CEM 852 Exam-1

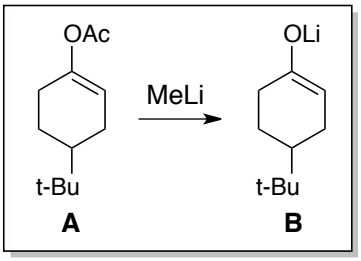
February 20, 2016

This exam consists of 5 pages. Please make certain that your exam has all of the necessary pages. Total points possible for this exam are 100. In answering your questions, please write legibly and draw all structures clearly. Write all your answers in the exam booklets. Good luck.

I. The enolate of 4-t-butylcyclohexanone (**B**) can be generated by the reaction of enol ester **A** with MeLi.

(a) Provide a detailed arrow pushing mechanism for the reaction of **A** to **B** (2 pts)

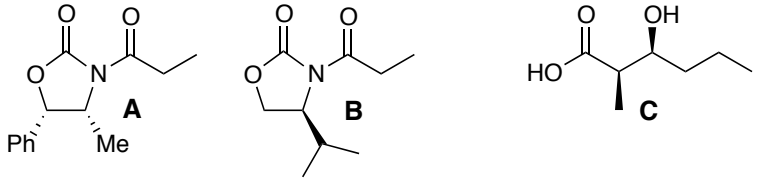
(b) Draw **B** as a partial chair and as a partial twist boat. (4 pts)



II. Rank the following compounds in terms of their carbonyl oxygen basicity from strongest to weakest: aldehyde, amide, carboxylic acid, ester, and ketone. (3 pts)

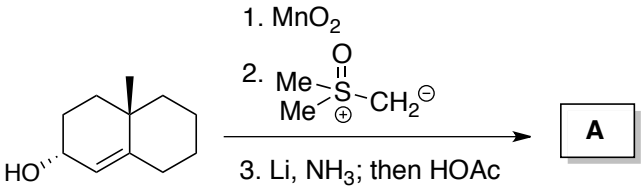
III. Provide examples that illustrate the difference between a stereoselective and a stereospecific reaction (4 pts)

IV. Which Evans' oxazolidinone should one use to form **C** in high enantiomeric excess? Explain your choice by illustrating a Zimmerman-Traxler transition structure that employs the oxazolidinone of your choosing. (4 pts)

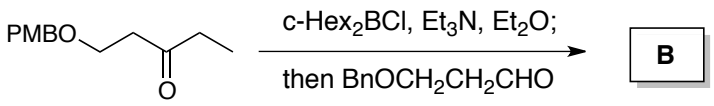


V. Provide the product or products of the reactions outlined below. Show all intermediate compounds and be sure to indicate the product's relative or absolute stereochemistry. For reactions where multiple products are possible, be sure to indicate the major and minor species. (27 pts)

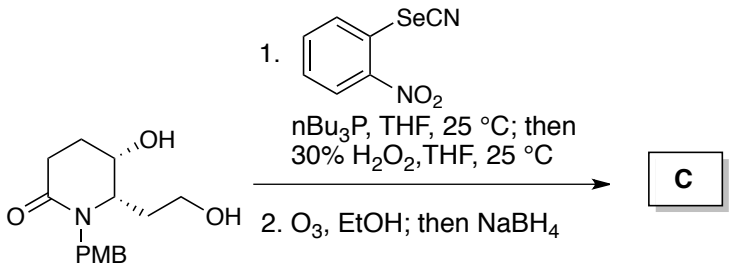
1.



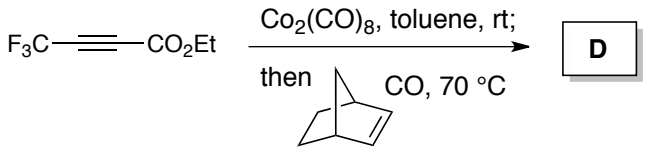
2.


PMBO
O
c-Hex2BCl, Et3N, Et2O;
then BnOCH2CH2CHO
B

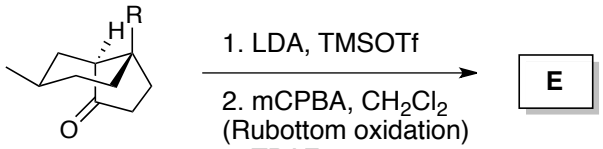
3.


1.
SeCN
NO2
nBu3P, THF, 25 °C; then
30% H2O2,THF, 25 °C
2. O3, EtOH; then NaBH4
OH
O
N
PMB
OH
C

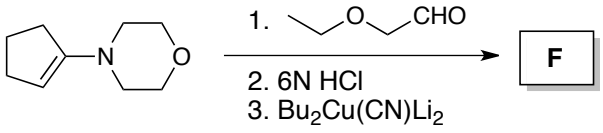
4.


