Final Exam
Chemistry 343 (PM)
Professor Gellman
18 December 2011

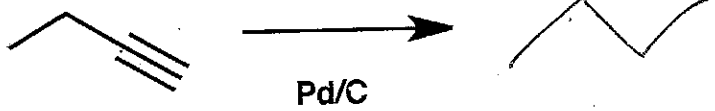
Last Name Answer

First Name Key

General Instructions:
(i) Use scratch paper at back of exam to work out answers; final answers must be recorded at the proper place on the exam itself for credit. Models are allowed.
(ii) Print your name on each page.
(iii) Please keep your paper covered and your eyes on your own work. Misconduct will lead to failure in the course.

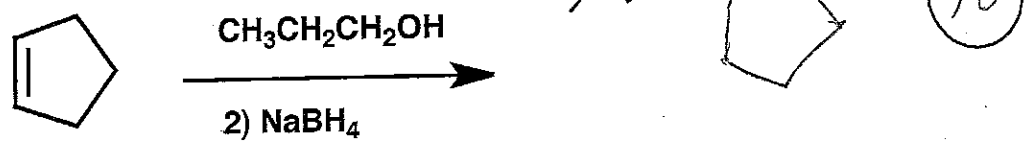
1. (36 points) Show the major product or products expected from each reaction.

(a)



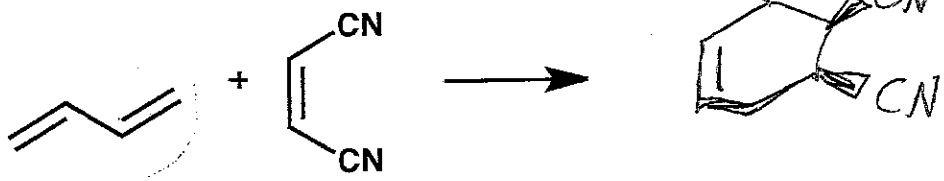
+6

(b)



+6

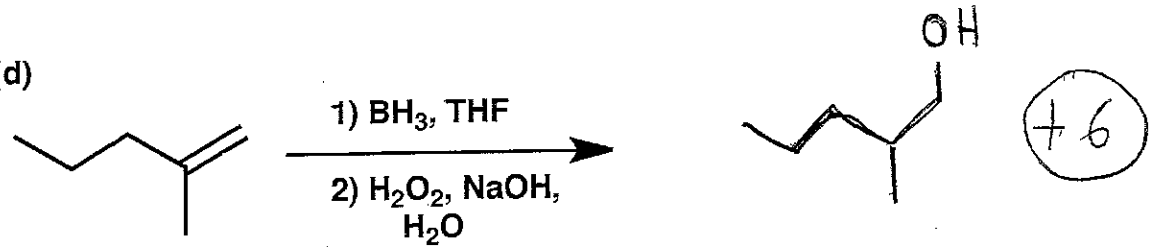
(c)



+6

(-2 for under or incorrect stereochemistry)

(d)



+6

(racemic) <--- [Not required]

(-2 for "OH")

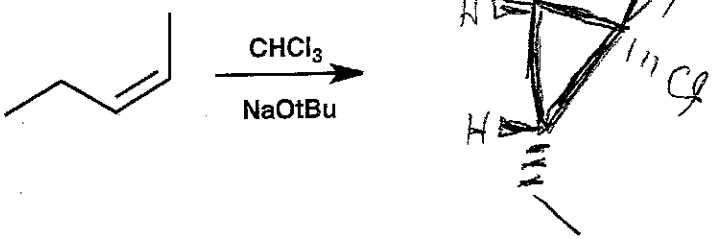
(continued on next page)

(Not required) ---> (racemic)

Name _____

1. (cont.)

