NAME:

There are six questions on this test. You are allowed to use molecular models but nothing else. A periodic table is provided at the end of the exam.

<table>
<thead>
<tr>
<th>Question</th>
<th>Points</th>
<th>Possible</th>
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<tbody>
<tr>
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<tr>
<td>total</td>
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</tbody>
</table>
1. Rank the following series by the trend requested.
   a.(15) Rank the following compounds by rate of S_N1 reactivity. Molecule that will react the fastest in an S_N1 reaction is 1 while the slowest is 5.

   ![Cl] ![Br] ![Cl] ![Cl] ![I]

   _______ _______ _______ _______ _______

   b.(15) Rank the following compounds by radical stability. The most stable radical is 1 while the least stable radical is 5.

   ![C] ![CH3] ![CH3] ![CH2] ![CH3]

   _______ _______ _______ _______ _______

   c.(15) Rank the following compounds by anion stability. The most stable anion is 1 while the least stable anion is 5.

   ![CH3O] ![CH3NH] ![CH3CH2] ![CH3C] ![CH3CHCH3]

   _______ _______ _______ _______ _______
2. Provide answers for the following halogenation questions.
   a. (7) Supply the correct monobromination product.
   
   \[ \text{[Chemical Structure]} \rightarrow \text{Br}_2, \text{hv} \]

   b. (7) Supply the correct monobromination product.
   
   \[ \text{[Chemical Structure]} \rightarrow \text{Br}_2, \text{hv} \]

   c. (7) Supply the correct monobromination product.
   
   \[ \text{[Chemical Structure]} \rightarrow \text{Br}_2, \text{hv} \]

   d. (9) Supply all monochlorination products.
   
   \[ \text{[Chemical Structure]} \rightarrow \text{Cl}_2, \text{hv} \]

   e. (5) In part d would the rate be faster or slower if a monofluorination was attempted instead of the monochlorination?
3. (8 pts each) Supply the correct product for the following reactions. Only supply one structure representing the preferred pathway. Indicate any regio or stereochemistry as required.

a. 
\[
\begin{array}{c}
\text{H}_3\text{CH}_2\text{C} \quad \text{Br} \\
\text{H} \quad \text{CH}_3 \\
\text{H} \quad \text{CH}_2\text{CH}_3
\end{array}
\xrightarrow{\text{NaOCH}_3}
\]

b. 
\[
\begin{array}{c}
\text{H}_3\text{C} \quad \text{Br} \\
\text{H} \quad \text{H} \\
\text{H} \quad \text{H}
\end{array}
\xrightarrow{\text{NaOCH}_3}
\]

c. 
\[
\begin{array}{c}
\text{Br} \quad \text{CH}_3
\end{array}
\xrightarrow{\text{NaOC(CH}_3)_3}
\]

d. 
\[
\begin{array}{c}
\text{Br} \quad \text{Br}
\end{array}
\xrightarrow{\text{KI}}
\]

e. 
\[
\begin{array}{c}
\text{Br} \quad \text{CH}_3
\end{array}
\xrightarrow{\text{AgNO}_3} \quad \text{CH}_3\text{OH}
\]
f. \[
\text{CH}_3\text{I} \rightarrow \text{CH}_3\text{SNa}
\]
g. \[
\text{Br(CH}_2\text{CH}_2\text{CH}_2\text{Br)} \rightarrow \text{NaOCH}_3
\]
h. \[
\text{Cl(CH}_2\text{CH}_2\text{CH}_2\text{Cl)} \rightarrow \text{NaI}
\]
i. \[
\text{Br(CH}_2\text{CH}_2\text{CH}_2\text{Br)} \rightarrow \text{CH}_3\text{NH}_2\text{excess}
\]
j. \[
\text{Cl(CH}_2\text{CH}_2\text{CH}_2\text{Cl)} \rightarrow \text{CH}_3\text{CH}_2\text{OH} \Delta
\]
4. (15) Indicate how the following molecule can be synthesized starting with an alkyl halide. Need to show what reagents will produce this product with the quickest rate.

\[ \text{[diagram of molecule]} \]

5. (15) The starting material shown, 1-propanol, can be converted to 1-bromopropane with HBr. When 1-propanol is reacted with NaBr, however, no reaction occurs.

\[ \text{OH} \quad \text{HBr} \quad \text{Br} \]
\[ \text{NaBr} \quad \text{no reaction} \]

a. Draw the mechanism indicating the S\textsubscript{N}2 pathway that creates 1-bromopropane with HBr. In order to do this use the appropriate arrow conventions which are used in organic chemistry to show a mechanism, thus indicating what is the nucleophile, what is the electrophile and what is the leaving group.

b. Why does the reaction not work when NaBr is used instead?
When converting chlorocyclohexane to bromocyclohexane a student should consider whether the reaction occurs by an $S_N1$ or $S_N2$ pathway. Compare the RATE of each of these pathways if the following changes are made to the reaction. Therefore for each question (a-f) answer by stating if that change will make either an $S_N1$ or $S_N2$ pathway faster, slower, or no change compared to the reaction shown. Each question has two answers: what happens to the $S_N1$ and what happens to the $S_N2$ pathways with the indicated change.

a. (10) The chlorocyclohexane is changed to 1-chloro-1-methylcyclohexane.

b. (10) The Chlorine is replaced with an Iodine.

c. (10) Sodium bromide is replaced with sodium iodide.

d. (10) The temperature the reaction is run at is raised.

e. (10) Change chlorocyclohexane to the starting material shown.

f. (10) The solvent is changed from methanol to hexanes.