

Chapter 2 The Chemical Basis of Life

Multiple Choice Questions

1. Which of the following is not one of the most common elements in living things?
 - A. carbon
 - B. oxygen
 - C. hydrogen
 - 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. element
 - 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 outermost 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.

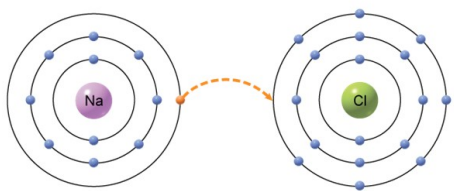
7. An atom that has an electrical charge is called a(n)

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

8. A covalent bond occurs when _____.

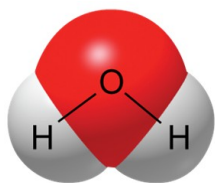
- A. protons are transferred from one atom to another
- B. neutrons are shared between two atoms to form an isotope
- C. electrons are shared between two atoms to complete their octets
- D. the hydrogen of one water molecule is attracted to the oxygen of another water molecule
- E. electrons are transferred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

9. The type of bond that would form from the transfer of an electron from one atom to another, as depicted in the figure, is a



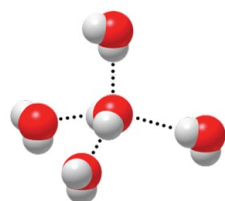
- A. covalent.
B. ionic.
C. hydrogen.
D. atomic.
E. isotope.
10. Which of these does not occur when a sodium atom transfers an electron to a chlorine atom?
- A. The sodium atom becomes a positively charged ion.
B. The positive and negative ions will attract each other, forming a crystal if no water is present.
C. The ions will separate in the presence of water.
D. There is a 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, $\text{C}_6\text{H}_{12}\text{O}_6$, is best described as a(n) _____.
- A. element
B. isotope
C. compound
D. ion
E. charged atom

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



- A. transfer of electrons
- B. unequal sharing of electrons
- C. its ability to freeze
- D. its hydrogen bonds
- E. its change in density when frozen

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. valence shells
- E. solvents

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 _____.

- 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 _____.
- A. the concentration of H^+ present in a solution
 - B. the concentration of OH^- present in a solution
 - C. the total amount of all ions in a solution
 - D. the ability of a solution to buffer
 - E. the 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. The term to describe any substance which can prevent the pH of a solution from changing by either releasing or absorbing H^+ in a solution is
- 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 better able to maintain their internal body temperature because the temperature of their environment changes very slowly.
 - D. Small insects can walk on water.
 - E. Ice cubes float.
21. What property of water causes sugar to dissolve in coffee?
- A. Water has high heat capacity.
 - B. Water is less dense as 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 neighbor 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^+) ion
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 as ice.
 - C. Water is a good solvent.
 - D. Water is cohesive.
 - E. Water molecules form by covalent bonding.
25. If average temperatures from South Dakota were compared to temperatures from Oregon it would show that Oregon has warmer winters and cooler summers than South Dakota does. Account for why this could be when they are at similar latitudes?
- A. South Dakota has less 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 do a strong acid and a weak acid differ?
- A. A strong acid has less 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^+ ion 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^+ ion.
 - E. It relaxes the stomach muscles.
28. Which of the following is not a contributing event in the formation of acid rain?
- A. Fossil fuels consume oxygen removing it from the atmosphere.
 - B. Coal & oil emit sulfur dioxide and nitrogen oxide when they are burned.
 - C. Fossil fuel emission gases combine with water in the atmosphere.
 - D. A solution of sulfuric acid and nitric acid forms.
 - E. Precipitation containing sulfuric acid and nitric acid fall to the Earth.
29. What do lemons, tomatoes, and coffee all have in common chemically?
- A. They are all foods that people consume.
 - B. They all produce (H^+) in solution, making them acids.
 - C. They all are fruits.
 - D. They all taste bitter.
 - E. They are all slippery to the touch.
30. 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 soda can 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. When hot chocolate mix is added to water the hot chocolate is the _____ and the water is the _____.
- A. solvent; solute
 - B. molecule; compound
 - C. solute; solvent
 - D. compound; molecule
 - E. element; compound

32. A coke 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

33. Isotopes of an atom differ in their

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

34.

