**Section 6.2 Notes – Covalent Bonding**

Read pages 165-169 in order to complete the reading guide and answer the questions.

The elements in sugar are carbon, oxygen, and hydrogen. All three are nonmetals, which have relatively high ionization energies. A transfer of electrons does not tend to occur between nonmetal atoms. So, how are two nonmetals able to form bonds?

**Covalent Bonds**

You and a friend are participating in a treasure hunt. The rules state that the first person to find all eight items on a list will win a 21-speed bicycle. After about an hour, you have found six of the items on the list and your friend has found the other two. You and your friend have incomplete sets of items. But if you are willing to \_\_\_\_\_\_\_\_\_\_\_ your items with your friend, together you will have a complete set of items and qualify for the prize. Of course, you will have to be willing to share the bicycle, too. When \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ join together, they display similar \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ strategy.

***Sharing Electrons***

A hydrogen atom has one electron. If it had two electrons, it would have the same electron \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ as a helium atom. Two hydrogen atoms can achieve a \_\_\_\_\_\_\_\_\_\_\_\_\_ electron configuration by sharing their electrons and forming a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_. A covalent bond is a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ bond in which two atoms share a pair of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ electrons. When two atoms share \_\_\_\_\_\_\_ pair of electrons, the bond is called a \_\_\_\_\_\_\_\_\_\_\_\_\_ bond.

* **Why would atoms want to share electrons?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

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***Molecules of Elements***

Two hydrogen atoms bonded together form a unit called a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. A molecule is a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ group of atoms that are joined together by one or more covalent \_\_\_\_\_\_\_\_\_\_. The hydrogen molecule is neutral because it contains two \_\_\_\_\_\_\_\_\_\_\_\_\_ (one from each atom) and two \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (one from each atom). What keeps the hydrogen atoms together in the molecule? The \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ between the shared electrons and the protons in each nucleus \_\_\_\_\_\_\_\_\_ the atoms \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in a covalent bond.

A chemical formula can be used to \_\_\_\_\_\_\_\_\_\_\_\_\_\_ the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of an element as well as a compound. The element hydrogen has the chemical \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ H2. The subscript 2 indicates that there are two \_\_\_\_\_\_\_\_\_\_\_\_ in a molecule of hydrogen.

Many nonmetal elements exist as \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ models. *Diatomic* means “\_\_\_\_\_\_ atoms.” A halogen atom has seven valence electrons. If two halogen atoms share a valence electron from each atom, both atoms have eight \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ electrons.

* **What holds the atoms together in a covalent bond?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

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***Multiple Covalent Bonds***

Nitrogen has five valence electrons. If two nitrogen atoms shared a \_\_\_\_\_\_\_\_ of electrons, each one would have only six valence electrons. If they shared \_\_\_\_\_\_\_ pairs of electrons, each atom would have only seven valence electrons. When the atoms in a nitrogen molecule (N2) share \_\_\_\_\_\_\_\_\_\_ pairs of electrons, each atom has eight valence electrons. Each pair of \_\_\_\_\_\_\_\_\_\_\_\_\_ electrons is represented by a long dash in the structural formula. When two atoms share three pairs of electrons, the bond is called a \_\_\_\_\_\_\_\_\_\_\_\_ bond. When two atoms share two pairs of electrons, the bond is called a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ bond.

* **What does the subscript 2 in the formula for a hydrogen molecule indicate?\_\_\_\_\_\_\_**

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**Unequal Sharing of Electrons**

In general, elements on the \_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_ of the periodic table have a greater \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ for electrons than elements on the left have (except for noble gases). In general, elements at the \_\_\_\_\_\_\_ of a group have a greater attraction for \_\_\_\_\_\_\_\_\_\_\_\_\_\_ than elements at the bottom of a group have. Fluorine is on the far right and is at the top of its group. It has the strongest attraction for electrons and is the most \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ nonmetal.

***Polar Covalent Bonds***

In a molecule of an element, the atoms that form \_\_\_\_\_\_\_\_\_\_\_\_\_\_ bonds have the same ability to \_\_\_\_\_\_\_\_\_\_\_\_ an electron. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ electrons are \_\_\_\_\_\_\_\_\_\_\_\_\_\_ equally to the nuclei of both atoms. In a molecule of a compound, electrons may not be shared \_\_\_\_\_\_\_\_\_\_\_\_.

A chlorine atom has a greater attraction for electrons than a hydrogen atom does. In a hydrogen chloride molecule, the \_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ spend more time \_\_\_\_\_\_\_\_\_ the chlorine atom than near the hydrogen atom. A covalent bond in which electrons are not shared, equally is called a \_\_\_\_\_\_\_\_\_\_ covalent bond.

When atoms form a polar covalent bond, the atom with the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ for electrons has a partial \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ charge. The other atom has a partial \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ charge.

* **In a polar covalent bond, which atom has a partial negative charge?\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

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* **Which atom has a partial positive charge?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

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***Polar and Nonpolar Molecules***

Can you assume that a molecule that contains a polar covalent bond is polar? If a molecule has only \_\_\_\_\_\_\_ atoms, it will be \_\_\_\_\_\_\_\_\_\_\_. But, when molecules have more than two atoms, the answer is not as obvious. The\_\_\_\_\_\_\_\_ of atoms in a molecule and its \_\_\_\_\_\_\_\_\_\_ are factors that determine whether a molecule is polar or nonpolar.

In carbon dioxide, there are double bonds between each oxygen atom and the central carbon atom. Because oxygen has a \_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ for electrons than carbon does, each double bond is \_\_\_\_\_\_\_\_\_\_\_\_. However, the molecule is \_\_\_\_\_\_\_\_\_\_\_\_\_: all three atoms are lined up in a row. The carbon-oxygen double bonds are directly opposite each other. There is an \_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_ on the electrons from opposite directions. The pulls cancel out and the molecule as a whole is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

There are two single bonds in a water molecule. The bonds are polar because oxygen has a greater attraction for electrons than hydrogen does. Because the water molecule has a \_\_\_\_\_\_\_\_\_ shape rather than a linear shape, the polar bonds do not cancel out. The two hydrogen atoms are located on the \_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_ of the molecule, opposite the oxygen atom. The oxygen side of the molecule has a partial negative charged. The hydrogen side of the molecule has a partial positive charge.

* **What determines whether a molecule is polar or nonpolar?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

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**Attraction between Molecules**

In a molecular compound, there are \_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ between molecules. These attractions are not as strong as ionic or covalent bonds, but they are \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_ to hold molecules together in a liquid or solid. Attractions between \_\_\_\_\_\_\_\_\_\_ molecules are \_\_\_\_\_\_\_\_\_\_\_\_\_ than attractions between \_\_\_\_\_\_\_\_\_\_\_\_\_\_ molecules.

***Comprehension Questions***

1. What attractions hold atoms together in a covalent bond?

2. What happens to the charge on atoms when they form a polar covalent bond?

3. Name the two factors that determine whether a molecule is polar.

4. Compare the strength of attractions between polar molecules to the strength of attractions between nonpolar molecules.

5. What is a molecule?

Matching

6. \_\_\_\_\_\_covalent bond A) bond in which electrons are not shared equally

7. \_\_\_\_\_\_molecule B) chemical bond in which two atoms share a pair of valence electrons

8. \_\_\_\_\_\_polar covalent bond C) neutral group of atoms that are joined together by one or more covalent bonds