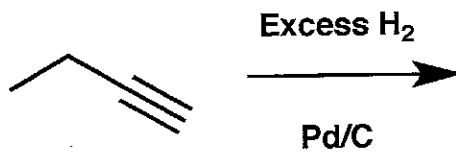


General Instructions:

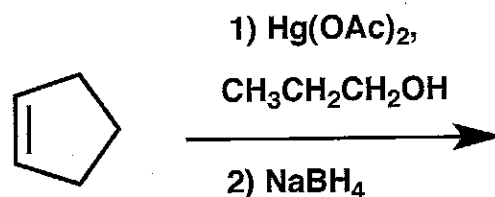
- (i) Use scratch paper at back of exam to work out answers; final answers must be recorded at the proper place on the exam itself for credit. Models are allowed.
- (ii) Print your name on each page.
- (iii) Please keep your paper covered and your eyes on your own work. Misconduct will lead to failure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

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

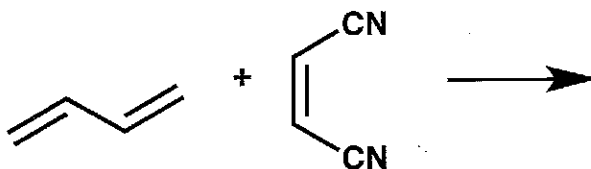
(a)



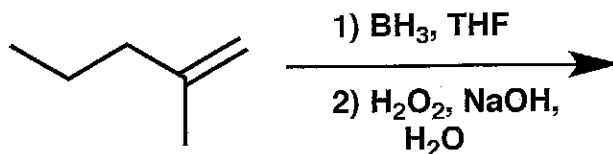
(b)



(c)

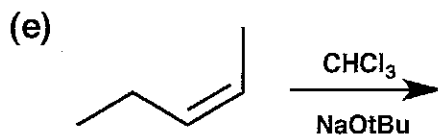


(d)

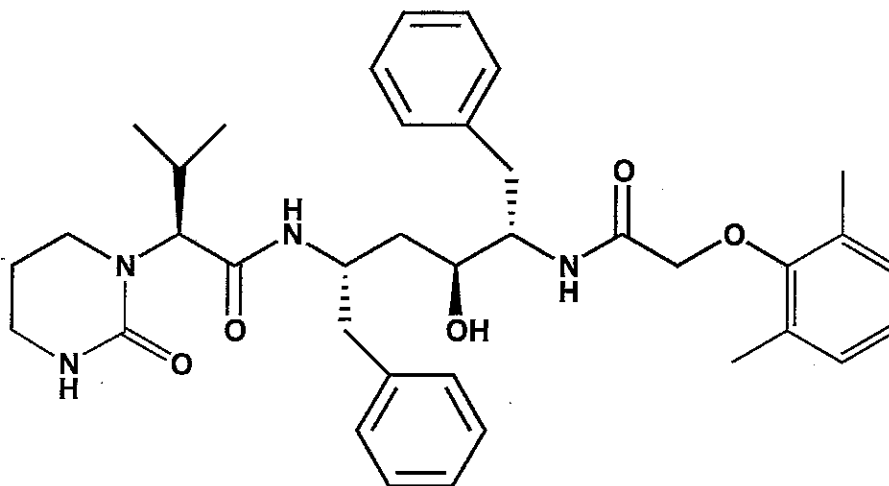


(continued on next page)

1. (cont.)

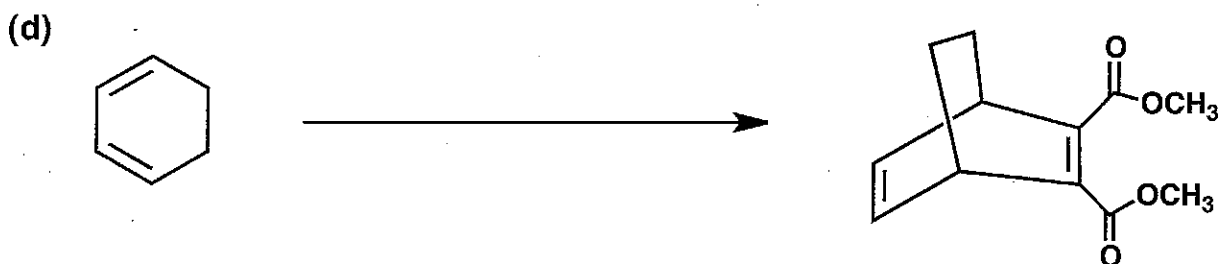
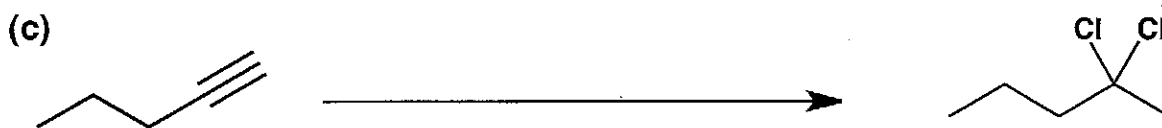
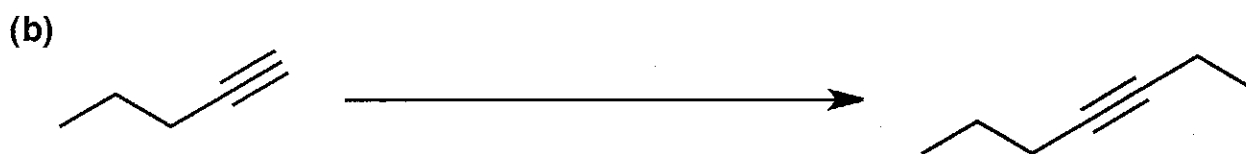


2. (12 points) Shown below is a drug called lopinavir for patients infected with HIV. CIRCLE all sp^3 stereogenic centers, and indicate whether the configuration is R or S.



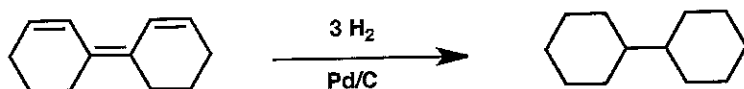
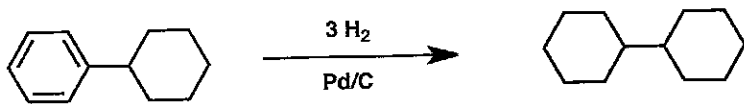
Name _____

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.



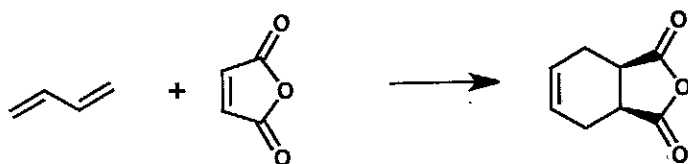
4. (6 points) Consider the two hydrogenation reactions below, both of which form the same product alkane, and both of which are exothermic (heat is released).

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



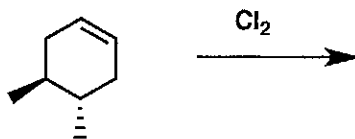
(b) Explain in ONE SENTENCE why you chose the circled reaction.

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



6. (20 points)

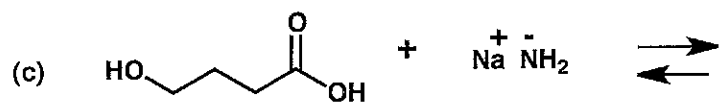
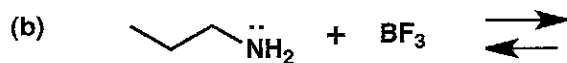
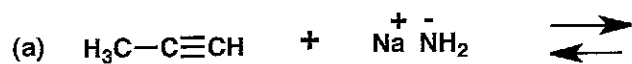
(a) The reaction shown below leads to two isomeric products. Draw those products.



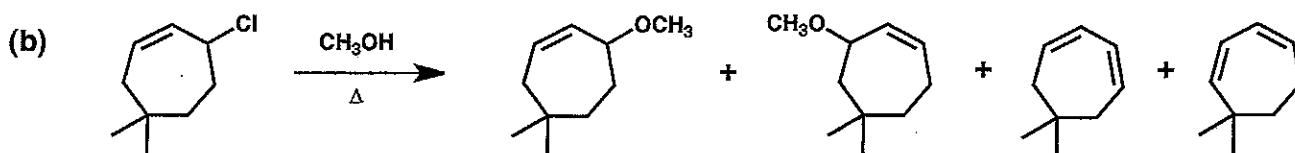
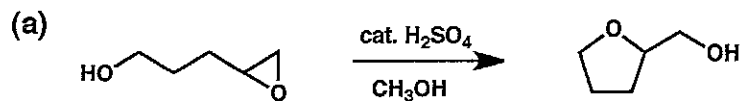
(Single enantiomer)

