Chemistry 230
Problem Set #2—Bonding and Organic Compounds; Functional Groups

Directions: Complete each problem below to the best of your ability. Submit your answers neatly and completely on a separate page(s).

1. Draw Lewis structures for each molecule below. Show all lone pairs and (nonzero) formal charges.
   a. COCl₂  
   b. HNO₂  
   c. CH₃N₂⁺

2. a. Draw all possible isomers of ethers with molecular formula C₅H₁₂O.
   b. Draw all possible isomers with molecular formula C₃H₄Cl.
   c. Draw all possible isomers with molecular formula C₃H₆O.

3. This question involves the structures of the natural products on page 2. Before beginning this question, be sure to watch the video lecture on functional groups and read sections 2.1 to 2.13 in the Solomons textbook.
   a. Circle and label all functional groups in these six molecules. Do not label any groups as “alkanes” (this term is reserved for molecules which contain no other functional groups). Do this directly on page 2; you do not need to redraw all the molecules.
   b. Carefully redraw Mycophenolic acid by hand (on another sheet of paper). Indicate the hybridization of all atoms (except hydrogen) which are not sp³-hybridized.
   c. Determine the molecular formula of (i) (-)-Galbonolide B, and (ii) Anthoplalone from the drawings provided.
   d. Which molecule contains a tertiary (³°) amine?
   e. Which molecule contains a primary (¹°) amine?
   f. Which molecule contains sp-hybridized carbon atoms?
   g. Suppose that Sphingofungin B is dissolved in water. Draw the predominant structure of the molecule as it should exist at equilibrium in solution. (Hint: The molecule contains an acidic functional group and a basic one).
   h. With careful drawings, show how Sphingofungin B is capable of making intramolecular hydrogen bonds (that is, one part of the molecule can form hydrogen bonds with another part.)
   i. Determine (i) the number of carbon atoms, and (ii) the number of π-bonds in Callipeltoside A.
4. This problem involves some internet research using the web site of Sigma-Aldrich, an important manufacturer of fine chemicals. The URL for their web site is http://www.sigmaaldrich.com

a. Find (i) the molecular formula and (ii) the molecular weight of Allura Red, a common organic dye. To do this, you will need to do a search by product name (all searches are initiated in the upper right corner of the main page).

b. Find (i) the names, (ii) the boiling points, and (iii) the densities of the common organic solvents with formulas CHCl₃ and CCl₄. To do this, you will need to search by molecular formula. Aldrich carries many different grades of some of its chemicals. It is usually fine to pick the chemical at the top of the list (it will usually say “ACS 99%” or “ACS reagent grade” or something similar). Do not pick compounds which are isotopically-labeled; the names of these compounds will contain ¹³C or deuterium (the ²H isotope of hydrogen, abbreviated D).

c. Provide the common names of at least five different scorpion venoms which are sold by Sigma-Aldrich. Search by keyword.

d. Product number V0376 is another rather nasty toxin sold by Aldrich. What animal does this toxin come from? What is one of the symptoms of exposure to this chemical? This can be found on the Material Safety Data Sheet (MSDS), another item which can be retrieved from the Aldrich web site.

e. Do a substructure search on each molecule whose structure is drawn below. Then, provide (i) the common name, and (ii) the melting point of each compound.

Instructions for substructure search: Select “substructure” as the type of search. A Java-based applet will open in your web browser which allows you to draw chemical structures. Choose “Exact(2D)” to search for a molecule which exactly matches the one you’ve drawn, or choose “Substructure(2D)” to find all molecules which contain the structure you’ve drawn as a portion of their structure. In this case, you will be doing an exact search.