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

Matching Questions

35.

Use the following terms to match the statements provided.

1. Their
number and
arrangement
determine
which
chemical
reactions an
element can
take part in

Ion ____

2. Their
number in an
atom is the
atomic number
of the element

Atom ____

3. The
smallest
particle of an
element that
retains the
properties of
that element

Electron ____

4. Their
numbers will
vary in
isotopes of the
same element

Proton ____

5. Created
when an atom
either loses or
gains
electrons in a
reaction,
resulting in an
overall net
charge

Neutron ____

Multiple Choice Questions

36.

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.

37.

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.

- 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 through out the body.

39.

The number of neutrons in the nucleus of an average atom of an element is best estimated by

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40.

Students were studying properties of water. One student placed a cup containing 80 mL of water in a freezer. Another student placed an identical cup containing 40 mL of water in the same freezer. Which of the following will be the same for both cups of water?

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41.

Engineers design city sidewalks using blocks of concrete separated by a small gap to prevent them from cracking. What property of water is being taken into account for this design? Water

A. is a
good
solvent.

B. is
less
dense
when
it is
frozen.

C. is
cohesive.

D. is
resistant
to
temperature
changes.

E. has
a
high
heat
capacity.

42.

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. mor

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43.

The atomic structure of water satisfies the octet rule by

A. having
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atoms.

B. having
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from
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transferred
to
the
oxygen
atom.

C. having
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44.

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

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45. 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 _____.

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B. pro
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46.

Why do cells need buffering agents?

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47.

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. attractions of opposite charges

48.

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

49.

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.

50.

The pH of pure water is _____ because

_____.

A. 7.0;
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dissociates
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51.

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

- A. Hydrogen atoms bond with each other to create stable outer electron shells of electrons. The way they form a hydrogen bond to an oxygen atom to create the water molecule.
- B. Oxy

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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 bonds

attractions with other water molecules.

D. Hydrogen bonds are formed between the two hydrogen atoms and the oxygen atom. This water molecule than forms a covalent bond with

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52.

The particles that are found in the nucleus of an atom are the

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- B. neu
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- C. ele
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- D. prot
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- E. ele
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53.

Which of these is a property of isotopes that make it useful in cell biology?

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55.

The reactivity of an atom depends on

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- 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.

ns.

57.

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

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58.

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

- A. hyd
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- B. ioni
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- C. cov
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- D. pol
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- E. all
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59.

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

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60.

A covalent bond involves the sharing of

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- B. prot
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- C. pair
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- D. at
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61.

Which of the following describe how an acid disrupts the chemical bonds of molecules in a cell?

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disrupt hydrogen bonds as the slightly positive portion of the molecule is more attracted to it than to the hydrogen that was part of the bond.

C. the OH^- ions can disrupt hydrogen bonds as the slight

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62.

You are caring for the freshwater aquarium of a friend while they are on vacation. You are told to check the pH of the tank and make sure that it stays between 6.5 and 7.0. When you check the water the pH is 8.0. The water in the tank is

A. 1 to 1.5 times more basic than it should be.

B. 1 to 1.5 times more acidic than it should be.

C. 10 to 15 times more basic than it should be.

D. 10 to 15 times more acidic

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E. 100
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63.

You are caring for the freshwater aquarium of a friend while they are on vacation. You are told to check the pH of the tank and make sure that it stays between 6.5 and 7.0. In order to assure that you do not have to worry about the pH you

A. treat
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fish
and
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B. add
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s in
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C. add
HCl
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that
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cha
nge
s in
the
tan
k's
pH.

D. do
not
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Chapter 2 The Chemical Basis of Life **Key**

Multiple Choice Questions

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

- A. carbon
- B. oxygen
- C. hydrogen
- 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.

Bloom's Level: 1. Remember
Learning Outcome: 02.01.01 Distinguish among the types, location, and charge of subatomic particles.
Mader - Chapter 02 #1
Section: 02.01
Topic: Chemistry

2.

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

- A. molecule
- B. element
- C. atom**
- D. compound
- E. electron

Elements are comprised of one kind of atom. These atoms all bear the same atomic number having a characteristic number of sub atomic particles that govern the properties of that element. Molecules have more than one atom present, so they are not in their simplest form. Compounds are comprised of two or more different elements.

