Unit B
Bonding

1. **Ions** – charged species. (rearrangement of e’)
   - Cations - positive
   - Anions - negative

Octect Rule

Noble gases are extra stable because they have eight valence e’. The p orbitals are filled. All other elements want to achieve the noble gas e’ configuration.

Positive ions-

Na loses 1 e’ to become Na+ 1s^22s^22p^63s^1 ------ 1s^22s^22p^6 + 1e’
Negative Ions-

\[ \text{S}\ 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^4\ \rightarrow\ 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6 \]

\[ \text{Same as Ne} \]

N gains 3e' to become N\(^3^-\) \[ 1s^2\ 2s^2\ 2p^3\ +\ 3e' \]

Group number will determine the number of electrons given up or accepted

Group electrons

<table>
<thead>
<tr>
<th>Group</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Charge</td>
<td>+1</td>
<td>+2</td>
<td>+3</td>
<td>-3</td>
<td>-2</td>
<td>-1</td>
</tr>
</tbody>
</table>

Metals take on positive charges, Non-metals negative charges

Examples \( \text{H}^+ \), \( \text{Be}^{2+} \), \( \text{Al}^{3+} \), \( \text{N}^{3-} \), \( \text{S}^{2-} \), \( \text{Cl}^- \)

Exception is H that can be \( \text{H}^+ \) or \( \text{H}^- \), in water \( \text{H}^+ = \text{H}_2\text{O}^- \)

2. Ionic Compounds – metal (left of periodic table, positive) + non-metal (right of periodic table, negative)

Positive and negative ions come together to form a compound. Ionic bond. Physical properties- usually form solid crystals and are poor conductors.
Ex.

\[ \text{K.} + :\text{Br:} \quad K^+ + \text{Br}^- \quad \text{KBr} \]

\[ \text{Ca:} + :\text{F:} \quad \text{Mg}^{2+} + \text{Cl}^- \quad \text{MgCl}_2 \]

\[ \text{Al:} + :\text{Cl:} \quad \text{Al}^{3+} + \text{Cl}^- \quad \text{AlCl}_3 \]

Write subscripts when doing ionic compounds they do not change. Two wheels per bike.

3. **Covalent Compounds** - sharing of e’, two non-metals

Look at Cl each atom want one more e’, neither wants to form a positive charge.

\[ \vdash \vdash \vdash + \vdash \vdash \vdash \rightarrow \vdash \vdash \vdash \vdash \]

Diatomic- \( X_2 \), other diatomic molecules Group 7 (F\(_2\),Cl\(_2\), Br\(_2\))and N\(_2\), O\(_2\), H\(_2\)

Look at NH\(_3\)
Covalent bonds- Non-metal, non-metal

<table>
<thead>
<tr>
<th>Group Number</th>
<th>Valence e’</th>
<th>Covalent bonds (neutral molecule)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
<td>3</td>
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<tr>
<td>6</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>7</td>
<td>7</td>
<td>1</td>
</tr>
</tbody>
</table>

Must full fill octet

Can have multiple bonds.
Ex. $\text{CO}_2$

\[ \ddot{\text{O}}=\text{C}=\ddot{\text{O}} \]

Ex. $\text{C}_2\text{H}_2$

\[ \text{H}–\text{C}=\text{C}–\text{H} \]

4. Exceptions to the octet.

a. $\text{NO}$ \quad $\text{NO}_2$

\[ \ddot{\text{N}}=\ddot{\text{O}} \quad \ddot{\text{O}}=\ddot{\text{N}} \]

b. The filling of D orbitals

\[
\begin{array}{ll}
\text{F} & \text{F} \\
\text{F} & \text{F} \\
\text{F} & \text{F} \\
\end{array}
\]

\[ 10 \text{ e}' \]

\[
\begin{array}{ll}
\text{F} & \text{F} \\
\text{F} & \text{F} \\
\text{F} & \text{F} \\
\end{array}
\]

\[ 12 \text{ e}' \]

c. Fewer than 8 e’.

\[
\begin{array}{ll}
\text{F}–\text{Be}–\text{F} \\
\text{F} & \text{F} \\
\text{F} & \text{F} \\
\end{array}
\]

\[ 4 \text{ e}' \]

\[
\begin{array}{ll}
\text{F} & \text{Be} \\
\text{F} & \text{F} \\
\end{array}
\]

\[ 6 \text{ e}' \]

5. Polarity- only with covalent bonds. (two non-metals)

Polar if unequal sharing on electrons, a net dipole moment, unsymmetrical e’ cloud.

\[ \text{F–F} \quad \text{share equally} \]

\[ \text{H–F} \quad \text{share un-equally} \]

Depends on electronegativity- amount an element attracts e’ pairs. (look at periodic table) F has the highest at 4.0. C H bonds are declared non-polar.
Ex. C-Cl

6. Metallic bonds- attraction between negative and positive metal ions delocalized e⁻.

metals combine to form a sort of mixture- properties dependent on concentration.

Brass- Cu and Zn
Bronze- Cu and Sn

One or more elements is an alloy.