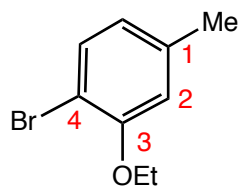


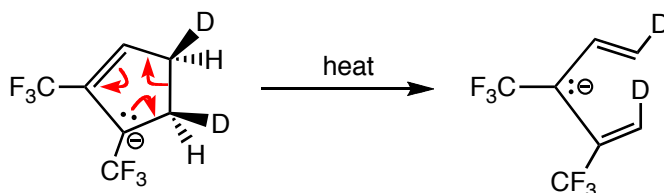


Question 1 (10 pts.) Give the IUPAC name for the following compound. Be sure to use cis/trans, E/Z or R/S where appropriate.



4-bromo-3-ethoxytoluene

Question 2 (20 pts) In this question you will be determining whether the provided reaction is allowed or forbidden



- a) give the curved arrow-pushing that describes the bond-making and bond breaking
- b) does the REACTION SHOWN, proceed via a conrotatory or disrotatory ring-opening?  
answer conrotatory
- c) how many electrons are involved in the transition state for the provided reaction?  
answer 6
- d) Give a justification for whether the REACTION SHOWN is allowed or forbidden. Your answer must include the following terms: Huckel and/or Mobius, conrotatory and/or disrotatory, aromatic, low energy and high energy transition state

the reaction shown has 6 electrons and proceeds via conrotatory ring-opening, which has a high energy Mobius transition state compared to the corresponding disrotatory transition state, which would be Huckel and aromatic, the reaction is thus forbidden

Extra Credit Question (5 pts.) Which important type of biological molecule has this cis-enediyne been shown to damage?



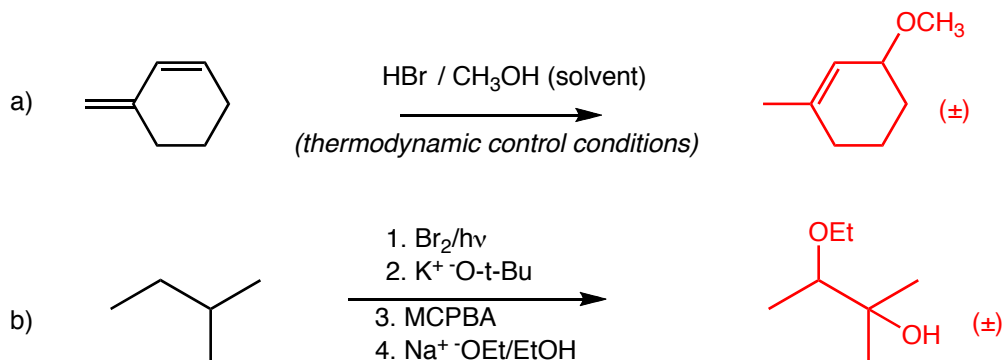
DNA

proteins

lipids

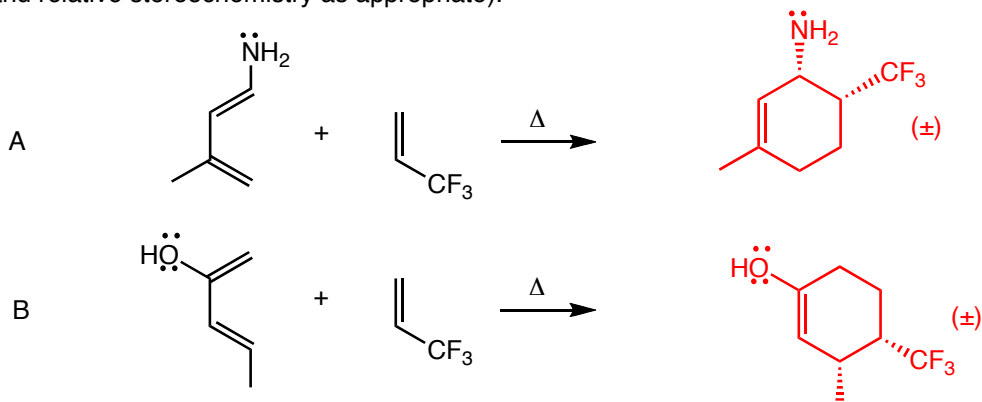
carbohydrates

Question 3 (16 pts) Give the major organic products of the following reactions, indicate both the **relative** and the **absolute** stereochemistry.

