

Chem 221b

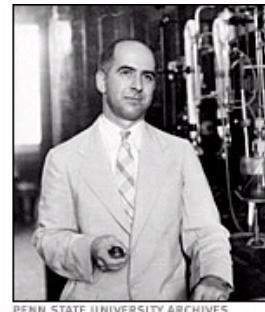
Problem Set 5

Chapter 18

Aldehydes and Ketones

Due: Monday, February 21, 2005

" There are more stories told about Russell Marker than perhaps any other chemist. Although many of these stories are apocryphal, they are so fascinating that most of us cannot bear to stop repeating them. This is the oral history of our profession that we pass to our colleagues and our students. They are the campfire stories that bind our profession together." --Steven M. Weinreb, *Russell & Mildred Marker Professor of Natural Products Chemistry, Pennsylvania State University*

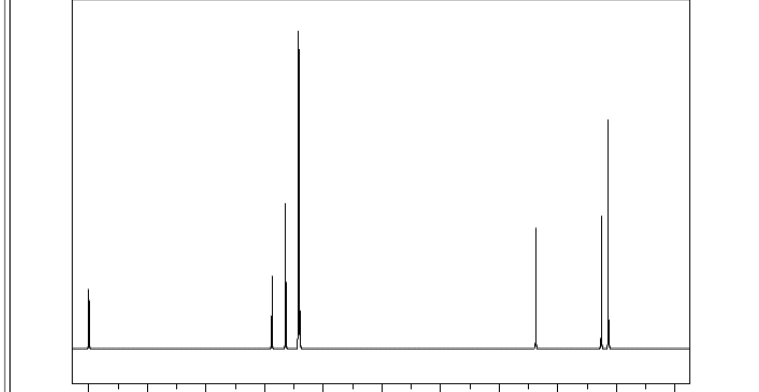
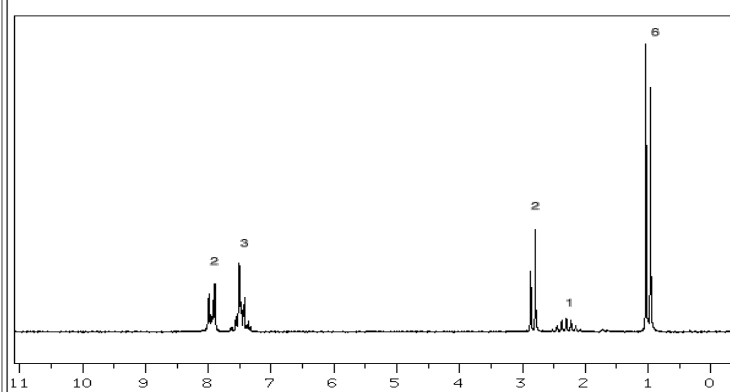
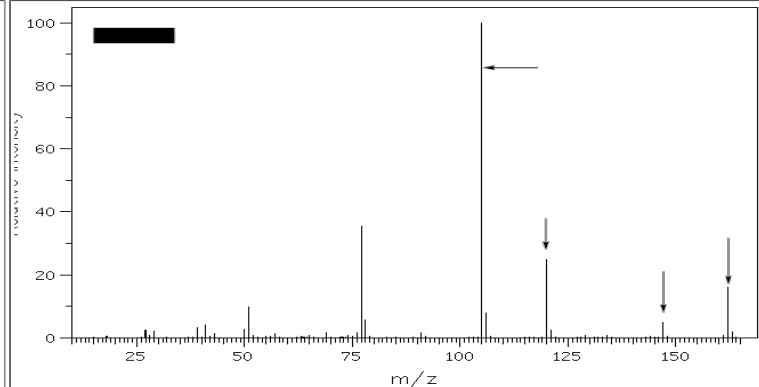


Russell Marker (1902-1995)

There are some practice exercises in the aldehyde and ketone modules in [ORGO](#).

1. Compound **A** (IR: 1685 cm^{-1}) displays the spectra shown (click on the spectra for larger versions).

- What is the structure of **A**?
- Assign the resonances in the NMR spectra.
- Assign the peaks (arrows) in the mass spectrum.



2. a) Design a synthesis of ketone **1** from benzene, ethylene, and acetone- d_6 .

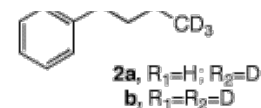
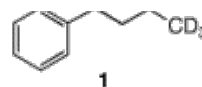
[Hexadeuteroacetone is a readily available ^1H NMR solvent.]



b) Draw a mass spectrum for **1**. How does it compare with the mass spectrum in problem 1?

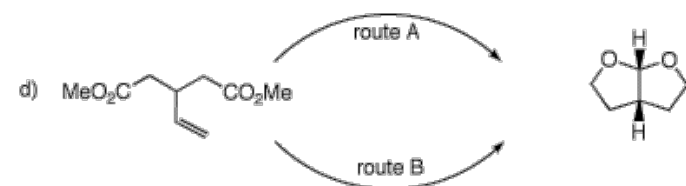
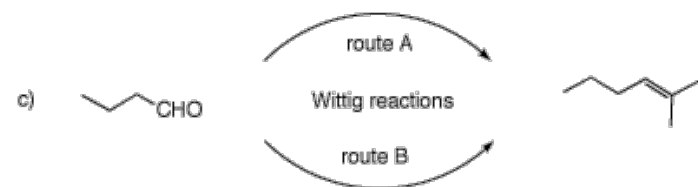
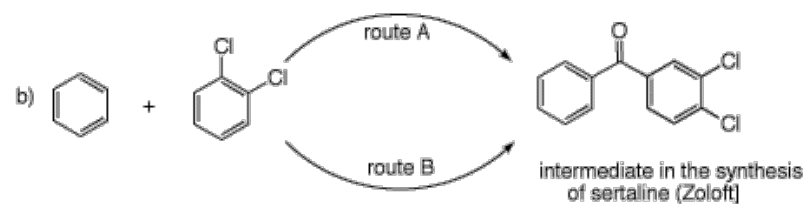
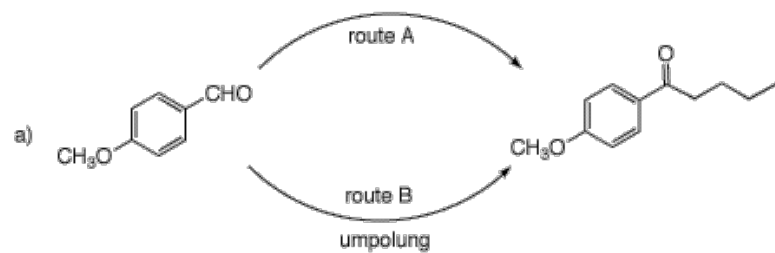
c) How would you prepare (\pm)-**2a** from **1**?

