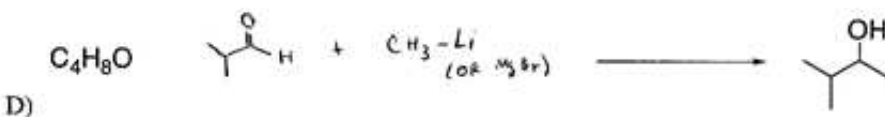
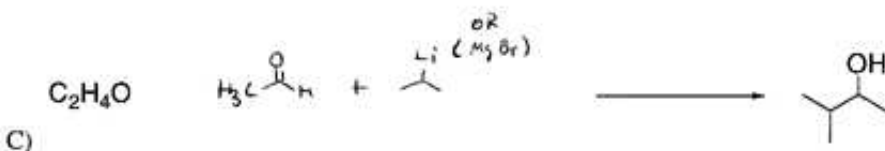
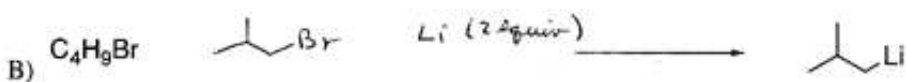
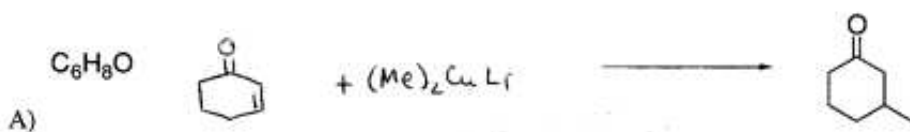
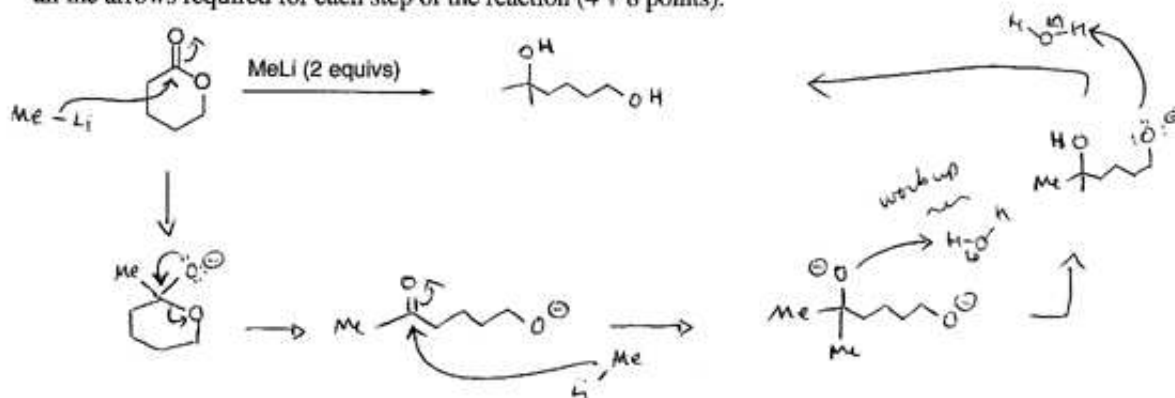


