Chem 41c Final Exam

Stoltz, Spring 2005, June 6, 2005

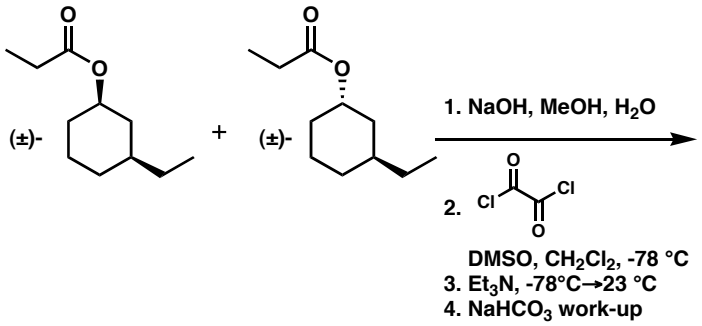
The exam begins when you turn to page 2. You have 4 hours to complete the exam. This is a closed note and closed book exam with no collaboration. You may use the periodic table on the last page of this packet. You may not use any other materials. The exam has a total of 180 points and counts for 40% of your course grade. The exam is due on Friday June 10, 2005 by 5 PM. Good luck.

There are 16 pages in this exam packet.

*Name:*_____

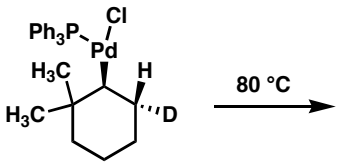
1. Predict the major non-volatile products (if any) of the following reactions or sequences. Clearly mark your answers by placing a **box** around the compound that you believe to be the major product. (5 points each).

a.

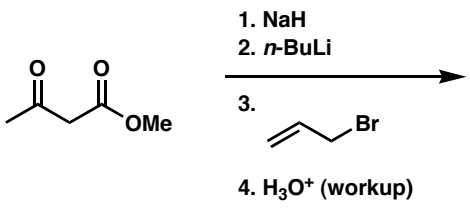


hint: one racemic non volitile product is formed

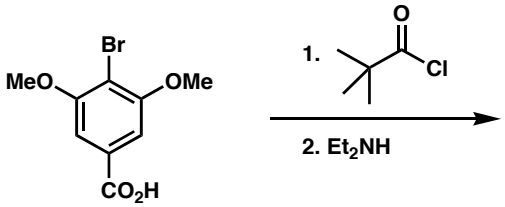
b.



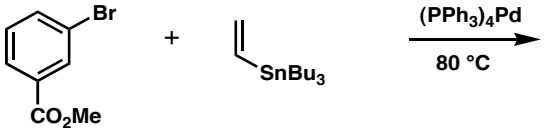
c.



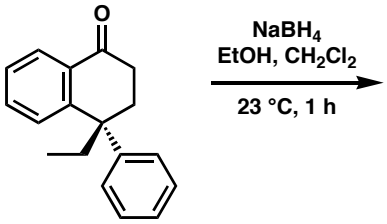
d.



e.

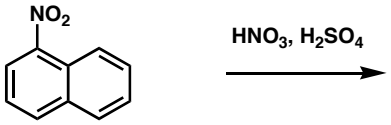


f.

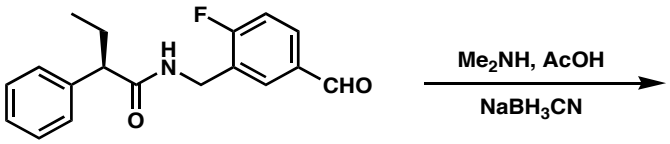


2 major products

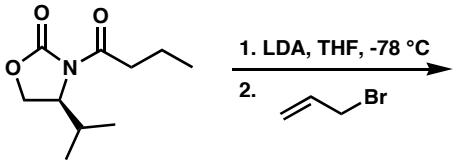
g.



h.

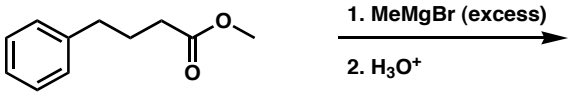


i.