d) How would you prepare **2b** from **1**?

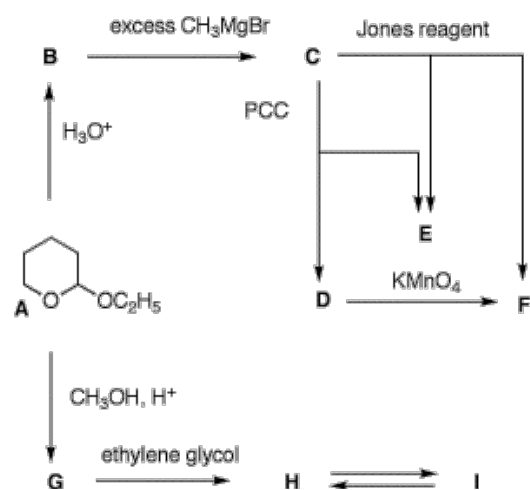


b, R₁=R₂=D

3. In each of the following questions, provide two routes for each chemical transformation. More than one reaction in each route may be required.

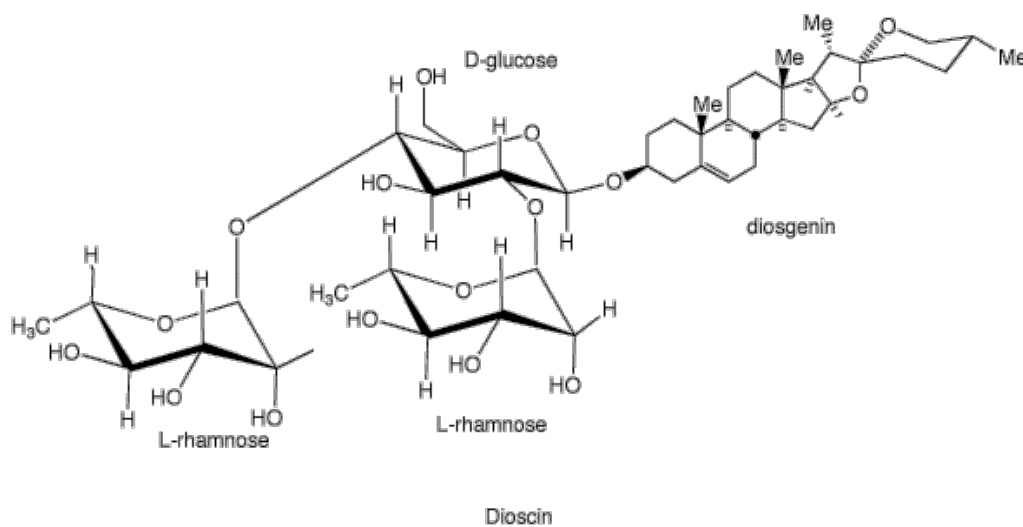


4. Provide structures for **A-I**. where mixture are formed, one compound may dominate. For reactions involving an acid catalyst, provide mechanisms.



5. When cyclohexene is subjected to ozonolysis in methanol/chloroform as a solvent, traces of HCl are produced and compound **A** ($C_9H_{20}O_5$) is formed. Neutralization of the acid with $NaHCO_3$ and subsequent exposure of **A** to dimethyl sulfide produces **B** $[(CH_3O)_2CHCH_2CH_2CH_2CH_2CHO]$, the monodimethyl acetal of adipaldehyde. Provide mechanisms for the formation of **A** and **B**. Why is direct formation of **B** from adipaldehyde, methanol, and an acid catalyst not an efficient procedure?

6. The background for this problem is located [here](#). In the 1930's, progesterone was a rare steroid that held promise for the reduction of miscarriages. Progesterone was prepared with great effort from oxidation products of cholesterol. Marker discovered that the rhizome of the Mexican yam (cabeza de negro; *Dioscorea villosa*) contained dioscin, a saponin (they cause lathering like soap). Marker extracted the tuber with ethanol and then treated the concentrated extract with hot aqueous HCl to remove the sugars D-glucose and L-rhamnose. Diosgenin, the sapogenin or aglycone (meaning the non-sugar portion of dioscin) was formed. The ketal of this compound was inert to aqueous acid, but Marker developed a way to degrade the side chain and thereby facilitate access to progesterone.



- How does diosgenin differ from cholesterol?
- Locate the four acetal (or ketal) functionalities in diosin.
- Why is diosgenin unreactive toward aqueous acid yet the sugars are readily removed from dioscin?
- Why does the first step in the Marker degradation differ from aqueous acid hydrolysis?
- Provide mechanisms for the last three steps in the degradation: Br_2 , CrO_3 , $Zn/HOAc$. Be sure to show how and why the double bond moves.

