Notes for Pearson Environmental Science: Your World, Your Turn, Chapter 3 Earth’s environmental Systems, Lesson 1 Matter and the environment

Guiding question: What properties of matter are most important to environmental systems?

I. Building blocks of Chemistry. Every environmental problem involves chemical imbalances, and every environmental solution requires restoration of that balance or equilibrium. A broad term for “chemical” is m\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_: anything that occupies space and has mass.

A. A\_\_\_\_\_\_\_\_\_\_\_ and E\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ are the building blocks of chemistry.

1. A\_\_\_\_\_\_\_\_\_\_\_\_\_\_ are the simplest, smallest stable—long-lasting—components of matter. These can be not be broken into different components by chemical reactions, but they can be changed into different substances via radioactive decay.

a. Figure 1: Each atom has two major sections:

1) The central core called the Nu\_\_\_\_\_\_\_\_\_\_\_\_\_ which contains two subatomic particles called pr\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ which have a po\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ charge and neu\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ which are not charged.

2) The very low density but high volume el\_\_\_\_\_\_\_\_\_\_\_\_\_\_ cl\_\_\_\_\_\_\_\_\_\_\_\_ which contains subatomic particles called an el\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ which have a n\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ charge.

2. E\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ are comprised of many atoms of the same type, as defined by their number of protons. These are pure substances that cannot be broken into simpler and different components by a chemical reaction or by a physical separation.

a. All atoms of the same element have the same number of p\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (p+), defined on the periodic table as their a\_\_\_\_\_\_\_\_\_\_\_\_\_ number. When neutral in charge, atoms have the same number of el\_\_\_\_\_\_\_\_\_\_\_(e-) & pr\_\_\_\_\_\_\_\_\_\_.

b. To find the number of protons, neutrons (no), and electrons present in the **most common isotope** of an element, round the average atomic mass to the nearest whole number, then use these formulas. Note #p+ is not always equal to #no!

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Periodic table square | Isotope name & notation | Rounded average atomic mass for the most common isotope’s mass=mass # | Atomic number = #P+ | If neutral, #p+ = #e- | Mass #-atomic # = #no |
| 6 12.01  C  carbon | Carbon-12  12C  6 | 12 a.m.u. | 6 | 6 | 12-6=6 |
|  | Hydrogen-1 |  |  |  |  |
|  | Nitrogen-14 |  |  |  |  |
|  | Oxygen-16 |  |  |  |  |
|  | Phosphorous-31 |  |  |  |  |
|  | Sulfur-32 |  |  |  |  |

c. N\_\_\_\_\_\_\_\_\_\_\_\_\_-t\_\_\_\_\_\_ natural elements exist, and these are described in the periodic table, using:

i. A chemical s\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ which abbreviates its name by use of one capital letter or a combination of one capital letter and one lower case letter. For example, \_\_\_\_\_\_\_\_\_ is the abbreviation for Carbon, while Ca is the abbreviation for \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

ii. Elements above 92 in atomic number are all manmade by collision of different atoms at such high velocity that they fuse for a short period of time (far less than a second) before undergoing radioactive decay to produce smaller atoms.

d. Each element may exist as several different isotopes which are atoms having the same number of protons and electrons, but a different number of n\_\_\_\_\_\_\_\_\_\_\_\_.

i. Some isotopes are stable, but others are radioactive, meaning that they decompose/decay to release a form of energy called nuclear radiation.

ii. After nuclear decay, isotopes become different elements because their number of protons changes during decay of the nucleus.

iii. Radioactive elements are dangerous to living things because they can cause destruction of molecules in the body, especially DNA, resulting in diseases or death.

e. Finding the numbers of p+, e-, and no of isotopes other than the most common one in nature uses the same methods as for the most common, except that the isotope’s name & notation, not the periodic table square’s average atomic mass, defines the mass of the isotope, and therefore, its number no.

|  |  |  |  |  |  |
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|  | Oxygen-18 |  |  |  |  |
|  | Phosphorous-32 |  |  |  |  |
|  | Sulfur-35 |  |  |  |  |

B. Figure 2 C\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ are groups of atoms that are joined together by chemical bonds. Compounds are pure substances that can be broken into simpler, different pure substances through chemical reactions.