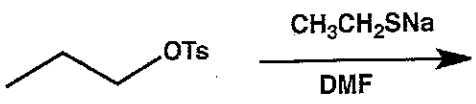
(e)



+6

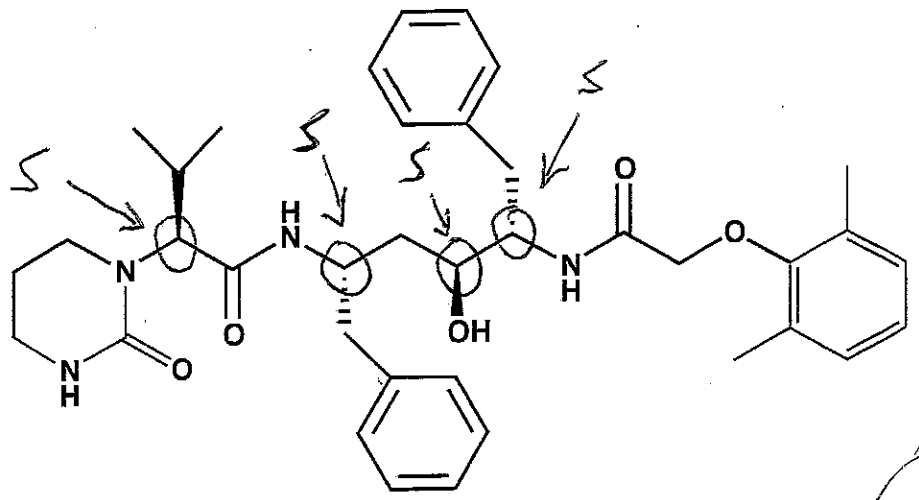
(-2 for incorrect or unclear stereochem.)

(f)



+6

2. (12 points) Shown below is a drug called lopinavir for patients infected with HIV. CIRCLE all sp^3 stereogenic centers, and indicate whether the configuration is R or S.



+1 for each correct circle

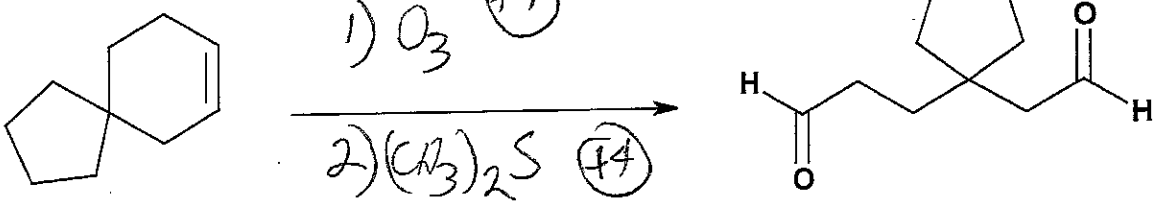
+2 for each correct R/S

-1 for non-stereocenter circled.

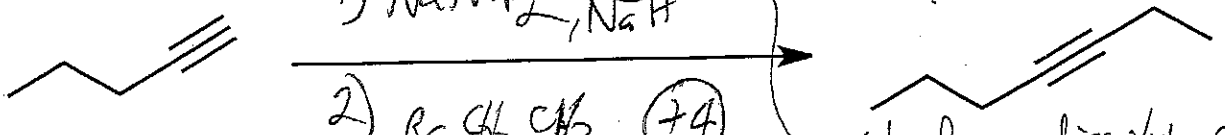
Name _____

3. (26 points) Show the reagents required to convert the starting molecule to the indicated product. If necessary, be sure to differentiate clearly between distinct steps, by using "1)," "2)," etc. over the arrow.

(a)



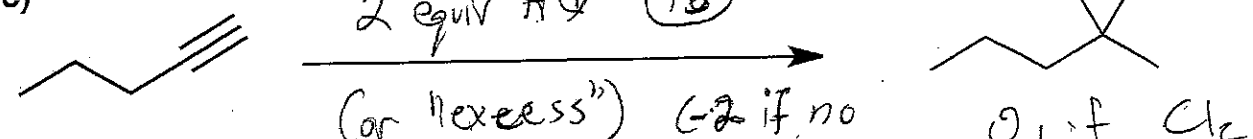
(b)



-2 if not shown in steps

4 pts for dissolving metal reduction (total)

