Chapter 1: Structure and Bonding

- Draw valid Lewis structures and count formal charge.
- Draw valid resonance structures
  - Identify major and minor resonance structures, and draw resonance hybrids.
- Draw molecules using condensed and skeletal structures
  - Differentiate between resonance structures and isomers
  - Determine a compound’s molecular geometry using VSEPR theory
- Draw organic molecules given their molecular formulas
- Assess the relationship between bond length and bond strength
- Predict polarity of molecules based on bonding and shape.
- Identify types of bonds in a molecule (sigma, pi).
- Identify types of orbitals used to make bonds.

Chapter 2: Acids and Bases

- Identify a compound as acidic, basic, or amphoteric.
- Differentiate between different acid and base definitions.
- Predict the products of an acid-base reaction
  - Identify all reaction components.
- Compare relative acidities using pKa values.
- Predict to which direction the equilibrium will lie for an acid-base reaction.
- Predict relative strengths of acids and bases using molecule structure. Remember:
  - Element: What element is the potential acidic H attached to
  - Hybridization: If all other things are equal, what is the hybridization of the atom directly attached to the acidic H
  - Resonance: Is the conjugate base stabilized by resonance?
  - Inductive: Electron-withdrawing elements nearby, but NOT directly attached to the acidic H

Chapter 3: Introduction to Organic Molecules and Functional Groups

- Recognize and identify common functional groups.
- MEMORIZATION ALERT: You will need to memorize functional group general structures and names.
➢ Identify the three intermolecular forces: Van der Waals, Dipole-Dipole, and Hydrogen bonding.
  ○ Be able to compare the strengths of these three forces.
➢ Rank molecules by their boiling point and melting point.
➢ Determine if a molecule is water soluble.
➢ Identify the electrophilic and nucleophilic sites within a molecule.

Chapter 1: Structure and Bonding

1. For each column of the table below, provide the missing Lewis structure and/or skeletal structure.

<table>
<thead>
<tr>
<th>Condensed Structure</th>
<th>(CH₃)₂CHNO₂</th>
<th>(CH₃CO)₂O</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lewis Structure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Skeletal Structure</td>
<td>NO₂</td>
<td></td>
</tr>
</tbody>
</table>
2. Label formal charges. Draw all resonance structures, showing electron movement and formal charges. Then draw the resonance hybrid.
   a.

   ![Chemical structure](image)

   b.

   ![Chemical structure](image)

3. Shown below is the skeletal structure for nicotine:

   ![Chemical structure](image)

   a. Are the indicated bonds nonpolar or polar?
Chapter 2: Acids and Bases

4. Identify the most acidic proton (H+) and most basic lone pair. Draw the products of the Bronsted-Lowry acid-base reactions. Label the acid, base, conjugate acid, and conjugate base. Determine which side of the equilibrium is favored.

a.

\[
\begin{align*}
\text{CH}_3\text{O}^+ & \quad \text{OH}^- \\
\text{CH}_3\text{O}^- & \quad \text{CH}_3\text{O}^+ \\
\end{align*}
\]

b.

\[
\begin{align*}
\text{H}_2\text{C} & \quad \text{NH}_2^- \\
\text{H}_3\text{C} & \quad \text{NH}_2^- \\
\end{align*}
\]
5.  
   a. Rank the following by acidity.

   ![Chemical structures A, B, C, D]

   b. Rank the following by basicity.

   ![Chemical structures A, B]

6. For each reaction, label the lewis acid, lewis base, nucleophile, and electrophile. Use curved arrow notation to show the movement of electrons and draw the product.

   a) 

   ![Chemical reaction diagram]
Chapter 3: Introduction to Organic Molecules and Functional Groups

7. Identify the functional groups in the following molecule. Note the classification (primary, secondary, tertiary, etc.) where appropriate.

8. What types of intermolecular forces are exhibited by each molecule? Which of the following molecules can hydrogen bond with another molecule like itself?

a)
9. Rank the following molecules in terms of:
   a) Increasing boiling point
      i) A
      b) B
      c) C
      d) D

   ii) A
      b) B
      c) C
b) Increasing melting point

Label the nucleophilic and electrophilic sites of each molecule.

a)

\[
\begin{align*}
&\text{Nucleophilic:} \\
&\text{Electrophilic:}
\end{align*}
\]

b)

\[
\begin{align*}
&\text{Nucleophilic:} \\
&\text{Electrophilic:}
\end{align*}
\]

c)

\[
\begin{align*}
&\text{Nucleophilic:} \\
&\text{Electrophilic:}
\end{align*}
\]