1. One type of **inorganic chemical compound** is called an i\_\_\_\_\_\_\_\_\_\_\_ c\_\_\_\_\_\_\_\_\_\_\_\_\_\_. Most of these compounds form when metal atoms transfer some of their electrons (the ones farthest from their nucleus, the valence electrons) over to the electron cloud of nonmetal atoms.

a. Having lost one or more valence e\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, the metal atoms are converted to p\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ charged i\_\_\_\_\_\_\_\_\_\_\_\_.

b. Having gained one or more valence e\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, the nonmetal atoms are converted to n\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ charged i\_\_\_\_\_\_\_\_\_\_\_\_.

c. The attraction holding + metal ions together with – nonmetal ions is called an i\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ bond.

d. The chemical f\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of an ionic compound shows which elements are bonded together, as well as how many of each. The subscript number written to the lower right of the chemical symbol shows how many atoms of the element are contained in each unit of the compound. MgCl2 contains 1 atom Mg & 2 atoms Cl, while K2NO2 contains 2 atoms K, 1 atom N, and 2 atoms O.

i. examples

CaCO3 calcium carbonate \_\_\_ Ca atom(s) \_\_\_ C atom(s) \_\_O atom(s)

NH4Cl ammonium chloride \_\_N atom(s) \_\_H atom(s) \_\_Cl atom(s)

K2CrO7 potassium chromate \_\_K atom(s) \_\_Cr atom(s) \_\_O atom(s)

ii. labeled sketches.

NaCl

2. M\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ are groups of nonmetal atoms joined through s\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of e\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in bonds called covalent bonds.

a. Two main classes are:

i. O\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_compounds which contain at least C and H and which may also contain other nonmetal atoms. H\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ are the simplest organic compounds, containing only C and H; fossil fuels are organic hydrocarbons Figure 3b. ( Other organic compounds are like hydrocarbons, but some of their atoms may be substituted for other atoms or groups of atoms,

ii. Inorganic compounds which do not contain both \_\_\_\_ and \_\_\_\_\_, but are made by covalent bonding of other nonmetal elements.

b. In organisms, these six elements \_\_\_\_ \_\_\_\_\_\_ \_\_\_\_\_\_ \_\_\_\_\_\_\_ \_\_\_\_ \_\_\_\_ form the millions of covalent compounds that make up more 96% of body mass.

i. The reason that only these 6 elements can form the millions of different covalent compounds in an organism’s body is that organic compounds are built by forming chains of atoms that branch of C\_\_\_\_\_\_\_\_\_\_\_ atoms, each of which can form \_\_\_\_\_\_covalent bonds.

ii. Each C can serve as a hub for attaching many different combinations of atoms.

iii. The C’s tend to be covalently bonded into long chains called the molecule’s carbon b\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

c. Covalent bonds are made from sh\_\_\_\_\_\_\_\_\_\_\_\_\_\_ valence \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. By sharing these valence electrons, each atom becomes more stable than it was when an unbounded element. T

i. The greater stability of the covalently bonded elements is due to their achieving a filled valence electron oc\_\_\_\_\_\_\_\_\_\_\_ by sharing electrons.

ii. labeled sketches as in Figure 2

CO2 inorganic covalent compound C2H5Cl organic covalent compound

NH3 inorganic covalent compound CH3F organic covalent compound

H2O inorganic covalent compound

C. Mixtures are formed when more than one element or compound is combined with another, but the two are not chemically bonded. Mixtures can be separated by physical means, like filtering or attraction of some components to a magnet, but not others.

1. A solution is an example of a mixture.

a. The components are mixed homogenously so that the mixture seems uniform.

b. The components stay uniformly mixed.

c. The component present in larger abundance is called the s\_\_\_\_\_\_\_\_\_\_. The component present in smaller abundance is called the s\_\_\_\_\_\_\_\_\_\_\_\_\_.

2. Ecologically important solutions are air (78%N2, 21% O2, less than 0.04% CO2, etc.), sea water, plant sap, animal body tissues and blood, and fresh water.