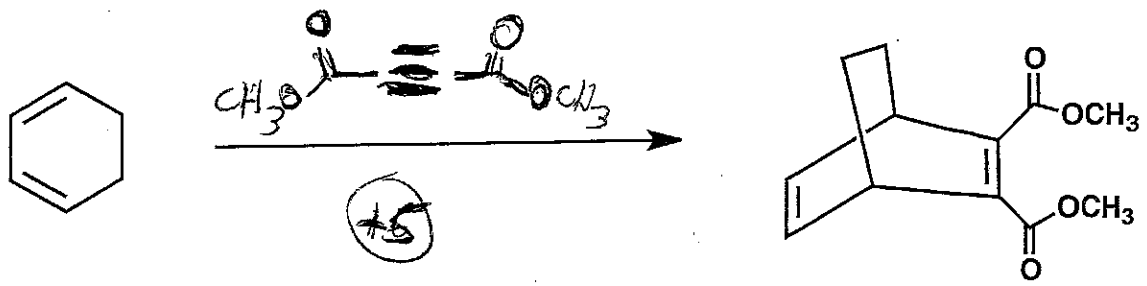
(c)



-2 if no stoichiometry indicated

0 pts if Cl_2

(d)



+3 if alkene

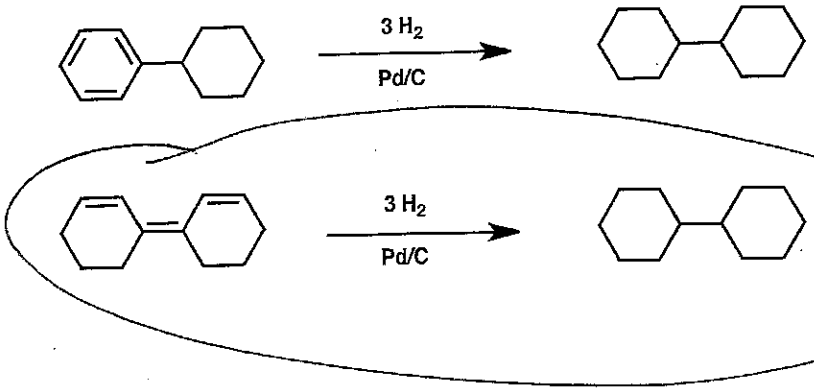
-2 for extra Rgts/weirdness

H5 I 6

Name _____

4. (6 points) Consider the two hydrogenation reactions below, both of which form the same product alkane, and both of which are exothermic (heat is released).

(a) CIRCLE the reaction that you expect to release MORE heat.



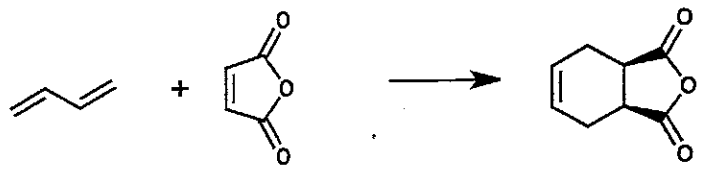
+2

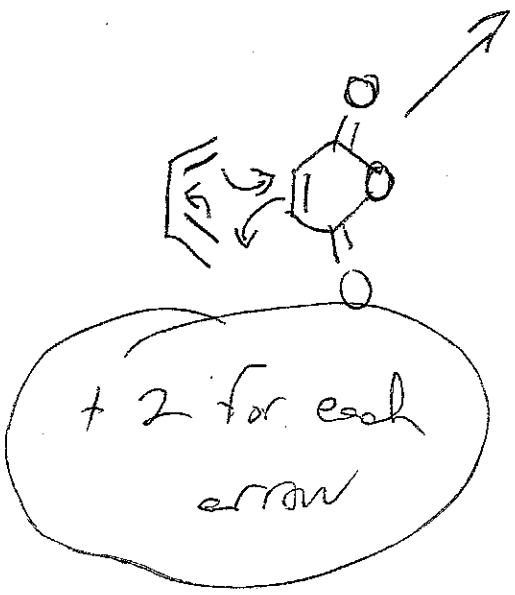
(b) Explain in ONE SENTENCE why you chose the circled reaction. (+2)

The starting material of the circled reaction is not aromatic and therefore less stable than the other starting material, which is aromatic. (+2)

+4 total

5. (6 points) Show a mechanism (curved arrows) for the reaction below.



