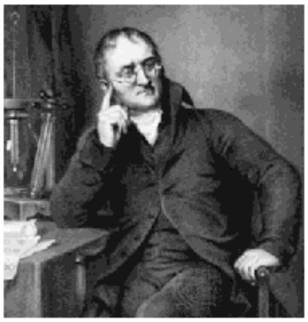
Chem 225b - Comprehensive Organic Chemistry

Problem Set 1

Chapters 1 and 2, Structure, Bonding, Reactivity

Due: Monday, January 28, 2008



John Dalton

(1766-1844)

John Dalton's formulation of an Atomic Theory in the first decade of the 19th century provided a theoretical basis for understanding chemical behavior. In addition to defining the Law of Multiple Proportions, he also formulated the Rule of Greatest Simplicity, which held that water was a binary compound, OH. (Note: Dalton did not use our modern symbols, which came to us from Berzelius, but rather circles that were distinguishable from one another.) Dalton established the combining masses of H to O in water as ~1:6. This ratio was later refined to 1:8. The Rule of Greatest Simplicity, which was at odds with Gay-Lussac's Law of Combining Volumes of Gases, did not lead to a correct formulation for the atomic composition of water. Moreover, although there was agreement regarding the combining masses of atoms in the first half of the nineteenth century, there was disagreement as to the unit mass of the common atoms encountered in organic chemistry: hydrogen (1), carbon (2x6 or 1x12), oxygen (2x8 or 1x16). Since hydrogen was the lightest of the elements, it was assigned a mass of one, a notion that is unrelated to today's mass of hydrogen owing to the presence of a single proton in the hydrogen nucleus. Berzelius's proposal of a mass scale based upon O = 100 would have worked as well.

For a Brief History of Organic Chemistry (PowerPoint), click here.

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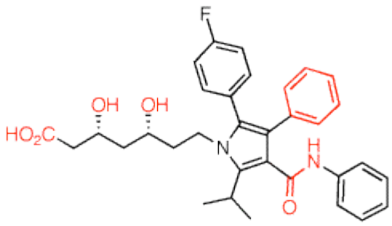
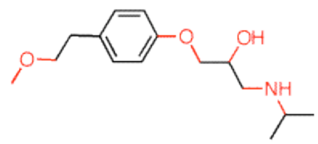
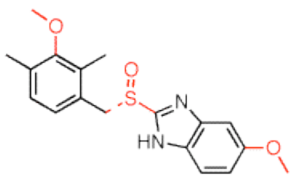
1. Circle and name the functional (in red) in each of the following compounds.



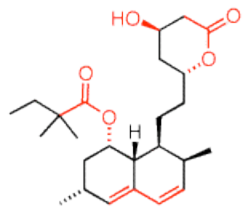
Lipitor HMG-CoA reductase Inhibitor
-lowers LDL cholesterol level



Toprol XL a beta blocker
-treatment of hypertension
and angina



Nexium proton pump inhibitor
-treatment of heartburn



Zocor HMG-CoA reductase Inhibitor
-lowers LDL cholesterol level

2. Draw resonance structures (if they exist) for the following compounds. Include all formal charges.

a) N_2CH_2 b) $(CH_3)_3BS(CH_3)_2$ c) $CH_2CHCH_2^+$ d) $^-CH_2CHO$

3. For each of the following acids or bases, identify the corresponding conjugate base or acid, whichever is appropriate.

a) $NaNH_2$ (sodamide)

b) acetic acid

c) NaOH

d) CH_3MgBr

e) C_2H_5OH

4. Arrange the acids and conjugate acids in problem #3 in order of decreasing acidity (increasing pKa).

5. Draw an orbital picture for the monomer, acrylonitrile (CH_2CHCN). Identify π-bonds and hybridization.

6. A normal alkane, C_nH_{2n+2}, is found to have a vapor density of 3.66 mg/mL at 200^{o}C and 1 atm.. Using the ideal gas law, determine the structure of the alkane. In the early 19th century, the vapor density of an unknown liquid was compared to the vapor density of air to determine the liquids molecular weight. Use the ideal gas law to illustrate this point. What constraints must be placed on this method?