

EXPERIMENT 1: Survival Organic Chemistry

Part I: Molecular Models (DRAFT VERSION)

The goal in this laboratory experience is to get you so you can easily and quickly move between empirical formulas, molecular formulas, condensed formulas, Lewis structural formulas and three dimensional models of relatively simple organic compounds. To accomplish this you will use your experience and chemical intuition combined with molecular models and computer graphics in a guided laboratory exploration into the 3-dimensional structure of organic compounds. After you have completed manipulating the molecular models you will synthesize two interesting organic compounds: acetylsalicylic acid and methyl salicylate. So if the first portion of the experience gives you a headache.... or if you think the first portion stinks....

So what??? Many new chemistry students find manipulating molecular models helps their understanding of the spatial relationships of atoms in molecules. Using computer graphics will also provide a new way to view and manipulate molecular models. Finally, a simple understanding of organic compounds early in the semester will provide you with structural insights that will help you better understand many of our chemical discussions in the area of chemical kinetics and acid/base chemistry.

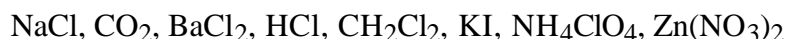
Some preliminary stuff:

Answer the four questions below on a separate sheet(s) of paper and be prepared to turn in to your TA at the beginning (discussion) of class on the day of your discussion/laboratory.

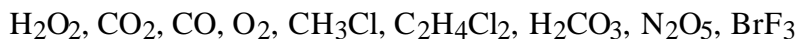
What you need to remember for this experience: Electron configuration, octet rule, valence electrons, simple Lewis structures, covalent bond, ionic bond, polar covalent bonds, sigma and pi bonds, single, double and triple bonds, bond lengths and angles, resonance, and bond dissociation energies.

As a way to get a handle on these concepts try the following problems;

1. Write the general rule for determining whether a chemical formula represents an ionic or a covalent compound. Which of the following formulas describe ionic and/or covalent compounds?



2. Draw a Lewis electron-dot structure for each of the covalent molecules below. Include all resonance structures if they are needed to adequately represent the bonding in the molecule. Identify those compounds containing double and triple bonds. Indicate whether the compound is polar or nonpolar. In each compound indicate the magnitude of all bond angles.



3. Determine the empirical and molecular formula and draw the Lewis structure for a compound which is 20.11% H and 79.89% C.
4. Your textbook will play an important role as a reference tool in this laboratory. Chapters and sections which will be important to refer to include;
Organic Chemistry Chapter 15, sections 15.1, 15.2, and 15.4.

Exploring structural features of simple organic compounds

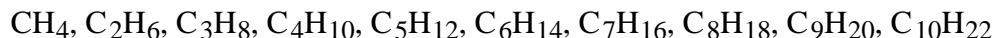
The goal of this part of the experiment is to get you to feel comfortable with moving between molecular formulas, Lewis structural formulas, and condensed formulas. To reach a reasonable level of comfort you will need to check out a model kit from the freshman chemistry storeroom. Each kit should contain:

Number	Color	Atom
10	black	carbon
6	green	chlorine
6	red	oxygen
2	blue	nitrogen
1	yellow	sulfur
22	white	hydrogen

Each packet should also contain thirty 1-inch plastic connectors which represent a pair of electrons, either a lone pair or a bonding pair.

PART I. Alkanes

The hydrocarbon compounds with the following molecular formulas are all classified as alkanes.



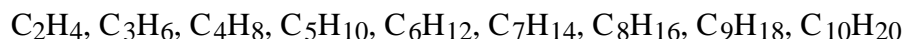
Use the molecular model kit to construct several examples of alkane compounds. Your TA will assign you three of the alkanes above. Write the Lewis structure and condensed structural formulas for each of the assigned alkanes.

Questions (use your textbook as a reference):

1. What is the general formula for an alkane?
2. What is a structural isomer? How many do each of the first seven alkanes have? Draw all of the structural isomers for one of the alkanes (your TA will tell you which one.)
3. Name all your compounds.
4. List some common physical properties of alkanes. What are some trends?
5. What is a cycloalkane? Give some examples.
6. What are some common reactions of alkanes?
7. What is a conformer (e.g., eclipsed, staggered and skewed)?
8. Are alkanes soluble or insoluble in water? Support your answer with a brief explanation.

PART II. Alkenes

The hydrocarbon compounds with the following molecular formulas are all classified as alkenes.



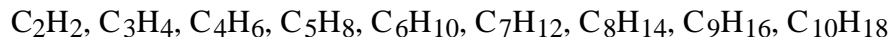
Use the molecular model kit to construct several examples of alkene compounds. Your TA will assign you three of the alkenes above. Write the Lewis structure and condensed structural formulas for three examples of the alkenes listed above.

Questions (use your textbook as a reference):

1. What is the general formula for an alkene?
2. What is a geometric isomer? How many do each of the first three alkenes have?
3. What are stereoisomers?
4. Name all your compounds.
5. List some common physical properties of alkenes. What are some trends?
6. What is a diene? Give some examples.
7. What are some common reactions of alkenes?

PART III. Alkynes

The hydrocarbon compounds with the following molecular formulas are all classified as alkanes.



Use the molecular model kit to construct several examples of alkyne compounds. Your TA will assign you three of the alkynes above. Write the Lewis structure and condensed structural formulas for three examples of the alkynes listed above. Name each of the alkynes you are assigned.

Questions:

1. What is the general formula for an alkyne?
2. Draw all of the structural isomers for one of the assigned alkynes.

PART IV. Aromatics

The hydrocarbon compound with the following molecular formulas is classified as an aromatic.



Use the molecular model kit to construct benzene. Use your laboratory book to write the Lewis structure and condensed structural formulas of the aromatic listed above.

PART V. Alcohols

The compounds with the following molecular formulas are all classified as alcohols.



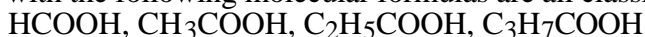
Use the molecular model kit to construct several examples of alcohol compounds. Write the Lewis structure and condensed structural formulas for two examples of the alcohols listed above. Use the model kit to help write the Lewis structures and condensed structural formulas.

Questions (use your textbook as a reference):

1. Name your compounds?
2. What is a primary, secondary and tertiary alcohol?
3. Are alcohols soluble or insoluble in water? Support your answer with a brief explanation.
4. What is an ether? How does an ether structurally differ from an alcohol?

PART VI. Carboxylic acids

The compounds with the following molecular formulas are all classified as carboxylic acids.



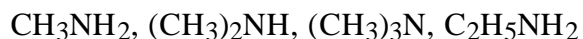
Use the molecular model kit to construct several examples of carboxylic acid compounds. Write the Lewis structure and condensed structural formulas for two examples of the carboxylic acids listed above.

Questions (use your textbook as a reference):

1. What is the important functional group in the carboxylic acids?
2. Name these carboxylic acids.
3. Are carboxylic acids soluble or insoluble in water? Support your answer with a brief explanation.
4. What is an ester? How does an ester structurally differ from a carboxylic acid?

PART VII. Amines

The compounds with the following molecular formulas are all classified as amines.



Use the molecular model kit to construct several examples of amine compounds. Write the Lewis structure and condensed structural formulas for two examples of the amines listed above.

Questions (use your textbook as a reference):

1. What is the important functional group in the amines?
2. What is a primary, secondary and tertiary amine?
3. What are amines derivatives of?
4. Name these amines.
5. Are amines soluble or insoluble in water? Support your answer with a brief explanation.