1. (a) (2 pts. ea.) Identify whether the following reactions will occur via an \( S_N1 \) or an \( S_N2 \) mechanism and (b) (5 pts. ea.) predict the products of the following substitution reactions. Remember to consider stereochemistry where appropriate.

i.

\[
\begin{align*}
&\text{Br} & \text{OH} \\
&\text{Br} & \text{DMSO}
\end{align*}
\]

ii.

\[
\begin{align*}
&\text{Br} & \text{CH}_3\text{O}^- & \text{DMSO} \\
&\text{Br} & 
\end{align*}
\]

2. Draw a mechanism for the following reaction.

\[
\begin{align*}
&\text{Br} & \text{EtOH} & \Delta \\
&\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3 \\
\end{align*}
\]

3. (8 pts.) Draw the product(s) of an E2 reaction on the following molecule.

\[
\begin{align*}
&\text{Br} \\
&\text{Br}
\end{align*}
\]
4. (8 pts.) Explain the product distribution in the following reaction.

![Reaction diagram]

5. (10 pts.) Using any alkyl halide and any alkoxide make the following molecules. If more than one route is possible, full credit will be awarded to the better route.

a. ![Molecule diagram]

b. ![Molecule diagram]

6. a. (6 pts. ea.) Predict the product(s) for the following E2 reactions.

b. (2 pts. ea) Identify the major product in each reaction.

i. ![Reaction diagram]

ii. ![Reaction diagram]
7. a. (6 pts. ea.) Predict the product(s) for the following E1 reactions.
   b. (2 pts. ea.) Identify the major product in each reaction.
   
   i. \[ \text{HO-CH} \rightarrow \text{H}_3\text{PO}_4/\text{H}_2\text{SO}_4 \]
      \[ \Delta \text{H}_2\text{O} \]

   ii. \[ \text{Br} \rightarrow \text{OH} \]

8. a. (2 pts. ea.) Identify the reaction type, and
   b. (4 pts. ea.) predict the product(s) in each of the following reactions.
   
   i. \[ \text{Br} \rightarrow \text{OH} \]

   ii. \[ \text{Br} \rightarrow \text{CH}_3\text{ONa} \]
      \[ \text{THF} \]

   iii. \[ \text{Br} \rightarrow \text{OH} \]
      \[ \Delta \]