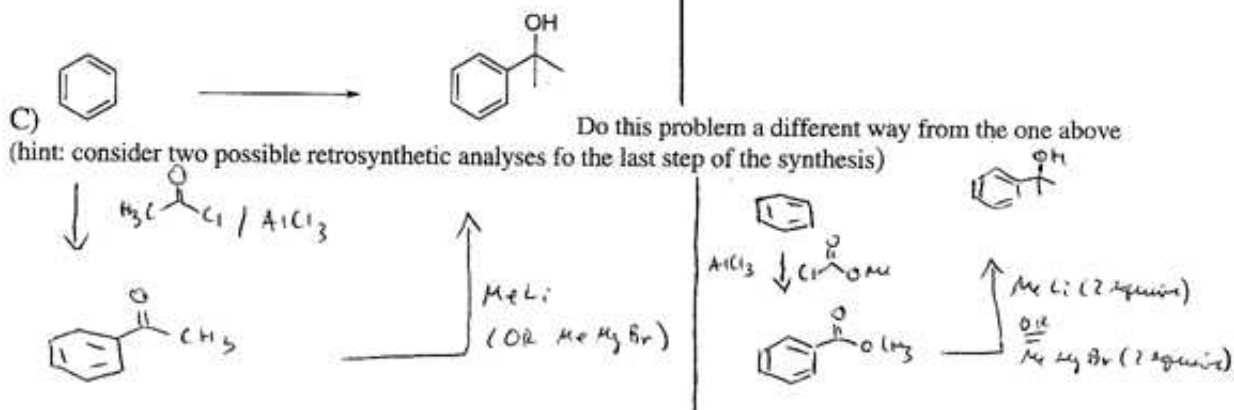
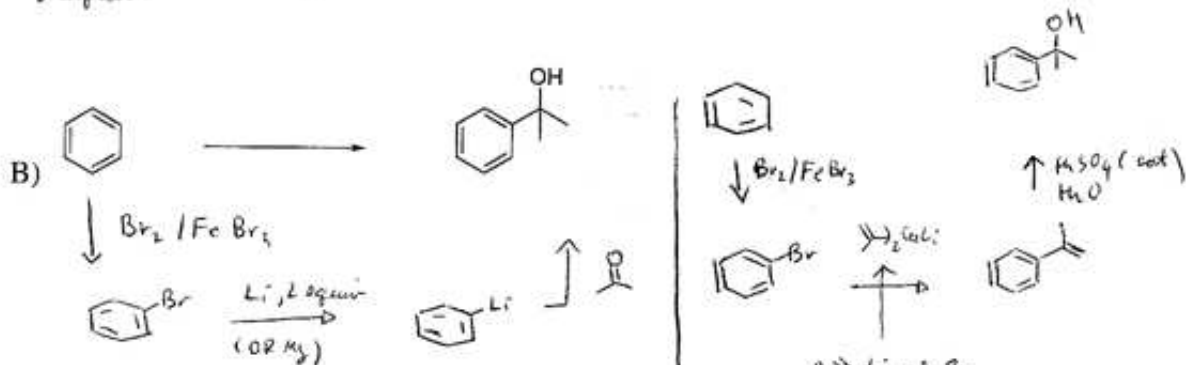
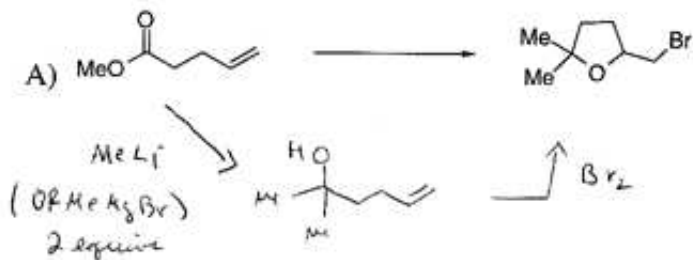
1) Provide the starting material and reagents to complete the following transformations (4 points each).



2) Provide the product and mechanism for the following reaction. Be sure to show all the intermediates and all the arrows required for each step of the reaction (4 + 8 points).



