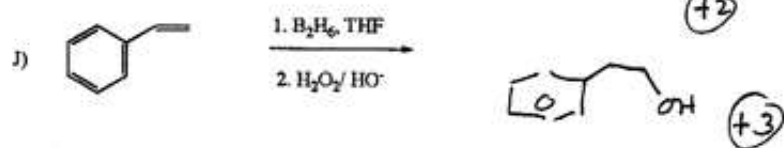
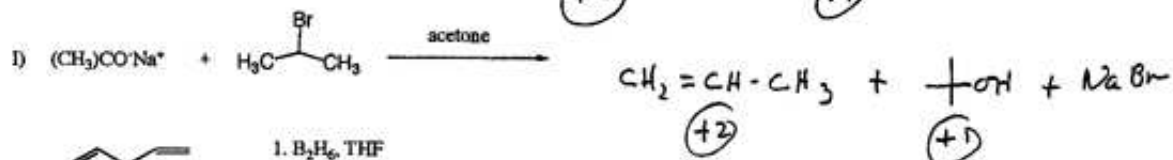
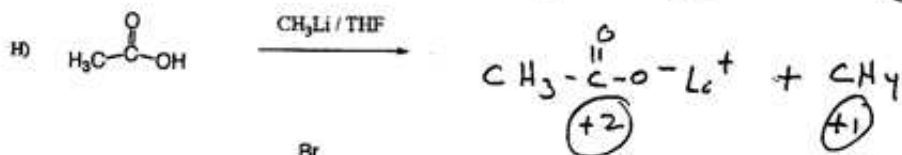
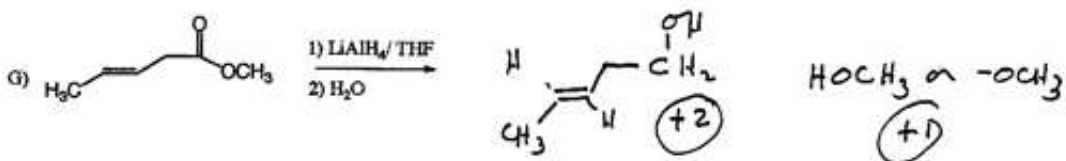
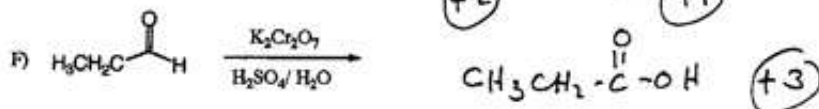
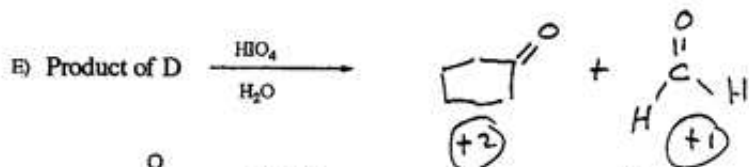
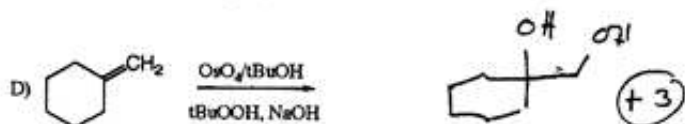
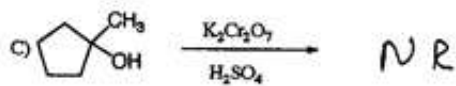
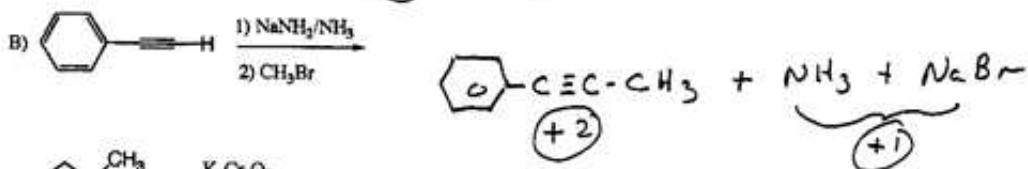
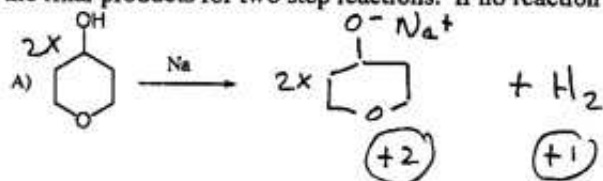
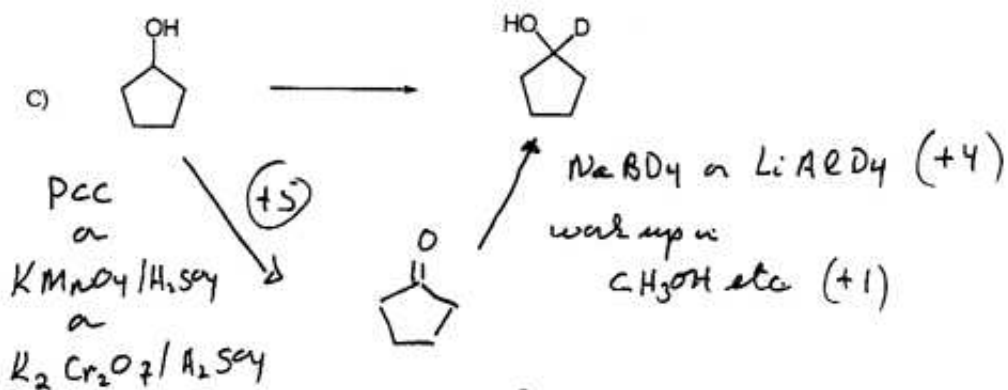
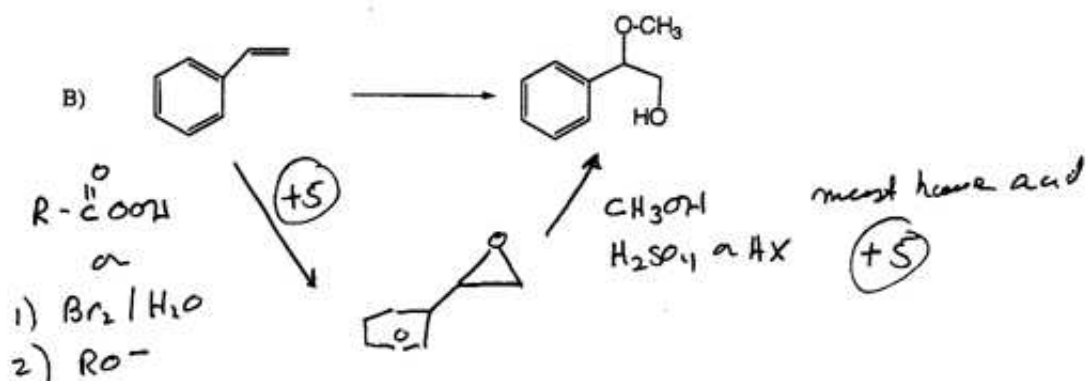
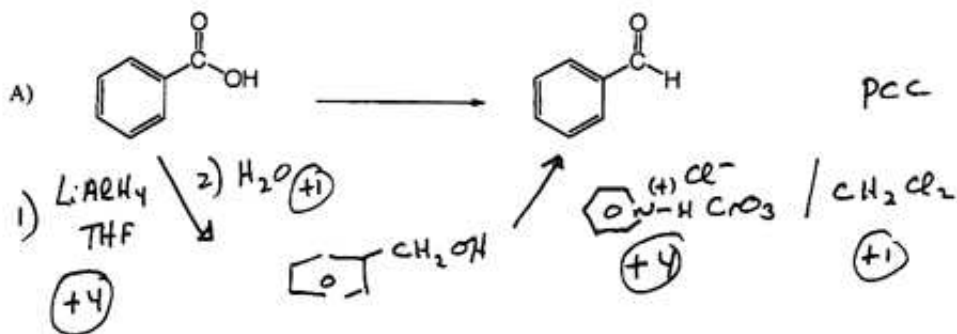