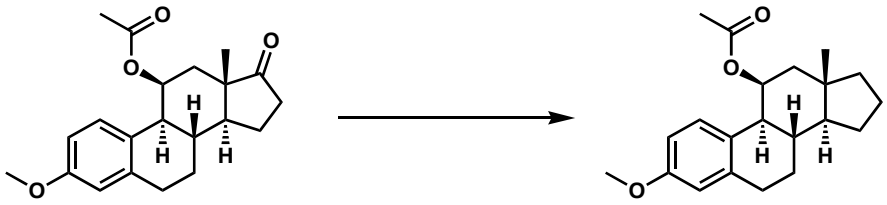
5 point bonus: what is the structure of LDA?

j.

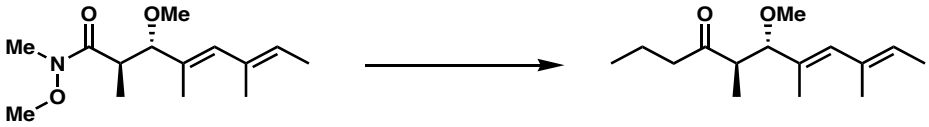


2. Provide reagents for the following transformations. They may be multistep processes, but should not be longer than 5 steps. (5 points each)

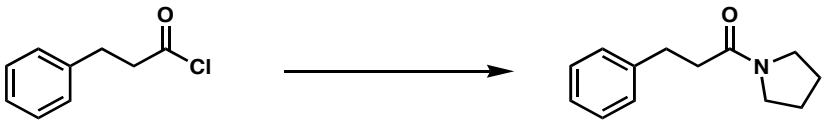
a.



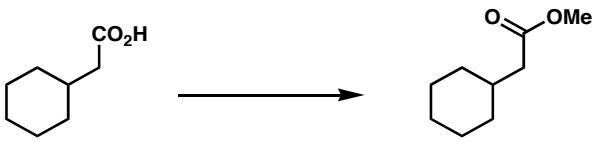
b.



