1. Rank the following compounds in the trend requested. (15 points each)
   a. Rank by acidity. The most acidic compound is 1, while the least acidic compound is 5.

   -SH  -OH  -SH  COOH  Cl-CH2OH
   |   |   |   |    |   |
   3  5  2  1  4

   b. Rank by alkene stability. The most stable alkene is 1, while the least stable alkene is 5.

   -  -  -  -  -
   |   |   |   |   |
   5  3  4  2  1

   c. Rank by water solubility. The compound that is the most soluble in water is 1, while the compound that is the least soluble in water is 5.

   HO-CH2-CH2OH  -CH2Br  -CH2CH2OH  -OH  OH
   |   |   |   |   |
   1  5  4  2  3
2. Glycols react with periodic acid to form a cyclic periodate intermediate. The periodate then decomposes to a pair of carbonyl compounds.

Of the following reactions that generate glycols, one reacts with periodic acid as shown above, while the second does not react with the periodic acid. Draw the structures obtained for each of these reactions. Assume proper work-up for each step. (12 points)

Why does one glycol not react with periodic acid? (6 points)

In the second reaction a trans stereochemistry is obtained for the glycol. The periodate cannot form with a trans stereochemistry of the two alcohols.

3.(8) Consider the reaction shown. Indicate a mechanism, by showing intermediates obtained during the reaction path, to yield the product shown.

b.(6) What would be obtained if the product shown were reacted with LAH?
4. Indicate the preferred product for each reaction. Assume proper work-up for each step.
(8 points each)

a. \[ \text{H}_2, \text{Pt} \]

b. \[ 1) \text{Hg(OAc)}_2, \text{H}_2\text{O} \]
   \[ 2) \text{NaBH}_4 \]

c. \[ \text{CH}_3\text{MgBr} \]

d. \[ \text{MgBr} \]

e. \[ \text{LAH} \]

f. \[ \text{HBr} \]
g.  
\[
\text{H}_3\text{C} \quad \xrightarrow{1) BH_3 \cdot \text{THF}} \quad \text{H}_2\text{O}_2, \text{NaOH} \quad \xrightarrow{2) \text{H}_3\text{C} = \text{CH}} \quad \text{H}_3\text{C} = \text{CH}_2\text{CHO}
\]

h.  
\[
\text{H}_3\text{C} \quad \xrightarrow{1) \text{NaNH}_2} \quad \xrightarrow{2) \text{O}} \quad \text{H}_3\text{C} = \text{CH}_2\text{OH}
\]

i.  
\[
\text{H}_3\text{CO} \quad \xrightarrow{\text{NaBH}_4} \quad \text{H}_3\text{CO} \quad \text{OH}
\]

j.  
\[
\text{H}_3\text{C} \quad \xrightarrow{\text{Br}_2, \text{H}_2\text{O}} \quad \text{H}_3\text{C} \quad \text{Br}
\]
5. Propose a method to synthesize the product shown with the indicated starting material. You may use any inorganic reagent you desire and any organic compound which contains four carbons or less. (15 points each)

a. 

\[
\begin{align*}
\text{HC} & \equiv \text{CH} & & \rightarrow & & \text{CH}_2\text{CH}_2\text{OH} \\
\text{HC} & \equiv \text{CH} & & \xrightarrow{\text{NaNH}_2} & & \text{HC} & \equiv \text{CNa} & & \xrightarrow{\text{Br}} & & \text{CH}_2\text{CH} & \equiv \\
\text{HgSO}_4, & & & & & & & & & & \text{H}_2\text{SO}_4 & & \text{CH}_2\text{OH} & & \xrightarrow{\text{LAH}} & & \text{CH}_2\text{CH}_2\text{CO} \\
\end{align*}
\]

These are one viable route to synthesize each product. Other possibilities exist. Any viable route will receive full credit.

b. 

\[
\begin{align*}
\text{C}_7\text{H}_{14}\text{OCH}_3 & & \rightarrow & & \text{C}_7\text{H}_{16} \\
\text{C}_7\text{H}_{14}\text{OCH}_3 & & \xrightarrow{\text{CH}_3\text{MgBr}} & & \text{C}_7\text{H}_{14}\text{HO} & & \xrightarrow{\text{H}_2\text{SO}_4} & & \text{C}_7\text{H}_{14}\text{CH} & \equiv & & \xrightarrow{\text{H}_2, \text{Pt}} & & \text{C}_7\text{H}_{16} \\
\end{align*}
\]
6. Indicate the structure for compounds A-I from the following roadmap on the next page. Only need to indicate the part with the higher molecular weight for compound E. (Pay attention to the direction of the arrows, for example when A reacts with sodium acetylide B is generated.) (7 points each)