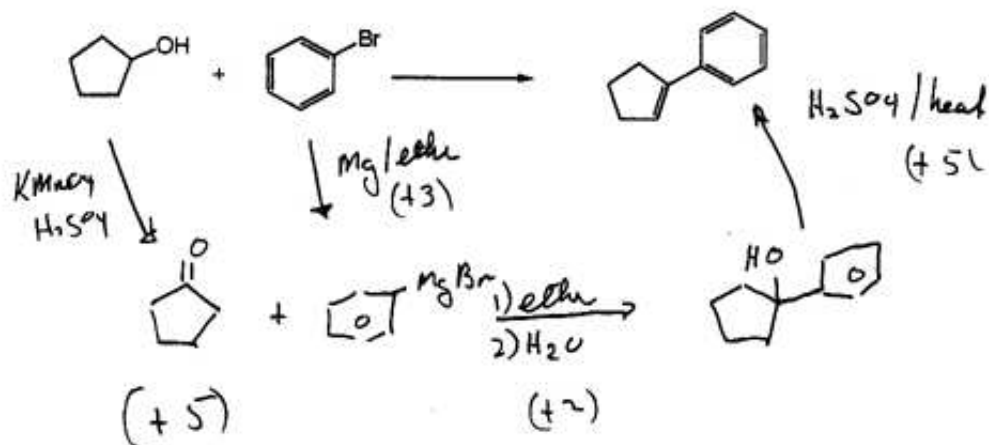
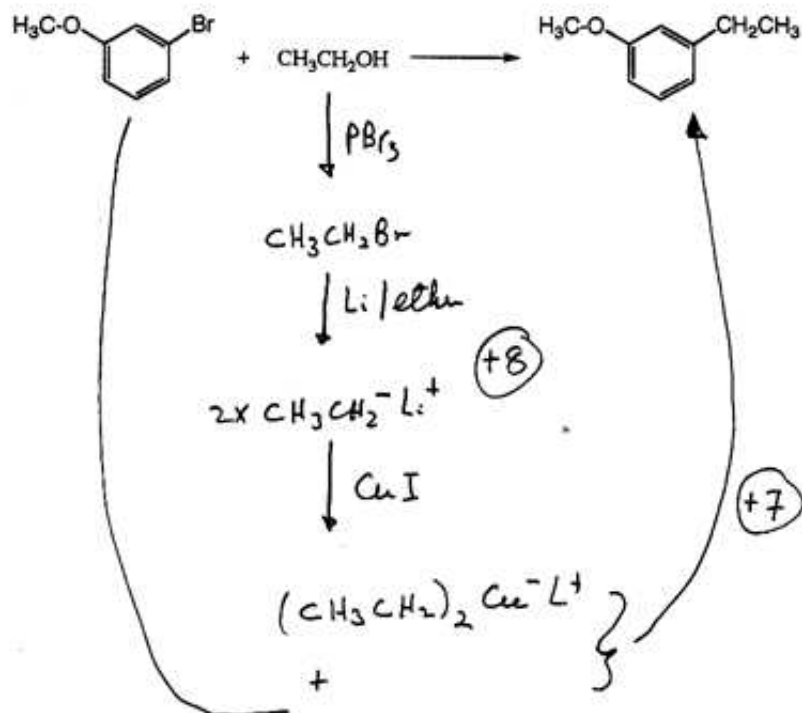
**Problem 1. (30 Points)** Give only the **major** products for the following reactions. Show only the final products for two step reactions. If no reaction occurs, please state No Reaction.



