9. (10 points) Propose a brief and efficient synthesis for the compound below, starting from 1-methyleclopentane.

\[
\begin{array}{c}
\text{OH} \\
\longrightarrow \quad \text{HO-}
\end{array}
\]

4. (6 points each) All three of the reactions below would not give the indicated products. For each, identify and describe the problem with the reaction as shown in the appropriate boxes on the answer sheet (4A-4C)

<table>
<thead>
<tr>
<th>4A</th>
<th>4B</th>
<th>4C</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Reaction Scheme" /></td>
<td><img src="image" alt="Reaction Scheme" /></td>
<td><img src="image" alt="Reaction Scheme" /></td>
</tr>
</tbody>
</table>

6. (4 points each) In boxes 5A-5H, fill in the missing structures. Keep the following directions in mind: If no reaction would occur, write “no reaction.” If a product is missing, show only the major organic product of the reaction; if two or more organic products would be formed in equal amounts, draw them all in the same box. If the starting material is missing, show the compound that would give the most efficient reaction to form the indicated product.

\[
\begin{array}{c}
\text{A} \quad \text{Ph} \quad \text{H}_2 \quad \text{MCPBA} \\
\text{D} \quad \text{Excess} \quad \text{HBr} \quad \text{HBr(Cy)}_2 \quad \text{H}_2\text{O}_2, \text{NaOH} \\
\text{G} \quad \text{H} \quad \text{1. O}_3 \quad \text{O}_2 \quad \text{Me}_2\text{S} \\
\end{array}
\]
f. Show the Newman (*looking down C1-C2 and C5- C4*) and chair projections for the following molecule:

(1S,2R,4R)-1-bromo-4-chloro-2-methylcyclohexane

Propose efficient syntheses
7. (a) Draw two additional important resonance forms for the following ion. Do not form additional formal charges. (6 pt) (b) Show curved arrow notation for converting between each resonance forms, and be sure to fill in any lone pairs you are using (4pt). (c) Label the major resonance contributor and explain your reasoning briefly. (6 pt)

Explanation for major resonance contributor:

Name the following compounds
Fill in the missing compounds/reagents

\[
\text{c. } \begin{array}{c}
\text{\text{C}}_6\text{H}_6 \rightarrow \text{C}_6\text{H}_{11}
\end{array}
\]

\[
\begin{align*}
1. \text{BH}_3 \\
2. \text{H}_2\text{O}_2, \text{NaOH}
\end{align*}
\]

\[
\begin{align*}
1. \text{Hg(OAc)}_2, \text{CH}_3\text{OH} \\
2. \text{NaBH}_4
\end{align*}
\]

\[
\begin{align*}
1. \text{O}_3 \\
2. \text{S(CH}_3)_2
\end{align*}
\]
6. Complete the following acid/base reactions and indicate which side the reaction favors. (9 pts.)

\[
\begin{align*}
\text{[Structure Image]}
\end{align*}
\]

10. In the following reaction, the acid and the conjugate acid are shown, with the acidic protons bolded. (a) Fill in the structures for the base and the conjugate base in the boxes. (b) Show curved arrows to represent the movement of electrons between the reactants and products. (c) Indicate whether the reactants or products will be favored at equilibrium by circling the appropriate set of equilibrium arrows. (8 pt)

\[
\begin{align*}
\text{[Structure Image]}
\end{align*}
\]

c. Indicate the hybridization of the N, C, and O in the following compound and use structures to explain your reasoning. (6 pts.)

\[
\begin{align*}
\text{[Structure Image]}
\end{align*}
\]