F3C
CO2Et
Co2(CO)8, toluene, rt;
then
CO, 70 °C
D

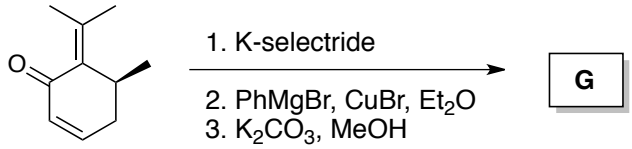
5.


H
R
O
1. LDA, TMSOTf
2. mCPBA, CH2Cl2
(Rubottom oxidation)
3. TBAF
E

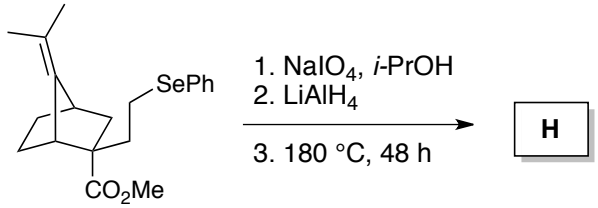
6.


N
O
1.
O
CHO
2. 6N HCl
3. Bu2Cu(CN)Li2
F

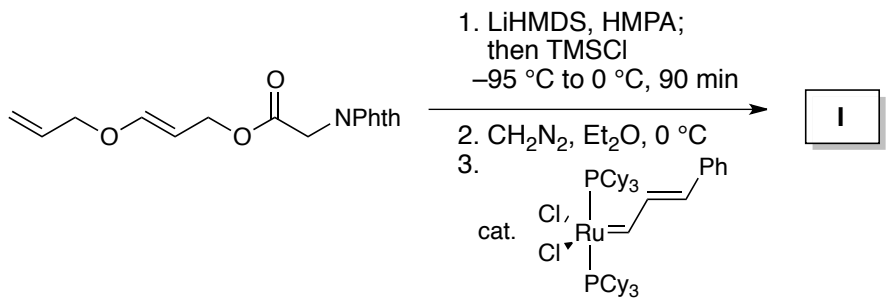
7.


O
1. K-selectride
2. PhMgBr, CuBr, Et2O
3. K2CO3, MeOH
G

8.


SePh
CO2Me
1. NaIO4, i-PrOH
2. LiAlH4
3. 180 °C, 48 h
H

9.



VI. Provide conditions that will effect the transformations outlined below. Some of these conversions will require more than one reaction, so be sure to show all intermediate compounds. (15 pts)

1.

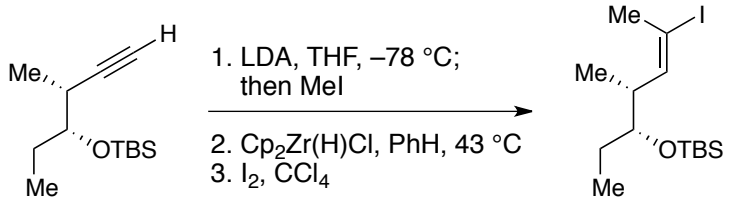
2.

3.

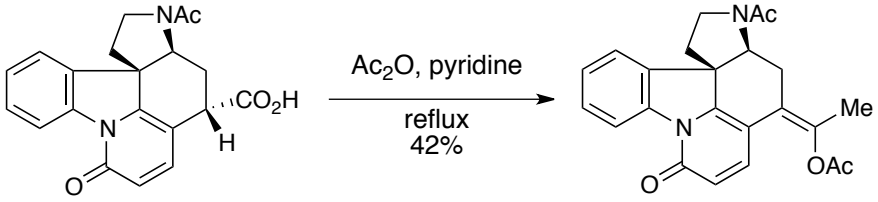
4.

5.

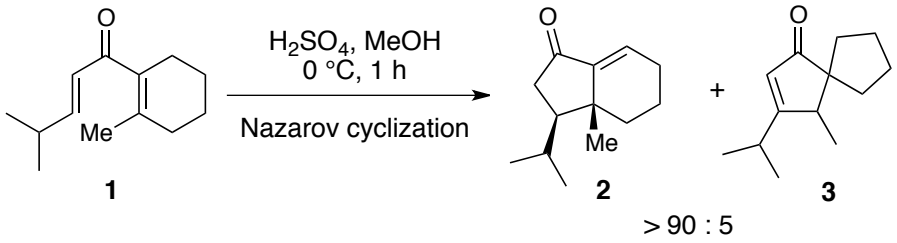
VII. Provide a detailed arrow (electron) pushing mechanism for the reaction below. (5 pts)



