

1. _____

5. _____

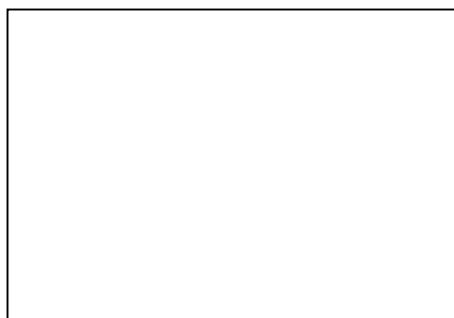
2. _____

6. _____

3. _____

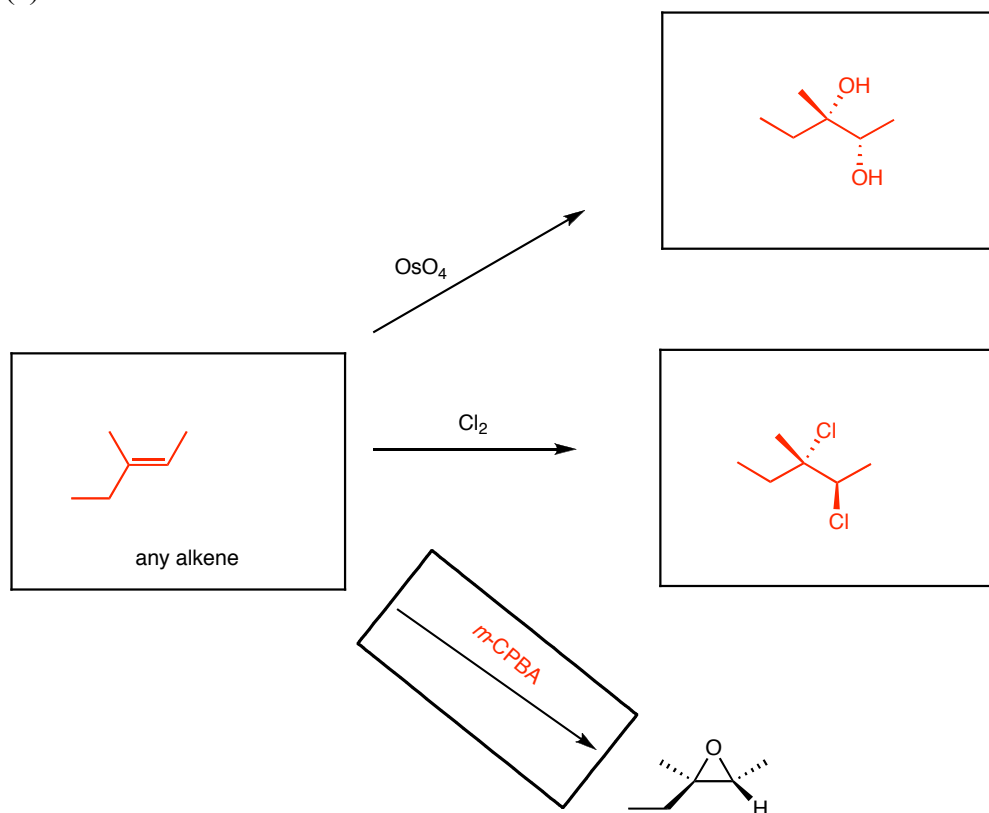
7. _____

4. _____

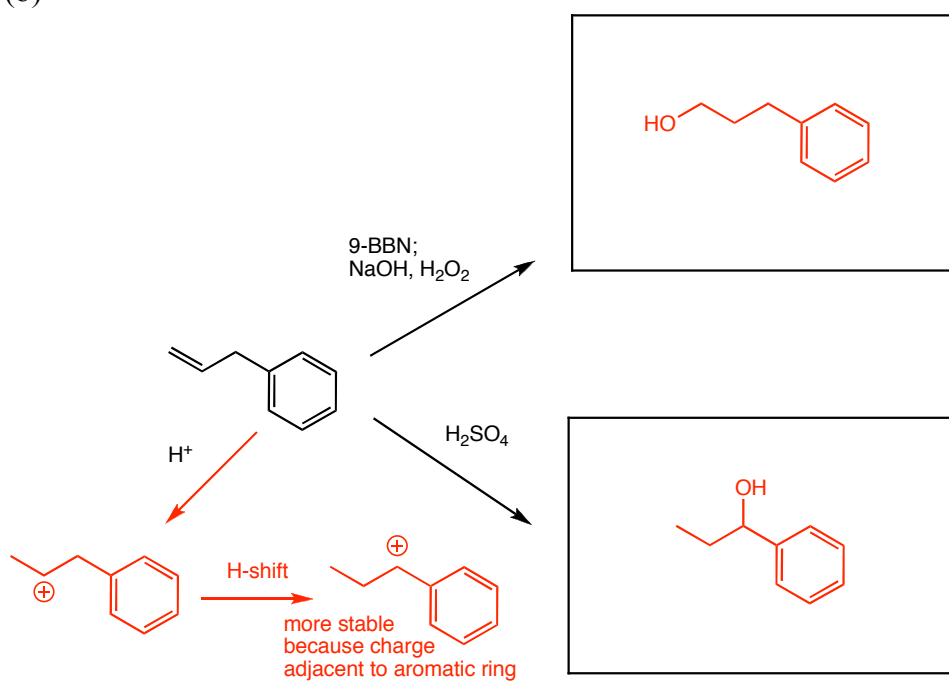


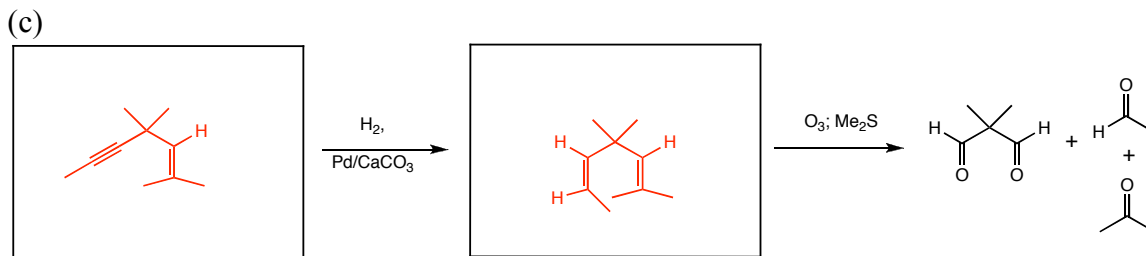