II. Macromolecules are large organic molecules—called polymers—made of smaller units called monomers

1. Proteins, Nucleic acids, carbohydrates, and lipids are the building blocks of life.
   1. These are the 4 types of macromolecules that are required in every cell of every organism.
   2. The characteristics of structure and function of the 4 types of macromolecules

|  |  |  |  |
| --- | --- | --- | --- |
| polymer | monomer | Most common functions in cells | Specific examples |
| carbohydrate | Monosaccharide or sugar | -Store energy  -Build cell walls | Sucrose (table sugar), starch, cellulose, chitin |
| Nucleic acids | Nucleotides A, T,C, G | -Store & transfer genetic information | DNA  RNA |
| Lipids | Fatty acids | -Store energy,  -Insulate & protect,  -Form cell membranes  -Send information | Saturated triglyceride fats,  Phospholipids,  Steroids (not polymers) |
| proteins | Amino acids | -Serve as enzymes that speed up chemical reactions  -Send information  -control cell processes  -serve as building materials in the cell | -Alcohol dehydrogenase enzyme breaks down alcohol,  -Peptide hormones,  -Regulatory proteins  -Collagen & keratin form hair & nails |

III. Water is strangest molecule on earth, yet it also the most common molecule on earth.

1. Water is a unique inorganic covalent compound with several unusual properties that make it essential for life. \_\_\_\_\_\_\_\_\_% of the earth is covered in water
2. Properties of water Figure 7
   1. Water is an ino\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ covalent compound because its atoms s\_\_\_\_\_\_\_\_\_\_electrons, but C\_\_\_\_\_\_\_\_\_\_\_ is not found in the molecule.
   2. Formula H2O shows that each molecule contains \_\_\_\_H atoms and \_\_ O atom
   3. The molecule’s O shares 1 pair of electrons with 2 different H atoms
      1. The electrons are more strongly attracted to O which has higher electronegativity.
      2. The electrons are less strongly attracted to each H, which has lower electronegativity than O.
      3. The c\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ O-H bonds are termed polar covalent bonds because of the une\_\_\_\_\_\_\_\_\_\_sharing of the electrons.
         1. The O is has a partial n\_\_\_\_\_\_\_\_\_\_\_\_ charge because it is nearer the shared electrons
         2. The H atoms each carry a partial p\_\_\_\_\_\_\_\_\_\_\_\_\_ charge because they are farther from the shared electrons.
      4. Because every water molecule is a polar covalent moleucle, then different water molecules can temporarily “stick to” each other by H\_\_\_\_\_\_\_\_\_\_\_\_\_ bonds.
         1. Sketch
         2. The term for water sticking to other molecules of water is c\_\_\_\_\_\_\_\_\_\_\_.
      5. Water molecules can also temporarily stick to other kinds of polar covalent compounds and to ionic compounds because the + ends of water are attracted to – parts of any other compound that is their solute.
         1. Substances that can be solutes for a water solvent are called hydro\_\_\_\_\_\_\_\_\_\_\_compounds.
         2. Attraction between water and other substances is called ad\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
      6. Water molecules cannot stick to nonp\_\_\_\_\_\_\_\_\_ covalent compounds, so when water is mixed with these (called hydro\_\_\_\_\_\_\_\_\_\_\_\_ or water fearing compounds), they separate into layers and cannot form a solution.

2. Figure 8. The polar covalent bonds of water give it necessary roles for allowing life on earth.

a. water’s a\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ gives it sur\_\_\_\_\_\_\_\_ t\_\_\_\_\_\_\_\_\_\_\_ needed to provide a habitat for animals like a water spider.

b. co\_\_\_\_\_\_\_\_\_\_\_\_\_ and ad\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ combined allows water to move up through the veins of plants by c\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ action. ( by adhesion, the water sticks to the polar covalent compound that forms the veins, then as the water is pulled upwards by transpiration—water evaporating out of leaves—then other waters are pulled upwards, too, by cohesion)

c. temperature of molecules increases as their increase their speed of movement away from each other; because water molecules have to absorb energy to break their “connections” (Hydrogen bonds) to other water molecules before they speed up, water’s temperature increases more slowly than most other compounds’. This s\_\_\_\_\_\_\_\_\_\_\_\_ the temperatures on earth, especially in and near large bodies of water. (for cooling, vice versa)

d. Figure 9. Solid water molecules f\_\_\_\_\_\_\_\_\_\_\_\_\_ on top of liquid water molecules, because the more spread out Hydrogen bonding arrangement of solid water makes it less dense. This insulates water and allows aquatic organisms to survive winter.

e. because water can dissolve both p\_\_\_\_\_\_\_\_\_\_\_\_\_\_ c\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and i\_\_\_\_\_\_\_ compounds, it is called the “u\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ s\_\_\_\_\_\_\_\_\_\_\_\_\_\_”…but remember that it can’t dissolve hydrophobic compounds. This ability of water to act as a s\_\_\_\_\_\_\_\_\_\_\_\_ allows it to transport solutes like nutrients and wastes throughout organisms, so water is the major component of the circulatory system or body fluids of most organisms.

i. However, water is also easily polluted because of its excellence as a solvent.

