1. (12pts) A. Provide an arrow mechanism for this reaction;

B. How many distinct stereoisomers form in this reaction?  

C. In ONE SENTENCE, how does your mechanism explain the STEREOCHEMISTRY of the reaction?

   The stereocenter is mixed because the carbocation intermediate can be attacked equally well from both faces.

D. In ONE SENTENCE, how does your mechanism explain the REGIOCHEMISTRY of the reaction?

   The chloride is attached to more substituted (Markovnikov) because formation of more stable carbocation...
2. (20pts) Predict the major product(s) of 5 of the following 6 reactions. Be sure to include proper stereochemistry. Put an “X” in the box you do not want graded, or else the first 5 will be graded.

- 4
  each
  \[
  \text{xs H}_2, \text{Pd}
  \]

- \[
  \text{Br}_2, \text{CH}_3\text{CH}_2\text{OH}
  \]

- 4-methylhex-2-yne
  \[
  \text{1 equiv. Cl}_2
  \]

- 1,2-dibromo-3-methylbutane
  \[
  \text{1. xs NaNH}_2
  \]
  \[
  \text{2. H}_2\text{O}
  \]

- 1-methylcyclopentene
  \[
  \text{OsO}_4, \text{NMO}
  \]

- 1
  \[
  \text{O}_3
  \]
  \[
  \text{2. DMS}
  \]
3. (20pts) Provide reagents or starting materials necessary for 5 of the following 6 transformations. CLEARLY MARK the one you do not want graded or else the first five will be graded. More than one step may be necessary.

1-butene

\[ \text{mCPBA or } \text{RCOO}_2H \]

\[ \text{RCOO}_2H \]

3,3-dimethylbut-1-ene

\[ \text{NaBH}_4 \]

3,3-dimethylbutan-2-ol

Na\textsuperscript{+} NH\textsubscript{3} (aq)

1,2-dimethylcyclopentene

\[ \text{H}_3\text{O}^+ \]

naphthalene

1. O\textsubscript{3}  
2. H\textsubscript{2}O

only product
4. (4pts) Draw a structure of an alkyne that can be converted into 3-ethylpentane upon hydrogenation. Provide a systematic name for this alkyne.

\[ \text{3-ethylpent-1-yne} \]

5. (6pts) Compound A has a molecular formula \( \text{C}_7\text{H}_{15}\text{Br} \). Treatment of compound A with sodium ethoxide yields only one elimination product (compound B) and no substitution products. When compound B is treated with dilute sulfuric acid, compound C is obtained, which has molecular formula \( \text{C}_7\text{H}_{16}\text{O} \). Draw the structures of compounds A, B, and C.

\[ \text{A} \quad \text{Br} \quad \text{EtO}^- \quad \text{B} \quad \text{OH} \quad \text{C} \quad \text{OH} \]
6. (12pts) Provide the necessary reagents for these multistep syntheses.

(No additional text is necessary as the diagram clearly illustrates the necessary reagents and steps.)

(also accept $H_2SO_4$) +6
7. (10pts) Which product would you expect to be the major product of this oxymercuration? Provide a mechanism, including all intermediates and arrows, to explain your answer.

[Diagram showing the reaction with intermediates and products labeled as major +2 and other intermediates indicated with arrows and reactions with Hg(OAC)₂ and NaBH₄]
8. (18pts) For the following two syntheses, provide all reagents necessary to complete the transformation from the starting material to the product.

A. Use any source of carbon.

B. Use acetylene as your only carbon source.