

Chemistry 230-002 Final Examination

Dr. Grossman's Section

December 15, 2005

Name (please PRINT LEGIBLY) _____
(last) (first)

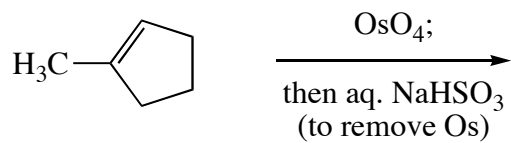
<u>Problem</u>	<u>Score</u>	
1. (a-h)	_____	/32
2. (a-b)	_____	/32
3. (a-b)	_____	/32
4. (a-f)	_____	/26
5. (a-d)	_____	/16
6. (a-d)	_____	/16
<u>Total</u>	_____	/154

Please observe the following.

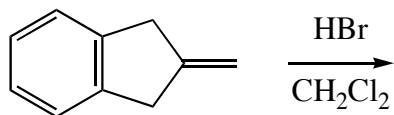
- 1) Write LARGE and LEGIBLY.
- 2) Read each question carefully before answering. Many points are never awarded on every exam because students do not read the instructions.
- 3) Explanations must be clear, coherent, and unambiguous to receive credit.
- 4) Your percentage score will be calculated on the basis of 150 points, not 154 points. In other words, there are four points of extra credit on this exam.

1. (4 pts. each, 32 pts. total) Draw the *major* product of each of the following reactions. Be sure to indicate the stereochemistry of the product, if appropriate.

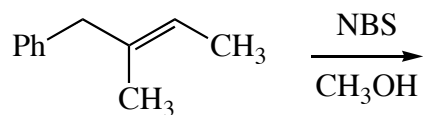
(a)



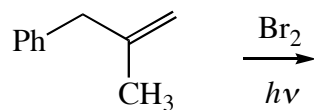
(b)



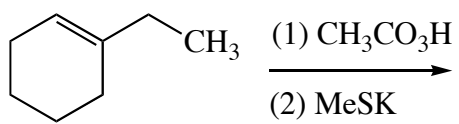
(c)



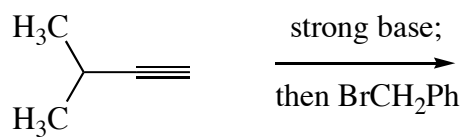
(d)



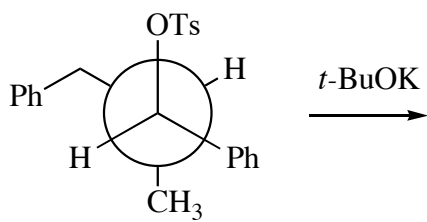
(e)



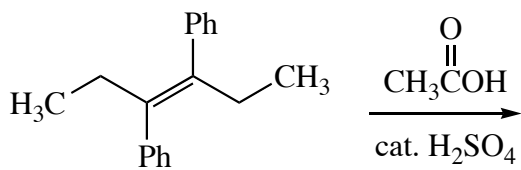
(f)



(g)

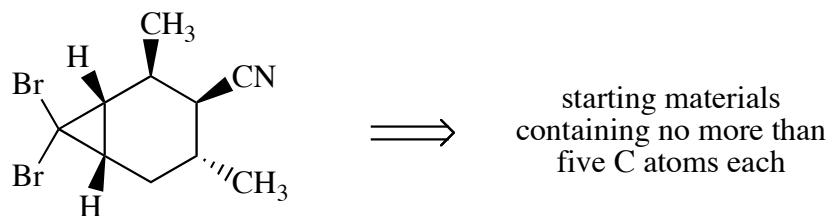


(h)

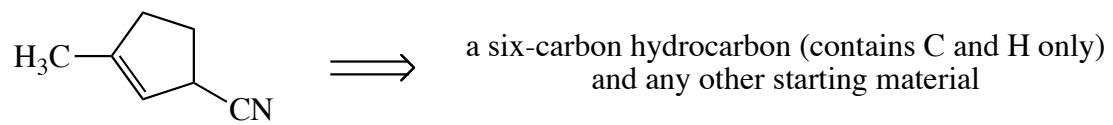


2. (32 pts. total) Design syntheses of each of the following compounds from the indicated starting materials. Show all reagents required for each transformation. You are advised to conduct a retrosynthetic analysis before working in the forward direction. Each synthesis will require more than one step.