3. Pure water disassociates into smaller ions under normal conditions, but at a low rate of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ molecules per Liter. H2O🡪 H+ + OH-  water🡪 protons or \_\_\_\_\_\_\_\_\_\_\_ + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ ions

a. Figure 10 shows that a measurement called pH is used to show the relative number of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in either each liter of pure water or in any water based (\_\_\_\_\_\_\_\_\_\_\_) solution.

i. In pure water, pH is\_\_\_\_\_\_\_\_\_\_ because concentrations (moles/liter) are \_\_\_\_\_\_\_

ii. when acidic substances are dissolved into water, they disassociate to produce \_\_\_\_\_ ions: For every 10X increase in the concentration of H+ in the solution, relative to OH-, the pH decreases by \_\_\_\_\_\_\_\_.

iii. when basic substances are dissolved into water, they disassociate to increase then number of \_\_\_\_\_\_ in the solution. For every 10X increase in the concentration of OH- in the water, relative to H+, the pH \_\_\_\_\_\_\_\_\_\_\_\_\_ by 1.

iv. acidic solutions have pH \_\_\_\_\_\_\_\_ than 7; neutral solutions have pH\_\_\_\_\_ as does pure water, and basic solutions have pH \_\_\_\_\_\_\_\_\_\_\_\_ than 7.

pH 14 is \_\_\_\_\_\_\_\_X more basic than pH 7

pH \_\_\_\_\_is 105 X more basic than pH 7

pH 10 is \_\_\_\_\_\_X more basic than pH 7

pH 8 is 101 X more basic than pH\_\_\_\_\_

pH \_\_\_\_\_ is 102 X more acidic than pH 7

pH 3 is 104 X more\_\_\_\_\_\_\_\_\_\_\_than pH 7

v. the pH of the soil and water is important because organisms are adapted to live in particular conditions of pH. When pH is different from that level, then molecules of the organism’s cells become \_\_\_\_\_\_\_\_\_\_\_\_\_\_ or even broken up, resulting in illness or death.

a. acid rain occurs when \_\_\_\_\_\_\_\_\_\_\_\_\_ SO2 and \_\_\_\_\_\_\_\_\_\_\_\_\_\_ NO2 gases released into the air-- often by burning of fossil fuels (these are contaminants mixed in with the hydrocarbons)—reacts with water to produce sulfuric acid and nitric acid. Lakes usually become barren of life by pH \_\_\_\_\_\_, and acid rain also damages plants and human structures like statues.

b. normal sea water pH is about \_\_\_\_, while normal rain water is about \_\_\_.

Associated homework: Your World, Your turn

Page 93 1-3, page 94 11-12 and 19-22, 95 page 32-33

KEY

Notes for Pearson Environmental Science: Your World, Your Turn, Chapter 3 Earth’s environmental Systems, Lesson 1 Matter and the environment

Guiding question: What properties of matter are most important to environmental systems?

I. Building blocks of Chemistry. Every environmental problem involves chemical imbalances, and every environmental solution requires restoration of that balance or equilibrium. A broad term for “chemical” is matter : anything that occupies space and has mass.

A. Atoms \_ and Elements\_ are the building blocks of chemistry.

1. Atoms are the simplest, smallest stable—long-lasting—components of matter. These can be not be broken into different components by chemical reactions, but they can be changed into different substances via radioactive decay.

a. Figure 1: Each atom has two major sections:

1) The central core called the Nu\_\_\_\_\_\_\_\_\_\_\_\_\_ which contains two subatomic particles called pr\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ which have a po\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ charge and neu\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ which are not charged.

