

Bonding

Chemical Bonding

Why haven't you grown up recognizing all of the elements around you? Because most substances are *compounds*. Very few elements are stable enough to exist pure. Instead they react with other elements to form compounds. Why?...

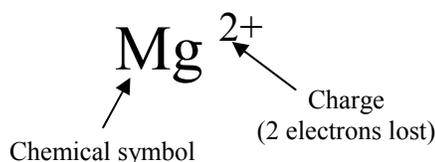
Octet Rule—atoms strive to achieve a full set of valence electrons. This is usually 8 (what are the exceptions). Atoms are more stable with a full outer shell.

To fulfill the octet rule atoms will lose, gain, or share electrons. Atoms will get 8 valence electrons the fastest way: metals will lose electrons; non-metals will gain electrons.

Why? Having a few more protons more than closest noble gas, metals have too much shielding—the electrons don't feel much attraction to the nucleus. Non-metals have more protons and can attract more electrons to the energy level.

Ion Notation Review

Ion—a non-neutral atom (different number of protons and electrons). To find charge or number of electrons, use: **protons—electrons = charge OR $p - e = \text{charge}$**



Cations — positive ions (metals);
Losers of electrons.

Anions — negative ions (non-metals);
Gainers of electrons.

Give the ion notation for an atom with 20 protons and 18 electrons.

Give the ion notation for Sulfur with 18 electrons.

What force will the two above ions feel?
Why?



Ionic Bonds—Bonds of attraction



Ionic bonds occur between *metal* and *non-metal* ions.

By itself sodium is very reactive (it will explode in water).

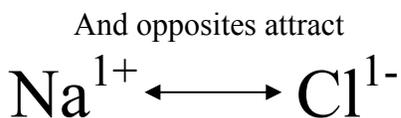
So it loses one electron.

Now, it has a full set of 8 outer electrons. It becomes a positive ion (a cation).

Chlorine (a poisonous gas) has 7 valence electrons so it needs one more to be stable.

So it gains one electron.

Now, it has a full set of 8 outer electrons. It is a ion with a 1+ charge (a cation).



To form a stable compound.



Will these ions make compounds?

Will these elements make ionic compounds?

Mg²⁺ and Li¹⁺? _____ Ca²⁺ and F¹⁻? _____

K and Li? _____ Al and F? _____

Na¹⁺ and O²⁻? _____ O²⁻ and Cl¹⁻? _____

Be and Cl? _____ Fe and O? _____

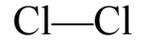
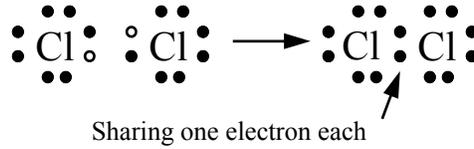
Name: _____

Period: _____

Covalent Bonds—Cooperative Bonding

Covalent bonds happen between two non-metals.

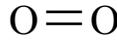
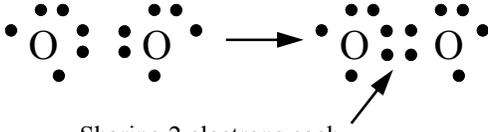
Sometimes there are no opposites around to form ionic bonds (Oh, NO!), but atoms will still find a way to get to that full shell of 8 valence electrons. So instead of gaining extra electrons they **SHARE THEM**. This is called a **COVALENT BOND**.



Sharing one electron each

Short cut notation for a *single* bond.

Each oxygen needs 2 more electrons.



Short cut notation for a *double* bond.

Sharing 2 electrons each

Ionic or covalent bonds?

Draw the covalent bond between 2 Nitrogens:

Draw the covalent bond between 2 Fluorines:

MgO _____ PO₅ _____ CaO _____

CO₂ _____ BeF₂ _____ SO₂ _____

Oxidation Numbers

The ions charges that atoms gain when they lose or gain their valence electrons are the number of electrons they can gain or lose when bonding. We call these Oxidation Numbers.

1		Oxidation Numbers						0	
1 H	2	3	4	3-	2-	1-	2 He		
3 Li	4 Be	5 B	6 C	7 N	8 O	9 F	10 Ne		
11 Na	12 Mg	13 Al	14 Si	15 P	16 S	17 Cl	18 Ar		
19 K	20 Ca	Transition Metals		31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr

Find the Oxidation Numbers for the following:

Be _____ H _____

O _____ He _____

Cl _____ Al _____

N _____ P _____

Li _____ Ar _____

Making Ionic Compounds

You can figure out how to make stable ionic compounds from the oxidation numbers. Lithium (1+) can give 1 electron; Oxygen (2-) needs 2 to be full. So Oxygen needs 2 Lithiums to balance as a compound.

- 1 Li¹⁺ O²⁻ Write the chemical symbols with the oxidation numbers.
- 2 ~~Li¹⁺ O²⁻~~ Cross the numbers not the signs.
- 3 Li₂O Reduce numbers or drop ones.

Ex. Make a balanced ionic compound of Calcium and Oxygen.

1. Ca²⁺ O²⁻ Chemical symbols and oxidation numbers.
2. Ca₂²⁺ O₂²⁻ Cross the numbers not the signs
3. CaO (2s reduce) Reduce numbers and drop ones.

Make ionic compounds from:	
Al and Cl:	Na and S: