Introduction to Bonding

Bonding Terminology

Bond Length = $\sum$ (Covalent Radii)
Introduction To Bonding

Foundational Thoughts

- Chemical bonds are attractive forces which hold atoms together to form compounds.
- These attractive forces are created when the valence electron clouds from two atoms interact with each other.
- There are several types of bonds which can form.
- The type of bond which forms depends on the characteristics of the atoms which are interacting......
  - Metal with a Non-Metal
  - Non-Metal with a Non-Metal
  - Metal with a Metal

Introduction To Bonding

Metal with a Non-Metal

- What are the chemical properties of metals?
- What are the chemical properties of non-metals?
- What do you think will happen when they react together?
Introduction To Bonding

Metal with a Non-Metal

- Ionic Bonding
  - A strong non-metal steals electrons from a weak metal
  - Ions are formed
  - These ions then attract to form a **salt**
    - A compound which contains ionic bonds

\[\begin{align*} +1 & \quad -1 \\ \text{Lithium} & \quad \text{Fluorine} \end{align*}\]

Lithium Fluoride Salt
Introduction To Bonding

Non-Metal with a Non-Metal

• What are the chemical properties of non-metals?
• What do you think will happen when 2 react together?
• There are two possible results
  • Equal Sharing
  • Unequal Sharing

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Non-Metal with a Non-Metal

• Non-Polar Covalent Bonding
  • Two atoms of the same non-metal
  • Equal Sharing
  • Forms **non-polar molecules**

Fluorine

Fluorine
Introduction To Bonding

Non-Metal with a Non-Metal

- Non-Polar Covalent Bonding
  - Two atoms of the same non-metal
  - Equal Sharing
  - Forms **non-polar molecules**

Fluorine  Fluorine

Non-Polar F₂ Molecule
Introduction To Bonding

Non-Metal with a Different Non-Metal

- Polar Covalent Bonding
  - Different non-metals close enough in strength that they share
  - This sharing is unequal - creates dipoles
    - Partial charge on a bond caused by unequal sharing
  - Forms polar molecules

Oxygen

Fluorine

Oxygen

Fluorine
Introduction To Bonding

Non-Metal with a Different Non-Metal

- Polar Covalent Bonding
  - Different non-metals close enough in strength that they share
  - This sharing is unequal - creates dipoles
  - Partial charge on a bond caused by unequal sharing
- Forms polar molecules

\[ \text{Oxygen} \quad \text{Polar O-F Molecule} \quad \text{Fluorine} \]

\[ \delta^+ \quad (\text{Positive Dipole}) \quad \delta^- \quad (\text{Negative Dipole}) \]

Introduction To Bonding

Metal with a Metal

- What are the chemical properties of metals?
- What do you think will happen when they react together?
Introduction To Bonding

Sea of Electrons

<table>
<thead>
<tr>
<th>Type of Bond</th>
<th>Formed By</th>
<th>Mode of Formation</th>
<th>Properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ionic</td>
<td>A metal &amp; a non-metal</td>
<td>-Electron transfer, creating ions which attract</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>-Forms <strong>Salts</strong> NaCl CaI₂</td>
<td>-ions in all phases</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>-solids insulate</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>-solids have high melting points</td>
</tr>
<tr>
<td>Covalent</td>
<td>2 non-metals</td>
<td>-Sharing electrons</td>
<td>-no ions</td>
</tr>
<tr>
<td></td>
<td>same - nonpolar, different - polar</td>
<td>-Forms <strong>Molecules</strong> CO₂ H₂O sugar, fats, proteins</td>
<td>-low melting pt</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-insulate in all phases</td>
</tr>
<tr>
<td>Metallic</td>
<td>atoms of metals</td>
<td>Delocalized sea of electrons around weak nuclei</td>
<td>-conduct</td>
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<td></td>
<td></td>
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<td>-ductile</td>
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<td>-malleable</td>
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<td>-shiny</td>
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<td></td>
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<td>-high melting pt</td>
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</tbody>
</table>