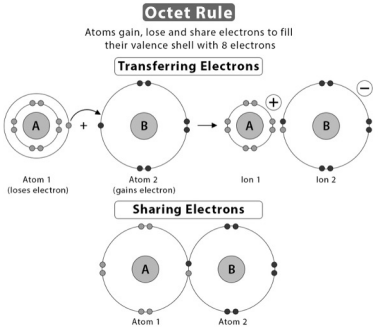
The *octet* rule for atoms



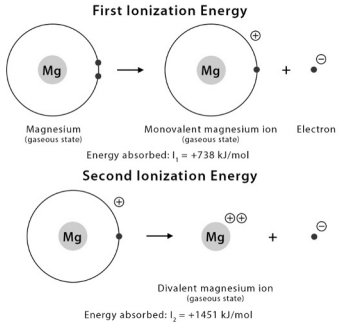
The *Octet Rule* for atoms is a basis rule of matter that states atoms would prefer an empty (*0 val e*$^-$) or full (*8 val e*$^-$) outer energy level

*Cation*s (*+ ion*) are ions that forms when atoms loses e$^-$

*Anion*s (*- ion*) are ions that forms when atoms gains e$^-$

2

Ionization Energy and Electron Affinity



Ionization Energy is the amount of energy required to remove an e$^-$ from an atom

Electron Affinity is the amount of energy absorbed when an atom gains an e$^-$ in a bond

Metals have **low** IE and **low** EA (*lose e*$^-$) *Non-Metals* have a **very high** IE and **high** EA (*gain e*$^-$)

3

Electronegativity

Electronegativity Chart
Representative (1A – 8A) Elements Only

H 2.1							He ---
Li 1.0	Be 1.5	B 2.0	C 2.5	N 3.0	O 3.5	F 4.0	Ne ---
Na 0.9	Mg 1.2	Al 1.5	Si 1.8	P 2.2	S 2.5	Cl 3.0	Ar ---
K 0.8	Ca 1.0	Ga 1.6	Ge 1.8	As 2.0	Se 2.4	Br 2.8	Kr 3.0
Rb 0.8	Sr 1.0	In 1.7	Sn 1.8	Sb 1.9	Te 2.1	I 2.5	Xe 2.6
Cs 0.7	Ba 0.9	Tl 1.8	Pb 1.8	Bi 1.9	Po 2.0	At 2.2	Rn ---
Fr 0.7	Ra 0.9						

Electronegativity is an atoms attraction of e$^-$ to its nucleus based on *octet rule*

Metals **low** electronegativity
Non-metals **high** electroneg

Electronegativity difference determines in an atom will gain, lose, or share electrons

4

Electronegativity Chart

Electronegativity Difference (*ED*)

$$ED = E_{higher} - E_{lower}$$

H 2.1																	He ---
Li 1.0	Be 1.5											B 2.0	C 2.5	N 3.0	O 3.5	F 4.0	Ne ---
Na 0.9	Mg 1.2											Al 1.5	Si 1.8	P 2.2	S 2.5	Cl 3.0	Ar ---
K 0.8	Ca 1.0	Sc 1.3	Ti 1.5	V 1.6	Cr 1.6	Mn 1.5	Fe 1.8	Co 1.8	Ni 1.8	Cu 1.9	Zn 1.6	Ga 1.6	Ge 1.8	As 2.0	Se 2.4	Br 2.8	Kr 3.0
Rb 0.8	Sr 1.0	Y 1.2	Zr 1.4	Nb 1.6	Mo 1.8	Tc 1.9	Ru 2.2	Rh 2.2	Pd 2.2	Ag 1.9	Cd 1.7	In 1.7	Sn 1.8	Sb 1.9	Te 2.1	I 2.5	Xe 2.6
Cs 0.7	Ba 0.9	La-Lu 1.1-1.2	Hf 1.3	Ta 1.5	W 1.7	Re 1.9	Os 2.2	Ir 2.2	Pt 2.2	Au 2.4	Hg 1.9	Tl 1.8	Pb 1.8	Bi 1.9	Po 2.0	At 2.2	Rn ---
Fr 0.7	Ra 0.9	Ac-No 1.1-1.7															

Ionic Bond	Polar Covalent Bond	Non-Polar Covalent Bond
Transfer of Electrons	Unequal Sharing of Electrons	Equal Sharing of Electrons
ED > 1.4 (*w/metal*)	ED < 1.4 & > 0.50	ED ≤ 0.50

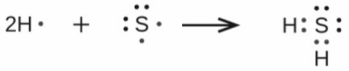
5

Types of Bonding Connections Between Atoms

Ionic Bond – ***Transfer of e⁻***

A *metal* and a *non-metal bond* (*combine*) with each other to obey the *octet rule*. The less *electroneg*. element (*metal*) transfers e⁻ to the more *electroneg*. element

Covalent Bond – ***Sharing of e⁻***



Two *non-metals bond* (combine) with each other to obey the *octet rule*. With similar *electronegativities* the atoms share electrons with each other

6

Determining Bond Type with Electronegativity

Electronegativity Difference (*ED*)

ED = $\text{Electroneg}_{\text{High}}$ - $\text{Electroneg}_{\text{Low}}$

Ionic Bond – **ED > 1.4** (*w/metal*)

An *ionic* bond involves a large difference in the attraction or the nucleus on e⁻ within atom, inc. a metal

Polar Covalent Bond (*w/non*) **ED < 1.9 but > 0.5** (*unequal*)

Non-Polar Covalent Bond **ED ≤ 0.5** (*equal*)

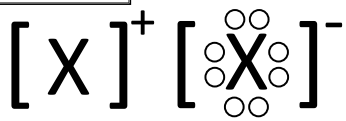
Lower difference in electoneg close to equal pull of nucleus

7

Ionization **and Lewis Dot Structures**

1 val e⁻	2 val e⁻	3 val e⁻	4 val e⁻
X	X	X	X
5 val e⁻	6 val e⁻	7 val e⁻	8 val e⁻
X	X	X	X

Neutral Atom Lewis Dot Structures *based on valence e⁻*



Cation (+) Anion (-)

Group Number	Lose/Gain	Group Number	Lose/Gain
1A / 1	Lose 1e⁻	5A / 15	Gain 3e⁻
2A / 2	Lose 2e⁻	6A / 16	Gain 2e⁻
3A / 13	Lose 3e⁻	7A / 17	Gain 1e⁻
4A / 14	Lose 4e⁻	8A / 18	No Ions

8

Ions and the Octet Rule *Key Terms*

Octet Rule
Basic Principle that atoms will always gain or lose electron to obtain either 0 or 8 valence e⁻

Electronegativity
The pull an atoms nucleus has on valence electrons from other atoms

Electron Affinity
Amount of energy gained when an atom gains on electron

Ionization Energy
Amount of energy required for an atom to lose an electron

1st and 2nd Ionization Energy
The amount of energy required to lose 1st or 2nd electron from an atom (*Groups 2A – 4A + Transition Atoms*)

Ion Lewis Dot Structure
Lewis Dot Structure after an atom has lose (*+ ion*) or gained (*- ion*) e⁻

9