1. Consider the somewhat related structures of acetone (2-propanone) and acetic acid. One way to look at these molecules would be to say that they differ only in the replacement of a \(-\text{CH}_2-\) group with an \(-\text{O}-\) atom. This seemingly small difference in structure has a very large effect on the physical properties of these two molecules.

\[
\begin{align*}
\text{H}_3\text{C} & \quad \text{O} \\
\text{CH}\text{CH}_3 & \quad \text{H}_3\text{C} \quad \text{O} \\
\text{MW} & = 58 \quad \text{MW} = 60 \\
p\text{Ka ca. 20} & \quad p\text{Ka ca. 5}
\end{align*}
\]

(a) Acetic acid is much stronger acid than acetone (pKa 5 vs. 20). Draw the structures for the conjugate bases of acetic acid and acetone, show all important resonance structures, and briefly describe why the difference in acidity is so large.

\[
\begin{align*}
\text{Acetate Amin is greatly stabilized by resonance because 2 structures are equal contributors - Negative charge is spread } & \frac{1}{2} + \frac{1}{2} \text{ between two electronegative oxygens.} \\
\text{In contrast, the enolate anion of acetone is best resonance structure has negative charge on oxygen, but the 2nd best resonance } & \text{structure has negative charge on less electronegative carbon. Charge is mainly on one oxygen in the acetate enolate } \\
& \text{and thus is less stable than having charge spread over 2 oxygens in acetate anion.}
\end{align*}
\]
(b) Despite their very similar molecular weights, acetic acid has a much higher boiling point than acetone (118 °C vs. 56 °C). What properties of acetic acid account for this large boiling point difference? Draw a structure that illustrates one of these special features.

Hydrogen bonding is very important for acetic acid and is not possible for acetone.

\[
\begin{align*}
\text{CH}_3 - & \quad \text{C} \quad - \quad \text{O} \\
\downarrow & \\
\text{O} & \quad \text{H} & \quad \text{...} & \quad \text{O}
\end{align*}
\]

2. Salicylic Acid can be converted into either methyl salicylate (oil of wintergreen) or into acetylsalicylic acid (aspirin). What reagents and reaction conditions can be used for each transformation. Write "electron pushing" mechanisms for both of these reactions.

\[
\begin{align*}
\text{Methyl Salicylate} & \quad \text{excess} \quad \text{CH}_3\text{OH} \\
\text{Salicylic Acid} & \quad \text{H}^+ \\
\text{Acetylsalicylic Acid}
\end{align*}
\]
3. Draw structures for the major organic products of the following reactions. (It is not necessary to write a balanced equation with respect to reagents and inorganic products.)

(a) 

(b) 

(c) 

(d) 

(e) 

4. (a) Write the products of the base catalyzed hydrolysis of the amine shown below.

(b) Write a reaction for the synthesis of this amide by a reaction that makes a new N-C bond.