1. Fill in the appropriate boxes. Assume all reactions are quenched and that both enantiomers (or diastereomers) are formed during the reaction. (5 pts ea)

(a)

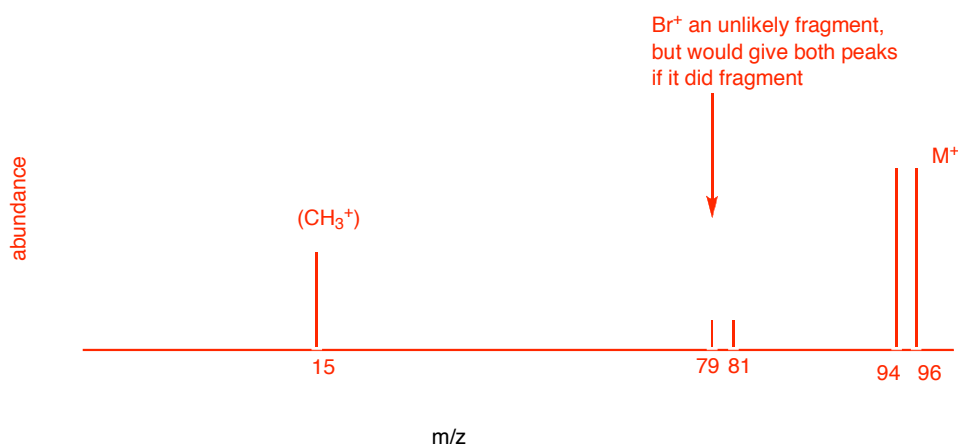


(b)

