Ch. 8 Notes

Covalent Bonds: formed when atoms share electrons. Shared electrons are part of the outer energy level of both atoms.

* Formed from 2 or more NON-metals

\[
\begin{align*}
\text{NaCl} & \quad \text{CO}_2 \\
\text{metal} & \quad \text{non-metal} \\
\text{Ionic compound} & \quad \text{Covalent (molecular) compound}
\end{align*}
\]

Covalent compounds form to increase stability 

- 2 forces
  - Repulsive: between the nuclei & the e-
  - Attractive: between the nucleus of one atom & e of the other

Covalent bond forms when attractive forces strongest.

\[
\begin{array}{c}
\text{F} \end{array}
\quad \begin{array}{c}
\text{F}
\end{array}
\]

Bonds to form an octet or noble gas configuration.

- "Octet" for hydrogen is 2
- Helium

\[
\begin{align*}
\text{lone pairs} & \quad \text{F} - \text{F} \\
\text{dashed represents} & \quad \text{a shared pair of e} \rightarrow \text{bonded pair}
\end{align*}
\]
Single Covalent Bond - sharing of 2 e−.

Group 17: form one single covalent bond

\[
\text{Cl} - \text{Cl}
\]

Group 16: form 2 single covalent bonds.

\[
\begin{align*}
\text{O} & - \text{H} \\
\text{H} & \\
\text{S} & - \text{F} \\
\text{F} & \\
\end{align*}
\]

Group 15 - form 3 bonds

\[
\begin{align*}
\text{H} & - \text{N} - \text{H} \\
\text{H} & \\
\end{align*}
\]

Group 14: form 4 bonds

\[
\begin{align*}
\text{H} & - \text{C} - \text{H} \\
\text{H} & \\
\end{align*}
\]
Diatomic Molecules - 7 naturally occurring

- Hydrogen H₂
- Chlorine Cl₂
- Nitrogen N₂
- Oxygen O₂
- Fluorine F₂
- Bromine Br₂
- Iodine I₂

Chemical Reactions:

\[ 2H₂ + O₂ \rightarrow 2H₂O \]

Molecular Structures:

- B₃
- PH₃
- H₂S
- HCl
- CCl₄
- SiH₄

C₁–C₁–C₁

Nonpolar Covalent Bonds

- O–O

Polar Covalent Bonds

- O=O

Double & Triple Covalent Bonds

- Double: 4 e⁻ shared (2 pairs)
- Triple: 6 e⁻ " (3 pairs)
**Sigma Bond \( \sigma \) - Single covalent bond**

- When a pair of shared e\(^{-}\) are centered between the two atoms
- Shared e\(^{-}\) are concentrated in the overlapping space between nuclei.

\[ \text{\( s \, s \), \( s \, p \), \( p \, p \)} \]

**Pi Bond \( \pi \)**

- Forms when parallel orbitals overlap.
- Shared e\(^{-}\) are in an area above or below the area centered between nuclei

\[ \text{\( p \), \( p \)} \]

- Multiple bonds
  - 1st is a sigma, rest are pi bonds

\[ \text{\( O = O \), \( N\!\!\overset{\sigma}{\rceil}N \), \( N\!\!\overset{\pi}{\rceil}N \)} \]
Bond Strength:
- Dependent on distance between nuclei
- Distance decreases with increasing # of shared e-
- Shorter bond length = stronger bond.
  strength: Triple > double > single

Energy:
- Energy released when bonds form
- Energy required to break bonds
  Called Bond dissociation Energy
Rules for naming binary molecular compounds
2 elements bonded with covalent bonds
2 non-metals \( \text{ex: N}_2\text{O} \)

1. Name first element, using the entire name
2. Second element ends in ide.
3. Use prefixes to indicate the \# of atoms.

\[\text{Di Nitrogen MonoOxide}\]

Exceptions
- If there is only one first element, can eliminate mono
- If there are two consecutive vowels, can eliminate one

\[\text{SO}_2 \quad \text{Sulfer Dioxide}\]
\[\text{NF}_3 \quad \text{Nitrogen triflouride}\]
\[\text{P}_2\text{O}_5 \quad \text{Diphosphorous Pentoxide}\]
\[\text{CCl}_4 \quad \text{Carbon TetraChloride}\]

Diatomic Elements
\[\text{H}_2 \quad \text{Hydrogen} \quad \text{Cl}_2 \quad \text{Chlorine}\]
\[\text{N}_2 \quad \text{Nitrogen} \quad \text{Br}_2 \quad \text{Bromine}\]
\[\text{O}_2 \quad \text{Oxygen} \quad \text{I}_2 \quad \text{Iodine}\]
\[\text{F}_2 \quad \text{Fluorine}\]
dihydrogen monoxide \( \text{H}_2\text{O} \)  \hspace{1cm} \text{Common Names}  
Chlorine trifluoride \( \text{ClF}_3 \)  \hspace{1cm} \text{H}_2\text{O} - \text{Water}  
Diphosphorus trioxide \( \text{P}_2\text{O}_3 \)  \hspace{1cm} \text{NH}_3 - \text{Ammonia}  
Disulfur decafluoride \( \text{S}_2\text{F}_{10} \)  \hspace{1cm} \text{CH}_4 - \text{Methane}  
Bromine \( \text{Br}_2 \)  

**Naming Acids:**  
Acids - Substance that produces hydrogen ions (H⁺) in solution.  
- **Binary Acids** - H⁺ and a monoatomic anion  
  1. First word is prefix "hydro" with the root of the anion with a suffix of "ic".  
  2. Second word is Acid.  
  Ex: HCl  Hydrochloric Acid  
      HBr  Hydrobromic Acid  
- **Oxyacids** - H⁺ and an oxyanion (polyatomic anion with oxygen)  
  1. "ite" : root of anion with suffix "ous" followed by "acid"  
     Ex: HNO₂  Nitrous Acid  
  2. "ate" : root of anion with suffix "ic" followed by "acid".  
     Ex: HNO₃  Nitric Acid
HI  Hydroiodic Acid  Phosphoric Acid  \(\text{H}_3\text{PO}_4\)  
HClO₃  Chloric Acid  Nitrous Acid  \(\text{H}_2\text{NO}_2\)  
HClO₂  Chlorous Acid  Hydrofluoric Acid  \(\text{H}_2\text{F}^-\text{F}^-\)  
H₂SO₄  Sulfuric Acid  Carbonic Acid  \(\text{H}_2\text{CO}_3\)  
H₂S  Hydro sulfurous Acid

Bases:
Compounds that produce \(\text{OH}^-\) (hydroxide ions) in solution
Named like any ionic compound
Ex: NaOH  Sodium hydroxide  
Ba(OH)₂  Barium hydroxide