1. Draw the structure of the major organic product of each of the following reactions. Show stereochemistry where appropriate (32 points)

a.)

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

b.)

\[ \text{H}_3\text{C} \quad \begin{array}{c} \text{OH} \\ \text{H} \end{array} \quad \xrightarrow{\text{PBr}_3} \quad \]

c.)

\[ \text{C}_8\text{H}_{16} \quad \xrightarrow{\text{NBS} \quad \text{CCl}_4} \quad \]

d.)

\[ \text{H}_3\text{C} \quad \begin{array}{c} \text{CH}_3 \\ \text{Br} \end{array} \quad \xrightarrow{\oplus \text{CN}} \quad \]

e.)

\[ \text{H} \quad \begin{array}{c} \text{Cl} \\ \text{H} \end{array} \quad \xrightarrow{\text{CH}_3\text{CH}_2\text{OH}} \quad \]

f.)

\[ \text{CH}_3 \quad \begin{array}{c} \text{CH}_3 \\ \text{CH}_3 \quad \text{CH}_3 \quad \text{CH}_3 \quad \text{CH}_3 \quad \text{Br} \quad \text{CH}_3 \end{array} \quad \xrightarrow{\text{CH}_3\text{O}^+} \quad \]

g.)

\[ \text{Cu-Li} \quad + \quad \text{CH}_3\text{CH}_2\text{Cl} \quad \]

h.)

\[ \begin{array}{c} \text{CH}_3 \\ \text{CH}_2 \end{array} \quad + \quad \begin{array}{c} \text{CH}_3 \\ \text{CH}_2 \end{array} \quad \begin{array}{c} \text{O} \\ \text{CH}_2 \end{array} \quad \]

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II. Draw the structures for all of the likely organic products of each of the following reactions. Show constitutional isomers only (ignore stereoisomers). (12 points)

a.)

\[
\begin{align*}
\text{NBS} \\
\text{CCl}_4
\end{align*}
\]

b.)

\[
\begin{align*}
\text{HCl}
\end{align*}
\]

III. Consider the following reaction to answer the questions below. (10 points)

\[
\begin{align*}
\text{HBr}
\end{align*}
\]

a.) Draw the structure of the major product formed under kinetic control conditions at low temperature.

b.) Draw the structure of the major product formed under thermodynamic control conditions at high temperature.
IV. Draw structures of organic reactants which would lead to the product shown as the major product in each of the following reactions. Show stereochemistry where appropriate (32 points)

a.)

b.)

c.)

\[ \text{H}_2\text{O} \]

d.)

\[ \text{Strong Base} \]

e.)

f.)

\[ \text{NaOH} \]

g.)

\[ \text{NaOH} \]

h.)

\[ \text{H}_2\text{O} \]
V. Circle the compounds which are conjugated. (6 points)

VI. Circle the compounds which can react as dienes in a Diels-Alder reaction. (6 points)

VII. Circle the most reactive dienophile. (2 points)