CHEM 330

Final Exam
December 15, 2015

Your name: _____

This a closed-notes, closed-book exam

The use of molecular models is allowed

This exam consists of 9 pages

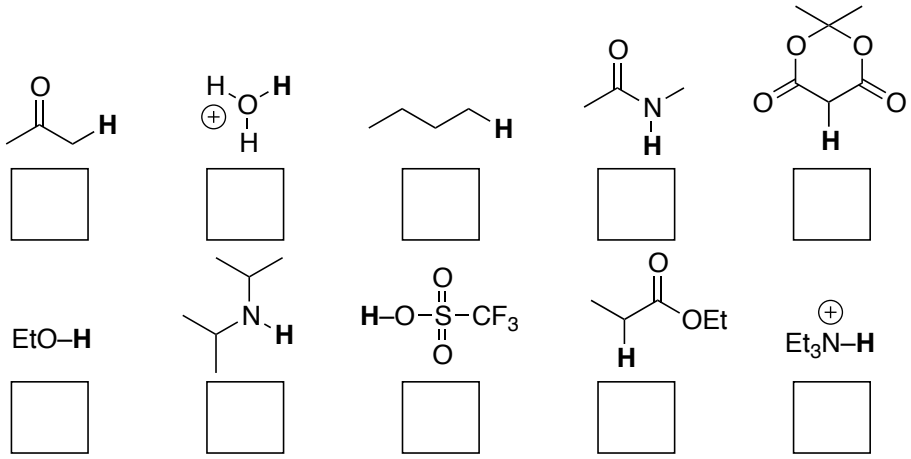
Time: 2h 30 min

1. _____ / 30
2. _____ / 30
3. _____ / 30
4. _____ / 40
5. _____ / 40
6. _____ / 40
7. _____ / 40

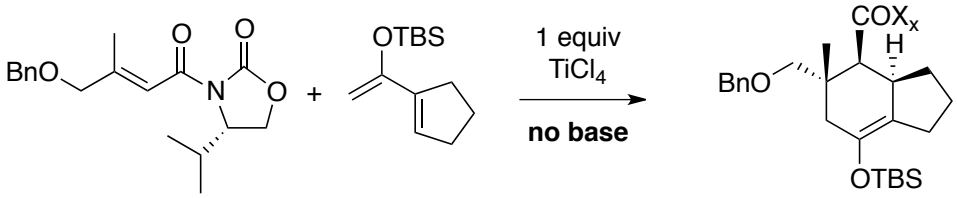
TOTAL _____ / 250 = _____ / 100

This exam counts for 50% of your CHEM 330 final grade

1. (30 pts.) Indicate the approximate pKa for the dissociation of the H in boldface in the substances shown below:



2. (30 pts.) Evans auxiliaries find use also in asymmetric Diels-Alder chemistry. To illustrate, addition of 1 equivalent of $TiCl_4$ to an equimolar solution of **A** and **B** results in the highly stereoselective formation of **C** (*Synthesis* **2015**, *47*, 3489). Account for the stereochemical outcome of this reaction (an accurate transition state diagram would be useful…).



A (1 equiv) **B** (1 equiv) **C**

3. (30 pts.) Write a chemical equation to show an example of (**no mechanisms** necessary):

   a. A cross-Claisen reaction that works well under conditions of thermodynamic control:

