming carbonic acid. This takes up the excess hydrogen ions (H^+) in the stomach, lowering the acidity of the stomach acid.

Blooms Level: 3. Apply
Learning Outcome: 02.03.03 Explain the purpose of a buffer.
Section: 02.03
Topic: Acids and Bases

28. What do lemons, tomatoes, and coffee all have in common chemically?

A. They are all foods that people consume.
B. They all produce H^+ ions in solution, making them acids.
C. They all are fruits.
D. They all taste bitter.
E. They are all slippery to the touch.

Acidic solutions have a sour taste and are often associated with indigestion. These are all acidic substances that dissociate in water, releasing hydrogen ions (H^+).

Blooms Level: 1. Remember
Learning Outcome: 02.03.01 Distinguish between an acid and a base.
Section: 02.03
Topic: Acids and Bases

29. Of the following examples, which best demonstrates the property of water cohesion?

A. Water can move up a 100-foot pine tree, from the roots to the leaves.

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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.

Cohesion refers to the ability of water molecules to cling to each other due to hydrogen bonding. Water evaporating from the leaves is immediately replaced with water molecules below it pulling a column of water up from the roots.

Blooms Level: 2. Understand
Learning Outcome: 02.02.02 List the properties of water that are important to life.
Section: 02.02
Topic: Properties of Water

30. 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

A pH below 7 is acidic. In this case the acid dissociates in water, releasing hydrogen ions to the solution.

Blooms Level: 3. Apply
Learning Outcome: 02.03.02 Interpret the pH scale.
Section: 02.03
Topic: Acids and Bases

31. Isotopes of an atom differ in their

A. atomic number.
B. atomic mass.
C. number of electrons.
D. atomic radius.
E. number of protons.

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.

Blooms Level: 2. Understand
Learning Outcome: 02.01.01 Distinguish among the types, locations, and charges of subatomic particles.
Section: 02.01
Topic: Atomic Structure

32. Which of the following is a property of acids?

A. release hydrogen ions when dissolved in a liquid
B. feel slippery when touched
C. taste bitter
D. release hydroxide ions when dissolved in a liquid
E. have a pH reading above 7.0

Acids have a sharp sour taste, pH below 7.0, and release hydrogen ions in water. Bases have a bitter taste, feel slippery, pH above 7.0, and release hydroxide ions when dissolved in water.

Blooms Level: 2. Understand
Learning Outcome: 02.03.01 Distinguish between an acid and a base.
Section: 02.03
Topic: Acids and Bases

33. Use the following terms to match the statements provided.

1. The smallest particle of an element that retains the properties of that element	Ion **3**
2. Their number in an atom is the atomic number of the element	Atom **1**
3. Created when an atom either loses or gains electrons in a reaction, resulting in an overall net charge	Electrons **4**

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4. Their number and arrangement determine which chemical reactions an element can take part in — Protons **2**

5. Their numbers will vary in isotopes of the same element — Neutrons **5**

Blooms Level: 2. Understand
Learning Outcome: 02.01.01 Distinguish among the types, locations, and charges of subatomic particles.
Section: 02.01
Topic: Atomic Structure

34. An element has an atomic number of 78. The number of protons and electrons in a neutral atom of the element are

A. 156 protons and 78 electrons.
B. 39 protons and 39 electrons.
C. 78 protons and 0 electrons.
D. 78 protons and 78 electrons.
E. 78 protons and 39 electrons.

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).

Blooms Level: 2. Understand
Learning Outcome: 02.01.01 Distinguish among the types, locations, and charges of subatomic particles.
Section: 02.01
Topic: Atomic Structure

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.

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.

Blooms Level: 1. Remember
Learning Outcome: 02.01.01 Distinguish among the types, locations, and charges of subatomic particles.
Section: 02.01
Topic: Atomic Structure

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.

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.

Blooms Level: 2. Understand
Learning Outcome: 02.01.03 Explain how isotopes are useful in the study of biology.
Section: 02.01
Topic: Chemical Reactions

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.

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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.

To determine the usual number of neutrons, subtract the number of protons from the mass number.

Blooms Level: 2. Understand
Learning Outcome: 02.01.01 Distinguish among the types, locations, and charges of subatomic particles.
Section: 02.01
Topic: Atomic Structure

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.

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.

Blooms Level: 1. Remember
Learning Outcome: 02.01.01 Distinguish among the types, locations, and charges of subatomic particles.
Section: 02.01
Topic: Atomic Structure

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.

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.

Blooms Level: 3. Apply
Learning Outcome: 02.01.02 Relate how the arrangement of electrons determines an element's reactivity.
Learning Outcome: 02.02.01 Describe the general structure of a water molecule.
Section: 02.01
Topic: Atomic Structure
Topic: Properties of Water

40. Which of the following would not be a valuable use for radioactive isotopes?

A. carbon-14 dating
B. destroying abnormal cells as a type of cancer treatment
C. tracing the path of various chemicals in the body for imaging
D. determining the age of biological specimens
E. damaging DNA of healthy cells

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.