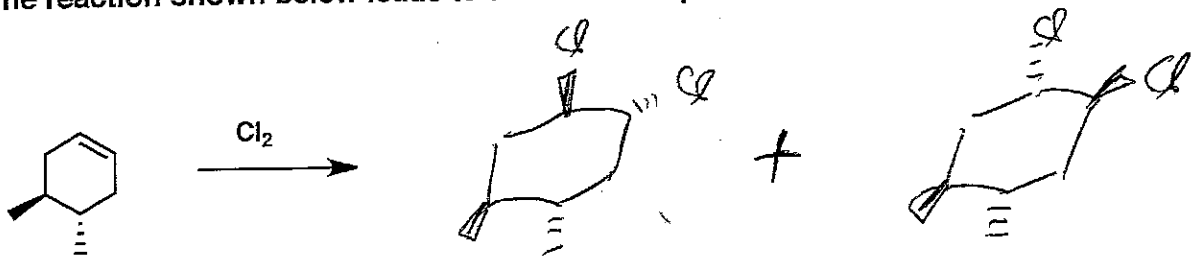


+2 for each arrow

Name _____

6. (20 points)

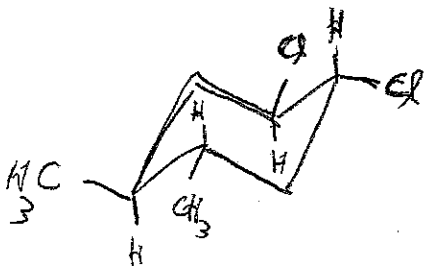
(a) The reaction shown below leads to two isomeric products. Draw those products.



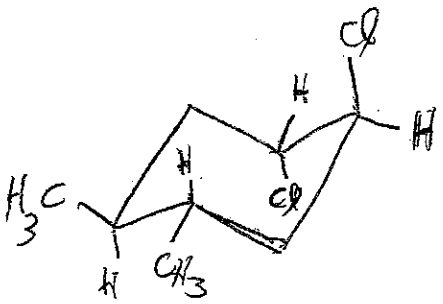
(Single enantiomer)

+4 +4

(b) Draw the most stable conformation of each product. (Note: A chlorine atom is smaller than a methyl group.)



+6



+6

(-2 for each incorrect enantiomer)

Name ________________

7. (18 points) For each part below, draw the other side of the expected acid-base equilibrium. (Do not be concerned with which side is favored.) In each case the two species are present in 1:1 molar ratio.

(a) $H_3C{-}C{\equiv}CH + \overset{+}{Na}\ \overset{-}{N}H_2 \rightleftharpoons H_3C{-}C{\equiv}C{:}^{\ominus}\ Na^{\oplus} + NH_3$

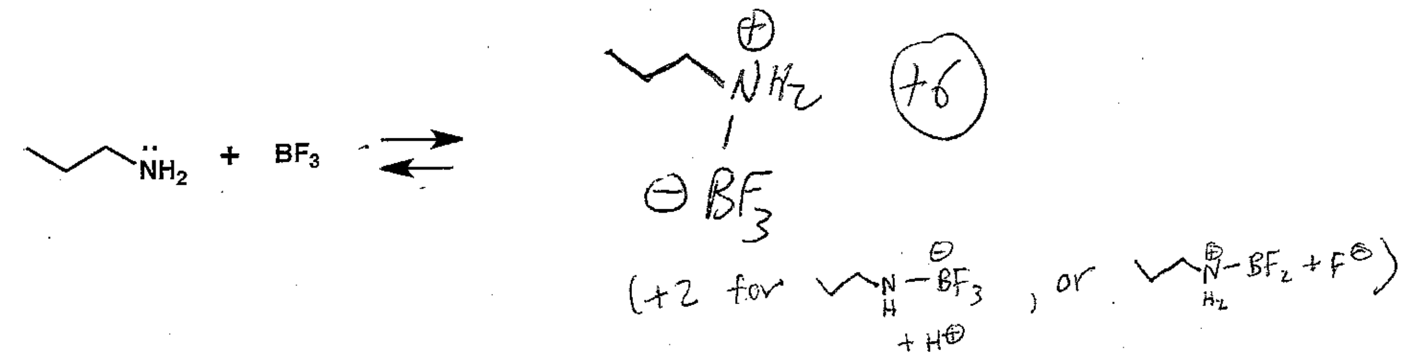
(+2)

(+3) +1 (+0, if other ions are wrong.)