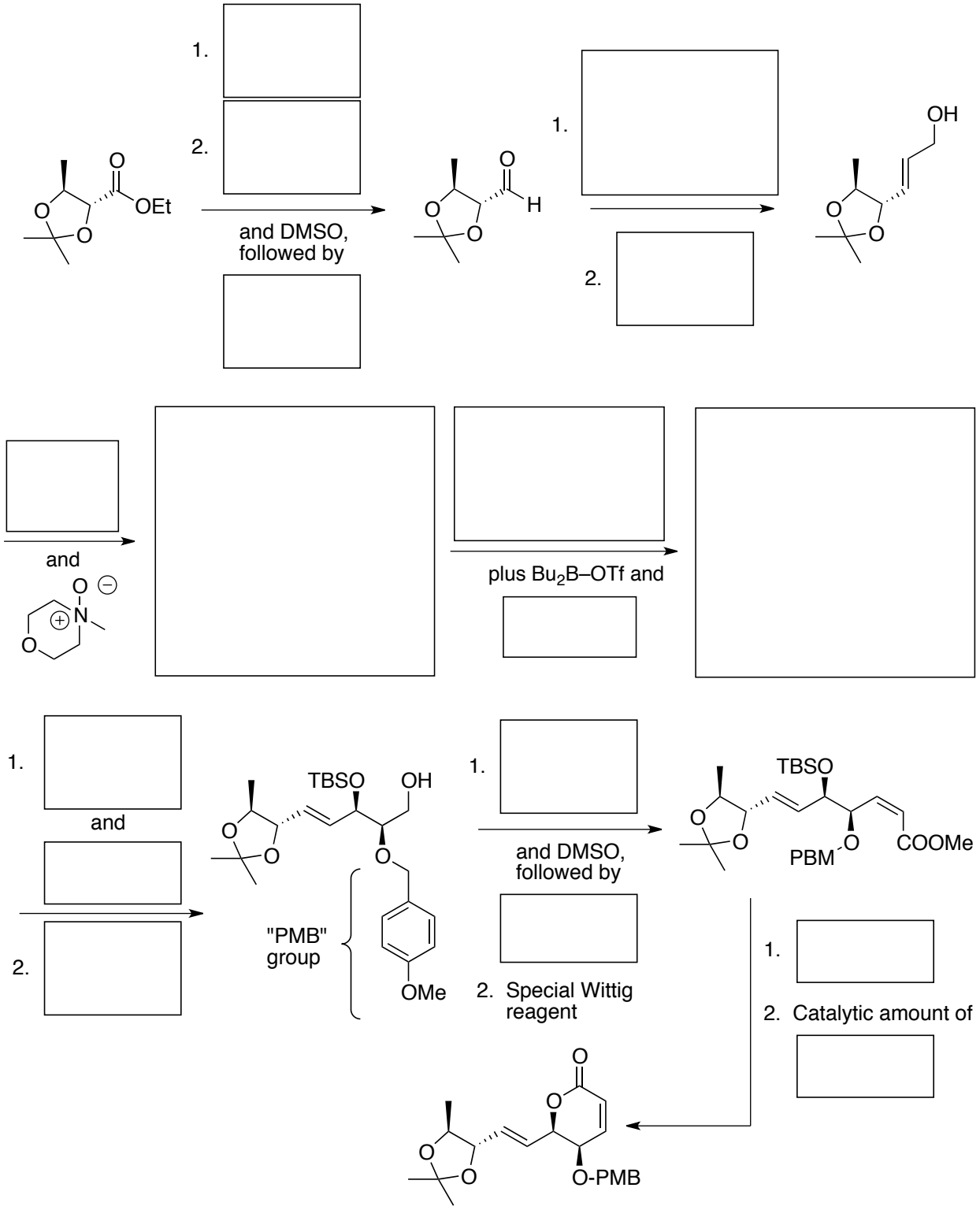
   b. A cross-Claisen reaction that works well only under conditions of kinetic control:

   c. A Prasad reduction:

   d. A reaction that probably occurs via a tightly bound (= closed) transition state:

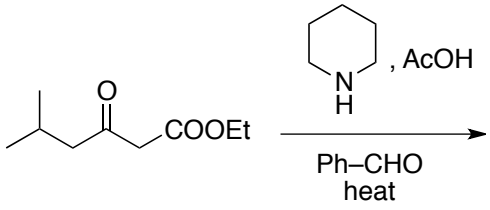
   e. A reaction that probably occurs via an extended (= open) transition state:

4. (40 pts.) The sequence below is inspired by a recent synthetic study on a family of bioactive compounds called phomopsolides (*Synthesis* **2014**, *46*, 2945). Complete this diagram by writing all the missing reagents / products in the appropriate boxes. **Important**: (i) aqueous workups are understood; (ii) compounds must be drawn with the correct configuration.

