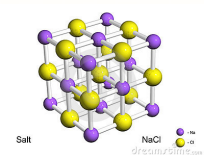
Ion Formation

Na ----------> $Na^+ + e^-$

$1s^2 2s^2 2p^6 3s^1$ $1s^2 2s^2 2p^6$



Cl + e^- ----------> Cl^-

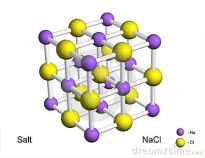
$1s^2 2s^2 2p^6 3s^2 3p^5$ $1s^2 2s^2 2p^6 3s^2 3p^6$

Ion Formation

Na ----------> $Na^+ + e^-$

$1s^2 2s^2 2p^6 3s^1$ $1s^2 2s^2 2p^6$

isoelectronic with Neon



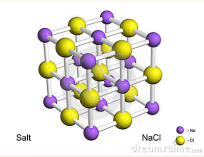
Cl + e^- ----------> Cl^-

$1s^2 2s^2 2p^6 3s^2 3p^5$ $1s^2 2s^2 2p^6 3s^2 3p^6$

isoelectronic with Argon

Ionic Bonding

- Electrons are transferred from a metal to a non-metal
- Held together by strong electrostatic force
- High Melting points



Ionic Bonding

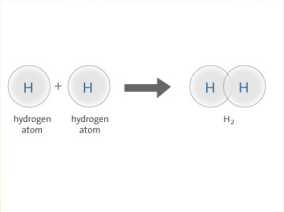
- Metal Non-metal bonds:

Ca^{2+} 2 Cl^- -------> $CaCl_2$

$Cu^+ + s^{2-}$ --------> Cu_2S

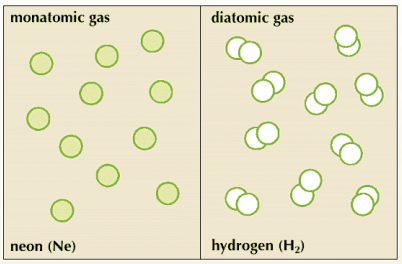
Covalent Bonding

- Electrons are shared (Not lost or gained)
- Usually between two non-metals
- Low Melting points



Covalent Bonding

- Why are Fluorine F2 and Hydrogen H2 diatomic?



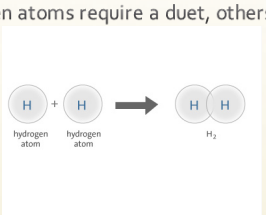
Covalent Bonding

- Goal: Central atom(s) achieve noble gas configuration

  Consider only **valence** electrons

  Pair up all electrons (each pair = 1 bond)

  Hydrogen atoms require a duet, others = **octet**



Lewis Structures

- Hydrogen H_2: each has one valence electron

  H• •H

  When paired, each H shares a duet.

  Fluorine F_2: each F atom begins with 7 valence electrons

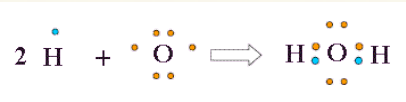
  

  When paired: each F shares an **octet**

Lewis Structures

- Oxygen has 6 valence electrons

- Each Hydrogen has 1 electron

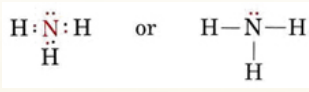


Lewis Structures

- Ammonia NH_3:

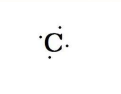
N has 5 valence electrons,

H has 1 valence electron



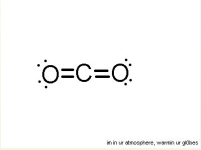
Lewis Structures

- Carbon dioxide CO_2



Carbon has 4 valence e⁻

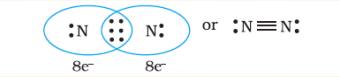
Oxygen has 6 valence e⁻



Lewis Structures

- Nitrogen gas, N_2

Each N has 5 valence e⁻



Lewis Structures

- Draw dot structures for the following:

C_2F_4

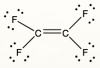
HCN

PCl_3

Lewis Structures

- Draw dot structures for the following:

C_2F_4



HCN

PCl_3

Lewis Structures

- Draw Lewis dot structures for the following molecules:

OF_2

C_2Cl_4

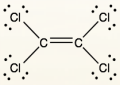
C_2H_2

Lewis Structures

- Draw Lewis dot structures for the following molecules:

OF_2

C_2Cl_4



C_2H_2

Polyatomic Ions

- Positive or negative charge indicates loss or gain of electrons:
- Hydroxide ion  one extra e^-
- Ammonium ion  one less e^-

Polyatomic Ions

- Draw Lewis dot structures for the following ions:

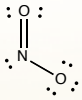
NO_2^-

CN^-

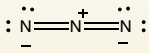
N_3^-

Polyatomic Ions

- Draw Lewis dot structures for the following ions:

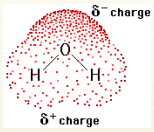
NO_2^- 

CN^- 

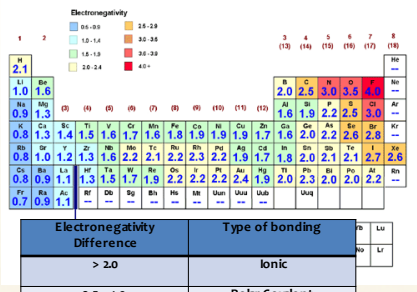
N_3^- 

Polarity

- Most chemical bonds not 100% ionic or 100% covalent
- Polar covalent bond:
  Polarity depends on Electronegativity difference



Electronegativity

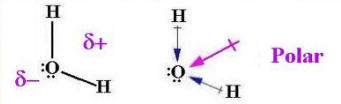


Electronegativity Difference	Type of bonding
> 2.0	Ionic
0.5 – 1.9	Polar Covalent
< 0.4	Covalent

Polarity

- H_2O

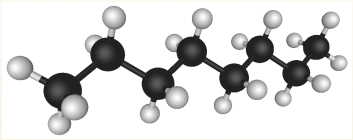
ΔEN = 3.5 – 2.1 = 1.4 O–H polar covalent bond



Polarity

- Octane C_8H_{18}

ΔEN = 2.5 – 2.1 = 0.4 C–H pure covalent



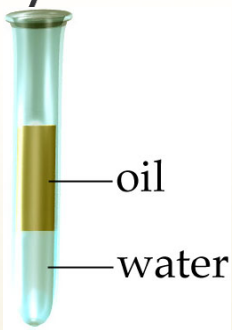
Miscibility

- Oil

  and

  Water

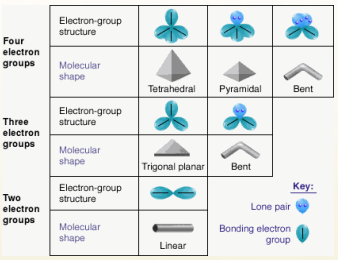
Polar and non-polar do not mix



Molecular Geometry

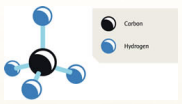
Count the number of bonds

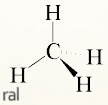
+ nonbonded pairs = 2, 3, 4



Molecular Geometry

- Methane

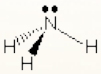




Tetrahedral

Molecular Geometry

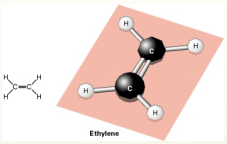
- Ammonia NH_3



Trigonal pyramidal (tetrahedral)

Molecular Geometry

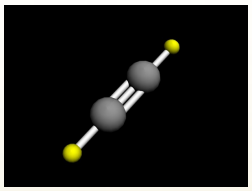
- Ethene C_2H_4
- Multiple bonds count as one



Trigonal planar

Molecular Geometry

- Acetylene C2H2



linear

Molecular Geometry

- Predict the molecular geometry for:

CH_3OH

C_2H_4

C_2H_2

Molecular Geometry

- Predict the molecular geometry for:

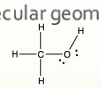
CH_3OH 

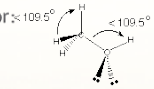
C_2H_4 

C_2H_2

Molecular Geometry

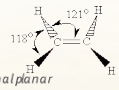
- Predict the molecular geometry for:

CH_3OH 



tetrahedral

C_2H_4 



trigonal planar

C_2H_2

linear

Molecular Geometry

- Predict the molecular geometry for:

H_2CO

CH_3C_2H

N_2O

Molecular Geometry

- Predict the molecular geometry for:

H_2CO

CH_3C_2H

N_2O