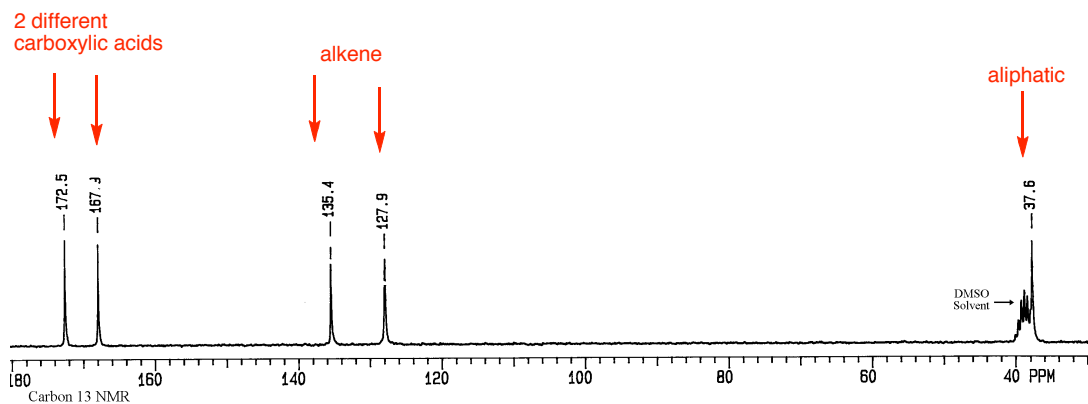
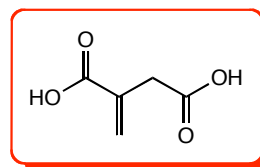
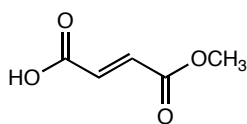
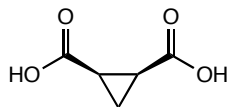




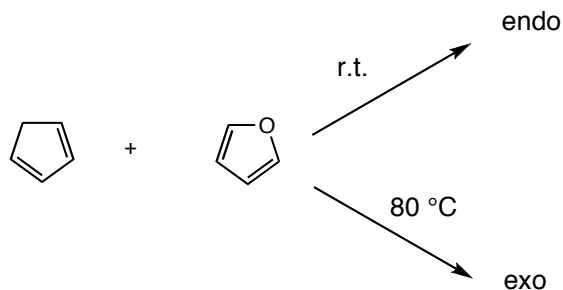
2. The mass spectra of compounds containing bromine have a distinctive pattern, since the natural abundances of ^{79}Br and ^{81}Br are almost equal and ^{80}Br is zero. Sketch the mass spectrum for CH_3Br . (6 pts)



3. Circle the isomer below that corresponds to the ^{13}C spectrum. (6 pts)



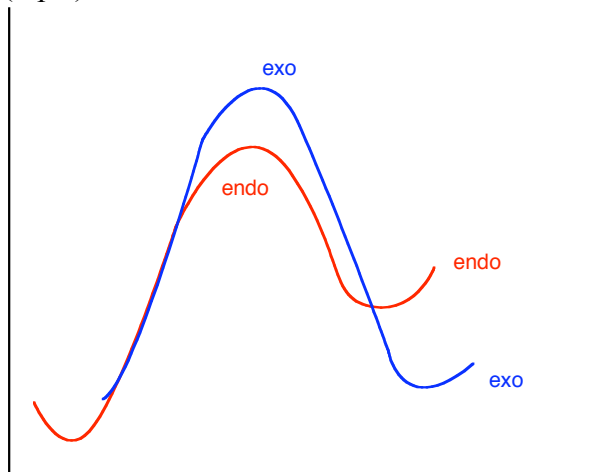
4. Experimental observations show that when cyclopentadiene and furan are mixed together at room temperature, the only product formed is the endo Diels-Alder product (cyclopentadiene acts as the diene, while furan is the dienophile). However, when they are mixed at elevated temperatures and extended reaction times, the exo isomer is formed.



(a) Draw the endo and the exo products of this reaction. Label each of them as either the kinetic product or the thermodynamic product. (8 pts)



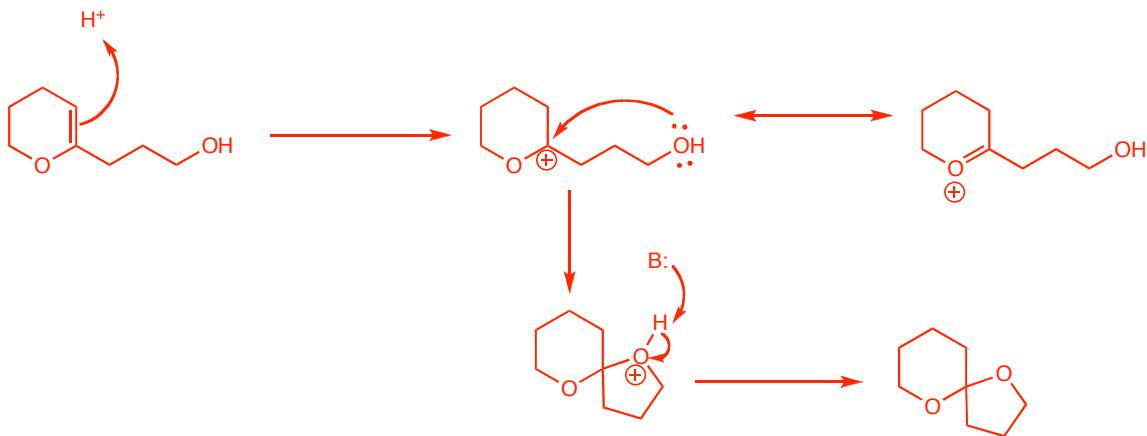
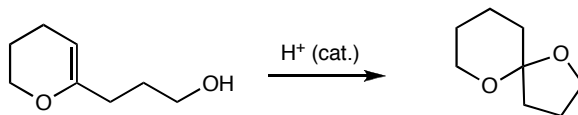
(b) Sketch a reaction coordinate for the reaction of cyclopentadiene with furan for the formation of both the endo and the exo products. Label all transition states and products. (6 pts)



