AT Chemistry 2011

POGIL on CHEMICAL BONDING

Part I: Ionic and Covalent Bonding

1. What are ions and how are they formed?

2. What is the name given to positive ions? What types of elements form these ions?

3. What is the name given to negative ions? What types of elements form these ions?

4. Do you recall Coulomb's law?

5. How is Coulomb's law related to ionic compounds?

6. Write an equation for Coulomb's law relating the charges and distance between the positive and negative ions in an ionic compound:

key idea – the first and more important consideration is the charge difference; second is difference in size



- 7. Compare the energy of interaction between the following ionic compounds and explain your reasoning:
 - a) MgO and NaCl
 - b) MgO and CaO
 - c) MgO and MgCl₂
 - d) NaCl and KCl
- 8. What type of bonding occurs when two nonmetals share electrons?
- 9. What is the name of the particular electron sharing bond when the two nonmetals share electrons equally?
- 10. Give one or two examples of the above:

- 11. Can a molecule (a molecule is a compound having covalent bonding) in which the electrons are shared equally have partial charges on each end? That is, can it be polar?
- 12. What is the name of the particular electron sharing bond when the two nonmetals share electrons unequally?
- 13. Give one or two examples of the above:

14. In the above examples, the electrons are drawn toward the more electronegative element. Can a molecule consisting of only two atoms in which electrons are shared unequally have partial positive and negative charges on each end? That is, is the molecule polar?

Polar molecules are also called **dipoles**. The "dipole moment" is illustrated with a line having an arrow at the end pointing to the more electronegative element.

15. Draw the arrow above the chemical formulas of the two examples you gave in question 13 above.

Electronegativity (EN) - the ability of an atom in a molecule to attract shared electrons to itself. Recall EN decreases down a group and increases across a period.

In summary:	ΔEN	Bond Type	
	zero	covalent	degree ionic
	intermediate	polar covalent	increases
	large	ionic	*

A molecule having polar bonds can have no dipole moment if the individual dipoles cancel each other out. This is determined by the shape of the molecule. Below is a table showing the five most common symmetric shapes in which individual polarities of bonds "line up" to cancel out, resulting in the molecule being overall nonpolar. This is valid if all the atoms bonded to the central atom are the same (so the electronegativity differences are the same).

Table 8.6	Arrangements of Electron	Pairs Around an	Atom Yielding Min	imum Repulsion
Numbe	r of Pairs	Arrangement of	f Electron Pairs	Example
2	Linear		: <u> </u>	9-9-9
3	Trigonal planar	\bigtriangledown	· ·	*
4	Tetrahedral	(Å.	÷
5	Trigonal bipyramida		120°	-
6	Octahedral			-

16. Does CH₄ have a dipole moment? If so, show the orientation of the dipole moment.

17. Does CHCl₃ have a dipole moment? If so, show the orientation of the dipole moment.

In summary, atoms will transfer or share electrons (when bonding) in such a way so that each atom attains a noble gas configuration (ns^2np^6) . In ionic compounds:

Group $1 = +1$	
2 = +2	metals lose electrons and nonmetals gain
3 = +3	electrons to be isoelectronic (identical
15 = -3 (N, P)	electron configuration) with the noble gas
16 = -2 (O, S)	closest to them
17 = -1	

18. For species that are isoelectronic, (e.g. like Ca²⁺ and Ar), what is the relationship between radius and atomic number (nuclear charge)?

19. Order the following ions from smallest to largest.

$$O^{2-}$$
 Na⁺ Mg²⁺ F⁻