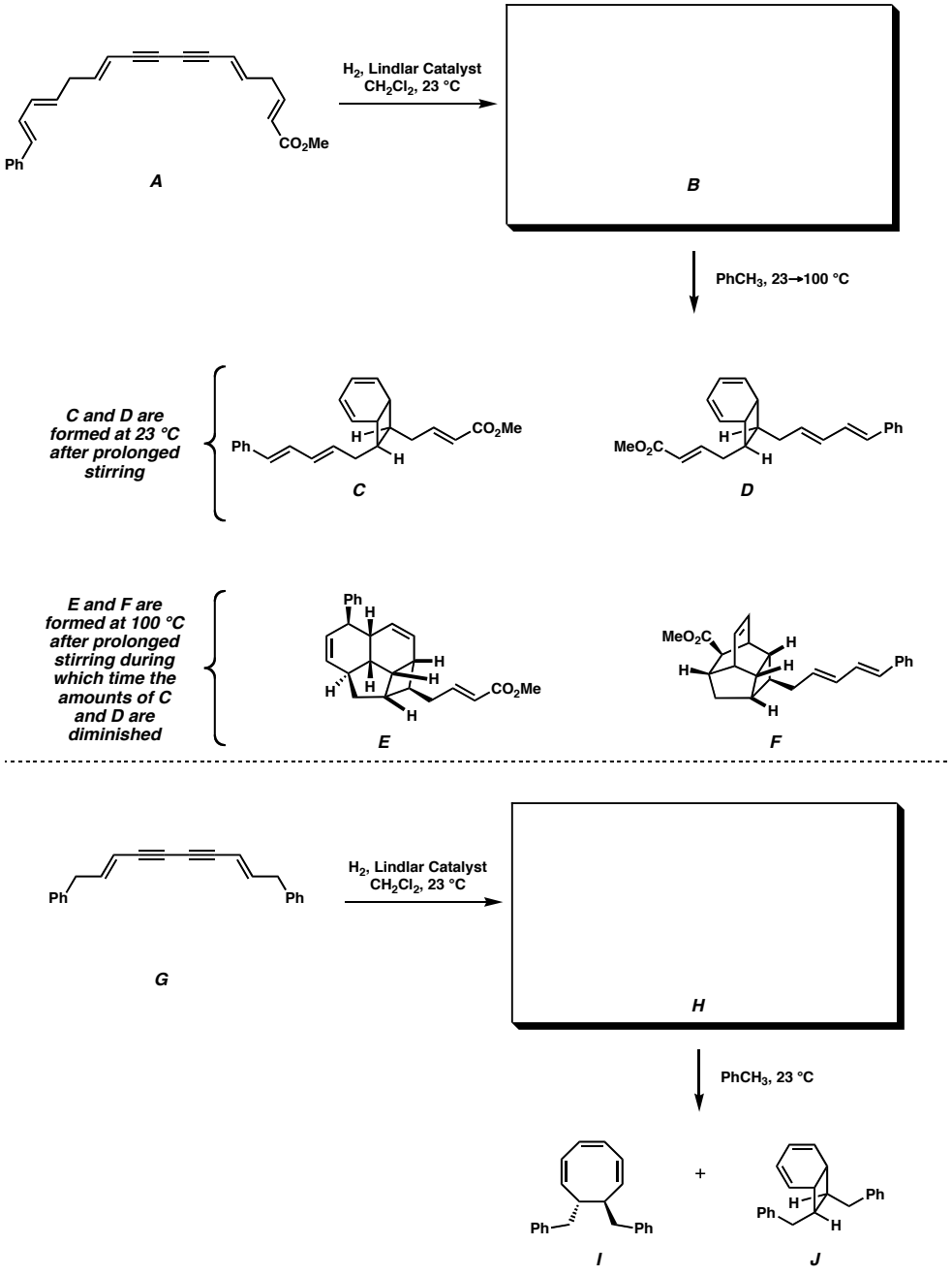
c.



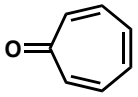
d.



3. Pericyclic reactions are interesting transformations that we studied this term. A remarkable cascade of such reactions on compound **B** produces a mixture of racemic compounds **C**-**F** simply upon heating. Compound **B** is prepared by Lindlar reduction of **A**. In a related system compound **G** is reduced to **H** and forms products **I** and **J** after prolonged stirring at 23 °C (eventually only **J** is observed). Your task is the following 1) identify the structures of **B** and **H**, 2) Describe a mechanism for the the conversion of **H** to **I** and **J**, (hint: it may be useful to draw an orbital diagram for **H** although not neccessary) and 3) As a bonus provide the mechanism for the formation of **E** and **F**. (10 points, 10 point bonus)



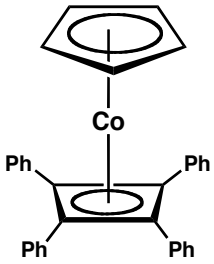
4. a) Draw the molecular orbitals for the olefin-containing portions of the following conjugated systems. Fill in the electrons and label the HOMO and LUMO for each system. (5 points)



b) Predict the product of the thermal [6+4] cycloaddition of these two compounds. Is the process allowed by frontier molecular orbital theory? Hint: Draw the compounds with the appropriate molecular orbitals first. (5 points)

5. In the following complexes, what is the formal oxidation state of the metal, the d^n description, and the electron count? Feel free to use the periodic table provided at the end of the exam. (5 points each-no partial credit)

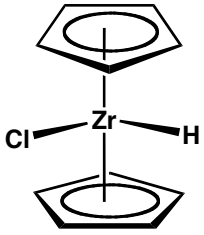
a.



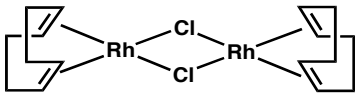
b.

