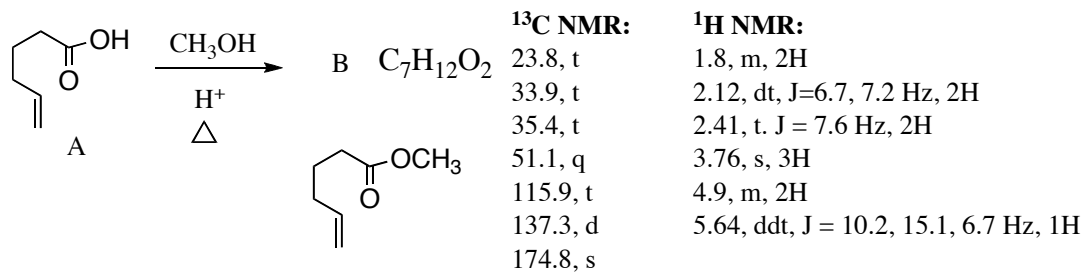
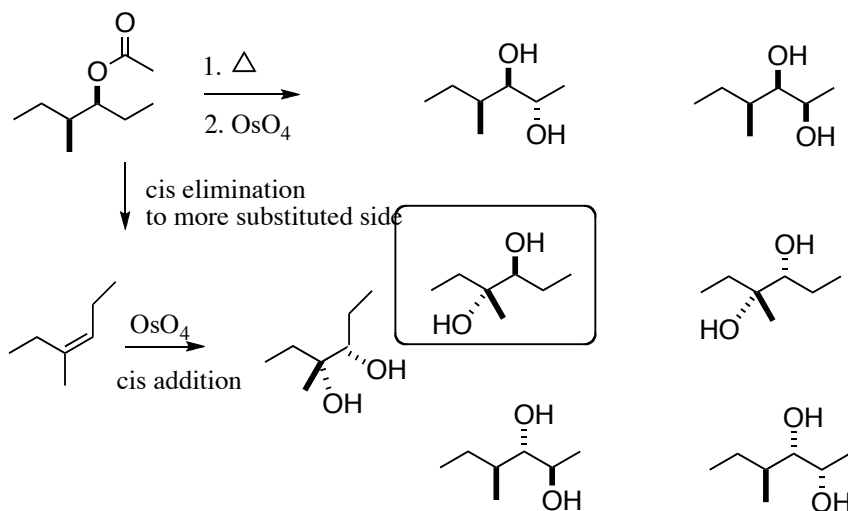


This is an open-book, open notes exam. Please show your work in detail.

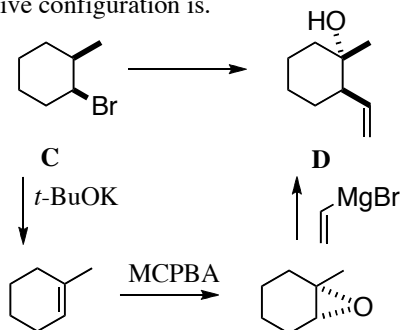
1. (20 points) Fill in the missing reagent(s), and draw the structure of **B**. You do not have to show mechanisms.



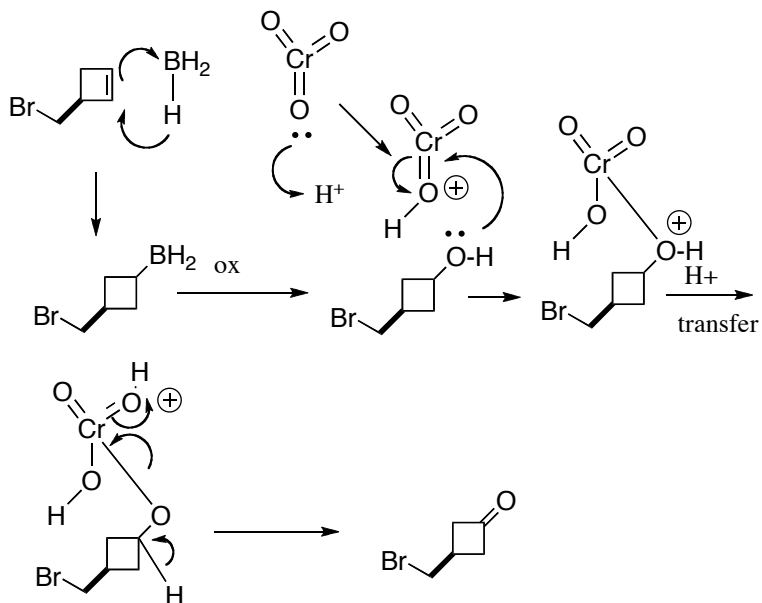
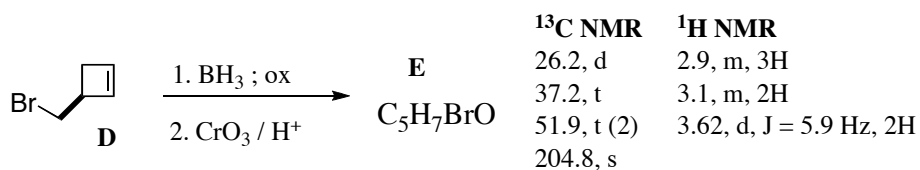
2. (20 points) Indicate the expected major product. Explain your reasoning in detail. Absolute configuration is not important, but relative configuration is.



3. (20 points) Outline the synthesis steps to convert **C** into **D**. In addition to **C**, you may use any piece that contributes three or fewer carbons to the final product. Absolute configuration is not important, but relative configuration is.



4. (20 points) Deduce the structure of **E**, and draw arrow-pushing mechanisms for the transformation. You do not need to show the mechanism for converting the C-B bond to the C-O bond.



5. (20 points) Draw a detailed arrow-pushing mechanism for the following transformation. 5/20 points for correctly showing the mapping of the starting materials onto the product, and fully listing bonds broken and bonds formed.

