Stability/Ionic & Covalent compounds

--Chemical **stability** is the ability to resist chemical change.
--The noble gases are chemically inert or unreactive, they are stable.
--When an atom has 8 valence e^-, a **stable octet**, that atom is chemically stable.
Except for Helium, all noble gases have 8 valence e^-.
--The most likely interactions between elements are those which tend to produce a stable octet and interactions are less likely once a stable octet has been achieved.
--The predictability of this behavior in the alkali metals, alkaline earth metals and main block elements (3A - 8A) is known as the **Octet Rule.**
--The alkali metals have 1 valence e-, in order to achieve a stable octet they simply lose 1 e^-.
The resulting stable particle has had a change in the number of electrons, thus giving the atom an electrical charge. It is now called an **ion**. Example: **K** (potassium) loses 1 e^- and has a stable octet much like argon.

	METALS	**NONMETALS**
tend to →	**Lose e-**	**Gain e-**
& become →	**+ ion**	**- ion**
examples →	K^+ Ca^{2+} Al^{3+}	N^{3-} O^{2-} F^-

--Any change that tends toward a greater stability will be favored
Thought: Will water run uphill or downhill?
--Most atoms will tend to form **bonds** in order to achieve more stability.
--When atoms combine in a chemical reaction, energy is often released, and a bond is formed. This **exothermic** energy can be measured.
--The more energy that is released in forming a bond, the more energy is required to break the bond. ***Ex***. If 500 kJ is required to form a bond 500 kJ will be needed to break it.
--A bond which was formed with a large release of energy will be stronger than a bond which released a small amount of energy. The stronger the bond; the more stable the product.

--Sodium is another example of an atom that may lose an e- in order to become stable. This results in a positively charged ion, or **Cation** --- Na^+
--Chlorine is an example of an atom that may gain an e-in order to become stable. This results in a negatively charged ion, or **Anion** --- Cl^-
--The attraction between a cation and an anion creates an **ionic bond**.
--A neutrally charged **ionic compound** is the result. $Na^+ + C1^- = NaCl$
--**Salts** are good examples of ionic compounds. These form when an ionic bond forms between a metal and a halogen.
--Ions and compounds are named systematically and consistently. This is known as a **nomenclature**.

--**Monatomic ions** are those formed when one atom loses or gains electrons.
The symbol of the ion must include its charge----Na^{+}, O^{2-}, Mg^{2+}

--Names of monatomic ions
--Cations---Element name + 'ion'
Sodium ion, magnesium ion
--Anions---Replace the end of the element's name with <u>-ide</u> + 'ion'
Chloride ion, oxide ion
--*Transition metals---Name of most transition metals will include the charge written in roman numerals.

Iron (Fe) Fe^{2+} --------Iron (II) ion
Fe^{3+} --------Iron (III) ion

--**<u>You must memorize</u>** the following transition metals since they do not form multiple ions:

Silver ion	Zinc ion	Cadmium ion
Ag^{+}	Zn^{2+}	Cd^{2+}

--Metals usually form cations, while nonmetals usually form anions.
--**Polyatomic ions** are ions composed of multiple atoms. These have specific names; you should be familiar enough with these to use them properly.
--Naming ionic compounds is as simple as writing a compound word:
(1) name of the cation + (2) name of the anion = name of the ionic compound

WARNING: Do NOT use the word 'ion' in the compound's name!

There are two types of ionic compounds:

1. ***<u>Binary ionic compounds</u>*** – **Bi**nary compounds consist of **2 monatomic ions** - (monatomic metal cation & monatomic nonmetal anion) or can be thought of as containing only 2 elements.

Naming a binary ionic compound follows this format:
(1) name of the metal cation *(if transition metal include the charge written in roman numerals)
(2) name of the nonmetal changing the ending to "ide"

Examples: NaCl = Sodium Chlor**ide** Al_2O_3 = Aluminum Ox**ide**
FeS = Iron **(II)** Sulf**ide** Fe_2S_3 = Iron **(III)** Sulf**ide**

2. ***<u>Ternary ionic compound</u>*** – is like a binary compound except the anion is a **polyatomic ion** instead of a monatomic ion. It is also known as a polyatomic ionic compound because it consists of more than 2 elements.

Naming a polyatomic ionic compound follows this format:
(1) name of the metal cation *(if transition metal include the charge written in roman numerals)
(2) name of the polyatomic anion (no change to its name)

Examples: $NaClO_2$ = Sodium Chlorite $NaClO_3$ = Sodium Chlorate
$Fe_3(PO_3)_2$ = Iron (II) Phosphite $FePO_4$ = Iron (III) Phosphate

Table of Polyatomic Ions

	Ion name and formula	
1–	acetate ion, $C_2H_3O_2^{-}$ bromate ion, BrO_3^{-} chlorate ion, ClO_3^{-} chlorite ion, ClO_2^{-} cyanide ion, CN^{-} dihydrogen phosphate, $H_2PO_4^{-}$ hydrogen carbonate ion (bicarbonate ion), HCO_3^{-}	hydrogen sulfate ion, HSO_4^{-} hydroxide ion, OH^{-} hypochlorite, ClO^{-} nitrate ion, NO_3^{-} nitrite, NO_2^{-} perchlorate, ClO_4^{-} permanganate, MnO_4^{-}
2–	carbonate ion, CO_3^{2-} chromate ion, CrO_4^{2-} dichromate ion, $Cr_2O_7^{2-}$ hydrogen phosphate, HPO_4^{2-}	oxalate ion, $C_2O_4^{2-}$ peroxide ion, O_2^{2-} sulfate ion, SO_4^{2-} sulfite ion, SO_3^{2-}
3–	arsenate ion, AsO_4^{3-}	phosphate ion, PO_4^{3-}
1+	ammonium ion, NH_4^{+}	

--The other type of bonding involves the sharing of electrons as opposed to the gain/loss of them. A bond resulting in the **sharing of electrons** is called a **covalent bond** and most often forms between two nonmetals.
--There are two main types of covalent bonds - (1) **polar** and (2) **nonpolar**.
--In a polar molecule the electrons are shared unevenly toward one side of the molecule, water for example. This results in a molecule with a positive and a negative end, "poles."
--In a nonpolar molecule the electrons are shared nearly evenly, methane for example.
--A useful tool used for representing covalent bonding is the electron dot diagram. With this the valence electrons are represented by dots placed around the element symbol. The dots are in particular position and are drawn in a specific order. This pattern follows the pattern in which electrons are believed to "fill in" the sub-levels of an energy level. The diagram to the right is the pattern you should follow.

-- Naming **molecular compounds** follows these rules:

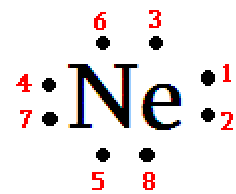
Prefix System – (binary compounds)

(1) Write the names of both elements
(2) Add prefixes to indicate # of atoms.
(3) Omit mono- prefix on the first element
(4) Change ending of the second element to **ide**

Examples:

CO_2 = carbon dioxide CO = carbon monoxide N_2P_5 = dinitrogen pentaphosphide

Electron Dot Diagram



Use for naming covalent compounds	
mono	**1**
di	**2**
tri	**3**
tetra	**4**
penta	**5**
hexa	**6**
hepta	**7**
octa	**8**
nona	**9**
deca	**10**