Chem 233: Problem Set #11 (on Chapter 11)

1. Name or draw structures for the following:

   A. acetylene

   \[ \text{H}_2\text{C} = \text{C} = \text{H} \]

   B. \[ \text{H} \]

   C. \[ \text{H}_3\text{C} - \text{C} \equiv \text{C} - \text{CH}_3 \]

   D. ethylene

   \[ \text{H}_2\text{C} = \text{C} = \text{H} \]

   E. 1, 5-dibromo-2-pentyne

   F. dimethylacetylene

   \[ \text{H} \]

   G. \[ \equiv \equiv \equiv \text{Br} \]

   H. \[ \text{H} \]

2. Draw the keto form for the following enol tautomers.

   A. \[ \text{H} \]

   B. \[ \text{H}_2\text{C} = \text{C} = \text{H} \]

   C. \[ \text{H}_3\text{C} - \text{C} \equiv \text{C} - \text{CH}_3 \]

3. Show the step-by-step mechanism for the acid catalyzed conversion of the enol tautomer in 2B to the keto tautomer.
4. Give the **reagents needed or the major organic product(s)** for the following reactions.

   A. \[
   \begin{array}{c}
   \text{HC} &=& \text{C} \\
   \text{CH}_3 &=& \text{Br}_2 (2 \text{ eq.}) \\
   \text{CH}_2\text{Cl}_2 \\
   \text{HC} &=& \text{C} \\
   \text{CH}_3 &=& \text{Br}_2 (2 \text{ eq.}) \\
   \text{CH}_2\text{Cl}_2 \\
   \end{array}
   \]

   B. \[
   \begin{array}{c}
   \text{H}_3\text{C} &=& \text{C} \\
   \text{C} &=& \text{H} \\
   \text{CH}_3 \\
   \text{H}_3\text{C} &=& \text{C} \\
   \text{C} &=& \text{CH}_3 \\
   \end{array}
   \]

   C. \[
   \begin{array}{c}
   \text{HC} &=& \text{C} \\
   \text{CH}_3 &=& \text{Cl}_2 (1 \text{ eq.}) \\
   \text{CH}_2\text{Cl}_2 \\
   \text{HC} &=& \text{C} \\
   \text{CH}_3 &=& \text{Cl}_2 (1 \text{ eq.}) \\
   \text{CH}_2\text{Cl}_2 \\
   \end{array}
   \]

   D. \[
   \begin{array}{c}
   \text{HC} &=& \text{C} \\
   \text{C} &=& \text{CH}_3 \\
   \text{HgSO}_4, \text{H}_2\text{SO}_4 \\
   \text{H}_2\text{O} \\
   \end{array}
   \]

   E. \[
   \begin{array}{c}
   \text{HC} &=& \text{C} \\
   \text{C} &=& \text{CH}_3 \\
   \text{Br} \\
   \end{array}
   \]

   F. \[
   \begin{array}{c}
   \text{H}_2\text{C} &=& \text{C} \\
   \text{C} &=& \text{H} \\
   \text{CH}_3 \\
   \text{H}_2/\text{Pd} \\
   \end{array}
   \]

   G. \[
   \begin{array}{c}
   \text{H}_3\text{C} &=& \text{C} \\
   \text{C} &=& \text{C} \\
   \text{CH}_3 &=& \text{HCl} \\
   \text{ether} \\
   \text{CH}_3 \\
   \end{array}
   \]

   H. \[
   \begin{array}{c}
   \text{H}_3\text{C} &=& \text{C} \\
   \text{CH}_4 &=& \text{H} \\
   \text{NaNH}_2, \text{NH}_3 \\
   \text{CH}_3\text{CH}_2\text{I} \\
   \end{array}
   \]

   I. \[
   \begin{array}{c}
   \text{H}_3\text{C} &=& \text{C} \\
   \text{C} &=& \text{H} \\
   \text{CH}_3 \\
   \end{array}
   \]

   J. \[
   \begin{array}{c}
   \text{HC} &=& \text{C} \\
   \text{C} &=& \text{H} \\
   \text{HgSO}_4, \text{H}_2\text{SO}_4 \\
   \text{H}_2\text{O} \\
   \end{array}
   \]

   K. \[
   \begin{array}{c}
   \text{HC} &=& \text{C} \\
   \text{C} &=& \text{H} \\
   \text{CH}_3 \\
   \text{1. BH}_3 \text{ in THF} \\
   \text{2. H}_2\text{O}, \text{OH}^* \\
   \end{array}
   \]

   L. \[
   \begin{array}{c}
   \text{HC} &=& \text{C} \\
   \text{C} &=& \text{CH}_3 \\
   \text{Br} \\
   \text{1. NaNH}_2, \text{NH}_3 \\
   \text{2. (CH}_3)_3\text{CCH}_2\text{CH}_2\text{Br} \\
   \end{array}
   \]

5. **Show step-by-step mechanisms for the reactions given in question 4C, 4E, and 4H.**

6. **Use the mechanism is 4C to explain why only the trans product is formed.**

7. **Use the mechanism in 4E to explain why very little (if any) of the rearranged product 2,3-dibromo-2,3-dimethylbutane is formed.**
8. Give a correct synthesis route for the following:

A. from \( \text{HC} = \text{CH} \)

B. from \( \text{HC} = \text{CH} \)

C. from \( \text{HC} = \text{CH} \)

D. from \( \text{HC} = \text{C} \rightarrow \text{CH}_3 \)

E. from \( \text{HC} = \text{CH} \)

F. from \( \text{HC} = \text{CH} \)
9. An organic molecule has the chemical formula \( \text{C}_{19}\text{H}_{16} \). This molecule reacts with two equivalents of \( \text{H}_2 \) over Lindlar’s catalyst, after which it reacts with 7 equivalents of \( \text{H}_2 \) over a \( \text{PtO}_2 \) catalyst.

A. How many degrees of unsaturation are present in \( \text{C}_{19}\text{H}_{16} \)?
B. How many triple bonds are present?
C. How many double bonds are present?
D. How many rings are present?
E. Draw a structure that fits the results.