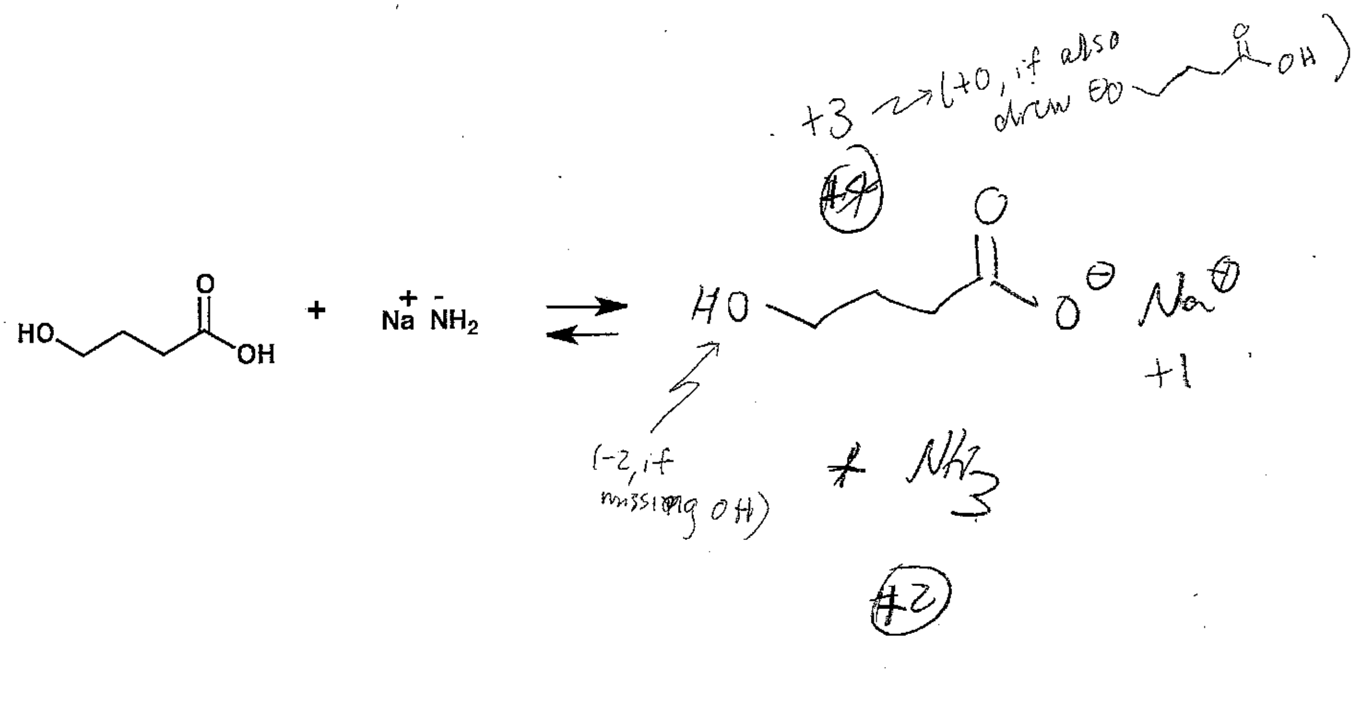
(-2 pts, for each compound missing charge)

(-1 pt, if drew Me–C≡C•⊖)

(b)