2) The very low density but high volume el\_\_\_\_\_\_\_\_\_\_\_\_\_\_ cl\_\_\_\_\_\_\_\_\_\_\_\_ which contains subatomic particles called an el\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ which have a n\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ charge.

2. E\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ are comprised of many atoms of the same type, as defined by their number of protons. These are pure substances that cannot be broken into simpler and different components by a chemical reaction or by a physical separation.

a. All atoms of the same element have the same number of p\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (p+), defined on the periodic table as their a\_\_\_\_\_\_\_\_\_\_\_\_\_ number. When neutral in charge, atoms have the same number of el\_\_\_\_\_\_\_\_\_\_\_(e-) & pr\_\_\_\_\_\_\_\_\_\_.

b. To find the number of protons, neutrons (no), and electrons present in the **most common isotope** of an element, round the average atomic mass to the nearest whole number, then use these formulas. Note #p+ is not always equal to #no!

|  |  |  |  |  |  |
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|  | Sulfur-32 |  |  |  |  |

c. N\_\_\_\_\_\_\_\_\_\_\_\_\_-t\_\_\_\_\_\_ natural elements exist, and these are described in the periodic table, using:

i. A chemical s\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ which abbreviates its name by use of one capital letter or a combination of one capital letter and one lower case letter. For example, \_\_\_\_\_\_\_\_\_ is the abbreviation for Carbon, while Ca is the abbreviation for \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

ii. Elements above 92 in atomic number are all manmade by collision of different atoms at such high velocity that they fuse for a short period of time (far less than a second) before undergoing radioactive decay to produce smaller atoms.

d. Each element may exist as several different isotopes which are atoms having the same number of protons and electrons, but a different number of n\_\_\_\_\_\_\_\_\_\_\_\_.

i. Some isotopes are stable, but others are radioactive, meaning that they decompose/decay to release a form of energy called nuclear radiation.

ii. After nuclear decay, isotopes become different elements because their number of protons changes during decay of the nucleus.

iii. Radioactive elements are dangerous to living things because they can cause destruction of molecules in the body, especially DNA, resulting in diseases or death.

e. Finding the numbers of p+, e-, and no of isotopes other than the most common one in nature uses the same methods as for the most common, except that the isotope’s name & notation, not the periodic table square’s average atomic mass, defines the mass of the isotope, and therefore, its number no.

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B. Figure 2 C\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ are groups of atoms that are joined together by chemical bonds. Compounds are pure substances that can be broken into simpler, different pure substances through chemical reactions.

1. One type of **inorganic chemical compound** is called an i\_\_\_\_\_\_\_\_\_\_\_ c\_\_\_\_\_\_\_\_\_\_\_\_\_\_. Most of these compounds form when metal atoms transfer some of their electrons (the ones farthest from their nucleus, the valence electrons) over to the electron cloud of nonmetal atoms.

a. Having lost one or more valence e\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, the metal atoms are converted to p\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ charged i\_\_\_\_\_\_\_\_\_\_\_\_.

b. Having gained one or more valence e\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, the nonmetal atoms are converted to n\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ charged i\_\_\_\_\_\_\_\_\_\_\_\_.

c. The attraction holding + metal ions together with – nonmetal ions is called an i\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ bond.

d. The chemical f\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of an ionic compound shows which elements are bonded together, as well as how many of each. The subscript number written to the lower right of the chemical symbol shows how many atoms of the element are contained in each unit of the compound. MgCl2 contains 1 atom Mg & 2 atoms Cl, while K2NO2 contains 2 atoms K, 1 atom N, and 2 atoms O.

i. examples

CaCO3 calcium carbonate \_\_\_ Ca atom(s) \_\_\_ C atom(s) \_\_O atom(s)

NH4Cl ammonium chloride \_\_N atom(s) \_\_H atom(s) \_\_Cl atom(s)

K2CrO7 potassium chromate \_\_K atom(s) \_\_Cr atom(s) \_\_O atom(s)

ii. labeled sketches.

