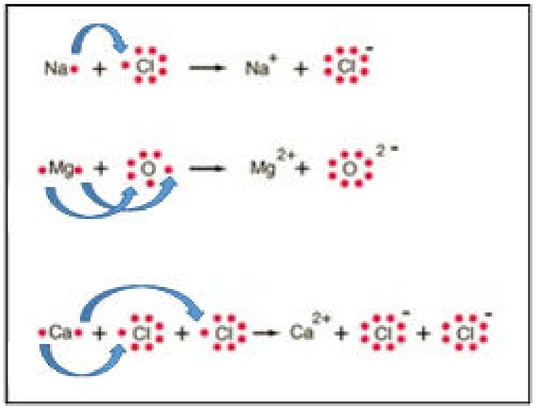
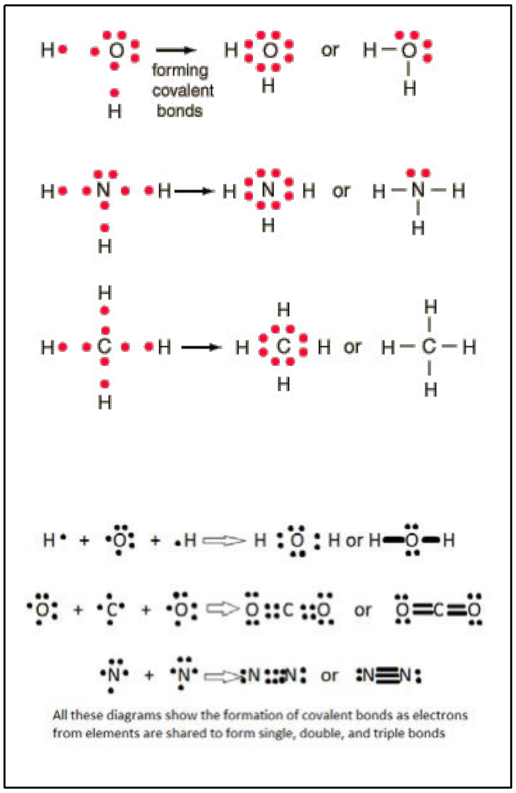
Unit 5 Test Review

Ionic Bonding



- Occurs between a metal and a nonmetal
- Valence electrons are transferred
- Metals (+ cations) and nonmetals (- anions)
- Large difference in electronegativity (>1.8)
- Most polar bond type
- Strongest intermolecular forces (opposites attract)
- High melting and high boiling points
- Solids in form of crystal lattice
- Lewis dots use scoop arrows and ions
- Lewis dots use single dots to show unpaired electrons and double dots to show "lone pairs"

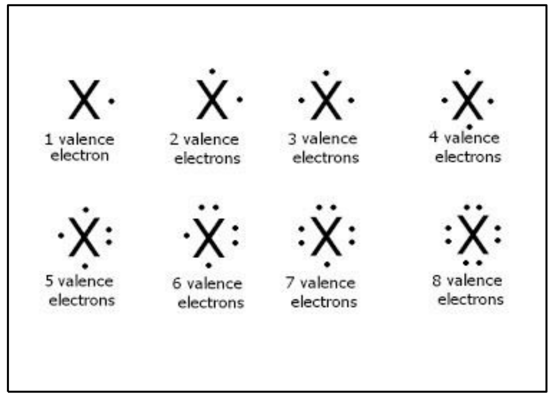
Covalent Bonding



- Occurs between nonmetals
- Valence electrons are shared
- No ionic charges (but may have dipoles)
- Polar covalent has asymmetrical shape with "uneven distribution" of electrons (0.5 – 1.6)
- Nonpolar covalent has symmetrical shape with "even distribution" of electrons (0 – 0.4)
- Small difference in electronegativity
- Weaker intermolecular forces
- Lower melting and Lower boiling points
- Polar covalent usually liquid at room temp
- Nonpolar covalent usually gas at room temp
- Lewis dots use straight lines to represent single, double and triple bonds.
- Lewis dots use single dots to show "bonding electrons" or "shared electrons" and double dots to show "lone pairs".

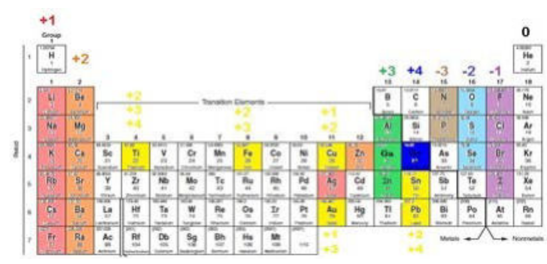
Valence Electrons

- Occupy the outermost orbital
- Belong to “s” and “p” blocks
- Determine type of chemical bond
- Determine chemical properties
- 1^{st} orbital can only hold 2 valence electrons
- All others can hold up to 8 valence electrons
- Lewis dots represent valence electrons



Oxidation Number

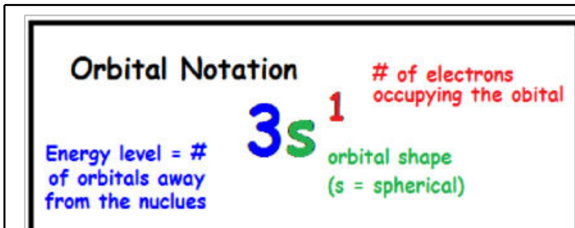
- Equals the number of valence electrons lost or gained to form an ion.
- Metals have positive oxidation numbers
- Nonmetals have negative oxidation numbers
- Transition elements have multiple oxidation numbers due to “unpaired electrons” in the dblock orbital.
- Transition metals use a ROMAN numeral to represent their oxidation number.
- Main group metals DO NOT use Roman numerals.
- Silver (Ag) is only +1 and Zinc (Zn) is only +2; therefore, they DO NOT use Roman numerals
- The Roman Numeral tells you the CHARGE on the ion, NOT the # of metal atoms
- To calculate the oxidation number for a transition element, you must know the charge of the anion and the total net charges for the positive and negative sides.