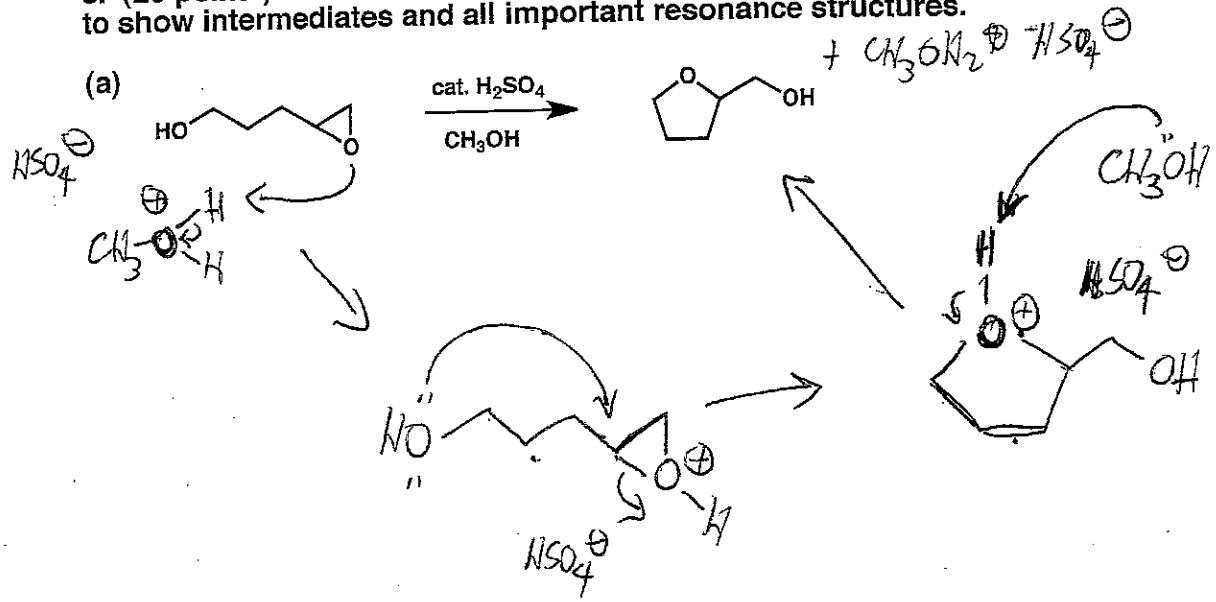
(c)



Name _____

8. (26 points) Provide a mechanism (curved arrows) for each reaction shown below. Be sure to show intermediates and all important resonance structures.

(a)

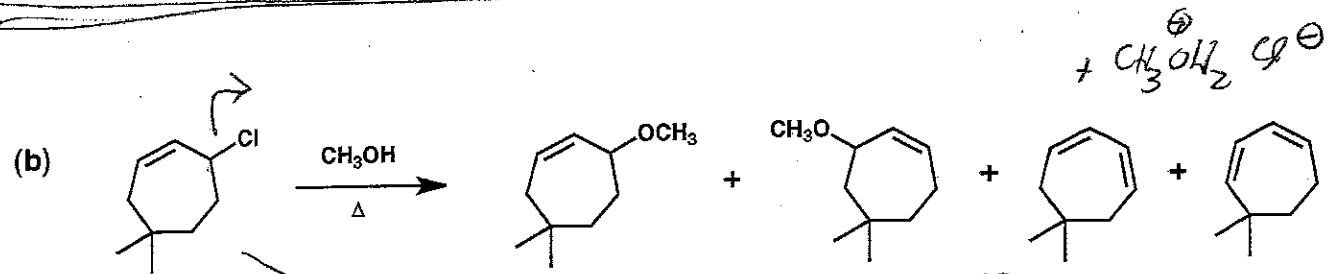


+2 for each set of arrows (+6 total)

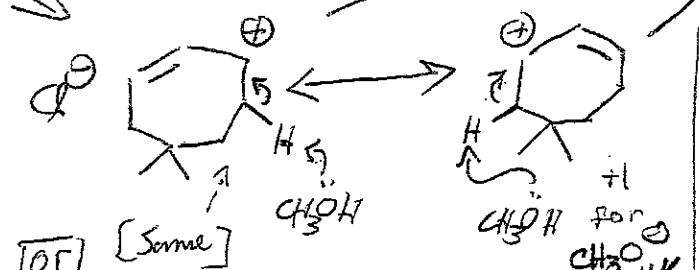
+2 for each intermediate (+4 total)

-1 missing charges

(b)

