1. For each of the following line structures, identify all functional groups present and label the molecular framework as acyclic (no rings or straight chain), carbocyclic (rings containing only carbon) or heterocyclic (rings containing a heteroatom).

   I.  
   ![I](image1)

   II.  
   ![II](image2)

   III.  
   ![III](image3)

   IV.  
   ![IV](image4)

   V.  
   ![V](image5)

   VI.  
   ![VI](image6)

   VII.  
   ![VII](image7)

   VIII.  
   ![VIII](image8)

   IX.  
   ![IX](image9)

   X.  
   ![X](image10)

2. Draw structural formulas for the FIVE constitutional (structural) isomers of C₆H₁₄. Hint: Start with a six carbon straight chain, then with a five carbon branched chain and finally with a four carbon branched chain.

3. For an organic compound with the chemical formula C₃H₆O, there are many different constitutional isomers. Write a structural formula for C₃H₆O that designates a(n) .....  
   A. acyclic ketone  
   B. acyclic alcohol  
   C. carbocyclic alcohol  
   D. acyclic ether  
   E. acyclic aldehyde
F. heterocyclic ether (or epoxide)

G. How many degrees of unsaturation in each of the structures written in A-F? Remember, each pi bond counts as one degree of unsaturation and each ring as another. Thus, a double bond has one degree of unsaturation; a triple bond, two; and each ring, one.

4. Consider the hydrocarbon C$_5$H$_6$.
A. Draw different constitutional isomers for this molecule that contain:
   I. a five carbon ring
   II. a four carbon ring
   III. a three carbon ring
   IV. two double bonds (acyclic)
   V. a triple bond (acyclic)
B. How many degrees of unsaturation in this hydrocarbon?

5. For the following sets of organic compounds, arrange in order from highest boiling point to lowest boiling point. Give a short explanation for the given boiling point order.

   A. CH$_3$CH$_2$CH$_3$ (propane) vs. CH$_3$CH$_2$CH$_2$CH$_2$CH$_3$ or CH$_3$(CH$_2$)$_4$CH$_3$ (hexane)

   B. [Diagram of isomers]

   Note: All have the chemical formula C$_7$H$_{16}$.

6. Arrange the following compounds: 1) in order of decreasing boiling point, 2) in order of decreasing solubility in water, and 3) in order of decreasing solubility in CCl$_4$.

   I

   [Diagram of compounds]

   II

   [Diagram of compounds]