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2. M\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ are groups of nonmetal atoms joined through s\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of e\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in bonds called covalent bonds.

a. Two main classes are:

i. O\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_compounds which contain at least C and H and which may also contain other nonmetal atoms. H\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ are the simplest organic compounds, containing only C and H; fossil fuels are organic hydrocarbons Figure 3b. ( Other organic compounds are like hydrocarbons, but some of their atoms may be substituted for other atoms or groups of atoms,

ii. Inorganic compounds which do not contain both \_\_\_\_ and \_\_\_\_\_, but are made by covalent bonding of other nonmetal elements.

b. In organisms, these six elements \_\_\_\_ \_\_\_\_\_\_ \_\_\_\_\_\_ \_\_\_\_\_\_\_ \_\_\_\_ \_\_\_\_ form the millions of covalent compounds that make up more 96% of body mass.

i. The reason that only these 6 elements can form the millions of different covalent compounds in an organism’s body is that organic compounds are built by forming chains of atoms that branch of C\_\_\_\_\_\_\_\_\_\_\_ atoms, each of which can form \_\_\_\_\_\_covalent bonds.

ii. Each C can serve as a hub for attaching many different combinations of atoms.

iii. The C’s tend to be covalently bonded into long chains called the molecule’s carbon b\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

c. Covalent bonds are made from sh\_\_\_\_\_\_\_\_\_\_\_\_\_\_ valence \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. By sharing these valence electrons, each atom becomes more stable than it was when an unbounded element. T

i. The greater stability of the covalently bonded elements is due to their achieving a filled valence electron oc\_\_\_\_\_\_\_\_\_\_\_ by sharing electrons.

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2. Ecologically important solutions are air (78%N2, 21% O2, less than 0.04% CO2, etc.), sea water, plant sap, animal body tissues and blood, and fresh water.

II. Macromolecules are large organic molecules—called polymers—made of smaller units called monomers

1. Proteins, Nucleic acids, carbohydrates, and lipids are the building blocks of life.
   1. These are the 4 types of macromolecules that are required in every cell of every organism.
   2. The characteristics of structure and function of the 4 types of macromolecules

|  |  |  |  |
| --- | --- | --- | --- |
| polymer | monomer | Most common functions in cells | Specific examples |
| carbohydrate | Monosaccharide or sugar | -Store energy  -Build cell walls | Sucrose (table sugar), starch, cellulose, chitin |
| Nucleic acids | Nucleotides A, T,C, G | -Store & transfer genetic information | DNA  RNA |
| Lipids | Fatty acids | -Store energy,  -Insulate & protect,  -Form cell membranes  -Send information | Saturated triglyceride fats,  Phospholipids,  Steroids (not polymers) |
| proteins | Amino acids | -Serve as enzymes that speed up chemical reactions  -Send information  -control cell processes  -serve as building materials in the cell | -Alcohol dehydrogenase enzyme breaks down alcohol,  -Peptide hormones,  -Regulatory proteins  -Collagen & keratin form hair & nails |

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1. Water is a unique inorganic covalent compound with several unusual properties that make it essential for life. \_\_\_\_\_\_\_\_\_% of the earth is covered in water
2. Properties of water Figure 7
   1. Water is an ino\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ covalent compound because its atoms s\_\_\_\_\_\_\_\_\_\_electrons, but C\_\_\_\_\_\_\_\_\_\_\_ is not found in the molecule.
   2. Formula H2O shows that each molecule contains \_\_\_\_H atoms and \_\_ O atom
   3. The molecule’s O shares 1 pair of electrons with 2 different H atoms
      1. The electrons are more strongly attracted to O which has higher electronegativity.
      2. The electrons are less strongly attracted to each H, which has lower electronegativity than O.
      3. The c\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ O-H bonds are termed polar covalent bonds because of the une\_\_\_\_\_\_\_\_\_\_sharing of the electrons.
         1. The O is has a partial n\_\_\_\_\_\_\_\_\_\_\_\_ charge because it is nearer the shared electrons
         2. The H atoms each carry a partial p\_\_\_\_\_\_\_\_\_\_\_\_\_ charge because they are farther from the shared electrons.
      4. Because every water molecule is a polar covalent moleucle, then different water molecules can temporarily “stick to” each other by H\_\_\_\_\_\_\_\_\_\_\_\_\_ bonds.
         1. Sketch
         2. The term for water sticking to other molecules of water is c\_\_\_\_\_\_\_\_\_\_\_.
      5. Water molecules can also temporarily stick to other kinds of polar covalent compounds and to ionic compounds because the + ends of water are attracted to – parts of any other compound that is their solute.
         1. Substances that can be solutes for a water solvent are called hydro\_\_\_\_\_\_\_\_\_\_\_compounds.
         2. Attraction between water and other substances is called ad\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
      6. Water molecules cannot stick to nonp\_\_\_\_\_\_\_\_\_ covalent compounds, so when water is mixed with these (called hydro\_\_\_\_\_\_\_\_\_\_\_\_ or water fearing compounds), they separate into layers and cannot form a solution.

