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 **eight of the following ten** reactions. **You should leave two out.** Do not include mechanism here. Be sure to include stereochemistry and indicate resonance where appropriate (you can abbreviate here). 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. (8 Points each, 64 points total) **One equivalent means one mole of reagent for each molecule of starting material.**

**Note:** D = deuterium

**a.**

\[ \text{Hg(OOCCH}_3\text{)}_2 + \text{CH}_3\text{CH}_2\text{OH} \xrightarrow{\text{THF}} \text{products} \]

1. $\text{Hg(OOCCH}_3\text{)}_2$, $\text{CH}_3\text{CH}_2\text{OH}$, THF
2. $\text{NaBH}_4$, $\text{OH}^-$

**b.**

\[ \text{products} \]

There is no $\text{H}_2\text{O}$

Most people wrote the right product but
2. Using resonance structures, please rank the following protons in terms of acidity. You must use resonance theory in your explanation. Draw all resonance forms. Please do not abbreviate. 20 points.
A 5 resonance Forms

6 resonance Forms

The second acid yields a greater distribution of charge, weaker base = weaker conjugate base = stronger acid
3. 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).

a. \[ \text{H}_{2}\text{SO}_{4} \quad \text{H}_{2}\text{O, heat} \]

b. \[ \text{HBr} \quad \text{ROOR, hv} \]
4. Briefly explain two of the following three of reactions and any associated data (24 points, 12 each)

a. 
\[
\text{CH}_2 = \text{CH}_2 + \text{HBr} \rightarrow \text{Br} \quad \text{Br} \quad 45\% \\
\text{Br} \quad 55\% \\
\text{CH}_2 = \text{CH}_2 + \text{HCl} \rightarrow \text{Cl} \quad \text{Cl} \quad 17\% \\
\text{Cl} \quad 83\%
\]

b. 
\[\text{H}_2\text{O}\text{H}_2\text{SO}_4\text{H}_2\text{O}\rightarrow\]

Note: Best to explain with structures/mechanism
Most people did not write the complete mechanism

b. 
\[\text{H}_2\text{O}\text{H}_2\text{SO}_4\text{H}_2\text{O}\rightarrow\]

See text Laedon
This was graded very liberally
Two explanations for this

1. Rate of attack of Br⁻ is higher than CO₂ and/or
2. Rate of methyl shift is harder than hydride shift.
b.

\[ \text{Chemical structure diagram} \]

\[ \text{Coated with } \text{CF}_3-\text{Cl} \rightarrow \text{Coated with } \cdot\text{CF}_3, \cdot\text{Cl} \text{ (light)} \]
Electrophile

\[ \text{CF}_3 \]

\[ \text{Cl} \quad \text{Cl} \quad \text{CF}_3 \]

\[ \text{CF}_3 \]

\[ \text{Cl} \quad \text{Cl} \quad \text{CF}_3 \]
4. Outline a synthesis of the following target molecules from an alkene and the appropriate reagents. Only give reactions (no mechanism required or desired).

(12 points)

Bromination of trans-cinnamic acid

Try adding