(a) (16 pts.)



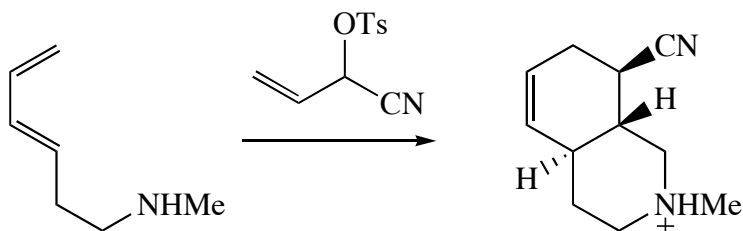
(b) (16 pts.)



3. (32 pts. total) Draw reasonable mechanisms for each of the following reactions. Use the curved arrow convention to show the movement of electrons. If the reaction proceeds by a free-radical mechanism, *draw* and *clearly label* the initiation and propagation steps; you do not need to draw termination steps.

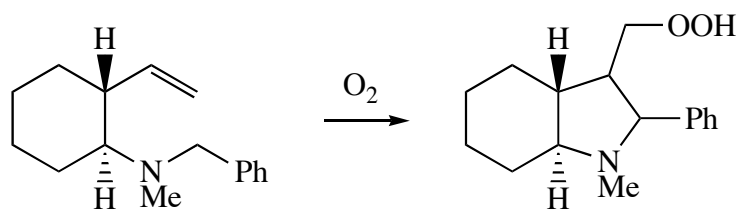
Remember to obey Grossman's Rule!

(a) (10 pts.)

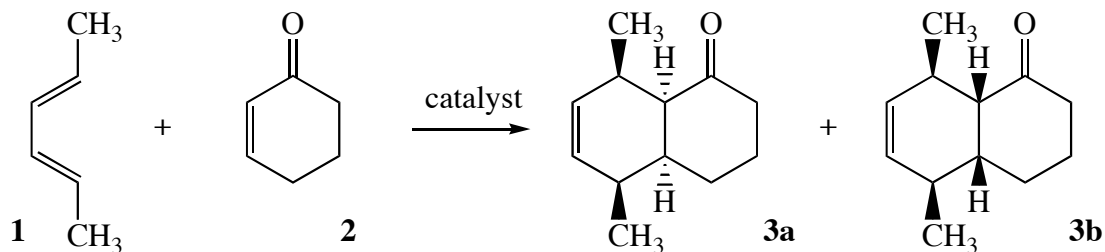


Remember to obey Grossman's Rule!

(b) (22 pts.)



4. (26 pts. total) Consider the following Diels–Alder reaction of **1** and **2** to give **3a** and **3b**.