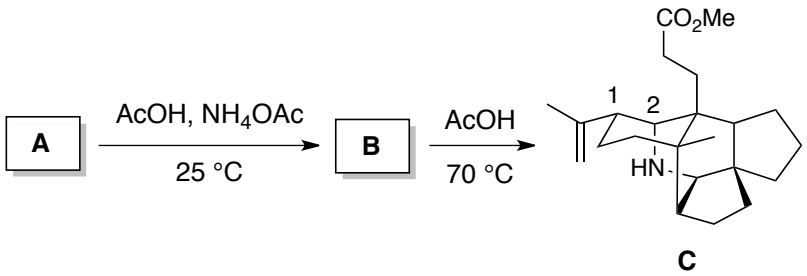
VIII. Provide a detailed arrow (electron) pushing mechanism for the reaction below. (5 pts)



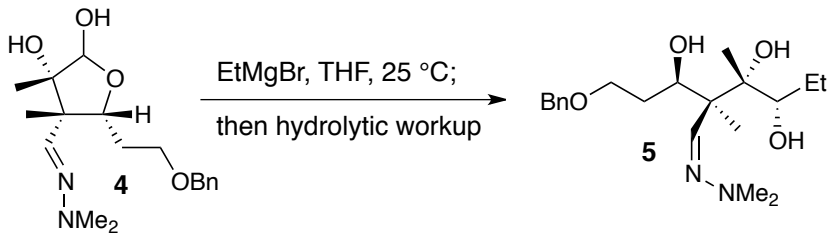
IX. Nazarov cyclization of **1** affords **2** and **3** in a ratio of >90:5. Provide a detailed arrow (electron) pushing mechanism for the formation of these both products. (**Hint**: Both **2** and **3** are formed via a common intermediate). (8 pts)



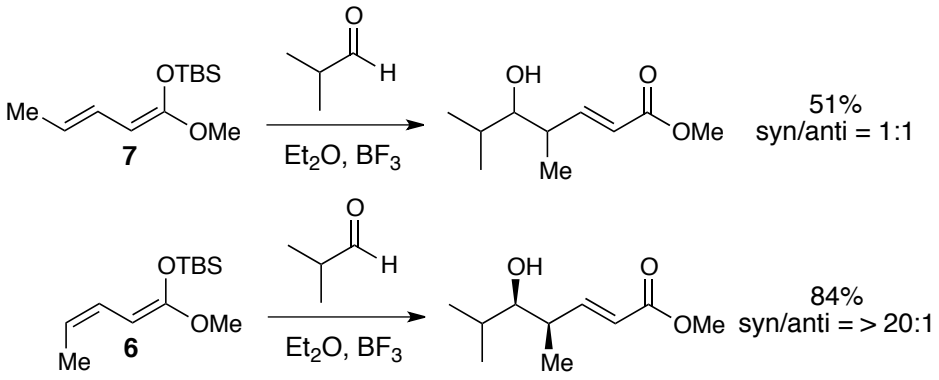
X. Treatment of **A** with acetic acid at rt triggers a [4+2] cycloaddition between a hetero diene and a trisubstituted dienophile to form an iminium containing six membered ring **B**. Heating **B** in acetic acid then triggers an aza-prins reaction that forms the C–C bond between carbons 1 and 2 indicated in structure **C**. Provide structures for **A** and **B**. (6 pts)



XI. Explain the stereochemical outcome of the reaction below. (5 pts)



XII. Ketene acetals 3,4-*Z* (**6**) and the 3,4-*E* (**7**) can both be made to undergo vinylogous Mukaiyamam aldol reactions with isobutyraldehyde. Interestingly, the *E*-configured ketene acetal (**7**) gave a *low yield and poor syn/anti-selectivity*. In contrast, *Z*-ketene acetal **6** gave *high yields and was > 20:1 syn selective*. Provide an argument for the observations. (**Hint**: Both **6** and **7** react with isobutyraldehyde via open transition structures, however in these reactions steric interactions between the Lewis acid and the substituents on **6** and **7** are <u>less</u> disruptive than steric interactions between the isopropyl group on the aldehyde and the substituents on **6** and **7**). (12 pts)



Bonus Question: Valentines Day was celebrated last weekend. The day first became associated with romantic love in 14th century England and over time evolved into the day on which many couples express their love for each other by presenting flowers, offering confectionery, sending greeting cards, and sharing a kiss (or two). Since the 1950's, we've had better kissing through chemistry, courtesy the invention of "kissable lipstick" by what chemist? (2 pts)

(a) Hazel Bishop

(b) Katharine Burr Blodgett

(c) Marie Maynard Daly

(d) Stephanie Kwolek

(e) Estée Lauder