1. Write structural formulas for all the aldehydes and ketones of the molecular formula $C_4H_6O$.

   a) Are any of these compounds stereoisomers?
   b) Are any of these compounds chiral?
   c) Which of these are conjugated ketones or aldehydes?
   d) Which of these can be prepared by an aldol condensation?

2. Certain groups other than carbonyl groups can enhance the acidity of $\alpha$-hydrogens. Three such groups are nitro, cyano and sulfonyl. Write resonance structures for the anions derived from each of the following compounds by loss of an $\alpha$-hydrogen.

\[
\begin{align*}
\text{Nitro:} & \quad \text{Resonance 1} \\
\text{Cyano:} & \quad \text{Resonance 2} \\
\text{Sulfonyl:} & \quad \text{Resonance 3}
\end{align*}
\]
3. Show how you would accomplish the following transformation. Show the intermediate isolable products. More than one step is required.

a)

![Ketoester transformation](image1)

b)

![Formaldehyde transformation](image2)

4. Give the product(s) and the mechanism.

a)

![Esterification](image3)

b)

![Hydrolysis](image4)

a conjugated aldehyde
5. The following questions address the stereochemical aspects of the alkylation of 2-methylcyclohexanone.

\[
\begin{array}{c}
\text{O} \\
\text{1. LDA} \\
\text{2. Br} & \text{Ph} \\
\text{Ph} & \text{O} \\
\text{52\%} & \text{O} \\
\text{7\%} & \text{Ph} \\
\end{array}
\]

a) Which of the products are chiral?

b) How many stereoisomers, including enantiomers and diastereomers, are possible for each of the products?

c) If the reactant is a racemic mixture, will either of the products be optically active, if so, which ones?

d) If the reactant is optically active, will either of the products be optically active, if so, which ones?

6. Terreic acid is a naturally occurring antibiotic substance. Its actual structure is an enol isomer of the structure shown. Write all theoretically possible enol forms of terreic acid. Which is the actual structure (the most stable one)? This antibiotic was isolated in 1949 and its structure was not determined till the advent of NMR in 1958.