1. Provide the reagents

a) \[
\text{EtLi} \quad \text{Et} \quad \text{Et}
\]

b) \[
\text{AgNO}_3 \quad \text{Br}_2, \Delta
\]

c) \[
\text{Et}_2\text{CuLi} \quad \text{Et}
\]

d) \[
\text{I}_2, \text{NaOH}
\]

e) \[
\text{LDA} \quad \text{Et} \quad \text{Et}
\]

f) \[
\text{NaOH, then } H^+ \quad \text{PBr}_3, \text{Br}_2
\]

1) LDA
2) \[\text{EtBr}\]

2) Provide a multistep synthesis

1) NaOEt
2) H^+, \Delta

1) NaOH
2) H^+

1) NaOEt
2) EtOH
3) Rationalize the following observations:

![Chemical reaction diagram]

Deprotonation with 1 equiv of base gives the most stable anion, which is then alkylated.

BuLi is a strong enough base to remove a second proton. Alkylation of the less stabilized (and thus more nucleophilic) anion is fastest.

4. Provide a mechanism for the formation of 1 and 2:

![Chemical reaction diagram]
5. Circle the product, and explain using your knowledge of molecular orbitals of the following transformation

\[
\text{step 1. Draw the MO energy levels and fill in the electrons}
\]

8 pi electrons; 8 MO's

\[
\text{step 2. Determine the symmetry of the Highest Occupied Molecular Orbital (HOMO)}
\]

\[
\text{step 3. Decide if the reaction must be conrotatory or disrotatory}
\]

\[
\text{step 4. Follow the stereochemistry}
\]

methyls are trans
6. The conversion of Dewar benzene (3) to benzene is extremely exothermic (by 60 kcal/mol), yet it occurs only very slowly under thermal conditions. However, photolysis converts Dewar benzene into benzene very readily. Explain why, using your knowledge of electrocyclic rearrangements to determine the problem with a concerted thermal ring opening, and why a concerted photochemical ring opening should be facile.

\[
\begin{array}{c}
\text{H} \\
\text{H}
\end{array}
\]
\[ \Delta \]
\[ \text{X} \]
\[ H \]
\[ \text{3} \]
\[ h\nu \]
\[ \text{H} \]
\[ \text{H} \]
\[ \text{R} \]
\[ \text{R} \]
\[ \text{R} \]
\[ \text{R} \]

For this problem, we need to think about ring opening. Construct the MO’s and fill in the electrons as you did for problem 5. The opening has to be conrotatory to give the thermal HOMO.

\[
\begin{array}{c}
\text{H} \\
\text{H}
\end{array}
\]
\[ \text{H} \]
\[ \text{R} \]
\[ \text{R} \]
\[ \text{R} \]
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\[ \text{R} \]
\[
\begin{array}{c}
\text{H} \\
\text{H}
\end{array}
\]
\[ \text{H} \]
\[ \text{R} \]
\[ \text{R} \]
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\[
\begin{array}{c}
\text{H} \\
\text{H}
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\]
\[ \text{H} \]
\[ \text{R} \]
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\begin{array}{c}
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\[ \text{H} \]
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\[
\begin{array}{c}
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\[ \text{H} \]
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\[
\begin{array}{c}
\text{H} \\
\text{H}
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\[ \text{H} \]
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\[
\begin{array}{c}
\text{H} \\
\text{H}
\end{array}
\]
\[ \text{H} \]
\[ \text{R} \]
\[ \text{R} \]
\[ \text{R} \]
\[ \text{R} \]
\[ \text{R} \]
\[ \text{R} \]
\[
\begin{array}{c}
\text{H} \\
\text{H}
\end{array}
\]
\[ \text{H} \]
\[ \text{R} \]
\[ \text{R} \]
\[ \text{R} \]
\[ \text{R} \]
\[ \text{R} \]
\[ \text{R} \]
\[
\begin{array}{c}
\text{H} \\
\text{H}
\end{array}
\]
\[ \text{H} \]
\[ \text{R} \]
\[ \text{R} \]
\[ \text{R} \]
\[ \text{R} \]
\[ \text{R} \]
\[ \text{R} \]
\[
\begin{array}{c}
\text{H} \\
\text{H}
\end{array}
\]
\[ \text{H} \]
\[ \text{R} \]
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\[ \text{R} \]
\[
\begin{array}{c}
\text{H} \\
\text{H}
\end{array}
\]
\[ \text{H} \]
\[ \text{R} \]
\[ \text{R} \]
\[ \text{R} \]
\[ \text{R} \]
\[ \text{R} \]
\[ \text{R} \]

Photochemically, we change the symmetry of the HOMO, and a concerted electrocyclic ring opening would be disrotatory. This could give a product with two cis double bonds, as is found in benzene.