1. Give the product(s) for the following reactions. Show stereochemistry in 3-D when appropriate and all stereoisomers.

\[
\begin{align*}
\text{Br} & \quad \text{Cl}_2 \\ 
\text{H}_2 & \quad \text{Pd/C} \\
\text{Br} & \quad \text{OK} \\
\text{H}_2\text{SO}_4 & \quad \text{H}_2\text{O} \\
\text{Cl} & \quad \text{CH}_3\text{OH}
\end{align*}
\]

2. Show how you would accomplish the following synthesis. More than one step is required. Show intermediate isolated products along the way.

\[
\begin{align*}
\text{Br} & \quad \text{K}^+\text{Bu} \\ 
\text{H}^+\text{Bu} & \\
\text{Br} & \quad \text{NaI}
\end{align*}
\]
3. Give the mechanism of the following reaction showing electron-pushing arrows and all intermediates.

4.(a) Write the mechanism of the following reaction.

(b) Is the rate of the reaction faster, slower or the same when done with CH₃CH₂OH as solvent? Why?

The reaction will be slower. CH₃CH₂OH is a polar protic solvent, which will solvate the nucleophile (SCN) well. This encumbers the nucleophile, causing it to react more slowly with alkyl bromide.

*CH₃CH₂OH may also act as a nucleophile and its use as a solvent will result in additional products.
5. (a) Which would you expect to react faster in a E2 reaction with NaOH, trans-4-tert-butyl-1-bromocyclohexane or cis-4-tert-butyl-1-bromocyclohexane? Why?

(b) Draw the mechanism and product(s) for the faster of the two reactions.

(c) Write an expression for the rate law of the reaction. Use "k" for the rate constant.

\[
\text{Rate} = k [\text{cis-4-tert-butyl-1-bromocyclohexane}][\text{HO}^-]
\]

6. (a) Draw a mechanism for the reaction shown below. Be sure to account for the formation of both stereoisomers.

(b) Is the reaction unimolecular or bimolecular?

unimolecular

(c) Write an expression for the rate law of the reaction. Use "k" for the rate constant.

\[
\text{Rate} = k [\text{R-3-bromo-3-methylhexane}]
\]