What?
Functional groups are particular arrangements of atoms that frequently occur in molecular structures. These functional groups have their own names (alcohol, ester, alkene, etc.) and they often are the basis of organizing organic chemistry.

Why?
The structure, reactivity and synthesis of a functional group are often very similar in different compounds. That is, the –OH group in methanol (\(\text{CH}_3\text{OH}\)) has essentially the same reactivity in most reactions as the –OH group in cholesterol (\(\text{C}_{27}\text{H}_{45}\text{OH}\)), whose molecular structure is quite different from methanol.

1. Draw 5 different compounds with the molecular formula = \(\text{C}_6\text{H}_{12}\text{O}\), and identify all of the functional groups present in your compounds, and arrange them into different families of organic compounds (e.g. alcohols, ketones).

2. Choose, and redraw, any three compounds from problem 1, and discuss how IR spectroscopy could be used to distinguish them from each other.

Common IR Absorptions

<table>
<thead>
<tr>
<th>Functional Group</th>
<th>Absorption Range</th>
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</thead>
<tbody>
<tr>
<td>Alcohol: O-H (stretching)</td>
<td>3590-3650 cm(^{-1})</td>
</tr>
<tr>
<td>Alkynyl: C≡C (stretching)</td>
<td>2100-2260 cm(^{-1})</td>
</tr>
<tr>
<td>Alkenyl: =C-H (stretching)</td>
<td>3010-3095 cm(^{-1})</td>
</tr>
<tr>
<td>Alkyl: -C-H (stretching)</td>
<td>2853-2962 cm(^{-1})</td>
</tr>
<tr>
<td>Aldehyde: C=O (stretching)</td>
<td>1620-1680 cm(^{-1})</td>
</tr>
<tr>
<td>Alcohol/Ether: C-O (stretching)</td>
<td>1020-1275 cm(^{-1})</td>
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</tbody>
</table>

3. List all of the noncovalent intermolecular interactions experienced by each of the three compounds from problem 2. Then, arrange these compounds in order of increasing boiling points.

4. Acetone (\(\text{CH}_3\text{COCH}_3\)) is a common low boiling organic compound that is unusual because it is a good solvent for organic compounds and is miscible with water. Draw the best Lewis structure of acetone showing all the bonds and non-bonding electrons.

5. Although acetone is a neutral compound it can act as both a base and acid to give two reactive intermediates. Draw the two most stable resonance structures for each of these reactive intermediates (I and II) clearly showing all bonds, all non-bonding electrons and formal charges. Circle the most stable resonance structure for each intermediate and give a reason for your choice.

\[
\begin{align*}
\text{CH}_3\text{COCH}_2^- + \text{H}^+ & \rightarrow \text{CH}_3\text{COCH}_3 \\
\text{acetone} & \rightarrow \text{CH}_3\text{COCHCH}_3^- \\
\end{align*}
\]

6. The anion (I) reacts with H\(^{+}\) to give two products. Give the structures of these two products showing all non-bonded electrons.

\[
\begin{align*}
\text{CH}_3\text{COCH}_2^- + \text{H}^+ & \rightarrow 2 \text{ products, both with the formula C}_3\text{H}_5\text{O} \\
\end{align*}
\]

7. Are these two compounds from problem 6 constitutional isomers (different connectivities)?