Bloom's Level: 1. Remember
Learning Outcome: 02.01.01 Distinguish among the types, location, and charge of subatomic particles.
Mader - Chapter 02 #2
Section: 02.01
Topic: Chemistry

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, those being protons, neutrons and 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

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

5. Isotopes of an element differ in their _____.

- A. prot
on
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er
- B. ele
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n
nu
mb
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- C. neu
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nu
mb
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- D. typ
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ds
- E. ato
mic
nu
mb
er

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.

6.

An atom's outermost electron shell

A. is
filled
with
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

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The negatively charged electrons are so small that their mass is negligible to the overall mass of the atom. 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.

Bloom's Level: 2. Understand
Learning Outcome: 02.01.01 Distinguish among the types, location, and charge of subatomic particles.
Mader - Chapter 02 #6
Section: 02.01
Topic: Chemistry

7.

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

- A. ion.
- B. mol
ecu
le.
- C. isot
ope
.
- D. ele
me
nt.
- E. prot
on.

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.

Bloom's Level: 1. Remember
Learning Outcome: 02.01.01 Distinguish among the types, location, and charge of subatomic particles.
Mader - Chapter 02 #7
Section: 02.01
Topic: Chemistry

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

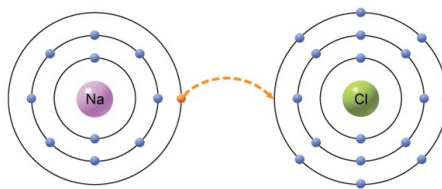
C. electrons are shared between two atoms to complete their octet

- ets
- D. the
hyd
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- E. ele
ctro
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A covalent bond results when two atoms share electrons in order to have a completed outer shell (octet).

9.

The type of bond that would form from the transfer of an electron from one atom to another, as depicted in the figure, is a



- 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.

Bloom's Level: 2. Understand

Figure: 02.07a

Learning Outcome: 02.01.04 Contrast ionic and covalent bonds.

Mader - Chapter 02 #9

Section: 02.01

Topic: Chemistry

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.

arated in the presence of water.

D. There is a 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.

Bloom's Level: 3. Apply
Learning Outcome: 02.01.04 Contrast ionic and covalent bonds.
Mader - Chapter 02 #10
Section: 02.01
Topic: Chemistry

11. Which of the following is NOT a compound?

- A. H_2
O
- B. O_2**
- C. Na
Cl
- D. CO
²
- E. Mg
 Cl_2

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

Bloom's Level: 3. Apply
Learning Outcome: 02.01.05 Relate how bonding leads to the formation of molecules and compounds.
Mader - Chapter 02 #11
Section: 02.01
Topic: Chemistry

12.

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

- A. element
- B. isotope
- C. compound**
- D. ion
- E. charged 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.

Bloom's Level: 2. Understand

Figure: 02.09a

Learning Outcome: 02.01.05 Relate how bonding leads to the formation of molecules and compounds.

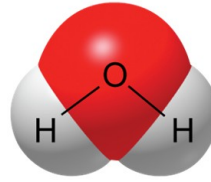
Mader - Chapter 02 #12

Topic: Chemistry

13.

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

_____.



- A. tran
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ns
- B.** une
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of
ele
ctro
ns
- C. its
abili
ty
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- D. its
hyd
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- E. its
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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.

Bloom's Level: 2. Understand

Figure: 02.09a

Learning Outcome: 02.02.01 Explain how the properties of water make life possible.

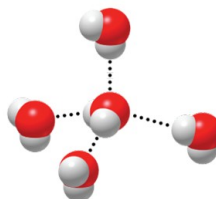
Mader - Chapter 02 #13

Section: 02.02

Topic: Chemistry

14.

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



- A. cov
ale
nt
bon
ds
- B.** hyd
rog
en
bon
ds
- C. ioni
c
bon
ds
- D. val
enc
e
she
lls
- E. solv
ent
s

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.

Bloom's Level: 2. Understand

Figure: 02.09b

Learning Outcome: 02.02.01 Explain how the properties of water make life possible.

15.

Which of the following is NOT a property of water?