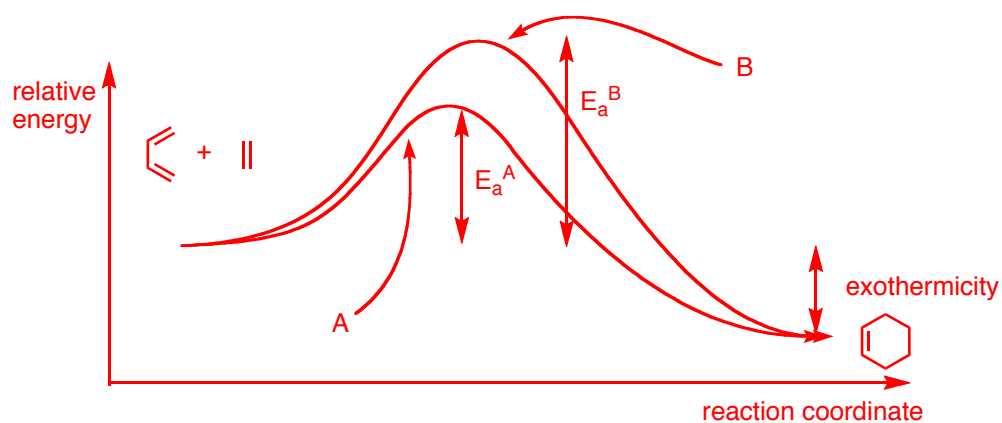


Question 4 (23 pts)

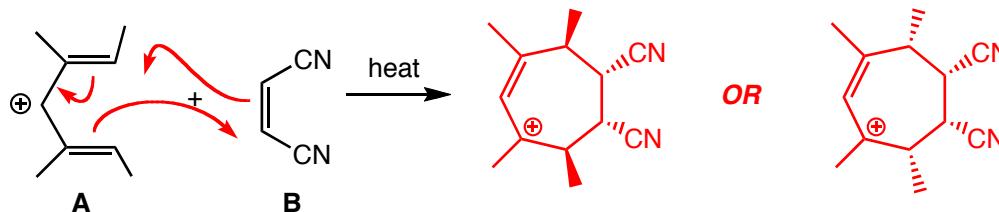
a) Give the products of the following two Diels-Alder reactions (be sure to specify both absolute and relative stereochemistry as appropriate).



b) Draw a reaction energy diagram for these two reactions, clearly indicating which diagram refers to reaction A and which to reaction B. Clearly indicate the activation energy for the reactions A and B. Assume both reactions have similar exothermicities, indicate the exothermicity.



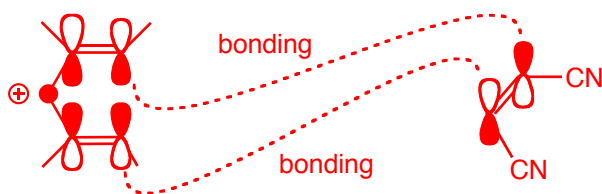
Question 6 (24 pts). Give the ALLOWED product of the following cycloaddition reaction



a) Give the curved arrow-pushing that describes the bond-making and breaking.

b) Redraw the cation **A** and give a pictorial representation of the wavefunction of the HOMO ON TOP OF THE STRUCTURE

c) Redraw the dicyanoethylene **B** and give a pictorial representation of the wavefunction of the LUMO ON TOP OF THE STRUCTURE

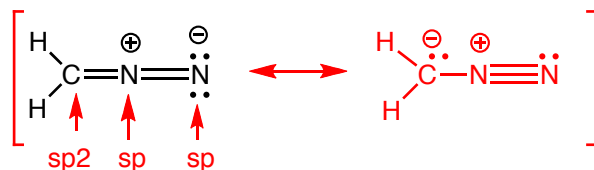


d) Give a brief justification for the structures of your allowed product, you must include the following terms in your justification: suprafacial and/or antarafacial, HOMO, LUMO, bonding and/or anti-bonding

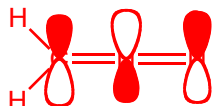
the ALLOWED product of the reaction must have two bonding interactions in the transition state, consideration of the wavefunctions of the HOMO and the LUMO indicates that suprafacial/suprafacial reaction is allowed, thus the 2 -CN groups start cis- and are on the same side in the product, and the two Me-groups on the outside of the cation end on the same side in the product

Question 7 (18 pts). For the provided structure:

