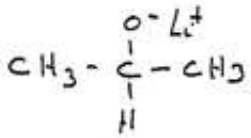
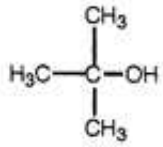
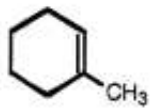
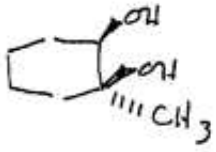
Problem 1.(30 points) Give the products for the following reactions. If there is more than 1 step, just give the **final** product. **If no reactions occur, state so. Show stereochemistry where appropriate.**

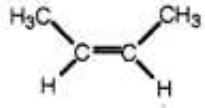
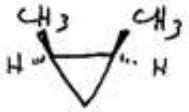
1. $CH_3OH \xrightarrow{Na}$ $CH_3O^- Na^+ + H_2$

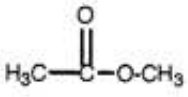
2. $H_3C\text{-}C\equiv C\text{-}H \xrightarrow[2)\ CH_3Br]{1)\ NaNH_2}$ $CH_3\text{-}C\equiv C\text{-}CH_3$

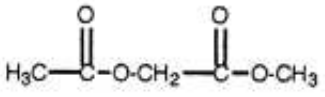
3. $CH_3Li + CH_3CHO \xrightarrow{ether}$ 

4.  $\xrightarrow[H_2SO_4]{K_2Cr_2O_7}$ NR

5.  $\xrightarrow[(CH_3)_3COOH,\ OH^-\ \text{t-butyl alcohol}]{OsO_4}$ 

6.  $\xrightarrow[Zn(Cu),\ ether]{CH_2I_2}$ 

7.  $\xrightarrow[CH_3OD]{NaBH_4}$ NR

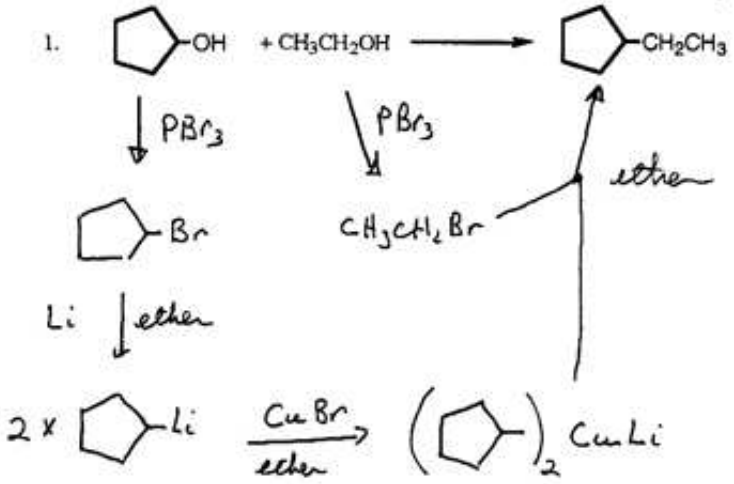
8.  $\xrightarrow[2)\ H_2O]{1)\ LiAlH_4/ether}$ $CH_3CH_2OH + HO\text{-}CH_2CH_2\text{-}OH + HO\text{-}CH_3$

9. $CH_3CH{=}CH_2 \xrightarrow[2)\ H_2O_2]{1)\ B_2H_6,\ diglyme}$ $CH_3CH_2\text{-}CH_2OH$

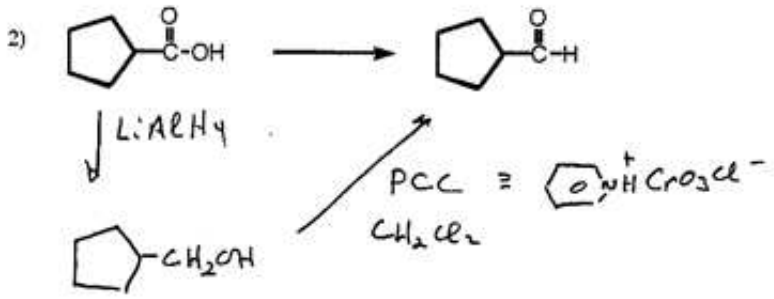
10. $CH_3OH + CH_3MgBr \xrightarrow{ether}$ $CH_4 + CH_3O^- Mg^+ Br$

Problem 2. (40 points) How would you carry out the following transformations.

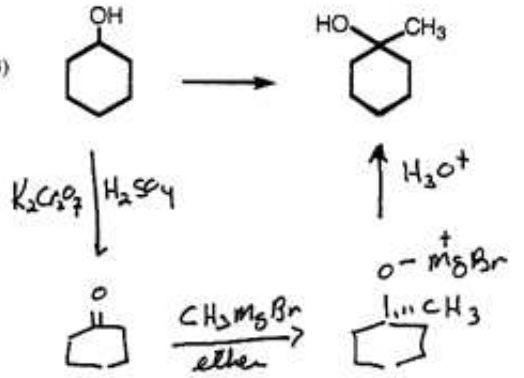
1.



2)

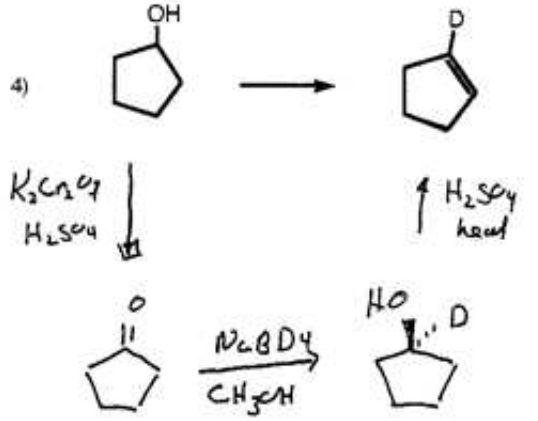


3)



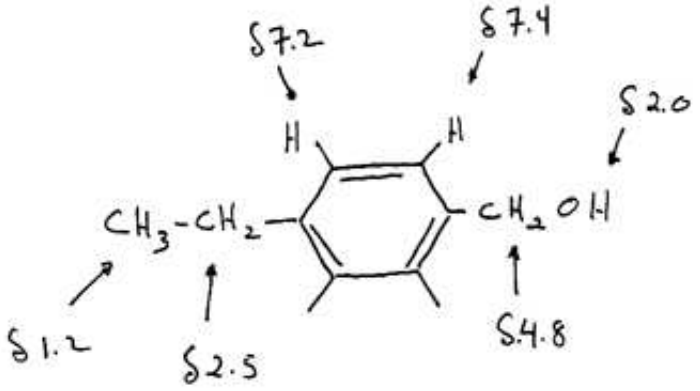
$CH_3Br \xrightarrow[ether]{Mg} CH_3MgBr$

4)



Problem 3. (20 points) Determine the structure of the compound that has the molecular formula $C_9H_{12}O$ whose NMR spectrum has the following resonances.

δ1.2 (triplet, 3H)	δ 2.5 (quartet, 2H)	δ 2.0 (broad, 1H)
δ 4.8 (singlet, 2H)	δ 7.2 (doublet, 2H)	δ 7.4 (doublet, 2H)



Problem 4. (10 points) What is the product of the reaction of 4 x CH_3CHO with $LiAlH_4$ in ether before the protic solvent is added?