- A. It is
a
goo
d
solv
ent.
- B.** It is
den
ser
wh
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froz
en
tha
n
wh
en
liqui
d.
- C. It is
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e.
- D. It
resi
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tem
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atur
e
cha
nge
s.
- E. It
can
be
fou
nd
as
a
soli
d,
liqui
d,
or
gas
.

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

density.

Bloom's Level: 1. Remember

Learning Outcome: 02.02.01 Explain how the properties of water make life possible.

Mader - Chapter 02 #15

Section: 02.02

Topic: Chemistry

16.

Bases can _____.

A. rele
ase
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y
hyd
rog
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ion
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B. tak
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up
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rog
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C. rele
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D. bot
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rog
en
ion
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and
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ase
hyd
roxi
de
ion
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E. rele
ase
hyd
rog

en
and
rele
ase
hyd
roxi
de

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

Bloom's Level: 2. Understand
Learning Outcome: 02.03.01 Distinguish between an acid and a base.
Mader - Chapter 02 #16
Section: 02.03
Topic: Chemistry

17.

The pH scale is a mathematical indicator of _____.

- A. the
con
cen
trati
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of
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- B. the
con
cen
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of
 OH^-
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t in
a
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- C. the
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pH indicates the number of hydrogen ions in a solution. It is used to indicate the acidity or basicity of a solution.

Bloom's Level: 2. Understand
Learning Outcome: 02.03.02 Interpret the pH scale.
Mader - Chapter 02 #17
Section: 02.03
Topic: Chemistry

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. rele
ase
 OH^-
- B.** tak
e
up
 H^+
- C. rele
ase
 H^+
- D. tak
e
up
 OH^-
- E. rele
ase
 OH^-
and
tak
e
up
 H^+

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

Bloom's Level: 3. Apply
Learning Outcome: 02.03.03 Explain the purpose of a buffer.

19.

The term to describe any substance which can prevent the pH of a solution from changing by either releasing or absorbing H^+ in a solution is

- 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. They help to resist pH changes because they can take up excess hydrogen ion (H^+) or hydroxide ion (OH^-)

Bloom's Level: 1. Remember

Learning Outcome: 02.03.03 Explain the purpose of a buffer.

Mader - Chapter 02 #19

Section: 02.03

Topic: Chemistry

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 better able to maintain their

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D. Sm
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wat
er.

E. Ice
cub
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floa
t.

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.

Bloom's Level: 4. Analyze

Learning Outcome: 02.02.01 Explain how the properties of water make life possible.

Mader - Chapter 02 #20

Section: 02.02

Topic: Chemistry

21.

What 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 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.

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 mineral

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ted.

D. The
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E. The
hyd
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ms
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ak
aw
ay
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m
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oxy
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and
esc
ape
as
vap
or.

Hydrogen bonds link water molecules together. As they absorb heat the bonds begin to break causing water to enter into gaseous state and evaporate into the environment.

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

A. oxy
gen
mol
ecu
les

B. hyd
rog
en
mol
ecu
les

C. wat
er
mol
ecu
les

D. hyd
roxi
de
(O
H⁻)
ion
s

E. hyd
rog
en
(H⁺)
ion

Hydrogen bonds link water molecules together. As they absorb heat the bonds begin to break causing water to enter into gaseous state and evaporate into the environment.

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 many 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.

Bloom's Level: 5. Evaluate

Learning Outcome: 02.02.01 Explain how the properties of water make life possible.

Mader - Chapter 02 #24

Section: 02.02

Topic: Chemistry

25.

If average temperatures from South Dakota were compared to temperatures from Oregon it would show that Oregon has warmer winters and cooler summers than South Dakota does. Account for why this could be when they are at similar latitudes?

A. South Dakota has less trees.

B. The Pacific ocean makes Oregon temperatures more moderate.

C. Oregon receives more rainfall.

D. South Dakota has fewer lakes and rivers.

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E. South
Dak
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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.

Bloom's Level: 4. Analyze
Learning Outcome: 02.02.01 Explain how the properties of water make life possible.
Mader - Chapter 02 #25
Section: 02.02
Topic: Chemistry

26.

How do a strong acid and a weak acid differ?

A. A strong acid has less 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

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E. A
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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.

Bloom's Level: 2. Understand

Learning Outcome: 02.03.01 Distinguish between an acid and a base.