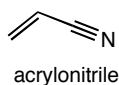
(c) What would be the result of heating a mixture of endo and exo products to 80 °C? (5 pts)

A mixture of the two products heated to 80 °C would be at equilibrium with the starting material. Eventually, all products would be converted to the most stable (exo) product.

5. Spiroketal are common structural motifs found in many natural products. One method for their synthesis is shown below. Propose a mechanism for this transformation. (8 pts)



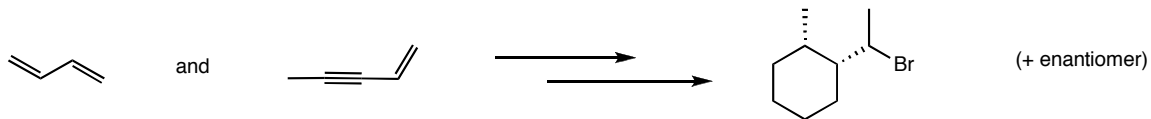
6. Sketch all of the bonding π molecular orbitals if acrylonitrile (below). (9 pts)



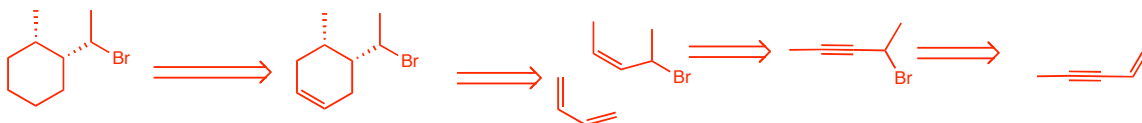
There is a four carbon π -system using the $2p_y$ orbitals. In addition, there is a two carbon π -system between the C-N to form the triple bond with the $2p_z$ orbitals. The bonding orbitals are:



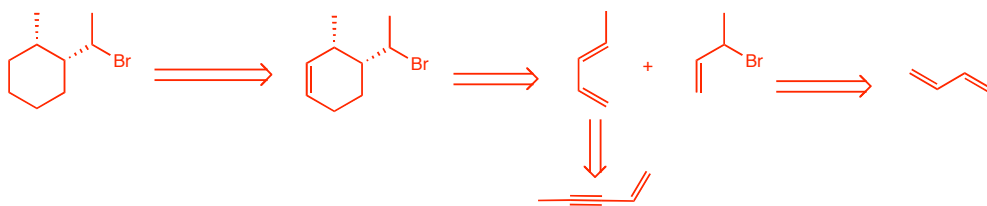
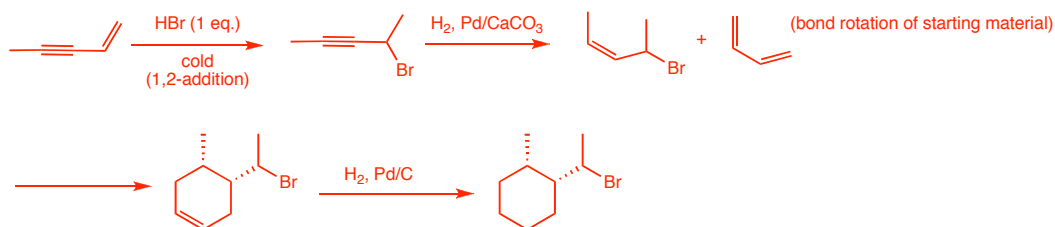
7. Using the starting materials given and any other inorganic reagent, propose a synthesis of the target molecule. (12 pts)



There are several possibilities. For this synthesis, the order of the steps was crucial to avoid unwanted reactivity at unwanted sites. Here are two possible answers:



Forward:



Forward:

