Chemistry 41c: Organic Chemistry

Spring 2011-In Class Activity #1 "Carbonyl Chemistry"

Create a team consisting of three to four Ch41c students and one pre-frosh if possible. Your job is to explain as much about a carbonyl group and the reactivity of carbonyl compounds to each other (including the pre-frosh) as possible. The following questions could serve as an outline for the discussion. On the other hand, if you have different insights, try to build your case in an alternate way (please show me this on the back if you do it this way).

At the end of the activity are a couple of mechanism problems that should be challenging. See if you and your pre-frosh can get up to that level by the end of class. (you may need to explain arrow pushing as well!).

Feel free to use any and all resources available in 153 Noyes (including the TAs). You have 40 minutes, so use your team's resources wisely. Most questions will seem simple, while some may be challenging and will require your creativity. Do your best! Also, remember that in organic chemistry, pictures often speak louder than words! You may not have time to finish this activity, but you can continue to think about these concepts and questions. (this exercise is worth 20 points)

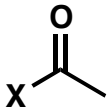
Who was on your team (limit to 4 people + a pre frosh)?

In Class we have extensively learned about the carbonyl group. Draw some pictures of this functionality. You may want to include a diagram of the important bonding orbitals and a separate picture of the antibonding orbitals.

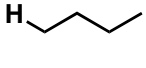
Explain what the different representations tell you about the reactivity of the various parts of the compound toward electrophiles and nucleophiles (you may need to explain these terms to the pre-frosh)

Show a specific reaction of a carbonyl-containing compound with a mechanism that might illustrate these basic reactivity principles.

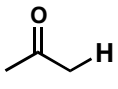
Now consider substitution attached to the carbonyl carbon (e.g., X in the structure below). Can you describe how different kinds of substituents enhance or detract from the general reactivity types you described above.



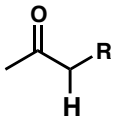
We have alluded to the reactivity of the α-carbon of carbonyl compounds many times (coming up in Chapter 22). Protons at the α-carbon are much more acidic than normal aliphatic protons (see below). Can you predict why this is the case and how substituents at both the carbonyl carbon and the α-carbon might influence the pKa of these protons. (some examples are below. You might try to rank them by pK_a)



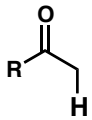
pK_a = ~50



pK_a = ~26



R = F, CO_2Me, Ph, etc.

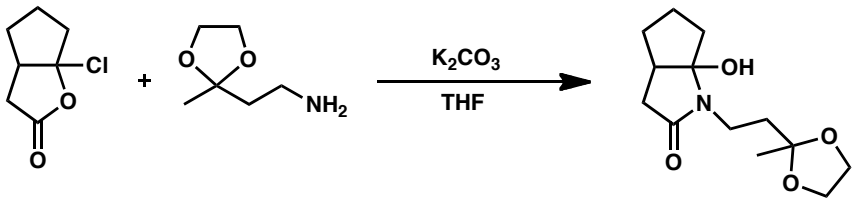


R = CH_3, OMe, NMe_2, etc.

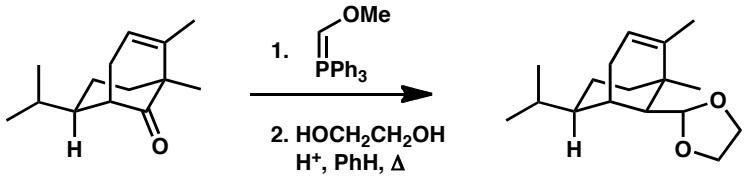
Here are a few reactions that have somewhat challenging mechanisms or illustrate interesting concepts. Maybe after working through this activity with your team, you can start to tackle these. Give them a try!

Provide a mechanism for the following reactions:

A.

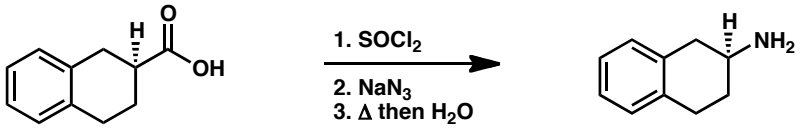


B.

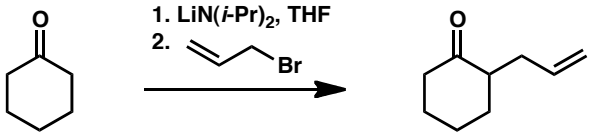


B *C*

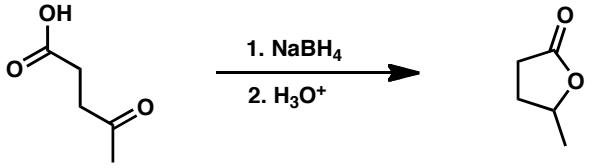
C.



D.



E. Rationalize the outcome of this reaction including the selectivity in the reduction step.



Did you learn anything from this exercise? (Was it fun, useful, or a waste of time?)