Questions 1. Starting with (S)-3-methyl-2-propanol, provide structures A-H for the following reactions. Pay attention to stereochemistry where appropriate.
Question 2. When *cis*-1-iodo-2-methylcyclohexane (A) is treated with potassium tert-butoxide, 1-methylcyclohexene (B) is formed as the major product (reaction 1). However, when *trans*-1-iodo-2-methylcyclohexane (C) is treated with potassium tert-butoxide, 3-methylcyclohexene (D) is formed (reaction 2) and the reaction proceeds more slowly than does reaction 1. Explain why the observed products are formed in reaction 1 and 2 and why reaction 2 proceeds more slowly.

\[ \text{Me} \quad \text{I} \quad \text{Me} \quad \text{CH}_3 \quad \text{OK} \]
\[ \text{CH}_3 \quad \text{Me} \quad \text{I} \quad \text{Me} \quad \text{CH}_3 \]

(1)

\[ \text{faster} \]

\[ \text{A} \quad \rightarrow \quad \text{B} \]

(2)

\[ \text{slower} \]

\[ \text{C} \quad \rightarrow \quad \text{D} \]

E2 elimination can only occur from axial iodide (needs anti-coplanar hydrogen atom)

Only this hydrogen is anti-coplanar with the leaving group

E2 elimination can only occur from axial iodide (needs anti-coplanar hydrogen atom)

*Compound C reacts more slowly because it must react through its diaxial conformation, which is much higher energy. At any given time only a small percentage of the molecules of C are in the diaxial conformation.*
Question 3. Explain the major difference in reactivity between the following pair of reactions:

- Hydroxide is a strong base and a moderate nucleophile. Elimination (E2) can be favored on secondary substrates.
- Bromide is a moderate nucleophile but a weak base. Substitution ($S_N^2$) will be favored on secondary substrates.