Solve the following problems in the space provided. You have 55 minutes to complete this closed book, closed notes exam. When you are in doubt, rely on your logic rather than vague memories. Write down what you do know to ensure some credit. Budget your time according to the point value of the problem. It is better to do most of an exam well than all of it poorly.

Write the major organic products for the following reactions. Do not include mechanism here. Be sure to include stereochemistry and indicate resonance where appropriate (please do not abbreviate). Hint: It is possible for any of the proposed reactions to be unlikely. In such a case, write "no reaction" in the space provided. Also, unless quantities are specified, assume that only one equivalent of reagent is present. (6 points each -- 54 points total)

Note: D = deuterium

a.  
1. Hg(OOCCH₃)₂(CH₃CH₂OH), THF
2. NaBH₄, OH⁻

b.  
\[ \text{NaOCC(CH₃)₃} \rightarrow \text{HOCH₂CH₃} \]

\[ \text{E₂ bulky base strong} \]

H₂SO₂CH₃

HOCH₂CH₃

Minor

OCH₂CH₃

OCH₂CH₃

H₂ (1 equivalent)

Pd/C
2. Write a complete mechanism (arrow formalism) leading to the major organic products for each of the following reactions. Be sure to include complete stereochemistry and all relevant resonance forms for your products (16 points each).

1. KOH, DMSO (CH₃SOCH₃)

2. NaNH₂CH₃, THF

3. acetone

THF = acetone = CH₃COCH₃

No Rxn
Poor Leaving Group
b. \[ \text{H}_2\text{SO}_4 \xrightarrow{\text{H}_2\text{O}, \text{heat}} \]

\[ \text{See attached} \]

or

\[ \text{OH}_2 \]

c. \[ \text{HBr} \xrightarrow{\text{ROOR, hv}} \]

\[ R-O=O-R \rightarrow R-O^* \]

\[ R-O^* + H-\text{Br} \rightarrow R-OH + \text{Br}^* \]

+ MI

\[ + H-Br \]
Stereochemistry

b. cont.
3. Explain three of the following four reactions and any associated data (30 points, 10 each)

a. 
\[
\begin{align*}
\text{Br}_2 & \quad \text{HBr} \quad \rightarrow \quad \text{Br}_2 & \quad \rightarrow \\
\text{Cl}_2 & \quad \text{HCl} \quad \rightarrow \quad \text{Cl}_2 \quad \rightarrow
\end{align*}
\]

Bromide is a better nucleophile than chloride (depending on solvent). It attacks initially formed cation faster than chloride. I compete favorably to rearrangement.

b. 
\[
\begin{align*}
\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{Cl} & \quad 80\% \text{ aqueous acetone} \quad \rightarrow \\
\text{HO}_2 & \quad \text{H}_2\text{O} \quad \rightarrow
\end{align*}
\]

Attack of \( \text{H}_2\text{O} \) occurs preferentially from back face.

Saw

elimination products

\[
\begin{align*}
\text{CH}_3\text{F} & \quad \text{F}^- \quad \rightarrow \quad \text{CH}_3\text{OH} \\
\text{CH}_3\text{F} & \quad \text{F}^- \quad \rightarrow \quad \text{HCON(CH}_3)_2
\end{align*}
\]

CH\(_3\)I would take 2.2 years for complete reaction.

CH\(_3\)F would take 1.2 seconds for complete reaction.

\[
\begin{align*}
\text{H}^- & \quad \text{O}^- \quad \text{O}^- \quad \text{H} \quad (\text{or } \text{H}_3\text{O}^+) \\
\text{OH} & \quad \text{H}_2\text{SO}_4 \quad \rightarrow \quad \text{C}_7\text{H}_5\text{O}_2
\end{align*}
\]

Note: Best to explain with structures/mechanism.
This solution impedes the nucleophilicity of $\Theta^-$ (It is all tied up with solvent molecules).

On the other hand, DMF, $\text{H}_2\text{C}=(\text{SO})\text{N}-\text{CH}_3$, is a polar, aprotic solvent. The $S^+$ site needed to solvate anions is relatively inaccessible so $\Theta^-$ is not solvated well. It is more like a true anion and much more nucleophilic.
4. Outline a synthesis of the following target molecule from the given starting material and any required reagents. Only give reactions (no mechanism required or desired). (8 points) Hint: it should take two reactions.