Elemental form	zero (0). Only one kind of atom present, no charge
Atomic ions	= the charge on the atom (monatomic ion)
Group 1A Li, Na, K, Rb, Cs	+1 unless in elemental form
Group 2A Be, Mg, Ca, Sr, Ba	+2 unless in elemental form
Hydrogen (H)	+1 when bonded to a nonmetal, -1 when bonded to a metal
Oxygen (O)	-1 in peroxides O_2^{2-}, -2 in all other compounds (most common)
Fluorine (F)	-1, always
Neutral compounds	The sum of all oxidation numbers of atoms or ions in a neutral compound is zero.
Ionic compounds	The sum of all oxidation numbers of atoms in an ionic compound is the charge on the polyatomic ion.

Electron Configurations

- Aufbau's Principle - fill the lowest energy level first



- Hund's Rule - each orbital must be filled once before pairing electrons
- Pauli's Principle - paired electrons must have opposite spins
- Electron configurations for ions are “**isoelectronic**” with noble gas configurations
- Positive ions (cations) remove electrons from the highest occupied orbital.
- Negative ions (anions) add electrons to highest occupied orbital.

SODIUM

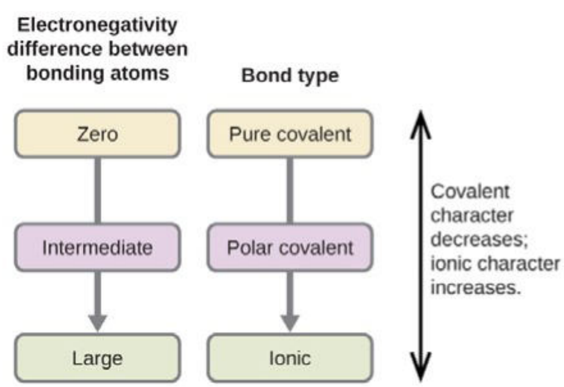
Na	$1s^2\ 2s^2\ 2p^6\ 3s^1$	
Na^+	$1s^2\ 2s^2\ 2p^6$	1 electron removed from the 3s orbital
Ne	$1s^2\ 2s^2\ 2p^6$	

CHLORINE

Cl	$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^5$	
Cl^-	$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6$	1 electron added to the 3p orbital
Ar	$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6$	

Electronegativity and Bond Type

• Electronegativity is a measure of an atoms desire to gain a bonding pair of electrons • The greater the difference in EN values between two atoms the more polar the bond.



Bond Type	Electronegativity Difference
pure covalent	< 0.4
polar covalent	between 0.4 and 1.8
ionic	> 1.8

Nomenclature Rules

- **Ionic bonding DOES NOT use Greek Prefixes**
- **Groups 1, 2, and 13 DO NOT use Roman Numerals • For Ionic Bonds, the name of the metal always comes first.**
- **Some Covalent Bonds DO NOT use Greek Prefixes – examples include diatomic elements, water, ammonia, and methane.**

Rules for Ionic Bonding

- **The metal always comes first.** ($NaCl$ is sodium chloride ***NOT*** $ClNa$ chlorine sodium)
- **The metal ions always keep their same name.** (No new ending change.)
- **Transition metals** (except silver - Ag and zinc - Zn) **and Tin – Sn and Lead – Pb must have a Roman numeral with the name to indicate which oxidation is present.** (Examples: Lead II oxide – PbO versus Lead IV oxide – PbO_2)
- **Nonmetals change their ending to –ide.** (Examples: nitride, oxide, sulfide, phosphide, fluoride, chloride, bromide, iodide, etc.)
- **Polyatomic ions involve two nonmetal atoms that are bonded together with an overall ionic charge.** (Examples: NH_4^{+1} ammonium, NO_3^{-1} nitrate, CO_3^{-2} carbonate, SO_4^{-2} sulfate, PO_4^{-3} phosphate, OH^{-1} hydroxide)
- **When writing the formula for polyatomic ions, if more than one polyatomic ion is present, you must use *parenthesis* and a *subscript* number to indicate the number of polyatomic ions present.** (Examples: Lead IV carbonate – $Pb(CO_3)_2$ and ammonium phosphate – $(NH_4)_3PO_4$.)

Rules for Covalent Bonding

The first element keeps the **same name** as shown on the periodic table. The second element ends in **–ide**. A **Greek** prefix is used to indicate the **# of atoms** in the molecule.

number of atoms	prefix	example	
1	mono	NO	nitrogen monoxide
2	di	NO_2	nitrogen dioxide
3	tri	N_2O_3	dinitrogen trioxide
4	tetra	N_2O_4	dinitrogen tetraoxide
5	penta	N_2O_5	dinitrogen pentaoxide
6	hexa	SF_6	sulphur hexa fluoride
7	hepta	IF_7	iodine hepta fluoride
8	octa	P_4O_8	tetra phosphur decoxide
9	nona	P_4S_9	tetra phusphur nona sulphide
10	deca	AS_4O_{10}	tetra arsinic decoxide