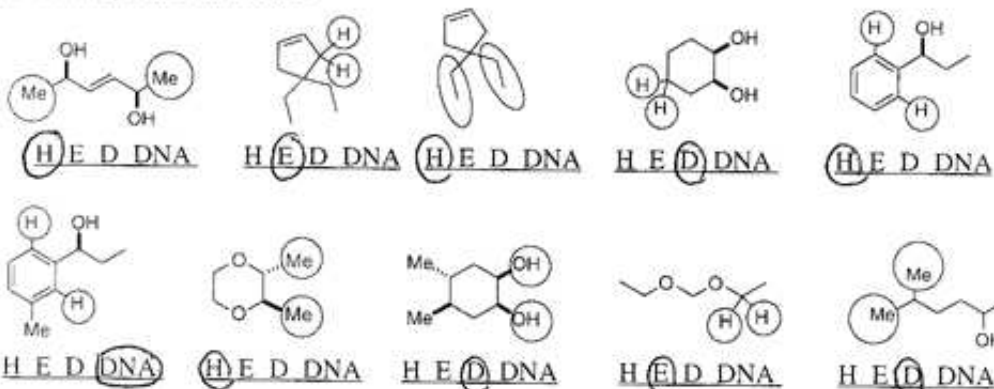
3) Complete the syntheses shown below using organic reagents of 5 carbons or less and any inorganic reagents you wish. If your synthesis requires more than one step, you must write the product of each step (6 points each).



4) Provide the product of the reaction shown below. If no reaction would occur, write "NR". 4 pts



4) Label the circled protons as homotopic (H), enantiotopic (E), diastereotopic (D), or does not apply (DNA) (2 points / molecule).

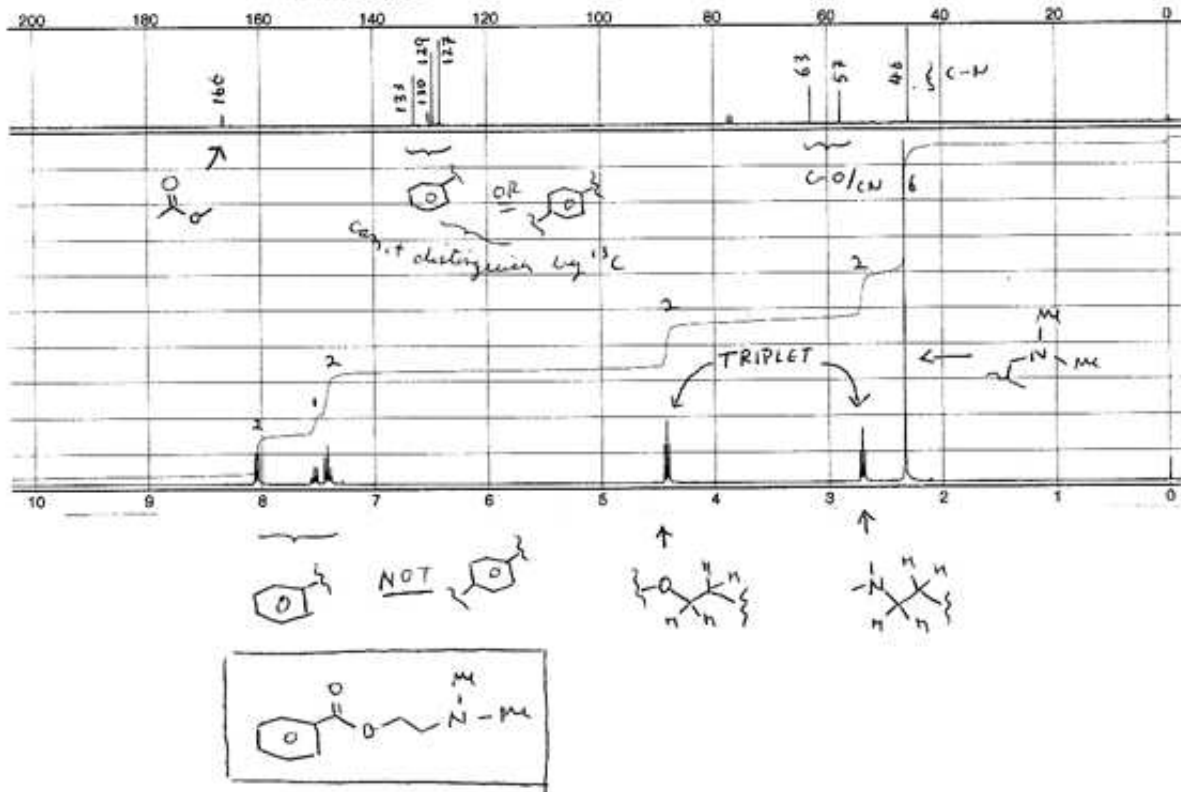


5a) A compound of molecular formula $C_{11}H_{15}NO_2$ provides the ^{13}C and 1H NMR spectra shown below. Answer the following questions regarding its structure: 10 points total