$(PPh_3)_3RhCl$

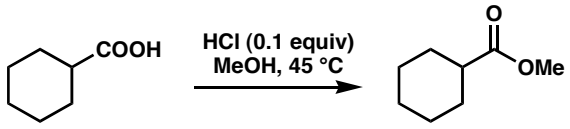
c.



d.

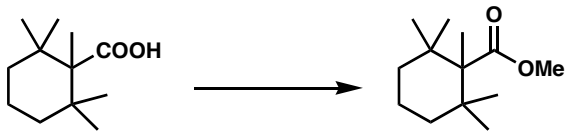


6. a) Provide a detailed curved arrow mechanism for the following reaction. What drives the equilibrium to the product side? (10 points)



1 *2*

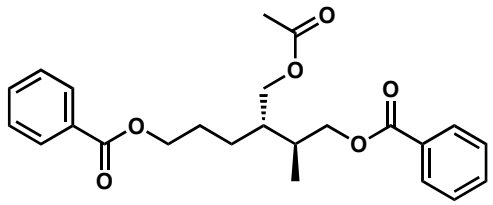
b) In contrast to part a of this problem, the following reaction (**3**→**4**) is extremely slow under the same conditions . Why do you think this is the case? Provide an alternative method for preparing the methyl ester **4** from carboxylic acid **3** that you believe would be fast and high yielding. Provide a detailed curved arrow mechanism for your new synthesis of **4** from **3** and explain why the new method should be better. (10 points)



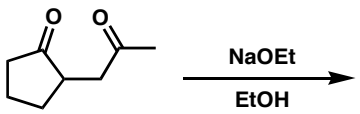
3 *4*

7. Design a retrosynthesis and a complete forward process (icluding reagents) for the synthesis of the following compound as a single diastereomer (in racemic form) starting from fragments of less than 6 carbons (or benzene). (20 points)

(±)-

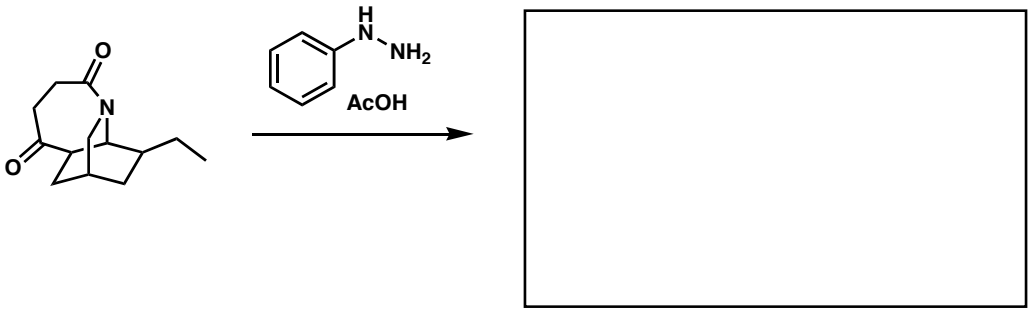


8. Predict the major aldol condensation product and draw a curved arrow mechanism. Draw at least one alternative aldol product and describe why it is not the major product. (10 points)