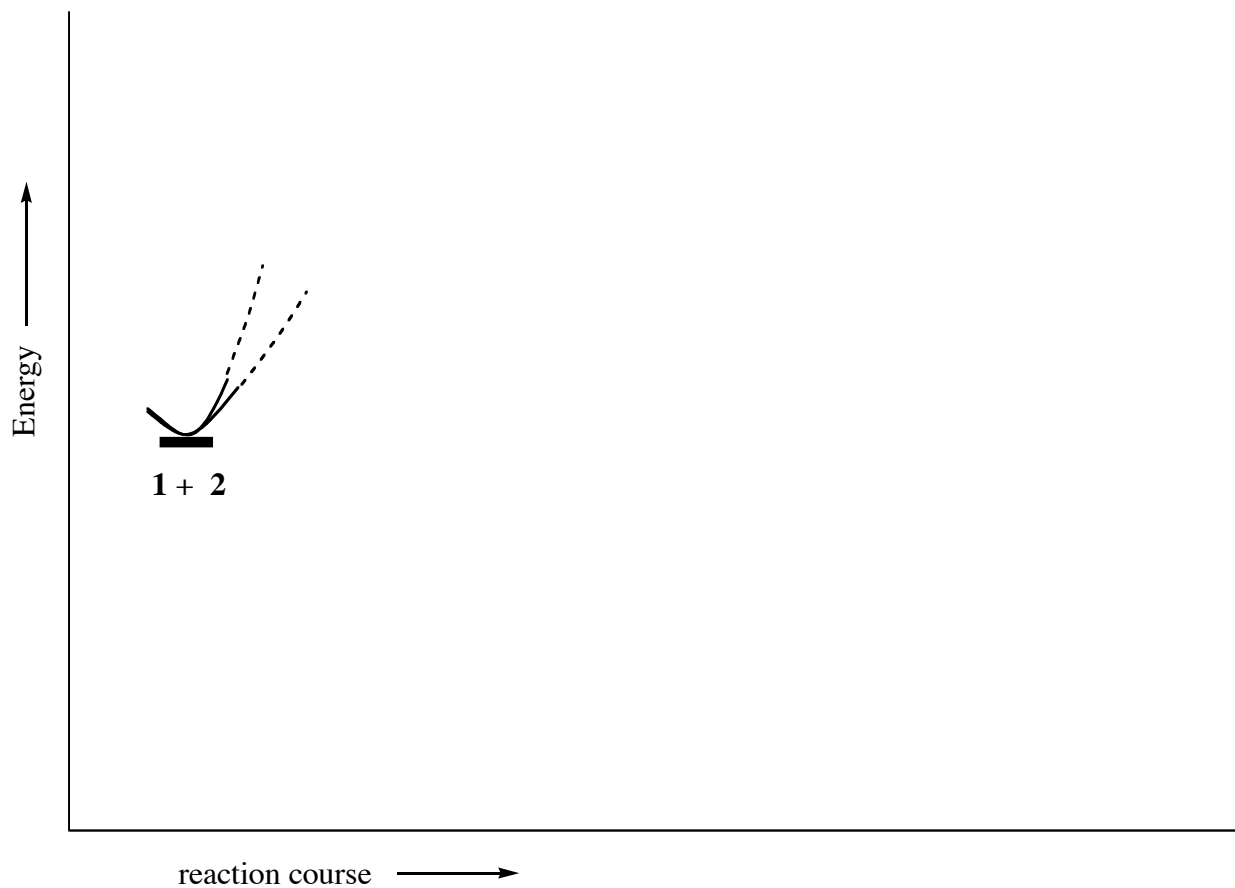
(a) (4 pts.) Describe the relationship of compounds **3a** and **3b** in two words or fewer and as specifically as possible. (You will lose one point if you misspell.)

(b) (4 pts.) Draw the enantiomer of **3a**. (The answer may or may not be **3b**.)

(c) (4 pts.) Is **3a** higher in energy than **3b**, lower in energy than **3b**, about the same energy as **3b**, or is there no way to tell? Explain your answer *briefly* and *coherently*.

(d) (4 pts.) In the reaction above, is more **3a** obtained, more **3b**, about the same amounts, or is there no way to tell? Explain your answer *briefly* and *coherently*.

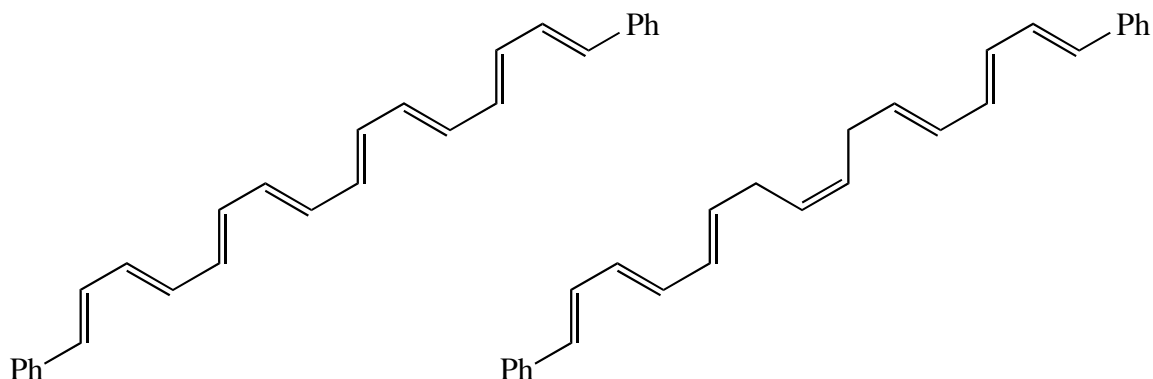
(e) (6 pts.) Using the information provided and your answers to (c) and (d), draw a reaction coordinate diagram that shows the proper relative energies of starting materials, transition states, and products in this reaction. *Clearly* label which product is **3a** and which one is **3b**. (I began the graph for you. One of the curved lines is the beginning of the coordinate leading to **3a**, and the other is the beginning of the coordinate leading to **3b**.)