2. Figure 8. The polar covalent bonds of water give it necessary roles for allowing life on earth.

a. water’s a\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ gives it sur\_\_\_\_\_\_\_\_ t\_\_\_\_\_\_\_\_\_\_\_ needed to provide a habitat for animals like a water spider.

b. co\_\_\_\_\_\_\_\_\_\_\_\_\_ and ad\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ combined allows water to move up through the veins of plants by c\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ action. ( by adhesion, the water sticks to the polar covalent compound that forms the veins, then as the water is pulled upwards by transpiration—water evaporating out of leaves—then other waters are pulled upwards, too, by cohesion)

c. temperature of molecules increases as their increase their speed of movement away from each other; because water molecules have to absorb energy to break their “connections” (Hydrogen bonds) to other water molecules before they speed up, water’s temperature increases more slowly than most other compounds’. This s\_\_\_\_\_\_\_\_\_\_\_\_ the temperatures on earth, especially in and near large bodies of water. (for cooling, vice versa)

d. Figure 9. Solid water molecules f\_\_\_\_\_\_\_\_\_\_\_\_\_ on top of liquid water molecules, because the more spread out Hydrogen bonding arrangement of solid water makes it less dense. This insulates water and allows aquatic organisms to survive winter.

e. because water can dissolve both p\_\_\_\_\_\_\_\_\_\_\_\_\_\_ c\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and i\_\_\_\_\_\_\_ compounds, it is called the “u\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ s\_\_\_\_\_\_\_\_\_\_\_\_\_\_”…but remember that it can’t dissolve hydrophobic compounds. This ability of water to act as a s\_\_\_\_\_\_\_\_\_\_\_\_ allows it to transport solutes like nutrients and wastes throughout organisms, so water is the major component of the circulatory system or body fluids of most organisms.

i. However, water is also easily polluted because of its excellence as a solvent.

3. Pure water disassociates into smaller ions under normal conditions, but at a low rate of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ molecules per Liter. H2O🡪 H+ + OH-  water🡪 protons or \_\_\_\_\_\_\_\_\_\_\_ + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ ions

a. Figure 10 shows that a measurement called pH is used to show the relative number of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in either each liter of pure water or in any water based (\_\_\_\_\_\_\_\_\_\_\_) solution.

i. In pure water, pH is\_\_\_\_\_\_\_\_\_\_ because concentrations (moles/liter) are \_\_\_\_\_\_\_

ii. when acidic substances are dissolved into water, they disassociate to produce \_\_\_\_\_ ions: For every 10X increase in the concentration of H+ in the solution, relative to OH-, the pH decreases by \_\_\_\_\_\_\_\_.

iii. when basic substances are dissolved into water, they disassociate to increase then number of \_\_\_\_\_\_ in the solution. For every 10X increase in the concentration of OH- in the water, relative to H+, the pH \_\_\_\_\_\_\_\_\_\_\_\_\_ by 1.

iv. acidic solutions have pH \_\_\_\_\_\_\_\_ than 7; neutral solutions have pH\_\_\_\_\_ as does pure water, and basic solutions have pH \_\_\_\_\_\_\_\_\_\_\_\_ than 7.

pH 14 is \_\_\_\_\_\_\_\_X more basic than pH 7

pH \_\_\_\_\_is 105 X more basic than pH 7

pH 10 is \_\_\_\_\_\_X more basic than pH 7

pH 8 is 101 X more basic than pH\_\_\_\_\_

pH \_\_\_\_\_ is 102 X more acidic than pH 7

pH 3 is 104 X more\_\_\_\_\_\_\_\_\_\_\_than pH 7

v. the pH of the soil and water is important because organisms are adapted to live in particular conditions of pH. When pH is different from that level, then molecules of the organism’s cells become \_\_\_\_\_\_\_\_\_\_\_\_\_\_ or even broken up, resulting in illness or death.

a. acid rain occurs when \_\_\_\_\_\_\_\_\_\_\_\_\_ SO2 and \_\_\_\_\_\_\_\_\_\_\_\_\_\_ NO2 gases released into the air-- often by burning of fossil fuels (these are contaminants mixed in with the hydrocarbons)—reacts with water to produce sulfuric acid and nitric acid. Lakes usually become barren of life by pH \_\_\_\_\_\_, and acid rain also damages plants and human structures like statues.

b. normal sea water pH is about \_\_\_\_, while normal rain water is about \_\_\_.

