

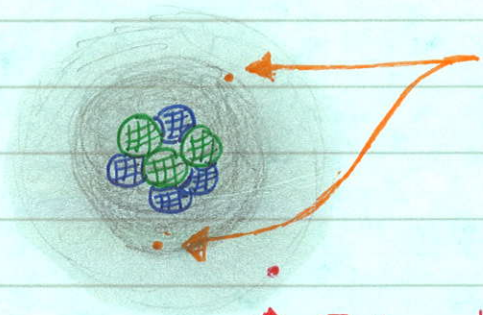
Chapter 4 Elements + Chemical Bonds

4-1

In nature, elements are rarely found in their pure form. Most elements are found naturally in compounds. These compounds are held together by chemical bonds.

In a neutral atom, the number of protons equal the number of electrons... but electrons are in constant motion around the nucleus and well - things can happen.

Li: Atomic # of 3



These electrons are strongly attracted to the nucleus. This is the lowest energy level and can only hold two electrons.

↑ This electron is on the next energy level and is not held as strongly to the nucleus. This outer shell is called the valence - and is where the chemical reaction takes place.

The number of valence electrons in each atom of an element help determine the type and number of bonds it can form.

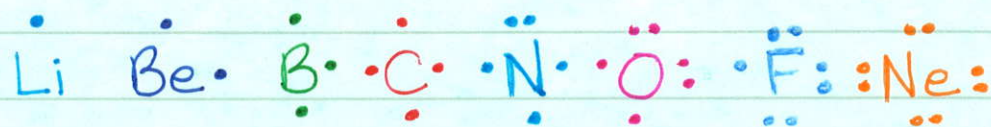
The Periodic Table is great!

Number of valence electrons

1																			18
H	2													13	14	15	16	17	He
Li	Be													B	C	N	O	F	Ne
Na	Mg	3	4	5	6	7	8	9	10	11	12			Al	Si	P	S	Cl	Ar
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn			Ga	Ge	As	Se	Br	Kr
Rb																			Xe

These groups are complicated

Electron Dot Diagrams: (1916- Gilbert Lewis)
A model that represents valence electrons in atoms as dots around a symbol.



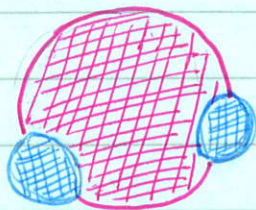
* Remember that helium has a full valence with only two electrons.

The noble gases (group 18) are stable because they have a full valence.

Atoms with unpaired dots are chemically unstable - or reactive.

4-2 Chemical bonds join atoms together.

A covalent bond is formed when two atoms share electrons.



H_2O Oxygen has 6 valence electrons. Hydrogen becomes stable with two valence electrons.

H_2O is a stable compound.

A molecule is a group of atoms held together by covalent bonds.

Single covalent bond $H:H$

Two double covalent bonds $:O::C::O:$

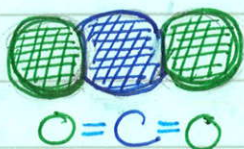
One triple covalent bond $:N:::N:$

Looking at the H_2O example, the oxygen atom attracts the shared electrons more strongly than the hydrogen atoms. The oxygen atom is slightly negative, the hydrogen atoms are slightly positive.

The unequal sharing of electrons results in a polar molecule.

A nonpolar molecule contains atoms that share their valence electrons equally.

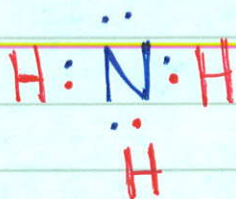
CO_2 is an example. The electrons are pulled equally by the carbon and the oxygen.



A chemical formula is a group of chemical symbols and numbers that represents the elements and the number of atoms of each element required.

NH_3 ← 3 hydrogen atoms
↳ 1 nitrogen atom

} This is one molecule of ammonia!



Is this a polar molecule or a nonpolar molecule?

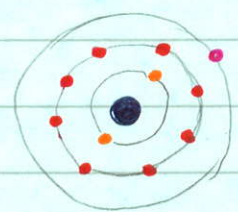
* Notice that nonmetals are involved in forming covalent bonds.

4-3 Ionic bonds!

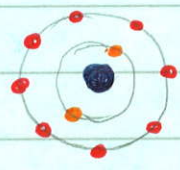
An ion is an atom with an electric charge because it has lost or gained electrons

When a metal and a nonmetal bond, valence electrons from the metal transfer to the nonmetal.

Na

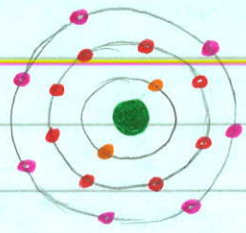


loses its valence electron →

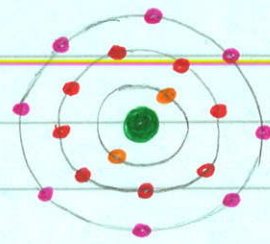


Sodium is now stable, and has a positive charge.

Cl



gains an electron →



Chlorine is now stable, and has a negative charge.

The attraction between positively and negatively charged ions in an ionic compound is an ionic bond.

* ionic bonds between metals and O → oxides

* most other ionic compounds are "salts"

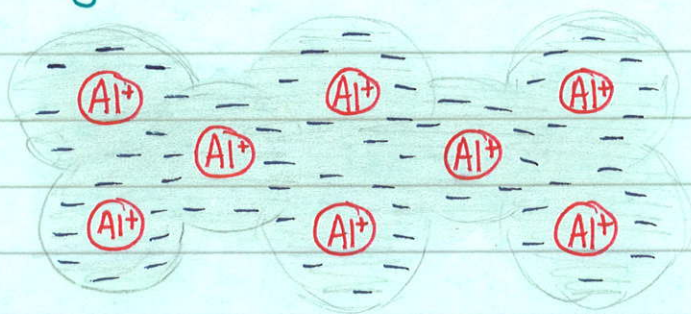
non metal
+
metal
ions

Ionic compounds are usually

- solid
- brittle
- have high melting and boiling points
- dissolve in water
- conduct electricity

Covalent compounds are made up of many molecules.

In an ionic compound, there are no molecules, just lots of oppositely charged ions.



The valence electrons move freely.

metal
ions
+
metal
ions

Metallic Compounds

- solid at room temperatures
- high melting and boiling points
- do not dissolve in water
- good conductors
- shiny
- malleable
- ductile