1. Draw *trans*-1,2-cyclohexanediol.

2. Rank the following compounds in order of increasing boiling point.
   A. CH₃CH₂OCH₃  B. CH₃CH₂CH₂OH  C. (CH₃)₂CHOH

3. Draw the organic product of the following substitution reaction.
   \[
   \text{CH}_3\text{CH}_2\text{CH}_2\text{Br} + \text{OH}^- \rightarrow
   \]

4. There are two routes to form this ether:
   - Route 1: CH₃CH₂OH + ______________________
   - Route 2: CH₃CH₂Br + ______________________

5. Draw the mechanism and major product of the reaction:
   \[
   \text{Br} \quad \text{OH} \quad \text{NaH} \quad \text{DMF} \quad \text{C}_6\text{H}_{10}\text{O} \quad \text{H}_2 \quad \text{NaBr}
   \]
6. Draw the products and a stepwise mechanism for the following reaction:

\[
\text{Cyclic molecule} \xrightarrow{TsOH} \text{Product}
\]

7. Draw a stepwise mechanism for the following reaction.

\[
\text{Cyclohexanol} \xrightarrow{\text{H}_2\text{SO}_4} \text{Product}
\]

8. Draw a stepwise mechanism for the following reaction:

\[
\text{Phenylmethyl alcohol} \xrightarrow{\text{H}_2\text{SO}_4} \text{Product}
\]
9. Show the more stable carbocation that forms through a 1,2-shift.

\[ \text{structure} \]

10. Draw the product and mechanism of the following reaction:

\[ \text{structure} \rightarrow \text{structure} \]

11. Draw a stepwise mechanism for the following reaction.

\[ \text{structure} \rightarrow \text{structure} \]

12. Draw a stepwise mechanism for the following reaction.

\[ \text{structure} \rightarrow \text{structure} \]

13. If the reaction of an alcohol with \( \text{PBr}_3 \) follows an \( \text{S}_\text{N}2 \) mechanism, what is the stereochemistry of the alkyl bromide formed from (2R)-2-butanol? Select the single best answer.

A. R  
B. S
14. Draw the organic product of the following reaction.

![Reaction](image)

15. Draw the products of the following reaction. Be sure to indicate stereochemistry.

![Reaction](image)

16. Draw the structure of one of the products when the following ether is treated with HBr.

\[(\text{CH}_3)_2\text{CH}–\text{O}–\text{CH}_2\text{CH}_3\]

17. The cis and trans isomers of 2,3-dimethyloxirane both react with \(\text{OH}^-\) to give 2,3-butanediol. One stereoisomer gives a single achiral product, and one gives two chiral enantiomers. Which epoxide gives one product?

![Epoxides](image)
18. Design a synthesis of (S)-3-azido-2-methylpentane from the indicated starting material.

\[
\text{H} \quad \text{N}_3 \quad \text{H} \quad \text{OH}
\]

19. Design a synthesis of cis-2-methylcyclopentyl acetate from the indicated starting material.

\[
\text{H} \quad \text{CH}_3 \quad \text{O}_2\text{CCH}_3 \quad \text{H} \quad \text{H} \quad \text{OH}
\]