A. NOMENCLATURE: (12 points, 4 pts. each)

Give an acceptable IUPAC name for each of the following compounds. Be sure to indicate the stereochemistry where appropriate.

a. 

\[
\begin{align*}
&\text{(3S,7R)-7-chloro-1-nonyn-3-ol} \\
&\text{OR}
\end{align*}
\]

b. 

\[
\begin{align*}
&\text{(4Z,6E)-7-bromo-4-ethyl-4,6-heptadien-3-ol} \\
&\text{OR}
\end{align*}
\]

c. 

\[
\text{4-(methyl ethenyl) phenol}
\]
B. FACTS (Total 26 points)

1. Place the following alcohols in order of their increasing reactivity in acid-catalyzed dehydration reactions (1 = least reactive, 3 = most reactive). (3 pts)

   ![Image of alcohol structures]

   2 \rightarrow 3 \rightarrow 1

2. Place the following alkenes in order of their increasing reactivity in reaction with HCl (1 = least reactive, 3 = most reactive). (3 pts)

   more stable the intermediate, faster the reaction

   ![Image of alkene structures]

   1 \rightarrow 2 \rightarrow 3

3. Check the box(es) below the reactive intermediate(s) that are generated during the reaction of CHCl₃ with KOH. (3 pts)

   ![Image of reaction structures]

   1 pt \rightarrow [ ]

   1 pt, if empty
4. Check the box(es) below the reagent(s) that can be used to produce Grignard reagent. (3 pts)

5. Place the following compounds in order of their increasing boiling points (1 = lowest boiling point, 3 = highest boiling point). (3 pts)

6. Place the following indicated bonds in order of their increasing bond length (1 = shortest, 3 = longest). (3 pts)
6. Check the box(es) below the reagent(s) that can be used to convert acetylene into acetylide anion. (5 pts)

\[ \text{H}_2\text{C} = \text{C} - \text{O}^\text{\text{K}}^- \quad \text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{Li} \quad \text{H}_3\text{C} - \text{C} - \text{O}^\text{\text{K}}^- \quad \text{NaNH}_2 \quad \text{CH}_3\text{CH}_2\text{MgBr} \]

\[ \square \quad \checkmark \quad \square \quad \checkmark \quad \checkmark \]

1 pt each if empty

7. Place the following compounds in order of their increasing stability (1 = least stable, 3 = most stable). (3 pts)

\[ \square \quad \text{strained ring} \quad \square \quad \text{tri subst.} \quad \square \quad \text{dis subst.} \]

1 3 2
C. REACTIONS: (42 points, 7 pts. each)

Please give the final major product, the starting material, or the reactants for each of the following reactions in the box provided. Be sure your answers indicate stereochemistry where appropriate. Intermediate products may be placed below the reaction for partial credit but not in the answer box.

1. \[ \begin{align*}
1. & \text{CH}_3\text{CO}^- \cdot \text{K}^+ \\
2. & \text{Br}_2 / \text{H}_2\text{O} \\
3. & \text{H}_2\text{SO}_4 / \text{heat} \\
\end{align*} \]

\[ \begin{align*}
\text{Br} & \quad \text{Br} \\
\text{2p}^+ & \quad \text{2p}^+ \\
\end{align*} \]

2. 

\[ \begin{align*}
1. & \text{NaNH}_2 / 150^\circ \text{C} (3 \text{ p}^+) \\
2. & \text{CH}_2\text{CH}_2\text{Br} (2 \text{ p}^+) \\
3. & \text{H}_2 / \text{Pd (BaSO}_4) / \text{quinoline (2p}^+) \quad \text{Lindlar's cat.} \\
\text{CH}_3\text{CH}_2\text{C} = \text{CCH}_2\text{CH}_3 & \quad \text{H}_2 / \text{Pd (BaSO}_4) / \text{quinoline} \\
\end{align*} \]

3. 

\[ \begin{align*}
1. & \text{CH}_3\text{CH}_2\text{O}^- \cdot \text{Na}^+ \\
2. & \text{MCPBA/CCl}_4 \\
3. & \text{H}_3\text{O}^+ \\
\text{MCPBA} & = \text{Cl}_2 \text{O} \\
\end{align*} \]

\[ \begin{align*}
\text{trans diol} & \quad \text{if stereo wrong} \\
\text{OK} & \quad \text{if stereo correct} \\
\end{align*} \]
4. \( \text{CH}_3 - \text{C} \equiv \text{C} - \text{CH}_3 \)
   1. Na / NH\(_3\)
   2. CHBr\(_3\) / KOH

5. \( \text{CH}_3 \)
   \( \text{CH}_3 \text{CH} = \text{C} \equiv \text{C} - \text{H} \)
   1. Si\(_2\)BH
   2. H\(_2\)O\(_2\)/OH\(^-\)
   3. M\(_2\)Br
   4. H\(_3\)O\(^+\) (or H\(_2\)O)

6. \( \text{H}_3\text{C} \)
   \( \text{C} \equiv \text{C} \) \( \text{CH}_3 \)
   1. O\(_3\)
   2. (CH\(_3\))\(_2\)S
   3. CH\(_3\)C\( \equiv \)C - Na\(^+\)
   4. H\(_3\)O\(^+\) (or H\(_2\)O)

3 pts (2 if wrong stereo)

2 pts
D. MECHANISM: (10 points)

The following reaction yields a mixture of products. Provide a clear mechanism for the formation of A, B and C. Use curved arrow notation to indicate "electron flow", and show all intermediates and formal charges.
E. Synthesis: 10 Points

From cyclohexane, any alkanes, alkenes or alkynes of two carbons or less, and any inorganic reagents, synthesize the compound below.

\[
\begin{align*}
\text{CH}_4 + 2\text{Br}_2 \xrightarrow{\text{UV}} & \text{CH}_3\text{Br} + \text{Br}_2 \quad \text{Mg/C}_2\text{H}_4 \quad \text{H}_2\text{SO}_4/\Delta \quad \text{H}_3\text{O}^+ \\
\text{HOC}_2\text{H}_5 + \text{BrMgCH}_2\text{CH}_3 \quad \text{Br}_2 / \text{CCl}_4 \quad \text{H}_2\text{C}:\text{CH}_2 \text{CH}_2 \text{CH}_2 \text{CH}_3 \\
\text{CH}_2\text{=CH}_2 \quad \text{Mg/} \text{Et}_2\text{O} \quad \text{PCC}/\text{CH}_2\text{Cl}_2 \quad \text{either} \quad \text{H} \quad \text{H}_2\text{O}_2/\text{NaOH} \quad \text{H}_2\text{C} \text{==C} \text{H}_2 \text{CH}_2 \text{CH}_3 \\
\text{NaBH}_4 \quad \text{Pd}(\text{BaSO}_4) \quad \text{quinoline} \quad \text{H}_2 \quad \text{HBr} \quad \text{ROOR}
\end{align*}
\]