**Problem 2. (30 points)** What reagents would you use to carry out the following reactions. More than one step may be involved.



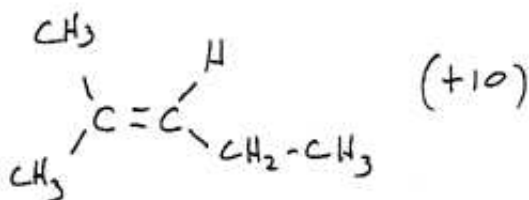
**Problem 3. (30 points)** How would you carry out the following transformations?



**Problem 4. (10 points)** Determine the structure of the compound that has the molecular formula  $C_6H_{12}$  whose NMR spectrum has the following resonances.

$\delta$  0.9 (triplet, 3H)       $\delta$  1.6 (singlet, 3H)       $\delta$  1.7 (singlet, 3H)

$\delta$  2.0 (pentet, 2H)       $\delta$  5.1 (triplet, 1H)



Compound class or type of proton	Chemical shift ( $\delta$ )
Protons bonded to carbon	
Alkane	0.9-1.8
Allylic	1.5-2.6
C-H adjacent to C=O	2.0-2.8
C-H adjacent to C=C	2.0-2.9
Alkyne	2.5
Benzylic	2.3-2.8
Amine	2.2-2.9
Alkyl chloride	3.1-4.1
Alkyl bromide	2.7-4.1
Alcohol or ether	3.3-3.7
Vinyl	4.5-6.5
Aryl	6.5-8.5
Aldehyde	9-10