Mader - Chapter 02 #26

Section: 02.03

Topic: Chemistry

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
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vin
g
as
a
buff
er
to
tak
e
up
exc
ess
 H^+
ion
fro
m
sto
ma
ch
aci
d.

B. It is
abl
e to
coa
t
the
sto
ma
ch
linin
g.

C. The
bic
arb
ona
te
hel
ps
to
cre
ate
mor
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d in
the

- sto
ma
ch.
- D. The
bic
arb
ona
te
act
s
as
a
stro
ng
aci
d
qui
ckly
diss
oci
atin
g
into
 H^+
ion.
- E. It
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s.

Bicarbonate acts as a buffer re-forming carbonic acid. This takes up the excess hydrogen ion (H^+) in the stomach. Lowering the acidity of the stomach acid.

Bloom's Level: 5. Evaluate
Learning Outcome: 02.03.03 Explain the purpose of a buffer.
Mader - Chapter 02 #27
Section: 02.03
Topic: Chemistry

28.

Which of the following is not a contributing event in the formation of acid rain?

A. Fossil fuels consumed removing it from the atmosphere.

B. Coal & oil emit sulfur dioxide and nitrogen oxide when they are burned.

C. Fossil fuel emissions

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atm
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e.

D. A
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sulf
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aci
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nitri
c
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E. Pre
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The burning of fossil fuels sends out emissions including sulfur dioxide and nitrogen oxides. When these gases combine with water in the atmosphere they form sulfuric acid

and nitric acid.

Bloom's Level: 2. Understand

Learning Outcome: 02.03.01 Distinguish between an acid and a base.

Mader - Chapter 02 #28

Section: 02.03

Topic: Chemistry

29.

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

A. They are all foods that people consume.

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

C. They all are fruits.

D. They all taste bitter.

E. They are all slippery to the touch.

ch.

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^+).

Bloom's Level: 3. Apply
Learning Outcome: 02.03.01 Distinguish between an acid and a base.
Mader - Chapter 02 #29
Section: 02.03
Topic: Chemistry

30.

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 poi

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D. A
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a
can
bur
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wh
en
it is
pla
ced
in
the
free
zer.

E. A
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e
bod
y of
fres
h
wat
er
tak
es
a
lon
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e to
war
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afte
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wint
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sea
son
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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.

31. When hot chocolate mix is added to water the hot chocolate is the _____ and the water is the _____.

- A. solv
ent;
sol
ute
- B. mol
ecu
le;
co
mp
oun
d
- C. sol
ute;
solv
ent**
- D. co
mp
oun
d;
mol
ecu
le
- E. ele
me
nt;
co
mp
oun
d

Water dissolves many polar nonionic substances by forming H bonds with them. The water is doing the dissolving function (the solvent) and the hot chocolate is being dissolved (solute).

32.

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

- A. H^+ ;
aci
d
- B. OH^- ;
aci
d
- C. H^+ ;
bas
e
- D. OH^- ;
bas
e
- E. H^+ ;
neu
tral
sol
utio
n

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

*Bloom's Level: 2. Understand
Learning Outcome: 02.03.02 Interpret the pH scale.
Mader - Chapter 02 #32
Section: 02.03
Topic: Chemistry*

33.

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.

Bloom's Level: 2. Understand
Learning Outcome: 02.01.01 Distinguish among the types, location, and charge of subatomic particles.
Mader - Chapter 02 #33
Section: 02.01
Topic: Chemistry

34.

Which of the following is a property of acids?

A. rele
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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.

Bloom's Level: 2. Understand
Learning Outcome: 02.03.01 Distinguish between an acid and a base.
Mader - Chapter 02 #34
Section: 02.03
Topic: Chemistry

Matching Questions

35.

Use the following terms to match the statements provided.

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

Bloom's Level: 2. Understand
Learning Outcome: 02.01.01 Distinguish among the types, location, and charge of subatomic particles.
Mader - Chapter 02 #35
Section: 02.01
Topic: Chemistry

Multiple Choice Questions

36.

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.

37.

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.

Bloom's Level: 1. Remember
Learning Outcome: 02.01.01 Distinguish among the types, location, and charge of subatomic particles.
Mader - Chapter 02 #37
Section: 02.01
Topic: Chemistry

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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.