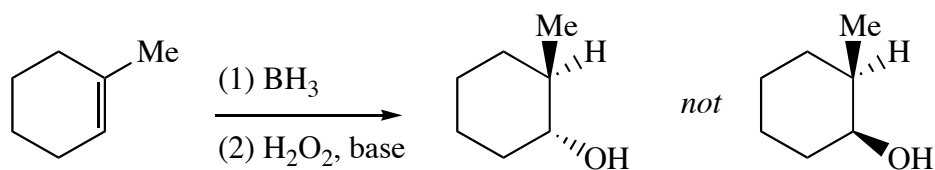
(f) (4 pts., extra credit) How could you modify the reaction above to make **3a** or **3b** in enantiomerically pure form?

5. (4 pts. each, 16 pts. total) Explain each of the following observations in no more than one or two short, easily understood sentences.

(a) The compound on the left is colored, but the compound on the right is colorless.

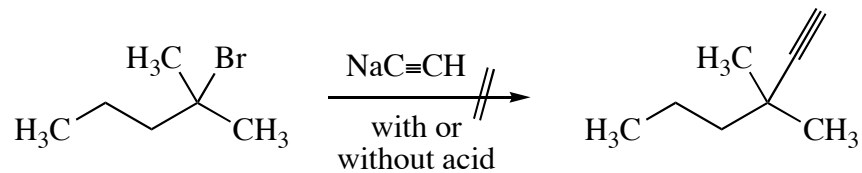


(b) Hydroboration–oxidation of an alkene gives only the product of syn addition.



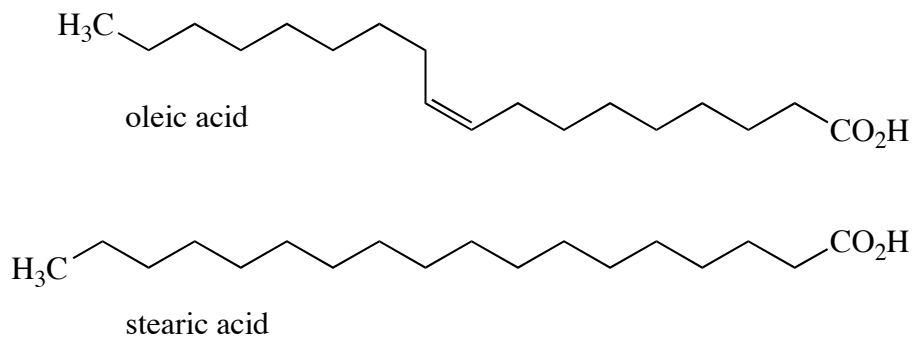
- (c) The reaction of CH_3CH_2^- with H^+ to give CH_3CH_3 is much stronger (more rapid, more exothermic) than the reaction of $\text{HC}\equiv\text{C}^-$ with H^+ to give $\text{HC}\equiv\text{CH}$.

- (d) The reaction below fails regardless of whether or not acid is added. (Explain both cases.)



6. (4 pts. each, 16 pts. total) Organic chemistry is involved in some important environmental and biological processes.

(a) One reason the food industry likes to use unhealthy saturated fats in their products is that saturated fats do not spoil as quickly as unsaturated fats. Spoilage is often caused by reaction with O_2 . Explain why unsaturated fats such as oleic acid are quicker to spoil than saturated fats such as stearic acid.



(b) A pile of oily rags in a garage may “spontaneously” catch on fire. A fire is simply a rapid, exothermic reaction of a compound with O_2 . Explain how a slow, slightly exothermic autoxidation reaction can eventually become a fire in a pile of oily rags. (Assume the oil consists of a mixture of alkanes with 10–20 C atoms.)