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

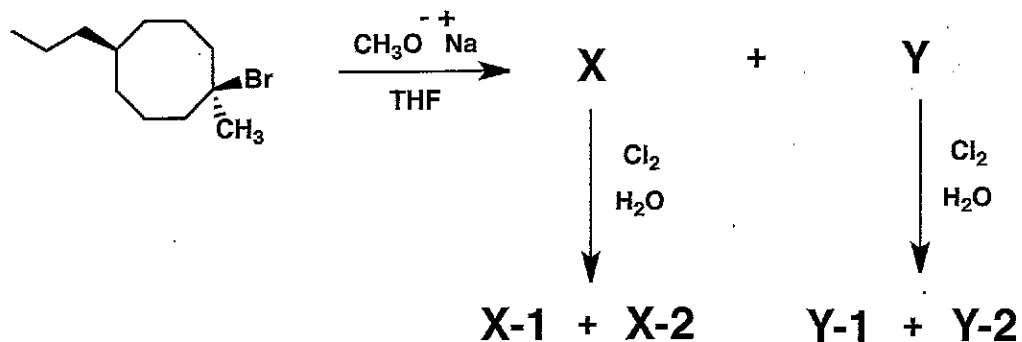
7. (18 points) For each part below, draw the other side of the expected acid-base equilibrium. (Do not be concerned with which side is favored.) In each case the two species are present in 1:1 molar ratio.



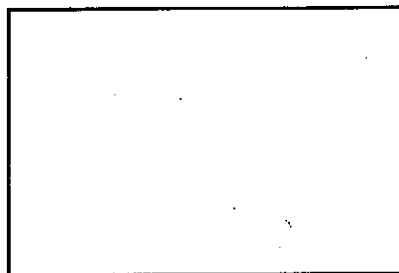
8. (26 points) Provide a mechanism (curved arrows) for each reaction shown below. Be sure to show intermediates and all important resonance structures.



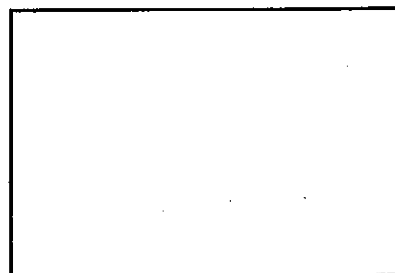
9. (30 points) When the starting material below is allowed to react under the conditions shown, two isomeric products result, X and Y. Y is chiral and racemic; X is not chiral. When compound X reacts with Cl_2 in water, two isomeric products are formed, X-1 and X-2; neither is chiral. When Y reacts with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



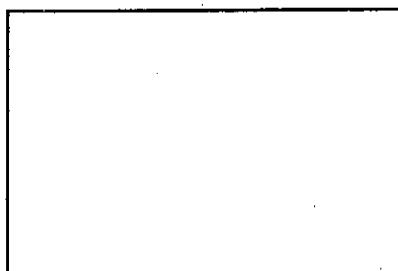
X =



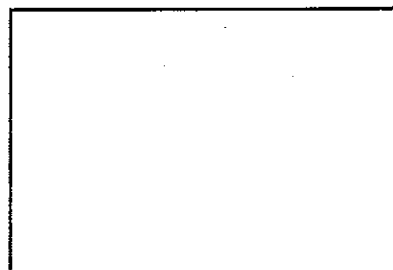
Y =



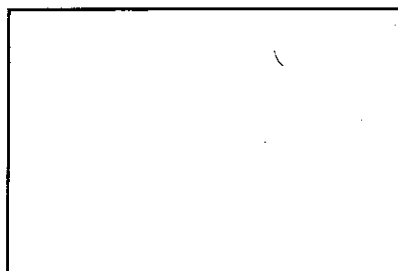
X-1 =



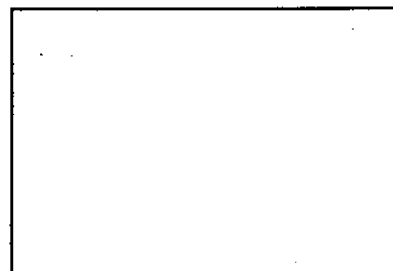
X-2 =



Y-1 =



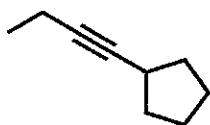
Y-2 =



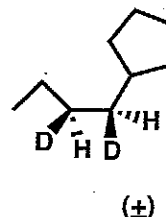
10. (20 points) Devise a synthetic route from the indicated starting material to the indicated target in each of the two cases below. Each route should be as short and as selective as possible. You may use any other organic molecules and any inorganic reagents in your synthetic plans. Show the expected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

(a)

Starting material =

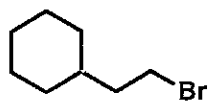


Target =



10. (cont.)

Starting material =



Target =

