This is an open-book, open notes exam. Please show your work in detail.

1. (10 points) Give the proper IUPAC name for each of the following:

   a. \( \text{(2S)-2-ethyl-5-hexenal} \)
   
   b. \( \text{cyclohexyl 3-methylbutanoate} \)

2. (10 points) Draw each of the following structures.

   a. \( \text{(3S, 5S)-1-bromo-5-chloro-3-octanol} \)

   b. \( \text{(2Z)-3-chloromethyl-4-methyl-2-pentenyl propanoate} \)

3. (20 points) For each pair of structures, indicate whether they are the same, enantiomers or diastereomers.

   a. \( \text{same} \)

   b. \( \text{enantiomers} \)

   c. \( \text{diastereomers} \)

   d. \( \text{enantiomers} \)
4. (20 points) For each pair of cyclohexanes, indicate which is the more stable. For each, explain your reasoning in detail.

a. 

In the more stable chairs, the t-butyl group is equatorial. There is not energy cost to A, since the methoxy group is equatorial. There is an energy cost to B, since the methoxy is axial.

b. 

In the more stable chair of D, all three substituents are equatorial, and well removed from each other. In C, all three substituents are equatorial, but there is an energy cost to the two equatorial methyl groups bumping in to each other.

5. (20 points) Deduce the structure of F, and draw a detailed arrow-pushing mechanism for the transformation of E to F.

\[
\text{Bu}_3\text{Sn-H} \quad \text{AIBN} \quad \Delta \\
\text{Bu}_3\text{Sn-Bu} \quad \text{Bu}_3\text{Sn-Br} \quad + \text{Bu}_3\text{SnBr}
\]

\[
\text{F} \quad \text{C}_7\text{H}_{12} \\
\text{13C NMR:} \\
26.4, \text{t} \\
28.4, \text{t (2)} \\
35.4, \text{t (2)} \\
106.4, \text{t} \\
150.1, \text{s}
\]
6. (20 points) Draw a detailed arrow-pushing mechanism for the transformation of G to H.