1. Rank the following alkenes in order of stability, 1 being most stable, 4 being least stable. (4)

\( \text{2} \) \hspace{1cm} \text{4} \hspace{1cm} \text{1} \hspace{1cm} \text{3} 

2. Determine the number of elements of unsaturation for \( \text{C}_5\text{H}_7\text{ClO} \). (3)

\[ EU = 2 \]

3. Give the proper IUPAC name or the structure for the following compounds. (4 points each)

a. \((E)-2\)-chloro-3-methyl-2-pentene

b. \( \text{cis-5-methyl-2-octene} \) or \( \text{Z-} \)

4. Rank the reactivity of the following alcohols towards HBr, 1 being the fastest reactant, 3 being the slowest reactant. (3 points)

\( \text{3} \) \hspace{1cm} \text{2} \hspace{1cm} \text{1} \hspace{1cm} \text{Cation Stability} \)
5. Predict the major product for the following reactions. You needn't bother to show any side products or minor products. Pay careful attention to orientation. (3 points each)

\[ \text{H}_2\text{O, H}^+ \quad \xrightarrow{\text{Hg(OAc)}_2, \text{CH}_3\text{OH}} \quad \text{NaBH}_4 \]

6. Predict the major product in each of the following reactions. Pay careful attention to stereochemistry! (3 points each)

\[ \text{H}_2, \text{Pt} \quad \xrightarrow{\text{Br}_2} \quad \text{Cl}_2, \text{H}_2\text{O} \quad \xrightarrow{\text{OsO}_4, \text{H}_2\text{O}_2} \]
7. Fill in the starting reactant. (4 points each)

\[ \text{CH}_3\text{CO}_2\text{H} \quad \text{H}_2\text{O} \]

8. Provide the major product of the following reaction sequences. (4 points each)

1. \( \text{H}_2\text{SO}_4, \Delta \)
2. \( \text{Br}_2 \)

9. What is a possible structure for a molecule A given the following? (6 points)
   a. is has the formula \( \text{C}_6\text{H}_{16} \)
   b. it reacts with \( \text{H}_2/\text{Pt} \) to give a product with formula \( \text{C}_6\text{H}_{12} \)
   c. upon ozonolysis (\( \text{O}_3; \text{Me}_2\text{S} \)) it gives two products, \( \text{CH}_2=\text{O} \) and a product \( \text{C}_5\text{H}_8\text{O} \).
10. Fill in the boxes. (6 points total)

\[
\text{\textbf{1. } } \text{O}_3 \\
\text{\textbf{2. } } \text{Me}_2\text{S}
\]

\[
\text{KMnO}_4, \Delta 
\]

\[
\text{2,3,6-} \text{OH} \\
\]

11. Provide reagents to accomplish the following transformations. (6 points each)

\[
\text{CH}_3\text{OH} \xrightarrow{1. \text{H}_2\text{SO}_4, \text{heat}} \text{Br} \\
\text{OH} \xrightarrow{2. \text{HBr}}
\]

\[
\text{Br} \xrightarrow{1. \text{NaOH} \text{ (small box)}} \text{OH} \\
\text{CH}_3 \xrightarrow{2. \text{BH}_3, \text{THF}} \\
\text{OH} \xrightarrow{3. \text{NaOH, H}_2\text{O}_2}
\]
12. Draw the mechanisms for the following reactions. Be sure to draw all intermediates, and try to correctly draw "electron-movement" arrows. (8 points for the first, 6 points for the second)

\[
\begin{align*}
\text{OH} & \quad \xrightarrow{\text{H}_2\text{SO}_4, \Delta} \quad \text{pentane} \\
\text{H}_2\text{SC}_4 & \quad \downarrow \\
\text{pentane} & \quad \xrightarrow{\text{H}_2\text{O}} \quad \text{pentane}
\end{align*}
\]

\[
\begin{align*}
\text{HBr} & \quad \rightarrow \quad \text{BrCH}_3 \\
\text{pentane} & \quad \xrightarrow{\text{Br}_2} \quad \text{pentane}
\end{align*}
\]

13. Draw as many isomers as you can for alkenes with formula C₅H₁₀. (8 points. 2 points off for each duplicate or each possible isomer not drawn.)

\[
\begin{align*}
\text{C}_5\text{H}_{10} & \quad \xrightarrow{\text{H}_2\text{O}} \quad \text{C}_5\text{H}_{10} \\
\text{C}_5\text{H}_{10} & \quad \xrightarrow{\text{H}_2\text{O}} \quad \text{C}_5\text{H}_{10} \\
\text{C}_5\text{H}_{10} & \quad \xrightarrow{\text{H}_2\text{O}} \quad \text{C}_5\text{H}_{10} \\
\text{C}_5\text{H}_{10} & \quad \xrightarrow{\text{H}_2\text{O}} \quad \text{C}_5\text{H}_{10}
\end{align*}
\]