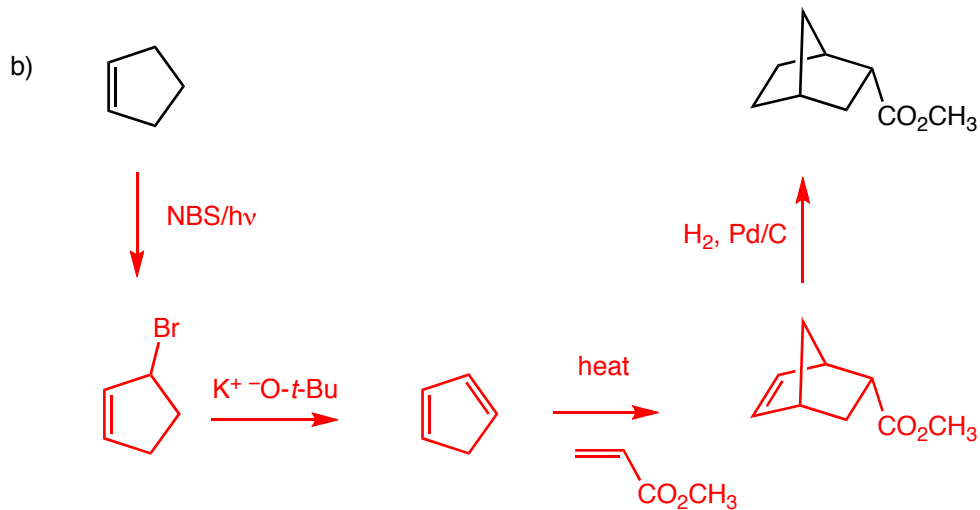
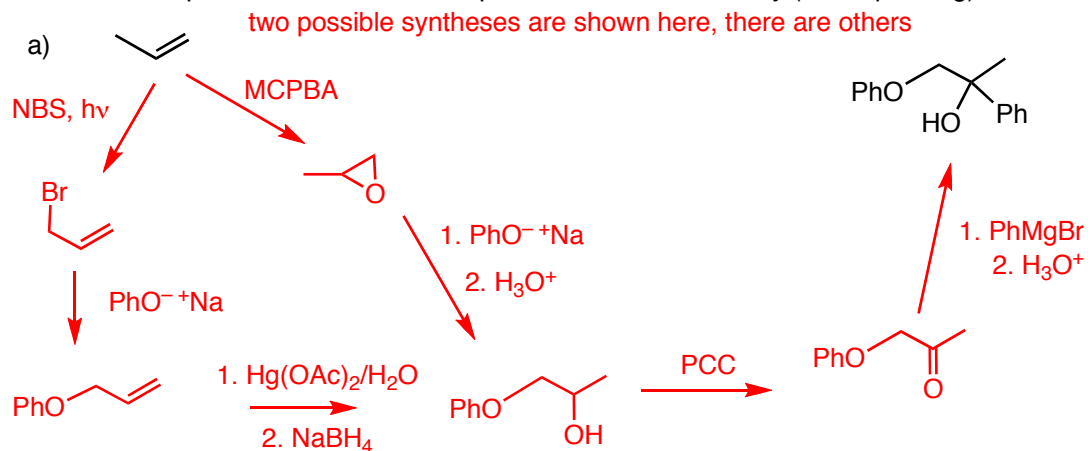
a) Give all reasonable resonance contributors and indicate the hybridization of the carbon and BOTH nitrogen atoms



b) Redraw the structure and draw a schematic representation of the wavefunction of the LUMO on TOP of your re-drawing of the structure



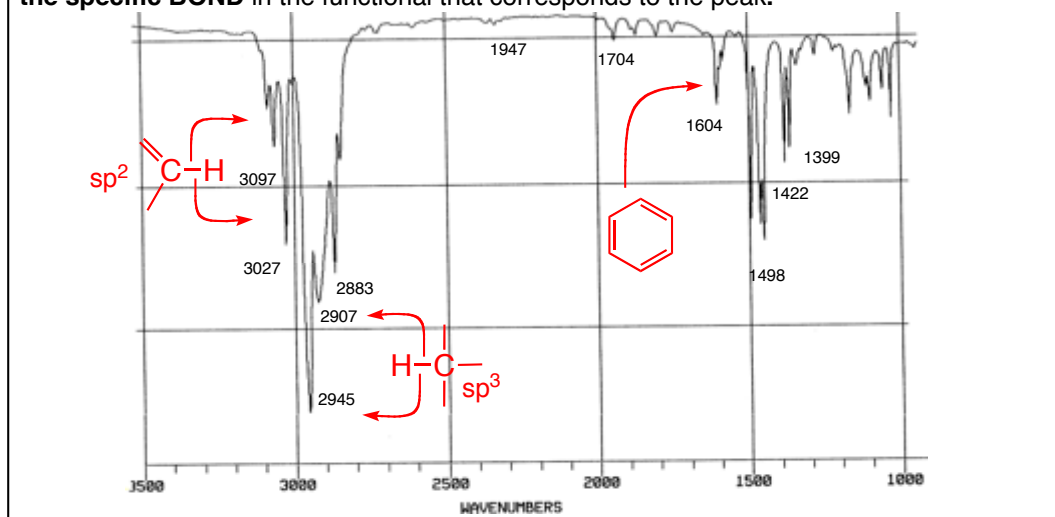
Question 5 (40 pts.) Show how you would make the target compounds on the right from the starting compounds on the left. Show reagents and conditions where appropriate, and the structures of important intermediate compounds. Do not show any (arrow pushing) mechanisms.



Question 8 (24 pts.) Provided are spectra for a compound with molecular formula  $C_{10}H_{14}$

a) Give the degrees of unsaturation 4 degrees of unsaturation

b) On the infrared spectrum, indicate the peaks that identify the functional groups in the molecule (including  $C(sp^3)-H$ ). Indicate **BOTH the functional group**, and where appropriate, **the specific BOND** in the functional that corresponds to the peak.



c) draw the structure and clearly indicate which hydrogens correspond to which signals in the proton nmr spectrum ONLY

