1. (8) a. Provide complete IUPAC names.

\[
(\text{R})-2\text{-chlorobutane}
\]

b. Rank by increasing \(\lambda_{\text{max}}\).

\[
\begin{array}{ccc}
\text{highest} & \text{2} & \text{lowest}
\end{array}
\]

c. Circle all aromatic compounds.

\[
\begin{array}{ccc}
\text{A} & \text{B} & \Delta
\end{array}
\]

2. (9) Draw a reaction coordinate for the reaction of 1,3-cyclohexadiene with Cl\(_2\), including the energy of two major products. Draw the molecular structure of the two major products beside their respective energies, and circle the product that would form in the greatest amount if the reaction was carried out at -72°C.

3. (9) Briefly explain which of the following is the best approach to the target molecule.

Proposal A:

\[
\begin{align*}
\text{CH}_3\text{Br} + \text{CH}_3\text{O}^- & \rightarrow \text{CH}_3\text{OCH}_3 \\
\text{subst. only}
\end{align*}
\]

Proposal B:

\[
\begin{align*}
\text{CH}_3\text{O}^- + \text{Br} & \rightarrow \text{CH}_3\text{Br} \\
\text{elim+ subst.}
\end{align*}
\]

Proposal B would have elimination competing w/ subst.
Proposal A would give only subst. + ... is better
4. (10) Give a complete and detailed mechanism for the following reaction.

5. (12) Identify the relationship between each pair of molecules and write it on the line below the pair. Choose from identical, constitutional isomers, conformers, enantiomers or diastereomers.

- diastereomers
- identical
- diastereomers
- enantiomers
6. (24) Do 2 of the following 3 problems—your choice. You can complete the problems on this page or the following blank page.
   
a. Clearly explain why only one product is formed in the following reaction, and identify that product.

   
   \[
   \text{TsO} \quad \text{Et} \quad \overset{\text{O'Na}^+}{\text{DMSO, } \Delta} \quad \text{TsO} \quad \text{Et} \quad \overset{\text{O'Na}^+}{\text{DMSO, } \Delta}
   \]

   
b. Synthesize

   

   from

   

c. Compound A (C_{15}H_{19}O) is an optically active alcohol that absorbs UV light but does not react with H\textsubscript{2}/Pd. When treated with H\textsubscript{3}PO\textsubscript{4} and heat, it forms Compound B, which has a \( \lambda\text{max} \) greater than that of Compound A. When treated with ozone followed by a reductive workup, Compounds C and D are formed. Complete the following table based on this information. Show your reasoning for full credit.

<table>
<thead>
<tr>
<th>Compound</th>
<th>Structure</th>
<th>Optically Active?</th>
<th>UV Absorbance?</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td><img src="image" alt="Structure A" /></td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>B</td>
<td><img src="image" alt="Structure B" /></td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>C</td>
<td><img src="image" alt="Structure C" /></td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>D</td>
<td><img src="image" alt="Structure D" /></td>
<td>N</td>
<td>Y</td>
</tr>
</tbody>
</table>
a. E2: in theory

\[ \text{products } H \text{ anti to } \text{J} \]

Only circled H is anti

b. 

\[ \text{Product forms, even though less stable} \]

* Have to O₃ before Birch reduction or you clear all dB.
7. (28) Provide the missing major products. **Include stereochemistry where relevant.** If no reaction would occur, simply write "N.R." in place of products.

\[
\text{TMSO} + \text{CN} \xrightarrow{\Delta} \text{CN} \xrightarrow{H^+} \text{CN}
\]

\[
\text{Na/NH}_3 \quad \text{NBS, hv} \quad \text{NaCN} \quad \text{NaCN}
\]

\[
\text{NaCN} \quad \text{CH}_3\text{OH} \quad \text{KMnO}_4, \text{H}^+ \quad \text{H}_2\text{O}, 100 \degree \text{C}
\]

\[
\text{NaNH}_2 \quad \text{Br} \quad \text{NaOH}_{\text{aq}} \quad \text{Cl}_2, \text{hv}
\]

\[
\text{NR} \quad \text{NR}
\]

\[
\text{NR}
\]

\[
\text{NR}
\]