Compounds

Bonding

- bonding is a chemical change that occurs during chemical reactions.
- There are **three** general ways in which electrons play a role in bonding.

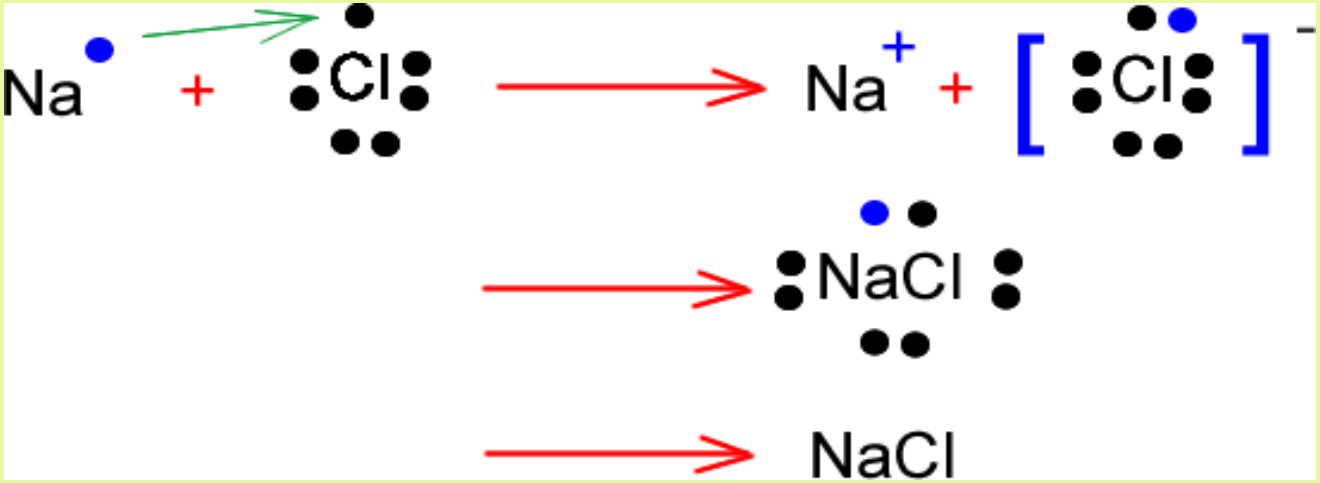
- Electrons can be moved from the atom of one element to another atom of a second element. This is known as **ionic bonding**

- They can be shared between two different atoms or they can be shared among atoms of the same element. This sharing type of bonding is **called molecular or covalent.**

Metallic bonding

- Some elements are surrounded by a cloud of free electrons which are shared among all atoms of the same element.
- takes place in metallic elements and explains the many properties of metals.

Ionic Compounds



- Form between metals and nonmetals
- Positive ions are attracted to negative ions

Properties of Ionic Compounds

- form crystals
- High melting point (all of them are solids at room temp.)
- Solubility (some are; some aren't)
- Conductivity – ionic solutions are conductive; molecular solutions are not
- Ionic compounds that dissolve in water and conduct electricity as solutions are called **electrolytes**

Polyatomic Ions:

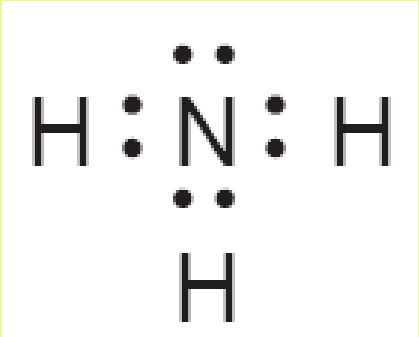
- a cluster of atoms that act collectively as a single ion
- They always act as a single unit in ionic compounds

Table of Polyatomic Ions

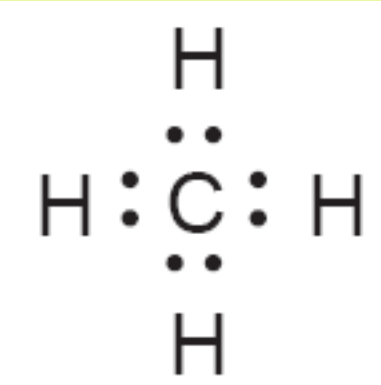
Polyatomic ions									
acetate	CH_3COO^-	hydrogen carbonate	HCO_3^-	cyanide	CN^-	phosphate	PO_4^{3-}	sulfite	SO_3^{2-}
ammonium	NH_4^+	chlorate	ClO_3^-	hydroxide	OH^-	hydrogen phosphate	HPO_4^{2-}	hydrogen sulfide	HS^-
benzoate	$C_6H_5COO^-$	hypochlorite	ClO^-	nitrate	NO_3^-	dihydrogen phosphate	$H_2PO_4^-$	hydrogen sulfate	HSO_4^-
borate	BO_3^{3-}	chromate	CrO_4^{2-}	nitrite	NO_2^-	silicate	SiO_3^{2-}	hydrogen sulfite	HSO_3^-
carbonate	CO_3^{2-}	dichromate	$Cr_2O_7^{2-}$	permanganate	MnO_4^-	sulfate	SO_4^{2-}		

