TYPES of BONDING

IONIC vs COVALENT vs METALLIC BONDING

- octet rule

  - atoms want same number of electrons as the noble gases (filled or empty valence shell)

  - 2 particles with the same number of electrons are *isoelectronic*

Eg. Ar atom has 18 e^- Cl atom has 17 e^-
Cl^{1-} ion has 18 e^-

Therefore, Ar and Cl^{1-} are isoelectronic.

1. IONIC BONDING

- transfer of electron(s) from metal atom to non-metal atom.

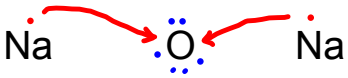
Eg. Lithium & Chlorine

Lewis diagram **[Li]$^{+}$** **[Cl]$^{-}$**

Chemical Formula **Li Cl**

Name **lithium chloride**

Eg. Sodium & Oxygen



Na_2O

sodium oxide

Eg. Magnesium & Sulfur

Eg. Calcium & Nitrogen

Eg. Potassium & Phosphorus

2. COVALENT BONDING

- between non-metal atoms
- both atoms prefer to gain electrons for stable octet, therefore they must share

Eg. Chlorine & Chlorine

Lewis diagram: Cl Cl single bond - share 1 pair of electrons

Structural diagram: Cl Cl

- 2 atoms of the same element --- ***Diatomic molecule***

EXERCISE: Sketch the molecule formed by each pair of atoms.

1. Oxygen & Oxygen

2. Nitrogen & Nitrogen

EXERCISE: Sketch each molecule.

1. H_2O

2. CO_2

3. CBr_4

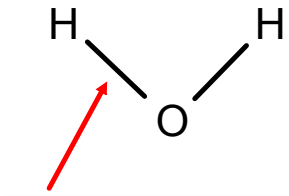
4. NH_3

5. HCN

6. POI

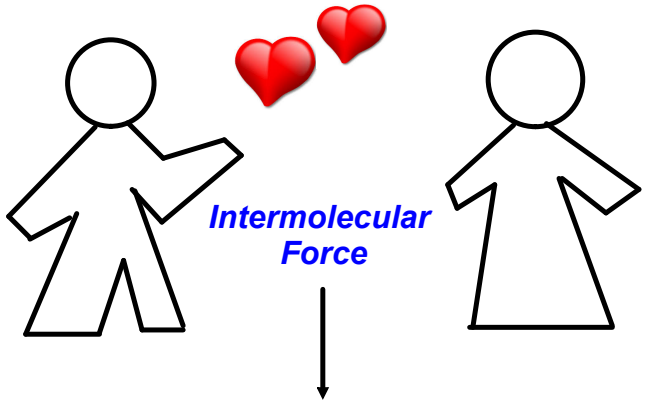
Intramolecular Forces of Attraction

- attraction between atoms of same molecule
- covalent bonds are strong



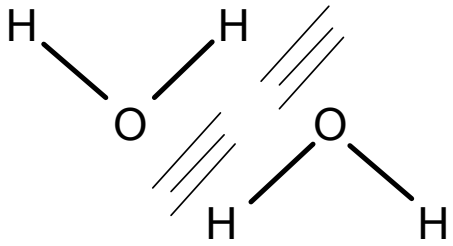
strong covalent bond,
intramolecular force of attraction

Intermolecular Forces of Attraction



attraction between nearby
molecules due to polarity

Eg.



- all covalent compounds have low mp/bp
  compared to ionic compounds
- intermolecular forces are weak
- covalent compounds do not form ions when dissolved in water
- remain neutral, therefore do not conduct electricity

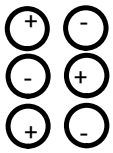
3. METALLIC BONDING

- pure metals & alloys (solid solutions of different metals)

- in metallic bonding, electrons are loosely held and form a shared "pool or sea of negative electrons" between positive nuclei.

    - therefore, easily conduct electricity & heat
    - ductile (hammer into sheets)

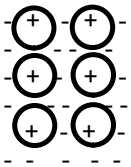
IONIC



when a hammer is used on an ionic compound, ions repel and shatter

- strong lattice structure

METALLIC



when hit with a hammer, atoms slide past one another, just like "grease"

- alloys are a homogeneous mixture of 2 or more metals - they have a uniform composition throughout

Practice Problems

4. For each pair of elements, determine ΔEN.
   - **(a)** magnesium and chlorine
   - **(b)** calcium and chlorine
   - **(c)** lithium and oxygen
   - **(d)** sodium and oxygen
   - **(e)** potassium and sulfur
   - **(f)** calcium and bromine
5. Draw Lewis structures to show how each pair of elements in question 4 forms bonds to achieve a stable octet.

Practice Problems

6. Show the formation of a covalent bond between two atoms of each diatomic element.
   - **(a)** iodine
   - **(b)** bromine
   - **(c)** hydrogen
   - **(d)** fluorine
7. Use Lewis structures to show the simplest way in which each pair of elements forms a covalent compound, according to the octet rule.
   - **(a)** hydrogen and oxygen
   - **(b)** chlorine and oxygen
   - **(c)** carbon and hydrogen
   - **(d)** iodine and hydrogen
   - **(e)** nitrogen and hydrogen
   - **(f)** hydrogen and rubidium

Practice Problems

8. One carbon atom is bonded to two sulfur atoms. Use a Lewis structure to represent the bonds.
9. A molecule contains one hydrogen atom bonded to a carbon atom, which is bonded to a nitrogen atom. Use a Lewis structure to represent the bonds.
10. Two carbon atoms and two hydrogen atoms bond together, forming a molecule. Each atom achieves a full outer electron level. Use a Lewis structure to represent the bonds.