Associated homework: Your World, Your turn

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FA-Building blocks of chemistry Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 9/16/2015 Mailbox \_\_\_\_\_

1. A broad term for “chemical” is \_\_\_\_\_\_\_\_\_\_\_\_\_\_ anything that occupies space and has mass.
2. \_\_\_\_\_\_\_\_\_\_\_\_\_\_ are the simplest, smallest stable—long-lasting—components of matter.
3. The central core of all atoms is called the \_\_\_\_\_\_\_\_\_\_\_\_\_
4. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ charged subatomic particles that are contained in the nucleus are called
5. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
6. Uncharged particles in the nucleus are called \_\_\_\_\_\_\_\_\_\_\_\_\_\_.
7. Tiny particle found orbiting around every atoms nucleus are called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, and
8. these tiny particles have a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ charge.
9. A pure substance composed of many atoms of the same kind is called an \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
10. The whole number found in each square of the periodic table increases from one square to the next, moving left to right. This number (91 for Pa, 92 for U) is called the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
11. As long as an atom is electrically neutral, then it contains the same number of protons & \_\_\_\_\_\_\_\_\_\_\_\_.
12. Copy the periodic table square for phosphorous, then identify the **atomic number** and the **average atomic mass** for all isotopes of phosphorous.

P

16 matches 13

13. Assume that the most abundant isotope of phosphorous has atomic mass that is the nearest whole number obtained by rounding the average atomic mass. What would the mass number be for the most common isotope of phosphorous? \_\_\_\_\_\_\_\_\_ atomic mass units (amu)

14. How many protons do phosphorous atoms, of ANY of its isotopes, contain? \_\_\_\_\_\_\_

15. In electrically neutral atoms of phosphorous, how many electrons are in the electron cloud? \_\_\_\_\_

16. How many neutrons would be found in an atom of phosphorous’ most common isotope?\_\_\_\_\_\_\_

17. The letter C in the periodic table square for carbon or the Ca found in the square for calcium is an abbreviation called the element’s chemical \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

18. Isotopes are forms of an element that have different numbers of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in their nuclei. For example, hydrogen has three common isotopes: hydrogen-1, hydrogen-2, and hydrogen-3.

19. Write the isotope notation for phosphorous-32 in the same form as carbon-14: 14C \_\_\_\_P\_

6

20. What is the mass number of atoms of the isotope phosphorous-32? \_\_\_\_\_\_\_\_\_\_\_\_\_

21. What is the number of protons found in an atom of phosphorous-32? \_\_\_\_\_\_\_\_\_\_\_\_\_\_

22. How many electrons would be found in 1 electrically neutral atom of phosphorous-32? \_\_\_\_\_\_\_

23. What is the number of neutrons in the nucleus of one atom of phosphorous-32? \_\_\_\_\_\_\_\_

24. Any chemically bonded group of atoms is called a chemical \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

25. Inorganic compounds do not contain any C atoms covalently bonded to H. Inorganic compounds formed by transfer of electrons from metal atoms to non metal atoms are called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

26. When an electrically neutral atom of Na metal loses one valence electron when it reacts with an atom of nonmetal Cl, it will form a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ charged ion. (original 11 protons, 11 electrons but after reaction 11 protons, 10 electrons)

27. When an electrically neutral atom of Cl nonmetal gains one valence electron when it reacts with an atom of metal Na, it will form a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ charged ion. (original 17 protons, 17 electrons but after reaction 17 protons, 18 electrons).

28. H2O and CaCO3 are examples of chemical \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. These chemical words show the numbers and kinds of atoms present in the chemical compound.

29. One unit of CaCO3 contains \_\_\_\_\_ **Ca**lcium atoms, \_\_\_**C**arbon atoms, and \_\_\_\_ **O**xygen atoms.