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.

a. 

\[ \text{I} \overset{\text{CH}_3\text{O}^-}{\text{THF}} \]

b. 

\[ \text{Br} \overset{\text{CH}_3\text{CH}_2\text{OH}}{\text{Br}} \]

c. 

\[ \text{Cl} \overset{\text{NaI}}{\text{acetone}} \]

d. 

\[ \text{Br} \overset{\text{H}_2\text{O}}{\text{Br}} \]

2. (2 pts. ea.) When dissolved in ethanol, which is the better nucleophile?

a. \( \text{SH}^- \) or \( \text{OH}^- \)

b. \( \text{NH}_3 \) or \( \text{PH}_3 \)

c. \( \text{SH}^- \) or \( \text{Cl}^- \)

3. (2 pts. ea.) When dissolved in THF, which is the better nucleophile?

a. \( \text{SH}^- \) or \( \text{OH}^- \)

b. \( \text{NH}_3 \) or \( \text{PH}_3 \)

c. \( \text{SH}^- \) or \( \text{Cl}^- \)
4. a. (6 pts.) Draw the product(s) of an E1 reaction on the following molecule (you do not have to draw chair or boat structures).

\[
\begin{array}{c}
\text{Br} \\
E1 \\
\end{array}
\]

b. (6 pts.) Draw the product(s) of an E2 reaction on the following molecule (you do not have to draw chair or boat structures).

\[
\begin{array}{c}
\text{Br} \\
E2 \\
\end{array}
\]

5. (10 pts.) Draw a mechanism that accounts for the product in the following reaction.

\[
\begin{array}{c}
\text{Br} \\
H_2O \\
\end{array}
\]

6. (6 pts. ea.) Predict the product(s) of each of the following E2 reactions and identify the major product for the reaction in 6b.

a. 

\[
\begin{array}{c}
\text{Br} \\
(\text{CH}_3)_2\text{CHOH} \\
\end{array}
\]

b. 

\[
\begin{array}{c}
\text{O}^- \\
(\text{CH}_3)_2\text{CHOH} \\
\end{array}
\]
7. (a) (2 pts. ea.) Identify the reaction type, and (b) (4 pts. ea.) predict the product(s) in each of the following reactions.

a. 
\[
\text{CH}_3\text{OH} \quad \text{CH}_3\text{ONa} \quad \text{DMSO}
\]

b. 
\[
\text{Br} \quad \text{CH}_3\text{ONa} \quad \text{DMSO}
\]

c. 
\[
\text{Br} \quad \text{CH}_3\text{ONa} \quad \text{THF}
\]

d. 
\[
\text{Br} \quad \text{CH}_3\text{OH} \quad \text{hot}
\]