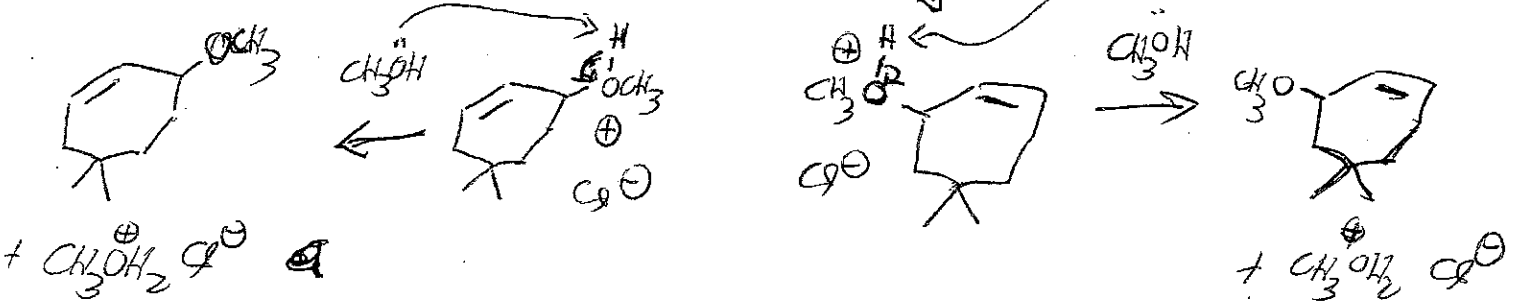


+2 for each C⊕ resonance structure, and +1 for each protonated ether intermediate (+6 total) +0 for no charge on protonated ether



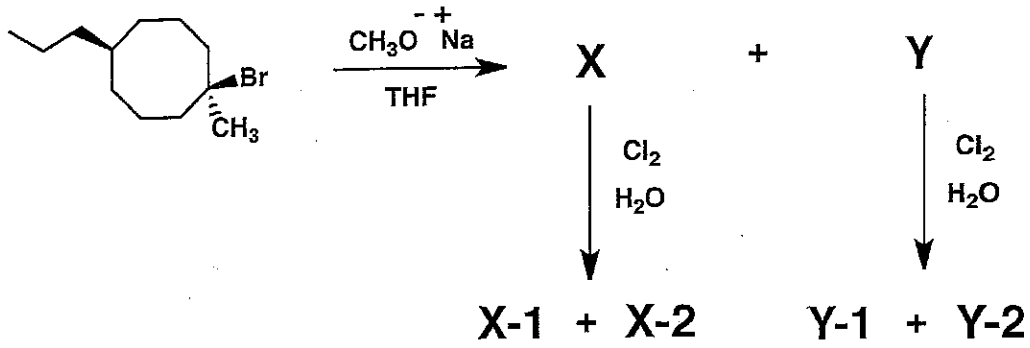
+2 for Cl leaving arrow; +1 for each intermediate arrow; +1 for each final deprotonation (2 arrows) (+10 total)

+1 for $CH_3O^\ominus$ attack

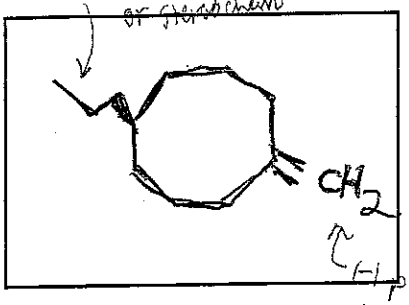


Name _____

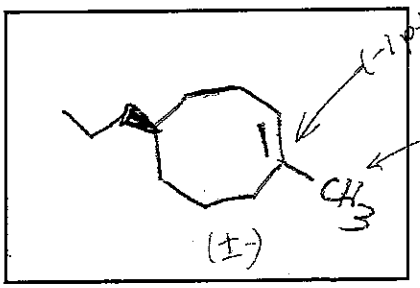
9. (30 points) When the starting material below is allowed to react under the conditions shown, two isomeric products result, X and Y. Y is chiral and racemic; X is not chiral. When compound X reacts with Cl_2 in water, two isomeric products are formed, X-1 and X-2; neither is chiral. When Y reacts with Cl_2 in water, two different products are formed; each is chiral and racemic. Give structures for all six molecules in the appropriate boxes.



