This is a closed book and note examination. If boxes are provided for your answer, only what is written in the boxes will be graded. You have 50 minutes to complete the test.

<table>
<thead>
<tr>
<th>Page</th>
<th>Points</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>
1. Name or draw the structures for the following molecular compounds including stereochemistry when possible. (2 pts each):

- 3-pentyl-6-hepten-2-ol
- 3-pentyhept-6-en-2-ol
- (E)-2-bromo-4-methyl-3-hexene
- 2-isopropyl-3-ethyl-2-methyloxirane
- 4-methyl-1,5-octadiyne
2. Rate the relative nucleophilicity from least to greatest (1-4, 1 being the least nucleophilic). (1 pt each):

\[
\begin{align*}
\text{4} & \quad \text{1} & \quad \text{3} & \quad \text{2}
\end{align*}
\]

3. Rate the relative basicity from greatest to least (1-4, 1 being the most basic). (1 pt each):

\[
\begin{align*}
\text{2} & \quad \text{4} & \quad \text{1} & \quad \text{3}
\end{align*}
\]

4. Label each C-C double bond as cis (C), trans (T), E, or Z. (1 pt each)

\[
\begin{align*}
\text{T} & \quad \text{Z} & \quad \text{E} & \quad \text{C}
\end{align*}
\]
5. Draw each of the monochlorinated products of the following reaction (6 pts).

\[
\begin{align*}
&\text{CH}_2=\text{CH}-
\end{align*}
\]

\[
\text{Cl}_2, \text{hv}
\]

\[
\begin{align*}
&\text{CH}_2=\text{CH}-
\end{align*}
\]

\[
\text{Cl}
\]

\[
\text{CH}_2=\text{CH}-
\]

\[
\text{Cl}
\]

6. Draw the monobromination products for the following reaction (6 pts).

\[
\begin{align*}
&\text{CH}_2-\text{CH}=\text{CH}-
\end{align*}
\]

\[
\text{NBS, hv}
\]

\[
\begin{align*}
&\text{Br} \quad \text{CH}_2=\text{CH}=\text{CH}-
\end{align*}
\]

\[
\text{Br}
\]

\[
\text{Br} \quad \text{CH}_2=\text{CH}=\text{CH}-
\]

Bonus: Draw the two resonance hybrids that lead to the above products (4 pts).
7. Fill in the boxes with the appropriate reagents, products, and responses (2 pts each).

\[
\text{HBr} \rightarrow \text{Br} \rightarrow \text{KO} \rightarrow \text{Br} \rightarrow \text{most stable alkene} \rightarrow \text{O}_3 \rightarrow \text{Si(CH}_3)_2
\]

\[
\text{H}_2 \text{Lindlar's cat} \rightarrow \text{OH} \rightarrow \text{Na, NH}_3
\]

\[
\text{Show Stereochemistry}
\]

\[
\text{HO} \rightarrow \text{H}_2\text{SO}_4
\]

\[
\text{CrO}_3 \rightarrow \text{H}_2\text{SO}_4 \rightarrow \text{H}_2\text{O}
\]

Bonus: Name this reaction. Jonas oxidation
8. Draw products of the following reactions after 1,2-alkyl or 1,2-hydride shifts. (2 pt each) Then, identify the type of 1,2 shift (1 pt each).

\[
\text{\begin{align*}
\text{Cyclohexanone} & \xrightarrow{\text{HBr}} \text{Bromo compound} \\
\text{2-Bromo-2-methylpropane} & \xrightarrow{\text{HO}^-} \text{2-Methyl-2-propanol or 2-Methyl-2-propanone} \\
\text{Ethene} & \xrightarrow{\text{H}_2\text{O}, \text{H}_2\text{SO}_4} \text{Hydroxy compound} \\
\text{Cyclopentanone} & \xrightarrow{\text{H}_2\text{SO}_4} \text{Ring expanded product}
\end{align*}}\]

9. Indicate the correct product or diethyl tartrate (DET) used in the reaction where necessary. (2 pts)

\[
\text{\begin{align*}
\text{Z-Butenedioic acid} & \xrightarrow{\text{Ti(OOPr)}_4, \text{BuOOH}, (-)-DET} \text{AS} \\
\text{E-Butenedioic acid} & \xrightarrow{\text{Ti(OOPr)}_4, \text{BuOOH}, (+)-DET} \text{AS} \\
\text{Cyclohexanol} & \xrightarrow{\text{Ti(OOPr)}_4, \text{BuOOH}, (-)-DET} \text{AS} \\
\text{Cyclopentanol} & \xrightarrow{\text{Ti(OOPr)}_4, \text{BuOOH}, (+)-DET} \text{AS}
\end{align*}}\]
10. Fill in the boxes with the appropriate products (2 pts each) and indicate whether the reaction is addition, substitution, elimination, oxidation, or reduction (1 pts each). Though a reaction may fit more than one classification, only put one.

- [Diagram with reactions and products]
  - Reduction or substitution
  - Reduction or addition
  - Addition or oxidation
  - Addition
  - Substitution
  - Elimination
11. Draw the mechanism for the following tautomerization (6 pts).

\[
\begin{align*}
\text{1,2-hydride shift} \quad &\quad \text{one of two products} \\
\end{align*}
\]

Bonus: How many RMB are in the product? (2 pts)
12. Devise a synthesis for the following molecule using the given starting material. (6 pts)