Bloom's Level: 2. Understand
Learning Outcome: 02.01.02 Explain how isotopes are useful in the study of biology.
Mader - Chapter 02 #38
Section: 02.01
Topic: Chemistry

39.

The number of neutrons in the nucleus of an average atom of an element is best estimated by

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

40.

Students were studying properties of water. One student placed a cup containing 80 mL of water in a freezer. Another student placed an identical cup containing 40 mL of water in the same freezer. Which of the following will be the same for both cups of water?

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Water expands as it freezes. Due to the hydrogen bonding of water molecules when water freezes, air is trapped between molecules. This will cause the water to occupy more space when frozen, and change its mass. The time for the two water samples to freeze is dependent on their volumes, but the temperature that it occurs at is a standard.

Bloom's Level: 5. Evaluate
Learning Outcome: 02.02.01 Explain how the properties of water make life possible.
Mader - Chapter 02 #40
Section: 02.02
Topic: Chemistry

41.

Engineers design city sidewalks using blocks of concrete separated by a small gap to prevent them from cracking. What property of water is being taken into account for this design? Water

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C. is
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E. has
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Water expands as it freezes. Due to the hydrogen bonding of water molecules when water freezes, air is trapped between molecules. This will cause the water to occupy more space when frozen. The gap in the sidewalks helps to accommodate for this expansion.

42.

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
electrons
than it
does
selectrons.

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.

Bloom's Level: 1. Remember
Learning Outcome: 02.01.01 Distinguish among the types, location, and charge of subatomic particles.
Mader - Chapter 02 #42
Section: 02.01
Topic: Chemistry

43.

The atomic structure of water satisfies the octet rule by

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

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D. hav
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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.

44.

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

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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.

Bloom's Level: 2. Understand
Learning Outcome: 02.01.02 Explain how isotopes are useful in the study of biology.
Mader - Chapter 02 #44
Section: 02.01
Topic: Chemistry

45.

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. 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.

Bloom's Level: 2. Understand
Learning Outcome: 02.01.01 Distinguish among the types, location, and charge of subatomic particles.
Mader - Chapter 02 #45
Section: 02.01
Topic: Chemistry

46.

Why do cells need buffering agents?

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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.

Bloom's Level: 2. Understand
Learning Outcome: 02.03.03 Explain the purpose of a buffer.
Mader - Chapter 02 #46
Section: 02.03
Topic: Chemistry

47.

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. attractions of 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.

*Bloom's Level: 4. Analyze
Learning Outcome: 02.01.04 Contrast ionic and covalent bonds.
Mader - Chapter 02 #47
Section: 02.01
Topic: Chemistry*

48.

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.

Bloom's Level: 4. Analyze
Learning Outcome: 02.01.01 Distinguish among the types, location, and charge of subatomic particles.
Mader - Chapter 02 #48
Section: 02.01
Topic: Chemistry

49.

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.

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 creates the property of cohesion that makes it possible to have this high surface tension.

50.

The pH of pure water is _____ because

_____.

A. 7.0;
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dissociates
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equal
number
of
 H^+
ions
and
 OH^-

B. 14.
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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^-).

Bloom's Level: 2. Understand
Learning Outcome: 02.03.02 Interpret the pH scale.
Mader - Chapter 02 #50
Section: 02.03
Topic: Chemistry

51.

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

- A. Hydrogen atoms bond with each other to create stable outer shell of electrons. The way for a hydrogen bond to an oxygen atom to create the water molecule.
- B. Oxy

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C. The
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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 bonds

attractions with other water molecules.

D. Hydrogen bonds are formed between the two hydrogen atoms and the oxygen atom. This water molecule than forms a covalent bond with

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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.

Bloom's Level: 5. Evaluate

Learning Outcome: 02.02.01 Explain how the properties of water make life possible.

Mader - Chapter 02 #51

Section: 02.02

Topic: Chemistry

52.

The 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, are found in the nucleus, and their number creates the atomic number assigned to that element. The neutrons are found in the nucleus as well and they with the protons create the majority of an atom's mass. The electrons bear a negative charge and govern the elements reactivity.

Bloom's Level: 1. Remember

Learning Outcome: 02.01.01 Distinguish among the types, location, and charge of subatomic particles.