Molecular Compounds

- form between nonmetals only

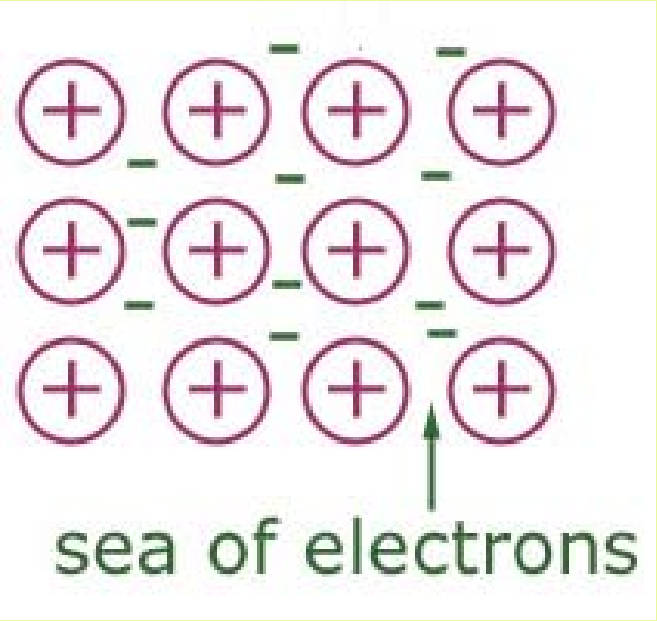


- involves covalent bonds



Metallic Bonds

- Metals high melting points and boiling points which means strong bonds between the atoms.
- The metal is held together by the attraction between the positive nuclei and the valence electrons.
- The electrons can move freely
- Metallic bonding allows metals to conduct heat and electricity, be flexible and malleable



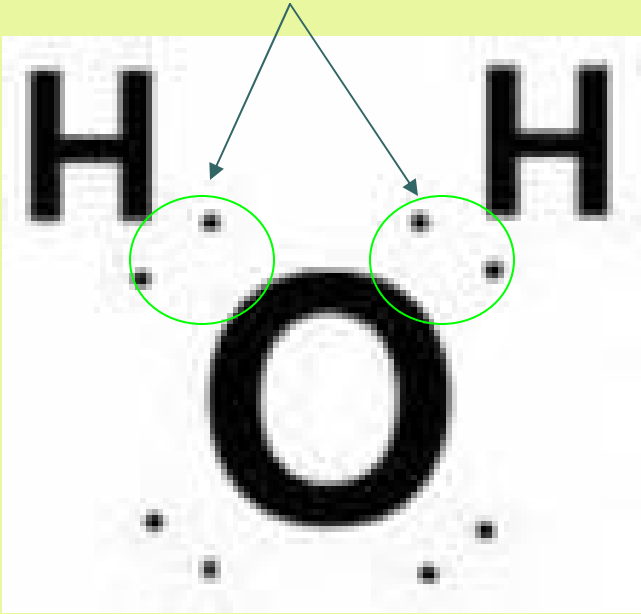
Hydrogen bonds

- In some covalent bonds, the shared electron is closer to the larger atom making that portion of the molecule slightly negative
- A hydrogen atom has only 1 proton so it can’t attract a shared electron as strongly as a larger atom so it becomes slightly more positive

- Hydrogen bonds explain why water has a higher boiling point than other molecular compounds of similar size, it takes a lot of heat to break the H bonds

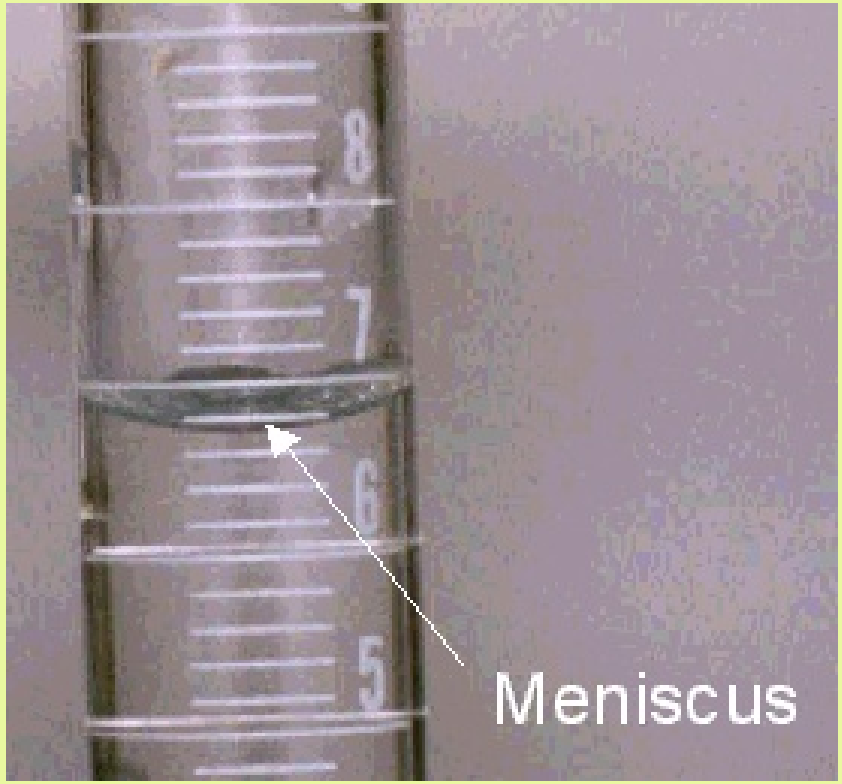
- the oxygen atom attracts the shared electrons more than the hydrogen atoms

