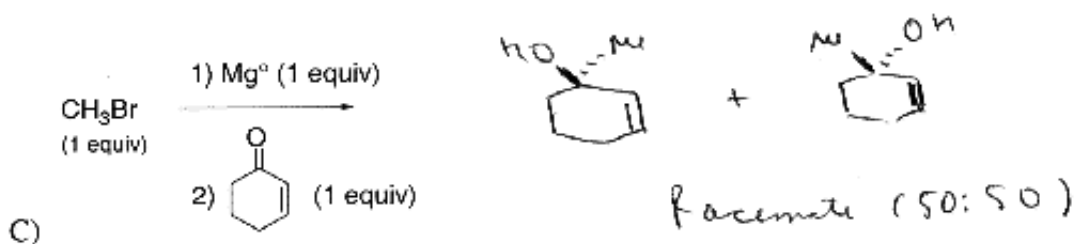
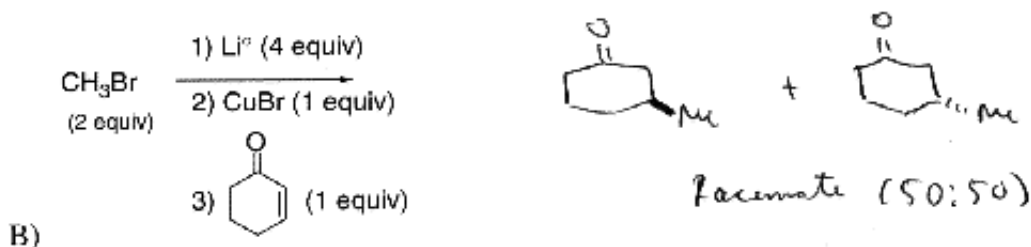
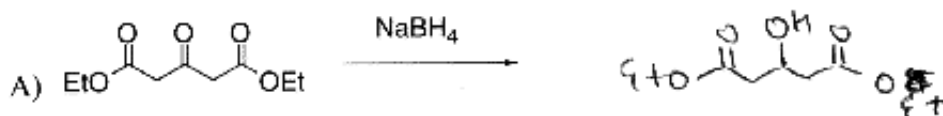
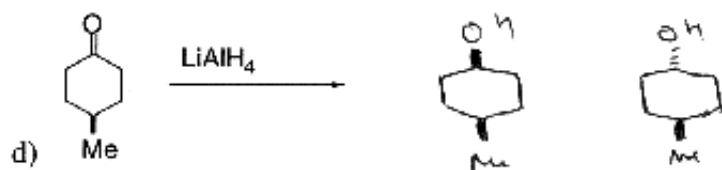
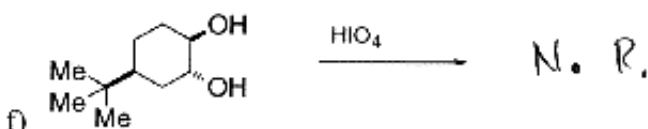
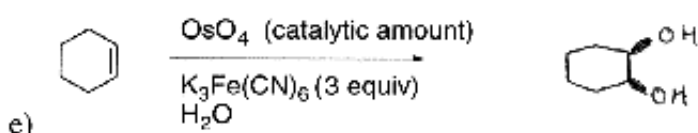


1) Provide the products of the following reactions. If no reaction would occur, then write NR. You do NOT have to write a mechanism for these reactions, just give the products. Draw all possible stereoisomers and indicate if they would be produced in equal or unequal amounts. (5 points each)





Diastereomers  $\therefore$  NOT produced  
in equal amounts

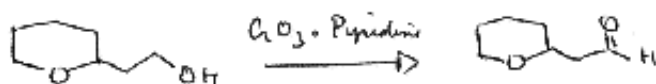
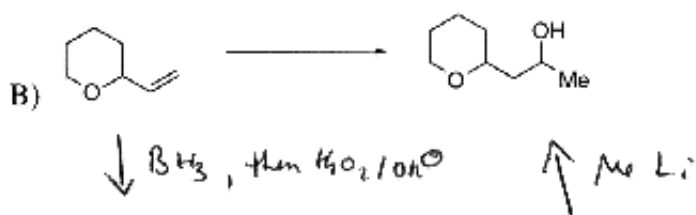
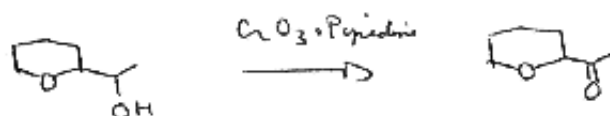
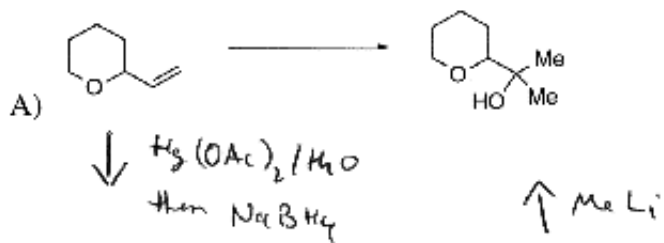