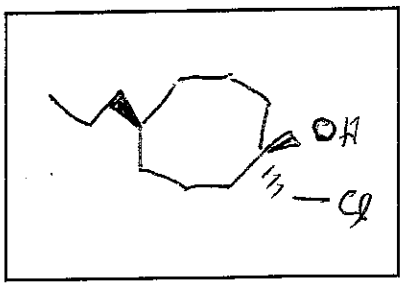
X =



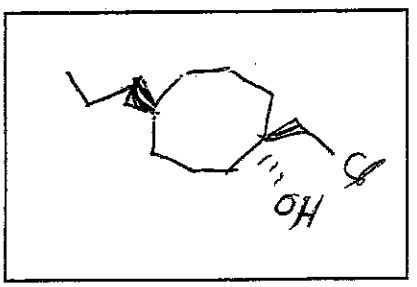
Y =



X-1 =

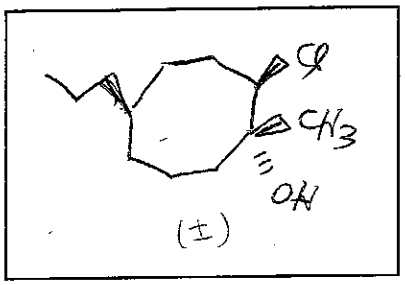


X-2 =

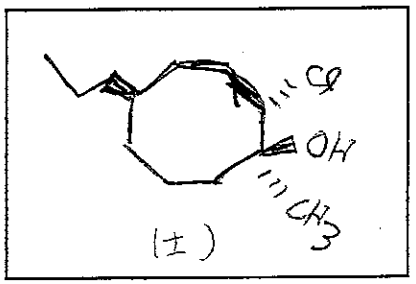


← swap ok →

Y-1 =



Y-2 =



← swap ok →

+0, for switching X-2 & Y-1 boxes, w/o relabeling boxes.

+0, if also draw an incorrect structure in box.

+ 5 each

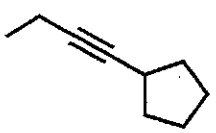
+ 2 each, if missing all stereochem, or incorrect stereochem

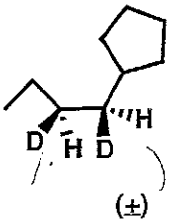
+ 0 for racemic

Name _____

10. (20 points) Devise a synthetic route from the indicated starting material to the indicated target in each of the two cases below. Each route should be as short and as selective as possible. You may use any other organic molecules and any inorganic reagents in your synthetic plans. Show the expected product after each step in each synthetic route. (Do not provide mechanistic information.)

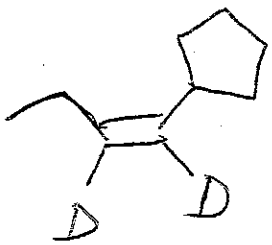
(a)

Starting material = 

Target = 

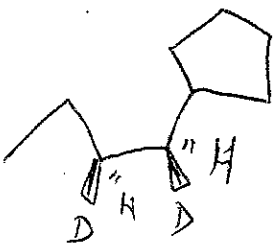
(±)

(+4) D_2, 1
Poisoned Catalyst 2



1. [D_2 & H_2 can be reversed]

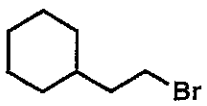
(+4) H_2, 1
Pd/C 2

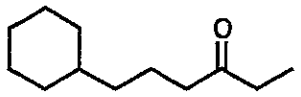


-- cont. on next page --

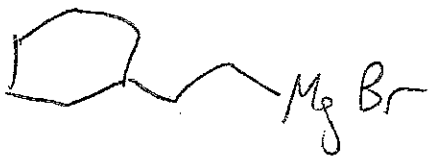
Name _____

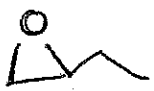
10. (cont.)

Starting material = 

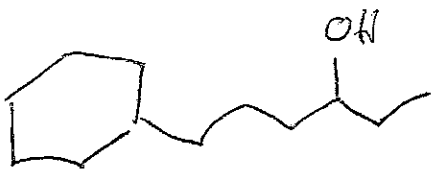
Target = 

(+4) Mg^0, Et_2O



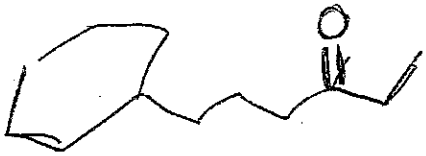
(+4) 1) 

2) $H_3O^{\oplus}$ <---- [Not required]

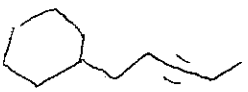


(4+) $Na_2Cr_2O_7$, H_2O, H_2SO_4

[Any Cr(+6) reagent ok.]



~~+6 pts~~ 2 pts



- 1 pt per wrong reagent { 4 pts other many extra steps

with 6 pts if all right but not selective