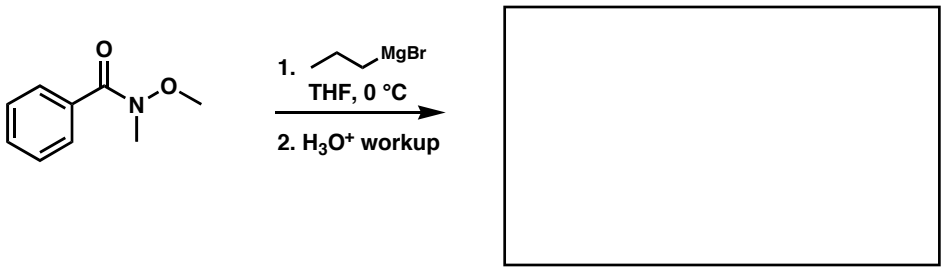


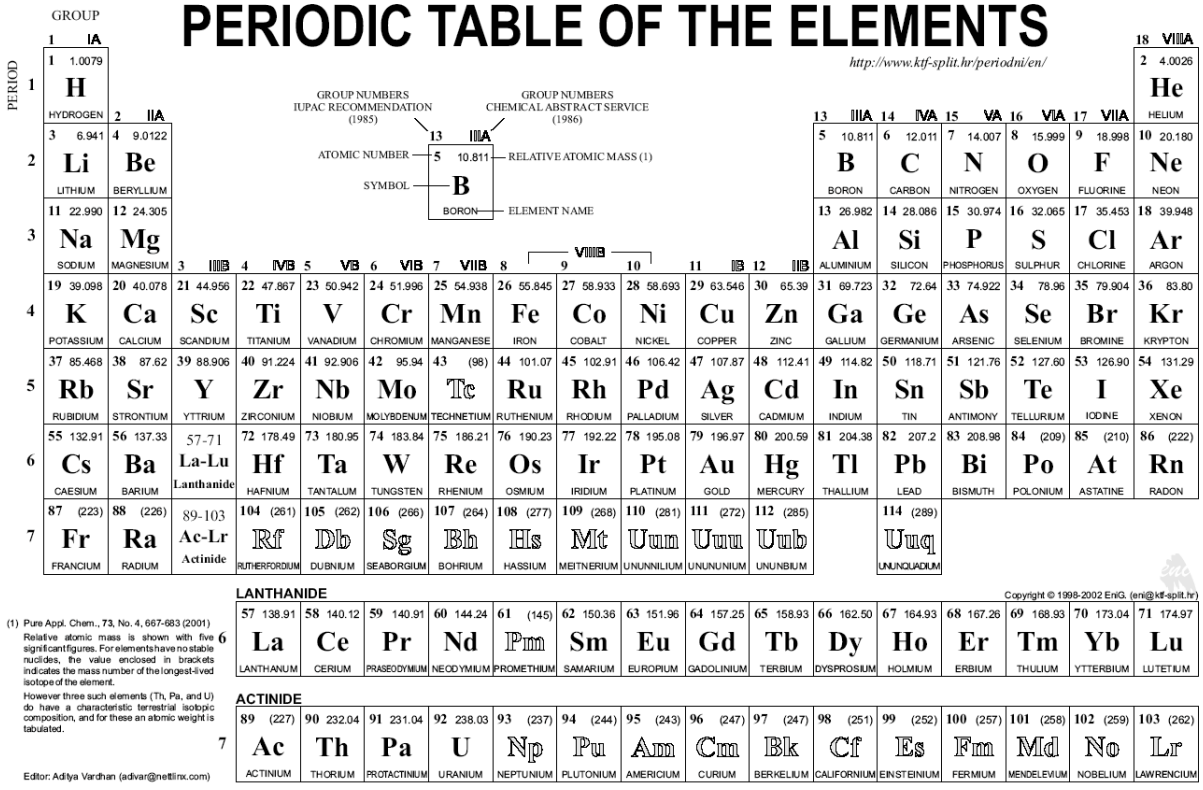
9. Predict the product of these reactions and provide curved arrow mechanisms for each. (20 points)

a.



b.




PERIODIC TABLE OF THE ELEMENTS
http://www.ktf-split.hr/periodni/en/
GROUP
PERIOD
GROUP NUMBERS IUPAC RECOMMENDATION (1985)
GROUP NUMBERS CHEMICAL ABSTRACT SERVICE (1986)
ATOMIC NUMBER
SYMBOL
RELATIVE ATOMIC MASS (1)
ELEMENT NAME
LANTHANIDE
ACTINIDE
(1) Pure Appl. Chem., 73, No. 4, 667-683 (2001)
Relative atomic mass is shown with five significant figures. For elements have no stable nuclides, the value enclosed in brackets indicates the mass number of the longest-lived isotope of the element.
However three such elements (Th, Pa, and U) do have a characteristic terrestrial isotopic composition, and for these an atomic weight is tabulated.
Editor: Aditya Vardhan (adivar@netlinx.com)
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The End