Shared electrons are closer to the oxygen atom



This end is slightly negative

- Water has a lot of **cohesion** (water molecules are attracted to each other)
- Water is a polar molecule (a + end and a – end)



Naming Ionic Compounds

- Name of + ion is 1st, followed by the – ion name
- Example: $BaCl_2$

- Barium chloride

NaOH

Sodium hydroxide

$(NH_4)_2CO_3$

Ammonium carbonate

What's the name?

- $CaCO_3$

Calcium carbonate

- $BaHPO_4$

Barium hydrogen phosphate

Formula?

- Lead (II) nitrate

Contains Pb^{2+} and NO_3^- ions

Need 2 nitrate ions to balance the Pb^{2+}

$Pb(NO_3)_2$

SnO_2

Contains 1 Sn ion and two O^{2-} ions

Total of 4- charges, have only 1 metal ion

Charge on tin ion must be 4+

Tin (IV) oxide

Molecular compounds

- Nonmetals only
- Some elements occur as molecules in nature
- See periodic table for the polyatomic elements

Polyatomic Elements

Elements			
astatine	At_2	iodine	I_2
bromine	Br_2	nitrogen	N_2
chlorine	Cl_2	oxygen	O_2
fluorine	F_2	phosphorus	P_4
hydrogen	H_2	sulfur	S_8

Prefixes for Molecular Compounds

1 = *mono*	6 = *hexa-*
2 = *di-*	7 = *hepta-*
3 = *tri-*	8 = *octa-*
4 = *tetra-*	9 = *ennea- (nona-)*
5 = *penta-*	10 = *deca-*

Naming molecules

- SF_2 sulphur difluoride
- CBr_4 carbon tetrabromide
- S_8 sulphur
- O_3 ozone

Diphosphorus trioxide

P_2O_3

Balancing Reactions

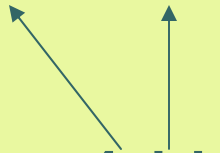
$$KCl + H_2O \rightarrow KOH + H_2 + Cl_2$$

- Need 2 Cl on left side

$$2KCl + H_2O \rightarrow KOH + H_2 + Cl_2$$

- Have 2 K on left, so we put a 2 in front of KOH

$$2KCl + H_2O \rightarrow 2KOH + H_2 + Cl_2$$



4 H

and 2 O

$$2KCl + 2H_2O \rightarrow 2KOH + H_2 + Cl_2$$

Check	Check
2 K	2 K
2Cl	2Cl
4 H	4 H
2 O	2 O

$$LiCl_{(aq)} + Pb(NO_3)_{2\ (aq)} \rightarrow ?$$

$$LiCl_{(aq)} + Pb(NO_3)_{2\ (aq)} \rightarrow LiNO_3 + PbCl_2$$

Balance the nitrate ion first

$$LiCl_{(aq)} + Pb(NO_3)_{2\ (aq)} \rightarrow 2LiNO_3 + PbCl_2$$

$$LiCl_{(aq)} + Pb(NO_3)_{2\ (aq)} \rightarrow 2LiNO_3 + PbCl_2$$

Balance the Li^+ next

$$2LiCl_{(aq)} + Pb(NO_3)_{2\ (aq)} \rightarrow 2LiNO_3 + PbCl_2$$

Check!

Example

- Balance the reaction between copper (I) iodide and lead (II) nitrate.

- $CuI + Pb(NO_3)_2 \rightarrow$ _____ + _____ (find products)

$\rightarrow CuNO_3 + PbI_2$

$$\_\_CuI + \_\_\_Pb(NO_3)_2 \rightarrow \_\_\_CuNO_3 + \_\_PbI_2$$

$$2\ CuI + \_\_\_Pb(NO_3)_2 \rightarrow 2\ CuNO_3 + \_\_PbI_2$$

$$2\ CuI + 1\ Pb(NO_3)_2 \rightarrow 2\ CuNO_3 + 1\ PbI_2$$