Chemical Bonding: Diagnostic Assessment

- Read the introduction on page 222. This gives a good outline about what the chapter will cover, as well as why this field of chemistry is important in everyday life.

- Examine the list of expectations in the margin on page 222. These are the learning goals for the chapter.

- Read the *REFLECT on your learning* questions, # 1-3, page 222. At this point in your learning, can you answer any of these, in part, or completely?

- As we work through the six sections, take note of any Application topics which grab your interest in this chapter. Check the list of proposed topics for the S.T.S.E. assignment. Start to form a research plan and begin thinking about a suitable presentation product for your chosen topic.

- Topics for review:
  - elements versus compounds (defining characteristics)
  - ionic bonding versus covalent bonding (formation)
  - ionic compounds versus molecular compounds (properties)

- Answer # 3, 8 - 10 pages 158, 159 to diagnose your current level of understanding on chemical bonding.
### Instructional Master 2.3A

**Bonding Capacity of Some Common Atoms and Comparison of Ionic and Molecular Solids**

**Table 1: Bonding Capacities of Some Common Atoms**

<table>
<thead>
<tr>
<th>Atom</th>
<th>Number of valence electrons</th>
<th>Number of bonding electrons</th>
<th>Bonding capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>carbon</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>nitrogen</td>
<td>5</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>oxygen</td>
<td>6</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>halogens</td>
<td>7</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>hydrogen</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

**Table 2: Comparison of Ionic and Molecular Solids**

<table>
<thead>
<tr>
<th>Properties</th>
<th>Ionic</th>
<th>Molecular</th>
</tr>
</thead>
<tbody>
<tr>
<td>Melting point</td>
<td>high</td>
<td>low</td>
</tr>
<tr>
<td>Electrical conductivity in the solid state</td>
<td>no conductivity</td>
<td>no conductivity</td>
</tr>
<tr>
<td></td>
<td>conductivity</td>
<td>conductivity</td>
</tr>
<tr>
<td>Consistency of solid</td>
<td>hard, brittle</td>
<td>soft, waxy or flexible</td>
</tr>
<tr>
<td>Examples</td>
<td>sodium chloride</td>
<td>iodine</td>
</tr>
<tr>
<td></td>
<td>copper(II) sulfate</td>
<td>phosphorus</td>
</tr>
</tbody>
</table>
Ionic Bonding

An electron is transferred from sodium to chlorine in the formation of an ionic bond.
**Summary of Drawing Lewis Structures**

1. Arrange the symbols of the elements of the compound as you would expect the atoms to be arranged in the compound. The element with the highest bonding capacity is generally written in the central position (Figure 2(a)).

2. Add up the number of valence electrons available in each of the atoms (Figure 2(b)). If the structure is a polyatomic ion, add one electron for each unit of negative charge, or subtract one for each unit of positive charge.

3. Place one pair of electrons between each adjacent pair of elements (forming single covalent bonds) (Figure 2(c)).

4. Place pairs of the remaining valence electrons as lone pairs on the peripheral atoms (not the central atom) (Figure 2(d)).

5. If octets are not complete, move lone pairs into bonding position between those atoms and the central atom until all octets are complete (Figure 2(e)).

6. If the peripheral atoms all have complete octets and there are pairs of electrons remaining, place these electrons as lone pairs on the central atom.

7. Count the number of bonds between the central atom and the peripheral atoms. If this number exceeds the bonding capacity of the central atom, one or more of the bonds is coordinate covalent. To identify which ones, try removing the peripheral atoms one at a time. If you can do this and leave the central structure with complete octets, you have identified coordinate covalent bonds (Figure 2(f)).

8. To give the structural formula, remove the dots representing the lone pairs and replace bond dots with dashes (Figure 2(g)).

![Figure 2](image-url)
4.1 Lewis Theory of Bonding

- Review the Lewis theory of bonding, starting with definitions of ionic and covalent bonding, followed by the key ideas of the Lewis theory (page 224).

- Define the following and write down other key terms from section 4.1 that you feel are important.
  - valence
  - stable octet
  - bonding electrons
  - coordinate covalent bond

- Review the "Rules of Drawing Lewis Structures" on page 225. (Be aware that there are exceptions to these rules: H, B, others)

- Read "Lewis Structures and Quantum Mechanics" on page 226.

- Read Sample Problem on page 226, then do #1, 3 - 5 on page 227.

- Read Sample Problem on page 228 and Examples 1 and 2 on page 229.

- Paraphrase the summary entitled "Procedure for Drawing Lewis Structures.

- Answer # 10 - 12 on page 229 and # 2, 4 on page 230.