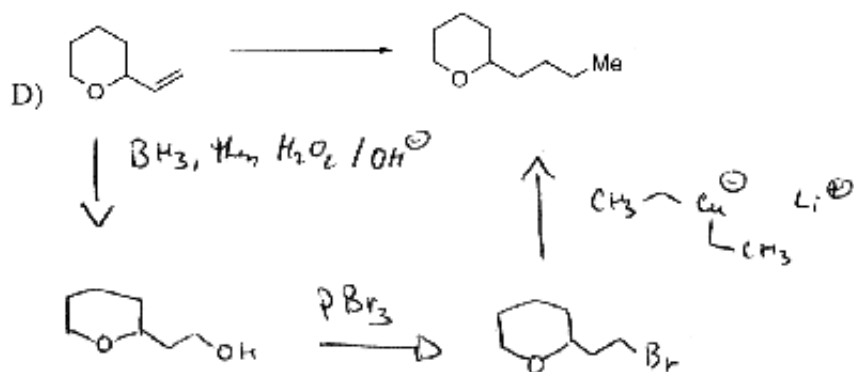
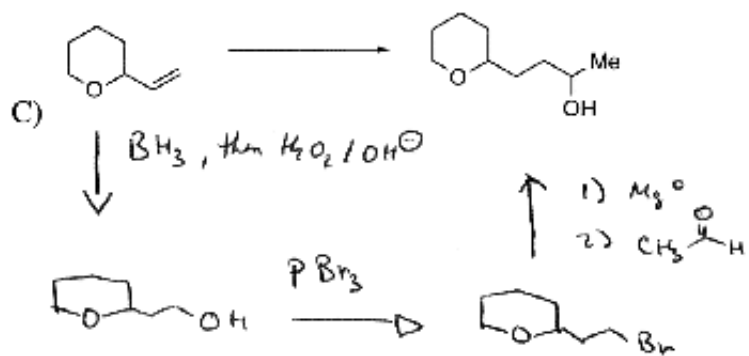
Diastereomers  $\therefore$  NOT produced  
in equal amounts

$\pi$

Don't forget to draw all the stereoisomers for each reaction!

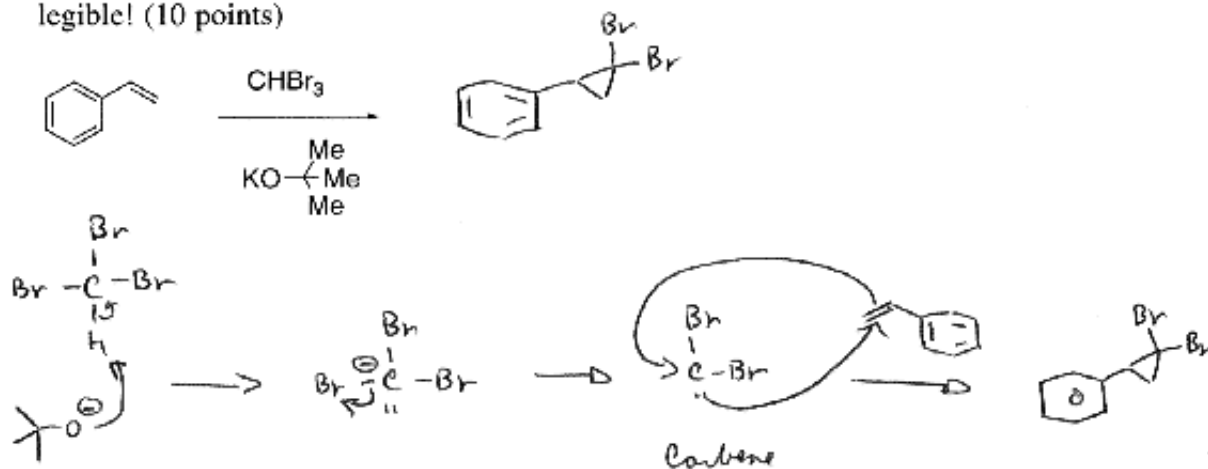
2 Complete **three of the four** syntheses shown below using organic reagents of 2 carbons or less and any inorganic reagents you wish. If you want partial credit, then write the product of each reaction (30 points). Clearly indicate which problem you don't want graded.



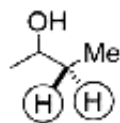


**CROSS OUT THE ONE SYNTHESIS YOU DON'T WANT GRADED!**

3) Provide the product and mechanism for the following reaction. Be sure to draw each arrow and show each step of the reaction for full credit. Be sure your answer is legible! (10 points)

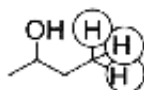


4) Label the circled protons as enantiotopic, diastereotopic homotopic or chemically inequivalent and indicate which of the circled sets of protons **must** appear at the same chemical shift in the  $^1\text{H}$  NMR spectrum. (9 points)



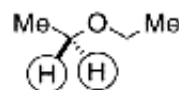
Diastereotopic

Different  $\delta$



Homotopic

Identical  $\delta$



Enantiotopic

Identical  $\delta$