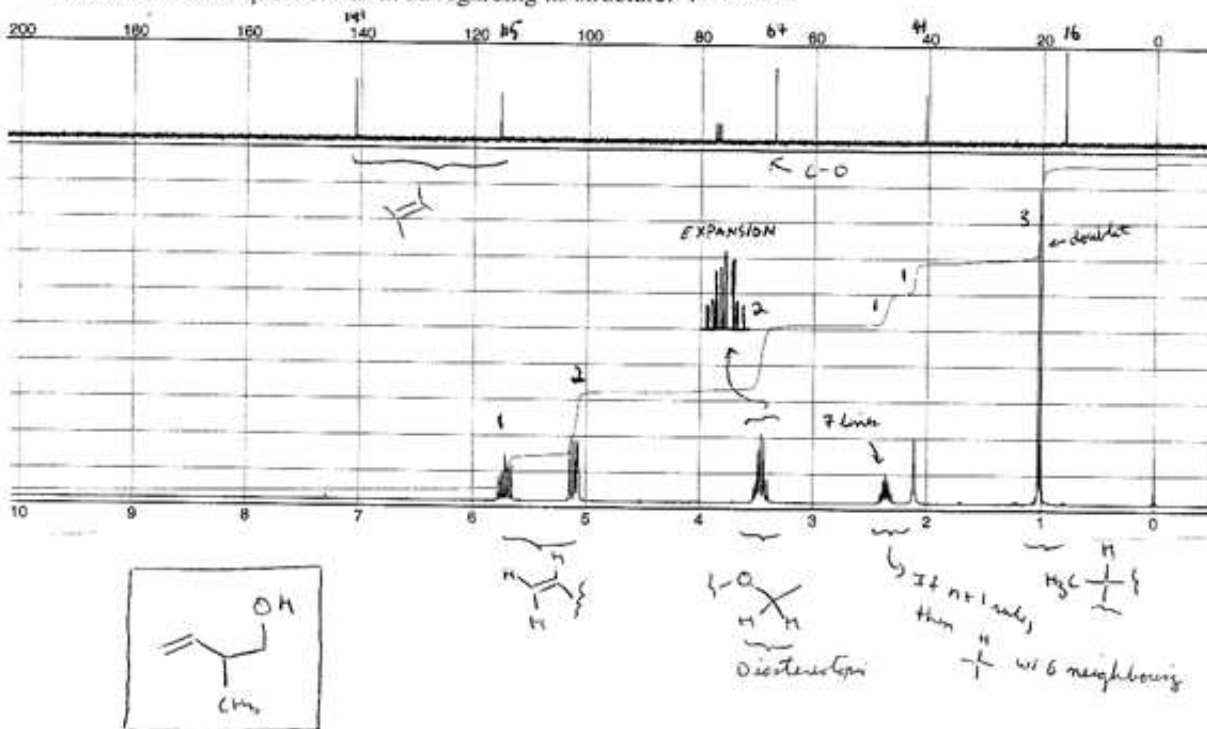
What functional groups or fragments can you conclude are present on the basis of the ^{13}C NMR spectrum?

What functional groups or fragments can you conclude are present on the basis of the 1H NMR spectrum?

What is the structure of the molecule?



5b) A compound of molecular formula $C_5H_{10}O$ provides the ^{13}C and 1H NMR spectra shown below. Answer the same questions as in 5a regarding its structure: 10 POINTS



5c) A compound of molecular formula C_4H_8O provides the ^{13}C and 1H NMR spectra shown below. Answer the same questions as in 5a regarding its structure: 10 POINTS

