1. Predict the pKa values for the following compounds.

\[
\text{OH} \quad \text{H} \quad \text{N} \quad \text{O} \quad \text{O}
\]

Knowing the pKa values, suggest a method to quantitatively form the following product.

\[
\begin{array}{c}
\text{O} \\
\text{O}
\end{array} \quad \xrightarrow{\text{B}^-} \quad \begin{array}{c}
\text{O} \\
\text{O}
\end{array}
\]

Explain how to form the isomeric product quantitatively.

\[
\begin{array}{c}
\text{O} \\
\text{O}
\end{array} \quad \xrightarrow{\text{B}^-} \quad \begin{array}{c}
\text{O} \\
\text{O}
\end{array}
\]

Draw the mechanism for the following transformation using a generic base (B-).

\[
\begin{array}{c}
\text{O} \\
\text{O}
\end{array} \quad \xrightarrow{\text{B}^-} \quad \begin{array}{c}
\text{O} \\
\text{O}
\end{array}
\]

Even though the pKa for an ester is higher than a ketone, explain why the reaction shown can occur quantitatively with an alkoxide base yet the ketone alkylations shown above cannot occur with an alkoxide base.

Which alkoxide base should be used in this reaction? Why?
2. An $\alpha,\beta$-unsaturated ketone can react in either a 1,2- or 1,4-addition (Michael) with a nucleophile.

\[
\begin{align*}
\text{RC} &= \text{O} \quad \text{NUC} \\
\text{O}N &\quad \text{RC} \\
\text{O} \quad \text{NUC}
\end{align*}
\]

Draw a mechanism for either type of reaction.

Whether a reaction occurs with 1,2- or 1,4-addition selectively often depends on the stability of the nucleophilic anion. A more stable anion occurs with 1,4 selectivity while a less stable anion occurs with 1,2 selectivity. Predict which is favored with the following nucleophiles.

\[
\begin{align*}
\text{O} &\quad \text{O} & \quad \text{N} \\
\text{O} &\quad \text{O} & \quad \text{CH}_3\text{MgBr} \\
\text{N} &\quad & \quad (\text{CH}_3)_2\text{CuLi}
\end{align*}
\]

Realizing the preference for 1,2 or 1,4-addition with various nucleophiles, indicate two procedures to form the following product using a Michael addition. In both cases, use methyl vinyl ketone (MVK) as the electrophile and use two different nucleophiles. Explain your choice of nucleophiles.

\[
\begin{align*}
\text{RC} &= \quad ? \\
\text{O} &\quad \text{O}
\end{align*}
\]