Chem 233: Problem Set #3 (on Chapter 3)

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. acyclic
   II. acyclic
   III. acyclic
   IV. acyclic
   V. acyclic
   VI. acyclic
   VII. carbocyclic
   VIII. carbocyclic
   IX. acyclic
   X. acyclic

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
3. \( \text{A. acyclic alkene} \)
\[
\text{no ring} ~ C=C \quad \text{no ring} \quad \text{C}=\text{C} \quad \text{OH}
\]

\( \text{B. cyclic alkene} \)
\[
\text{no ring} ~(\text{OH}) \quad \text{OH} \quad \text{OH}
\]

\[
\text{C. carbocyclic alcohol} \quad \text{ring with } \text{OH} \quad \text{ring carbons} \quad \text{OH}
\]
3D. acyclic ether

E. acyclic aldehyde

F. heterocyclic ether (e.g., epoxide)

G. Each structure has 1 degree of unsaturation.
   In each structure, there is either 1 double bond = 1 ring or 2 rings = 1 degree of unsaturation.

4. A. I. 5 ring

II. 4 ring
A. III 3 C ring

\[ \text{CH}_3\text{C} = \text{C} = \text{C} - \text{CH}_2 \]

or

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

or

\[ \text{H}_3\text{C} - \text{C} = \text{C} = \text{CH}_2 \]

or

\[ \text{H}_3\text{C} - \text{C} = \text{C} = \text{C} - \text{CH}_3 \]

or

\[ \text{H}_3\text{C} - \text{C} = \text{C} = \text{C} = \text{C} - \text{CH}_3 \]

or

\[ \text{H}_3\text{C} - \text{C} = \text{C} = \text{C} = \text{C} = \text{C} - \text{CH}_3 \]

IV. 3 double bonds (acyclic)

\[ \text{H}_2\text{C} = \text{C} = \text{C} = \text{C} = \text{CH}_3 \]

or

\[ \text{H}_2\text{C} = \text{C} = \text{C} = \text{C} = \text{C} = \text{CH}_3 \]

V. 4 triple bonds (acyclic)

\[ \text{H}_3\text{C} - \text{C} = \text{C} = \text{C} = \text{CH}_3 \]

or

\[ \text{H}_3\text{C} - \text{C} = \text{C} = \text{C} = \text{C} = \text{C} = \text{CH}_3 \]

et al.

\[ \text{CH}_3\text{C} = \text{C} = \text{C} = \text{C} = \text{CH}_3 \]

et al.

B. There are 5 degrees of unsaturation in every constitutional isomer of C-H8.
5. A.

\[ \text{C}_8 \text{H}_8 \] vs. \[ \text{C}_6 \text{H}_6 \]

**BP:** \[ \text{hexane} > \text{propane} \]

Hexane has more atoms and a longer chain, thus larger surface area over which IMFs can occur. As a result, hexane has stronger IMFs than propane and results in higher BP.

B.

\[ \text{C}_7 \text{H}_14 \]

**BP:**

\[ > \]

longer chain and large surface area over which IMFs can occur, and so stronger IMFs, 

higher BP

\[ > \]

branching lowers SA and weakens IMFs so lower BP

6. II. BP:

\[ \text{OH} \]

Sol'n in H_2O

Polar solvent

Sil'in:

Non-polar solvent

\[ \text{OH} > \text{OH} > \text{OH} \]

All have H-bonding, but first has most C atoms \( \rightarrow \) longer chain + stronger IMFs than others.

As length of non-polar carbon chain increases, solubility in H_2O decreases but solubility in nonpolar CCl_4 increases.
6. II. BP:

\[ \text{OH} > \text{CH} = \text{O} > \text{CH}_3 \]

- H-Bonding
- Dipole-Dipole
- LDF

Strongest IMS → Highest BP

Polar solvent + H-bonding

Solvability:

\[ \text{OH} > \text{CH} = \text{O} > \text{CH}_3 \]

Nonpolar solvent

Solvability:

\[ \text{CH}_3 > \text{CH} = \text{O} > \text{CH}_3 \text{OH} \]