Blooms Level: 2. Understand
Learning Outcome: 02.01.03 Explain how isotopes are useful in the study of biology.
Section: 02.01
Topic: Chemical Reactions

41. In the reaction $6CO_2 + 6H_2O C_6H_{12}O_6 + 6O_2$ carbon dioxide is one of the

A. reactants.
B. products.
C. enzymes.

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D. elements.
E. catalysts.

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.

Blooms Level: 2. Understand
Learning Outcome: 02.01.05 Identify the reactants and products in a chemical equation.
Section: 02.01
Topic: Chemical Reactions

42. Why do cells need buffering agents?

A. to minimize the changes in pH of their internal environment
B. to operate at a constant pH of 2.0
C. to carry out life functions in extremely acidic conditions
D. to help transfer electrons from one atom to another
E. to increase the amount of OH^- in their surroundings

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.

Blooms Level: 2. Understand
Learning Outcome: 02.03.03 Explain the purpose of a buffer.
Section: 02.03
Topic: Acids and Bases

43. Which of the following is not a way in which chemical bonds can be formed?

A. sharing electrons
B. losing electrons
C. splitting electrons
D. gaining electrons
E. attracting opposite charges

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.

Blooms Level: 2. Understand
Learning Outcome: 02.01.04 Contrast ionic and covalent bonds.
Section: 02.01
Topic: Chemical Reactions

44. Sulfur has an atomic number of 16. What would be the valence number of this element?

A. One
B. Two
C. Three
D. Four
E. Six

Sulfur has two electrons in the first shell, eight electrons in the second shell, leaving six electrons in its outer valence shell and consequently a valence number of two.

Blooms Level: 1. Remember
Learning Outcome: 02.01.02 Relate how the arrangement of electrons determines an element's reactivity.
Section: 02.01
Topic: Atomic Structure

45. 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.

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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 tightly to each other (surface tension). The hydrogen bonds between water molecules create the property of cohesion that makes it possible to have this high surface tension.

Blooms Level: 2. Understand
Learning Outcome: 02.02.02 List the properties of water that are important to life.
Section: 02.02
Topic: Properties of Water

46. The pH of pure water is _____ because _____.

A. 7.0; water dissociates an equal number of H^+ ions and OH^- ions
B. 14.0; water dissociates and more OH^- ions are formed because there are more hydrogen atoms in water
C. 1.0; water dissociates and more H^+ ions are formed since hydrogen is smaller and can separate from the oxygen easily
D. 7.0; there are no ions formed in pure water
E. acidic; there are more H^+ ions than OH^- ions present

Water's pH is 7.0. This is due to the fact that water dissociates an equal number of hydrogen (H^+) ions and hydroxide (OH^-) ions.

Blooms Level: 2. Understand
Learning Outcome: 02.03.02 Interpret the pH scale.
Section: 02.03
Topic: Acids and Bases
Topic: Properties of Water

47. Which of the following best describes the structure of how water molecules form and interact?

A. Hydrogen atoms bond with each other to create a stable outer shell of electrons. Then they form a hydrogen bond to an oxygen atom to create the water molecule.
B. Oxygen atoms transfer one electron to each of the hydrogen atoms, forming an ionic bond that attracts other water molecules to it.
C. The oxygen atom and hydrogen atoms form a covalent bond with one another to create stable outer shells of electrons. The electrons are shared unequally resulting in a polar molecule whose slight charges form weak hydrogen bond attractions with other water molecules.
D. Hydrogen bonds are formed between the two hydrogen atoms and the oxygen atom. This water molecule then forms a covalent bond with adjacent water molecules.
E. The oxygen atom is more electronegative than the two hydrogen atoms. Due to this, it removes the electron from each hydrogen atom. This satisfies the outer shell of oxygen. Then hydrogen bonds form between the two remaining hydrogen atoms to hold them near to the oxygen atom.

In a water molecule, the oxygen atom and hydrogen atoms form a covalent bond with one another to create stable outer 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. With this polarity, water molecules form weak attractions called hydrogen bonds. These create qualities of water that include the following: solvency, cohesion, surface tension, high heat capacity, and varying density.

Blooms Level: 1. Remember
Learning Outcome: 02.02.01 Describe the general structure of a water molecule.
Section: 02.02
Topic: Properties of Water

48. 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.

An atom is comprised of subatomic particles. The protons bear a positive charge and are found in the nucleus; their number creates the atomic number assigned to that element. The neutrons are found in the nucleus as well and with the protons create the majority of an atom's mass. The electrons bear a negative charge and govern the element's reactivity.