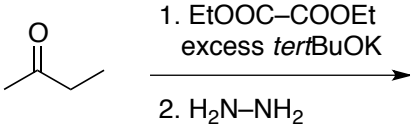


5. (40 pts.) Predict the structure of the major product expected from the following reactions. Notes: **(i) it is not necessary to draw mechanisms; (ii) compounds must be drawn with the appropriate configuration; (iii) aqueous workups are understood.**

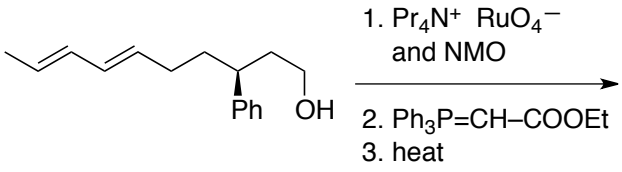
a.



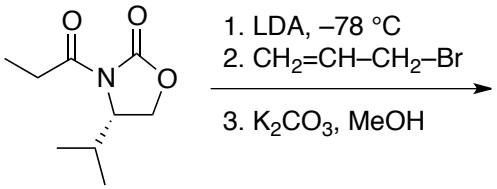
b.



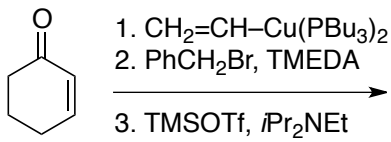
c.

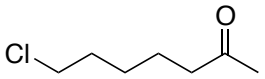


d.



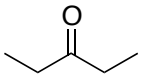
e.



f. 

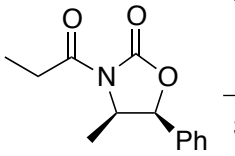
1. *tert*-BuOK
2. NaH, cat.

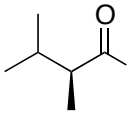
EtOH
$(EtO)_2C{=}O$

g. 

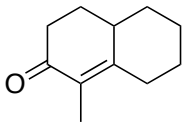
1. 9-BBN-OTf
   i-Pr_2NEt

2. $CH_3–CH_2–CHO$
3. $NaBH(OAc)_3$

h. 

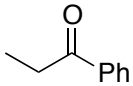
1. Bu_2BOTf, Et_3N
2. 

3. TBSCl, Et_3N
4. DIBAL

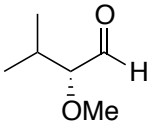
i. 

1. 1.1 equiv
   LDA, –78 °C
2. CH_3I
3. cat. NaOMe

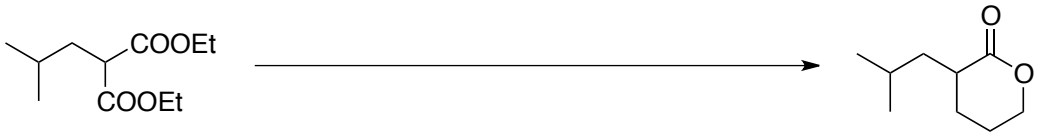
4. Li, NH_3 (liq.)
   tBuOH
5. $CH_2{=}CH–CH_2$-Br

j. 

1. $Cy_2B–Cl$, Et_3N

2. 

6. (40 pts.) Complete the following equations by indicating all the reagents that are necessary to effect the transformations shown. Provide your answers as a numbered list of reagents, in the correct order, written over/under the reaction arrows. **Note**: aqueous workups are understood and do not need to be included in your answers.

a. 

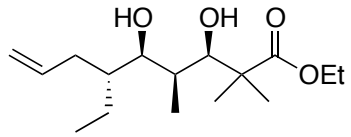
b. 

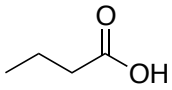
c. 

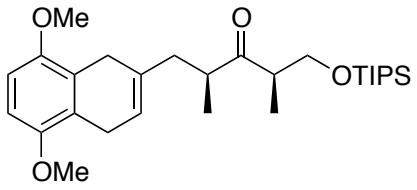
d. 

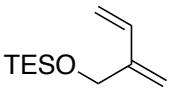
7. (40 pts.) Propose a method to achieve the enantioselective synthesis of the molecules shown below starting with the suggested compounds plus any additional building blocks that might be required (simple carbonyl compounds, alkyl halides…). Be careful about protecting groups and configurations of stereocenters. Assume the availability of all needed reagents, auxiliaries, etc. Present your answer as a **clear** flowchart.

It is not necessary to draw mechanisms or to indicate aqueous workups.

a. 

starting with 

b. 

starting with 

Happy Holidays !