Name:

Signature:

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1) ____________________
2) ____________________
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5) ____________________
6) ____________________
7) ____________________

Total ____________________
1) [12 pts] Give the products for the following reactions (indicate major/minor):

- $\text{HCl}$
- $\text{H}_2\text{SO}_4$ (conc.)
- $\text{HBr} / \text{Peroxides}$

2) [12 pts] Give the reagents for the following reactions:

- $\text{Br}$
- $\text{Na}^+\text{NH}_2^-$
- $\text{Br}_2 \text{ hv}$

3) [12 pts] Give the reactants for the following reactions:
4) [16 pts] Propose a multi-step synthesis to get from the structure on the left to the structure on the right. Use any inorganic reagents you need and any other carbon compound up to 4 carbons as additional materials.

A)

B)
5) [16 pts] Propose detailed mechanisms to account for the following reactions (use curved-arrow notation to indicate electron flow).

A) \[ \text{Br}_2 \rightarrow \begin{array}{c}
\text{H} \\
\text{Br} \\
\text{meso only}
\end{array} \]

B) \[ \text{H}_2\text{SO}_4 / \text{H}_2\text{O} \rightarrow \]
6) [15 pts] Deduce the chemical structure of the reaction components (A, B, and C) from the NMR and IR spectral data.

\[ \text{A} \xrightarrow{1) \text{Mg} / \text{Ether}} \xrightarrow{2) "B"} \xrightarrow{3) \text{H}_2\text{O}} \text{C} \]

**A:** \((\text{C}_3\text{H}_7\text{Br})\)

\(^1\text{H NMR} \delta \text{ in ppm} = 4.2 \text{ (heptet, 7 Hz, 1H)}; 1.7 \text{ (d, 7 Hz, 6H)}\)

**B:** \((\text{C}_4\text{H}_8\text{O})\)

\(^1\text{H NMR} \delta \text{ in ppm} = 2.5 \text{ (q, 7 Hz, 2H)}; 2.1 \text{ (s, 3H)}; 1.1 \text{ (t, 7 Hz, 3H)}\)

\(^{13}\text{C NMR (}^1\text{H decoupled)} \delta \text{ in ppm} = 209, 37, 29, 8.\)

IR \text{ 1705 cm}^{-1}

**C:** \((\text{C}_7\text{H}_{16}\text{O})\)

\(^{13}\text{C NMR (}^1\text{H decoupled)} \delta \text{ in ppm} = 7 \text{ signals (the most deshielded at 70 ppm)}\)

IR \text{ 3500 cm}^{-1}
7) [20 pts] Draw

a. two acyclic stereoisomers of \( C_7H_{14} \). Assign their stereochemical configuration. Circle the one with the largest H-H coupling constant.

b. the four olefins of \( C_4H_8 \). Rank them from most to least stable.

c. an isomer of \( C_6H_{12} \) that produces a pair of enantiomeric dibromides from its reaction with bromine.

d. two isomers of \( C_6H_{12}O_2 \). Circle the one with the fewest \( ^{13}C \) NMR signals