Blooms Level: 1. Remember
Learning Outcome: 02.01.01 Distinguish among the types, locations, and charges of subatomic particles.
Section: 02.01
Topic: Atomic Structure

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49. Radioactive isotopes are useful in biological studies because

A. an organism will take in a molecule with the isotope and use it normally, but the radioactive decay can be detected.
B. an organism will take in a molecule with the isotope but will only use it in a few specific reactions, not the normal ones.
C . an organism will take in the molecule with the isotope and then remove the isotope by sending it through the excretory system, while replacing the isotope with a normal atom.
D. they are easily visible and normal atoms are not.
E. they are easy and inexpensive to use in studies.

The number of neutrons does not influence the chemical reactivity of the atom, so they will form the same molecules, which allows living organisms to take them in and use them as they would normally. It is also possible to trace the atom through the processes that occur in the organism.

Blooms Level: 2. Understand
Learning Outcome: 02.01.03 Explain how isotopes are useful in the study of biology.
Section: 02.01
Topic: Atomic Structure

50. The reactivity of an atom depends on the number of

A. protons.
B. neutrons.
C. electrons.
D. valence electrons.
E. protons and neutrons in the nucleus.

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

Blooms Level: 2. Understand
Learning Outcome: 02.01.02 Relate how the arrangement of electrons determines an element's reactivity.
Section: 02.01
Topic: Atomic Structure
Topic: Chemical Bonds

51. 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.

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.

Blooms Level: 2. Understand
Learning Outcome: 02.01.02 Relate how the arrangement of electrons determines an element's reactivity.
Section: 02.01
Topic: Chemical Bonds

52. The electron arrangement for argon, which has 18 electrons, is

A. 2 in the inner energy shell, 8 in the second energy shell, and 8 in the outer energy shell.
B. 8 in the inner energy shell, 8 in the second energy shell, and 2 in the outer energy shell.
C. 6 in the inner energy shell, 6 in the second energy shell, and 6 in the outer energy shell.
D. 5 in the inner energy shell, 6 in the second energy shell, and 7 in the outer energy shell.
E. 7 in the inner energy shell, 6 in the second energy shell, and 5 in the outer energy shell.

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.

Blooms Level: 3. Apply
Learning Outcome: 02.01.02 Relate how the arrangement of electrons determines an element's reactivity.

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Section: 02.01
Topic: Atomic Structure

53. Inside a living cell, which type of bond would be the most stable?

A. hydrogen
B. ionic
C. covalent
D. polar
E. all bonds are equally stable in a living system

The interior of a living cell is an aqueous solution and the water molecules are capable of disrupting hydrogen and ionic bonds. The only bonds that are not affected by water's polarity are covalent bonds.

Blooms Level: 3. Apply
Learning Outcome: 02.01.04 Contrast ionic and covalent bonds.
Section: 02.01
Topic: Chemical Bonds

54. 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.

Ions form when an atom gives away or takes in an electron, but the actual bond does not form until the charged atoms ate attracted to one another.

Blooms Level: 2. Understand
Learning Outcome: 02.01.04 Contrast ionic and covalent bonds.
Section: 02.01
Topic: Chemical Bonds

55. A covalent bond involves the sharing of

A. electrons.
B. protons.
C. pairs of protons.
D. at least three electrons.
E. pairs of electrons.

In order to form covalent bonds each atom must contribute an equal number of electrons so, electrons are shared in pairs.

Blooms Level: 2. Understand
Learning Outcome: 02.01.04 Contrast ionic and covalent bonds.
Section: 02.01
Topic: Chemical Bonds

56. Which of the following describes how an acid disrupts the chemical bonds of molecules in a cell?

A. The H^+ ions can disrupt hydrogen bonds as the slightly negative portion of the molecule is more attracted to H^+ ions than to the hydrogen that was part of the bond.
B. The H^+ ions can disrupt hydrogen bonds as the slightly positive portion of the molecule is more attracted to H^+ ions than to the hydrogen that was part of the bond.
C. The OH^- ions can disrupt hydrogen bonds as the slightly positive portion of the molecule is more attracted to H^+ ions than to the hydrogen that was part of the bond.
D. The OH^- ions can disrupt hydrogen bonds as the slightly negative portion of the molecule is more attracted to H^+ ions than to the hydrogen that was part of the bond.
E. The H^+ ions disrupt the covalent bonds that hold the molecule together.

The positive charge of the H^+ ion is stronger than the slight positive charge of a hydrogen atom in a hydrogen bond and can, therefore, break the hydrogen bond as the slightly negative part of the polar molecule is attracted to it.

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Chapter 02: Test Bank Summary

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Learning Outcome: 02.02.02 List the properties of water that are important to life.	8
Learning Outcome: 02.03.01 Distinguish between an acid and a base.	5
Learning Outcome: 02.03.02 Interpret the pH scale.	3
Learning Outcome: 02.03.03 Explain the purpose of a buffer.	4
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