53.

Which of these is a property of isotopes that make it useful in cell biology?

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C. the
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The number of neutrons does not influence the chemical reactivity of the atom so they will form the same molecules allowing living organisms to take them in and use them as they would normally.

Bloom's Level: 4. Analyze

Learning Outcome: 02.01.02 Explain how isotopes are useful in the study of biology.

Mader - Chapter 02

Section: 02.01

Topic: Chemistry

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

55.

The reactivity of an atom depends on

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

Bloom's Level: 2. Understand
Learning Outcome: 02.01.03 Relate how the arrangement of electrons determines an elements reactivity.
Mader - Chapter 02
Section: 02.01
Topic: Chemistry

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B. the
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C. the
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D. the
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E. the
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As atoms give away, 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.

Bloom's Level: 2. Understand

Learning Outcome: 02.01.03 Relate how the arrangement of electrons determines an element's reactivity.

Mader - Chapter 02

Section: 02.01

Topic: Chemistry

57.

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

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With 18 electrons, argon has all three electrons levels filled. The most that the one closest to the nucleus can hold is 2, the most that the 2nd one can hold is 8 and the final one can also hold at most 8.

Bloom's Level: 3. Apply
Learning Outcome: 02.01.03 Relate how the arrangement of electrons determines an elements reactivity.
Mader - Chapter 02
Section: 02.01
Topic: Chemistry

58.

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.

Bloom's Level: 5. Evaluate
Learning Outcome: 02.01.04 Contrast ionic and covalent bonds.
Mader - Chapter 02
Section: 02.01
Topic: Chemistry

59.

An ionic bond forms when

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

B. an
atom
gives
away
or
takes
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proton.

C. a
negatively
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D. two
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E. two
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Ions form when an atom gives away or takes in an electron but the actual bond does not form until the charged atoms are attracted to one another.

Bloom's Level: 3. Apply
Learning Outcome: 02.01.05 Relate how bonding leads to the formation of molecules and compounds.
Mader - Chapter 02
Section: 02.01
Topic: Chemistry

60.

A covalent bond involves the sharing of

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- B. prot
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- C. pair
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- E.** pair
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In order to form covalent bonds each atom must contribute an equal number of electrons so, electrons are shared in pairs.

Bloom's Level: 3. Apply
Learning Outcome: 02.01.05 Relate how bonding leads to the formation of molecules and compounds.
Mader - Chapter 02
Section: 02.01
Topic: Chemistry

61.

Which of the following describe how an acid disrupts the chemical bonds of molecules in a cell?

A. the H^+ ion's can disrupt hydrogen bonds as the slightly negative portion of the molecule is more attracted to it than to the hydrogen that was part of the bond.

B. the H^+ ion's can

disrupt hydrogen bonds as the slightly positive portion of the molecule is more attracted to it than to the hydrogen that was part of the bond.

C. the OH^- ions can disrupt hydrogen bonds as the slightly

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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.

62.

You are caring for the freshwater aquarium of a friend while they are on vacation. You are told to check the pH of the tank and make sure that it stays between 6.5 and 7.0. When you check the water the pH is 8.0. The water in the tank is

A. 1 to 1.5 times more basic than it should be.

B. 1 to 1.5 times more acidic than it should be.

C. 10 to 15 times more basic than it should be.

D. 10 to 15 times more acidic

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Since the pH scale is a logarithmic scale each change from one whole number to the next is a tenfold change. The larger the number the more basic the solution.

Bloom's Level: 5. Evaluate
Learning Outcome: 02.03.02 Interpret the pH scale.
Mader - Chapter 02
Section: 02.03
Topic: Chemistry

63.

You are caring for the freshwater aquarium of a friend while they are on vacation. You are told to check the pH of the tank and make sure that it stays between 6.5 and 7.0. In order to assure that you do not have to worry about the pH you

A. treat the fish and the tank with aspirin.

B. add NaOH so that changes in the tank are calculated.

C. add HCl so that you can track the changes in the tank's pH.

D. do nothing since

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Adding a buffer to a solution will prevent large, sudden changes in the pH so adding it to the tank will make it more unlikely that you will see changes

Chapter 2 The Chemical Basis of Life **Summary**

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