Unit 5 Bonding (Naming, formulas, VSEPR)

Molecule- two or more atoms joined together, e.g. H_2 , CO_2

Compound- made of two or more elements, e.g. CO_2 , H_2O

Ionic compound-compound made of positive and negative ions.

Cation- positively charged ion; less electrons.

Anion- negatively charged ion; more electrons.

Formula unit- *smallest* whole number ratio of ions in an ionic compound.

Polyatomic ion- made up of two or more ions (as opposed to monatomic ion)

Molecular formula- shows the *actual* kinds and number of the atoms in a *neutral compound*.

Empirical formula- shows the kinds and numbers of atoms in the *smallest representative unit* of a substance.

Law of Definite Proportions- the masses of elements in any chemical compound are always in the same proportions.
H_2O_2 always has 16 grams of oxygen for every gram of hydrogen.

Binary compound- composed of two elements.

Covalent Bonding- occurs when atoms share electrons; ; usually two non-metals.

Ionic Bonding- occurs when there is a transfer of electrons; usually a metal with a non-metal.

Electronegativity is used to determine what type of bond is formed when atoms come together in a chemical reaction.
If the electronegativity difference is **greater** than 1.67 an **ionic bond** is formed.
If the electronegativity difference is **less** than 1.67 a **covalent bond** is formed.

Metallic Bonding- consist of the attraction of free floating valance electrons for positively charged metal ions.

Chemical Formula and Naming

Oxidation numbers (the charges) of ions give the information needed to write the formulas of many chemical compounds. There are several guidelines that will lead you to the correct solutions.

1. A neutral compound is one in which the charges on the ions (also called oxidation numbers) balance out to zero when combined.
2. One positive charge balances out one negative charge; two ions with a charge of 1+ each balance with one 2- charge, etc.
3. Atoms with positive charges, or positive oxidation numbers, are written first in a formula and first in the name of the compound.
4. In ionic compounds, metals with more than one oxidation number use Roman numerals in the NAME to indicate which ion is indicated. Roman numerals do not appear in formulas!!
5. Subscripts show the relative numbers of atoms or ions in a compound.
6. Entire polyatomic ions (ions made up of more than one element) are shown in parentheses if there is more than one of them in the formula and a subscript follows to show how many are needed. For example, aluminum (Al^{3+}) nitrate (NO_3^-) would be written as $Al(NO_3)_3$

Naming Acids

Acids without Oxygen are named with the prefix "Hydro" and end in "ic"

Examples:

HCl	is	Hydrochloric Acid
HF	is	Hydrofluoric Acid
HBr	is	Hydrobromic Acid

Some acids with oxygen have several forms and use suffixes with "-ic" and "-ous" endings. The "-ic" or regular ending for an acid comes from the polyatomic ion with the "-ate" ending. This gives the regular count for the oxygen for this type of acid.

Examples:

Polyatomic	Name	Acid Formula	Acid Name
SO_4	sulfate	H_2SO_4	Sulfuric acid
CO_3	carbonate	H_2CO_3	Carbonic acid
NO_3	nitrate	HNO_3	Nitric acid
PO_4	phosphate	H_3PO_4	Phosphoric acid

Once you know the "-ic" ending, count the number of oxygens in the other forms to find the name for the acid.

Two less oxygens	Hypo	_____	"-ous"	Acid
One less oxygen "-ite" form		_____	"-ous"	Acid
Regular "-ate" form		_____	"-ic"	Acid
One more oxygen	Per	_____	"-ic"	Acid

Examples:

Acid Formula	Polyatomic ion	Acid Name
H_2SO_2	2 less oxygens	Hyposulfurous Acid
H_2SO_3	Sulfite (1 less)	Sulfurous Acid
H_2SO_4	Sulfate	Sulfuric Acid
H_2SO_5	one more oxygen	Persulfuric Acid

$HClO$	two less oxygens	Hypochlorous acid
$HClO_2$	Chlorite (1 less)	Chlorous Acid
$HClO_3$	Chlorate	Chloric Acid
$HClO_4$	one more oxygen	Perchloric Acid
HNO_2	Nitrite	Nitrous Acid
HNO_3	Nitrate	Nitric Acid

Naming Bases

Bases are simply named as ionic compounds containing the hydroxide ion.

1. Give the name of the cation; the positive ion – either the metal or the polyatomic ion, e.g. ammonium [$NH4^{1+}$]
2. Write the anion name- polyatomic ion, e.g. hydroxide [OH^{1-}]

Examples of Bases:

$NaOH$	sodium hydroxide
$Ca(OH)_2$	calcium hydroxide
NH_4OH	ammonium hydroxide

Valence-shell electron-pair repulsion (VSEPR)- molecules adjust their three-dimensional (3-D) shapes so the valence-electron pairs are as far apart as possible. The shape is determined by the central atom, and the number of shared and unshared electron pairs around the atom.

Type	Bonding groups	Non-bonding pairs	Examples
Linear	**2**	**0**	**CO_2**
Trigonal planar	**3**	**0**	**BF_3, CO_3**
Tetrahedral	**4**	**0**	**CH_4, CCl_4, SO_4**
Trigonal pyramidal	**3**	**1**	**NH_3, NF_3, PCl_3**
Bent	**2**	**2**	**H_2O, ClO_2**