A. Nomenclature: (15 points)
Give an acceptable IUPAC name for each of the compounds in 1 and 2. Be sure to indicate the stereochemistry where appropriate. Following the required conventions, draw a proper Fischer projection for the compound in 3.

1. \[ \text{H}_3\text{C} \quad \text{H}_3\text{C} \]
   \[ \text{CH}_3 \quad \text{CH}_3 \]
   \[ (1R) \text{ or } (R) \]
   \[ -1\text{-cyclopropyl-1,3,3-trimethylcyclopentane} \]

2. \[ \text{H} \quad \text{Br} \quad \text{L} \quad \text{L} \quad \text{H} \]
   \[ (1E) \text{ or } (E) \]
   \[ -2\text{-bromo-1-cyclohexyl-3-ethylnonadiene} \]

3. (4S,5S)-2,2,5-tribromo-4-ethyl-5-methylnonane
   proper Fischer: 1
Facts: Total points = 29

1. In the box draw the lower energy transition state for the process below. (4pts.)

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R₂C=CR₂ + H-Br \[\text{slow} \rightarrow \text{RDS}\] H⁺ + R₂C-Br₂ \[\text{fast} \rightarrow \text{R₂C-Br₂}\]
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2. Place the following alkenes in order of increasing stability. (1=least stable, 3=most stable) (3 pts.)

2  
1  
3

3. Place the following halides in order of increasing reactivity in an E1 process. (1=least reactive, 3=most reactive) (3 pts.)

2 gives 1° ct  
1 gives vinyl  
3 gives 3° ct and res. stab.

4. Place the following alkanes in order of increasing BDE for the bond indicated. (1=lowest BDE, 3=highest BDE) (3 pts.)

3 gives 1° radical  
2 gives 1° radical  
1 gives 2° radical

form s most stable radical
5. Label each of the following pairs as identical, structural isomers, enantiomers or diastereomers. (9 pts.)

a. \[
\begin{align*}
\text{CH}_2\text{CH}_3 & \quad \text{CH}_2\text{CH}_3 \\
\text{H} & \quad \text{OH} \\
\text{H} & \quad \text{O} \quad \text{H} \\
\text{C} & \quad \text{OH} \\
\text{CH}_2\text{CH}_3 & \quad \text{CH}_2\text{CH}_3
\end{align*}
\]

\[\text{identical}\]

b. \[
\begin{align*}
\text{CH}_3\text{CH}_2 & \quad \text{C} \quad \text{H} \\
\text{CHO} & \quad \text{H} \\
\text{OH} & \quad \text{O} \quad \text{H} \\
\text{CH}_3\text{CH}_3 & \quad \text{CH}_3
\end{align*}
\]

\[\text{enantiomers}\]

c. \[
\begin{align*}
\text{H} & \quad \text{OH} \\
\text{CHO} & \quad \text{H} \\
\text{CO}_2\text{H} & \quad \text{H}_3\text{C} \\
\text{CH}_3 & \quad \text{OH}
\end{align*}
\]

\[\text{diastereomers}\]

6. Label the compound below as chiral or achiral. (3 points)

\[\text{chiral}\]

7. In the box provided, place the letter of the reaction with the faster rate. If the rate is the same, write "same" in the box. (4 pts.)

a) \[
\begin{align*}
\text{Br} & \quad \text{Br} \\
\text{I} & \quad \text{I} \\
\text{SN}_2 & \quad \text{I} \\
\text{NaI} / \text{H}_2\text{O} & \quad \text{protic}
\end{align*}
\]

b) \[
\begin{align*}
\text{Br} & \quad \text{Br} \\
\text{I} & \quad \text{I} \\
\text{NaI} / \text{acetone} & \quad \text{aprotic}
\end{align*}
\]

Answer: b
C. Reactions: Total = 36 points → 6 points each
Please provide an organic product in each answer box. If only one box is provided, give the major product. Be sure your drawing indicates stereochemistry if applicable.

1. \[ \text{Br} \rightarrow \text{CH}_3 \]
   \[ \text{NaCN (excess)} \]
   \[ \text{CH}_3\text{CN} \]
   \[ \text{neither react} \]
   \[ \text{3°} \]
   \[ \text{SN}_2 \]

2. \[ \text{H}_3\text{C} \rightarrow \text{Br} \]
   \[ \text{SYN} \]
   \[ \text{CH}_3\text{O}^-\text{Na}^+ \]
   \[ \text{CH}_3\text{OH} \]
   \[ \text{strong base} \]

3. \[ \text{NBS / light} \]
   \[ \text{Note: NBS = N-bromosuccinimide} \]

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4. Reaction with bulky base $\text{E}_2$ for substitution:
- Major: less substituted
- Minor: more substituted

5. Reaction in protic solvent with weak $\text{Nu}$:
- Reaction with $\text{CH}_3\text{OH}$ at $\text{Sn}_1$
- 3° halide

6. Reaction with small, strong base $\text{E}_2$:
- Small alkene
- Elimination of wrong Cl
D. Mechanism: (10 points)
The reaction presented below produces several products. Provide clear mechanisms to explain the formation of the two products shown. Use curved arrows to indicate "electron flow". Remember to show only one step at a time. Show all intermediates and all formal charges. Please do not show transition states.
E. Synthesis: (10 points)
Synthesize the molecule below from cyclohexane, alkanes of four carbons or less, and any inorganic reagents. (Please do not include mechanisms!)

\[ \begin{array}{c}
\text{Br} - \text{C}_6\text{H}_11 + \text{C}_2\text{H}_5\text{OH} \\
\uparrow \text{NBS} / \text{light} \\
\text{Br} - \text{C}_6\text{H}_10 \\
\uparrow \text{KOH} / \text{any strong base} \\
\text{Br} - \text{C}_6\text{H}_12 \\
\uparrow \text{Br}_2 / \text{light} \\
\text{C}_6\text{H}_12 \\
x = \\
\end{array} \]