Chemistry Name: _____

Section _____ CHEMICAL BONDS WS Date: _____

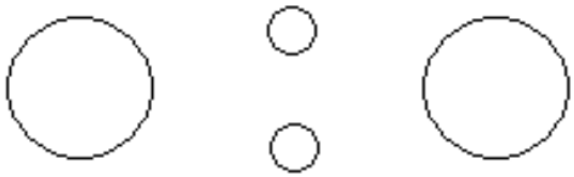
This worksheet is meant to help us understand the nature of chemical bonds. First we will consider how all chemical bonds are alike, then we will look at the difference between the types of chemical bonds. Please read page 206 of chapter 7 and the little inset at the top of page 241 of chapter 8 in your textbook. In the space below, define a chemical bond.

Chemical bond: _____

_____

_____

In the diagram below, add a plus sign (+) to show which of the circles on the diagram denote nuclei and negative signs (–) to show which circles denote electrons. Let me alter the definition you wrote above just slightly to help you. Chemical bonds are formed when two nuclei are mutually attracted to electrons between them.



Think about what you know about opposite charges. How do opposite charges affect each other?

_____

Why do the nuclei stay near the electrons in the center? _____

_____

_____

Why do the electrons stay between the nuclei? _____

_____

Now let us consider some of the variations in chemical bonds. These variations determine the different types of chemical bonds. We will consider seven different types of chemical bonds in chapters 7 and 8. I have rearranged these types to make the order run from (on average) the strongest type of bonds to the weakest type of bonds.

Chemical bond types

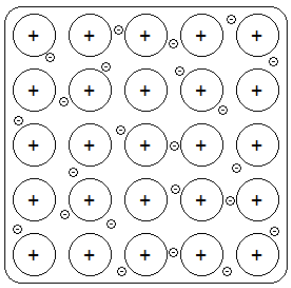
Metallic
Ionic
Polar covalent
Nonpolar covalent

The three intermolecular bonds are

Hydrogen bonds
Dipole – dipole bonds
London dispersion forces (sometimes known as **van der Waal's** forces)

Metallic bonds

Read the page 225 in your text. Then read the objectives of this section in the upper left hand corner of the page. Metals hold their valence electrons so loosely that they can actually drop them off' in the spaces between the metal atoms. Of course, once an atom loses an electron it becomes a positive ion. The diagram below is a model of metallic bonds.



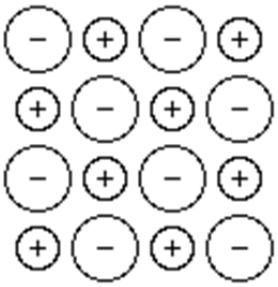
Circle the best choice in the parentheses in the following statements. In the diagram above, the circles with a + sign in the center represent the (positive ions / electrons). The little circles with negative signs randomly located between the ⊕ represent the (positive ions / electron sea). The delocalized electrons are actually located in the nearly empty p or d orbitals of the positive ion overlap and can be considered to be on two atoms at the same time.

Remember what we learned in the glass bending lab about bond strength and bond length. As bonds lengthen, they weaken rapidly. Consider the average size of a positive ion (see page 190 in your text) and the 'classical electron radius' of 0.0028 pm (although there seems to be no actual size to an electron). The strongest chemical bond we know is that of wolfram (tungsten). This metal doesn't melt until about 3000 ºC. Why do you think metallic bonds are so strong?

Ionic bonds

Read the 'Formation of an Ionic Bond' part of section 7-2 on page 210 in your text. Suppose an atom of sodium (effective nuclear charge = +1) gets near an atom of chlorine (effective nuclear charge = +7). What is likely to happen to the single valence electron on the sodium atom?

Whenever electrons are transferred in this way, the resulting positive atom (in this case Na^+) is called a cation (pronounced CAT eye on). The resulting negative ion (in this case Cl^-) is called an anion (pronounced AN eye on). The diagram below represents the ionic solid sodium chloride.



The circles with + signs in them represent the _____

ions and the circles with – signs in them represent the

_____ ions.

How would a positive ion affect a negative ion nearby? Because they

are opposite charges they would _____ each

other.

The center of the chloride ion is still a positive nucleus and the inside of the sodium ion is still a positive nucleus. The electrons in the valence shell of the chloride ion are between the two nuclei, so the ionic bond is, indeed, a chemical bond. But, as added extra bonding power, the oppositely charged ions still attract one another. This explains why ionic bonds are so strong.

Covalent bonds

Read pages 240 through 247 then page 266 in your text. Name the two types of covalent bonds discussed on page 266. What is true about the electrons in both types of covalent bonds?

_____

_____

In polar covalent bonds, electrons are shared unevenly. This makes the atom with the smaller electronegativity slightly positive (see figure 8.22 at the top of page 267). What symbol is used in diagram (b) to show a slight or partial positive charge? Also note that the chlorine has a slight negative charge. Since the HCl molecule formed has a slightly negative end and a slightly positive end, it is a polar molecule. In the space below, use circles to represent atoms and make the H atom smaller than the Cl atom and then use the symbols to show the partial charges to make a polar HCl molecule.

If the electrons are shared evenly, the bond will be a nonpolar covalent bond. In the space below, draw a sketch showing a hydrogen molecule, H_2.