

Chem 220a - Organic Chemistry

Problem Set 1

Chapters 1 and 2

Due: Monday, September 12, 2005



Antoine Lavoisier (1743-1794)

French scientist who developed dual names for chemical compounds and formulated the law of the conservation of mass. His work in chemical analysis led to the overthrow of the phlogiston theory (Stahl) by correctly explaining the role of oxygen in combustion.



Jons Jacob Berzelius (1779-1848)

Swedish chemist who gave us the modern symbols of the elements and discovered many of them. He was a proponent of the dualistic (electrochemical) theory and he recognized and defined the property of isomerism.

1. In 1818, William Prout, MD, presented a paper before the Royal Society of London on the oxidation of uric acid (**1**), the cause of gout. Treatment of uric acid with nitric acid formed purpuric acid **2**. Treatment of purpuric acid with ammonia gave a purple ammonium salt **3**, which was used as a dye (Murexide). Prout conducted a combustion analysis on **3** and found the percentages of carbon, hydrogen, nitrogen and oxygen found on page 423.

- Why do these four percentages add up so closely to 100% (99.98%)?
- What atomic masses did Prout use to

determine the number of each type of atom?

c) In determining the ratio 2:2:2:1, is there anything suspicious about the numbers?

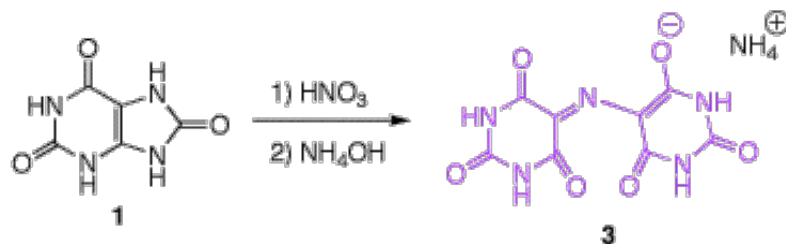
d) Knowing what you know from general chemistry, what would you suggest as the simplest empirical formula for **3**, based upon the data presented?

e) Of course, Prout had no idea about the structure of **3**. However, compare his empirical formula with the molecular formula derived from **3**. How well did he do?

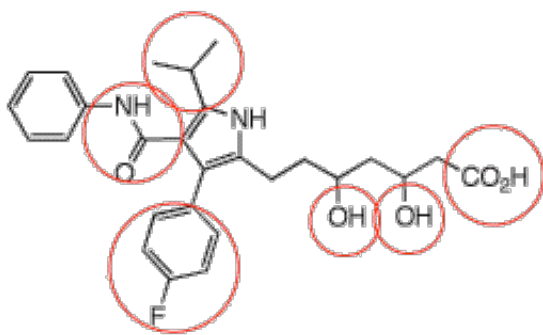
f) What is the structure of purpuric acid?

g) Purpuric acid has a $pK_a=0$. What does this value mean?

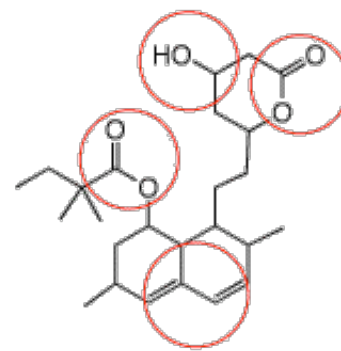
h) Using resonance structures, show why you would expect purpuric acid to be more acidic than [acetic acid](#).



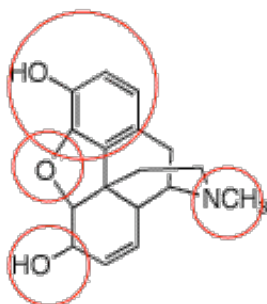
2. Define the functional groups or class of compound indicated by the circles in the following structures. [The inside of the front cover of your text is helpful. Print the structures and write the answers next to the circles.]



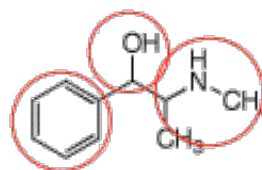
Lipitor (Atorvastatin, Pfizer, synthetic, sold as the sodium salt)



Zocor (Simvastatin, Merck, semi-synthetic)

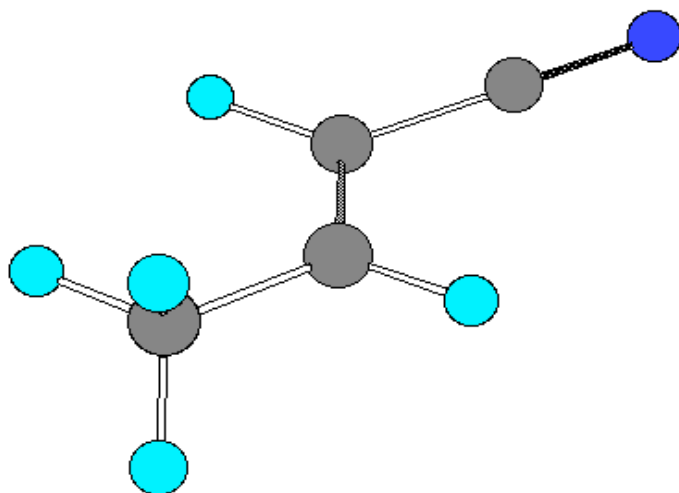


morphine



ephedrine or pseudoephedrine

3. For the compound (C_4H_5N) shown below, identify the hybridization of each of the carbon and nitrogen atoms. Redraw the structure showing π -bonds with p-orbitals.



Chime version. Get Chime [here](#).

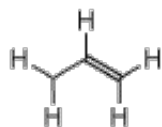
(First get Netscape 4.8 [here](#).)

4. Draw the structures that have the molecular formula $C_4H_{10}S$. Some of the structures are soluble in aqueous NaOH; others aren't. Use the [pKa table](#) to determine which of the two groups is soluble in base. Explain and illustrate.

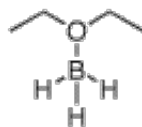
5. Assign charges and non-bonded electrons to each of the following nine species or compounds. If

resonance structures apply, draw them.

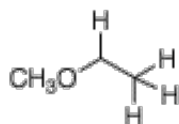
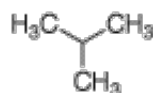
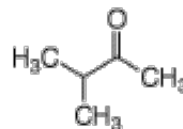
cations



neutral



anions



6. Which of the following compounds have a net dipole moment? Which ones are planar compounds? Compounds b) and c) are at best identical, or at worst, mirror images. Explain and illustrate.

