

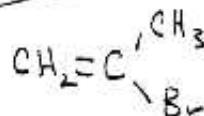
Name: Key (please print)

1. (15 pts) Identify the C₃H₅Br isomers on the basis of the following NMR results. Explain your reasoning.

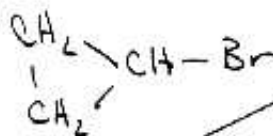
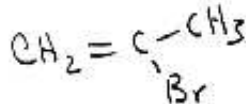
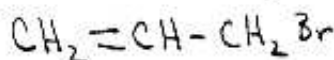
a) Isomer A has three peaks in its ¹³C NMR spectrum: δ 32.6 ppm, δ 118.8 ppm, and δ 134.2 ppm. CH2=CH-CH2Br *Has three diff carbons.*

b) Isomer B has two peaks in its ¹³C NMR spectrum: δ 12.0 ppm and δ 16.8 ppm. The peak at lower field is only half as intense as the one at higher field. CH2=C(CH3)Br *Has two different carbons*

c) Isomer C has the ¹H NMR spectrum shown below.




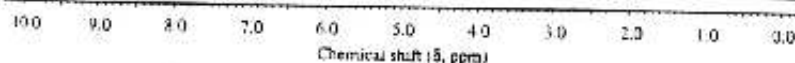
There are only 3 possibilities.



cis & trans

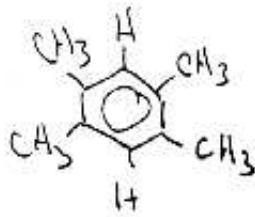
CH₂= protons

3
 *CH₃ not split*

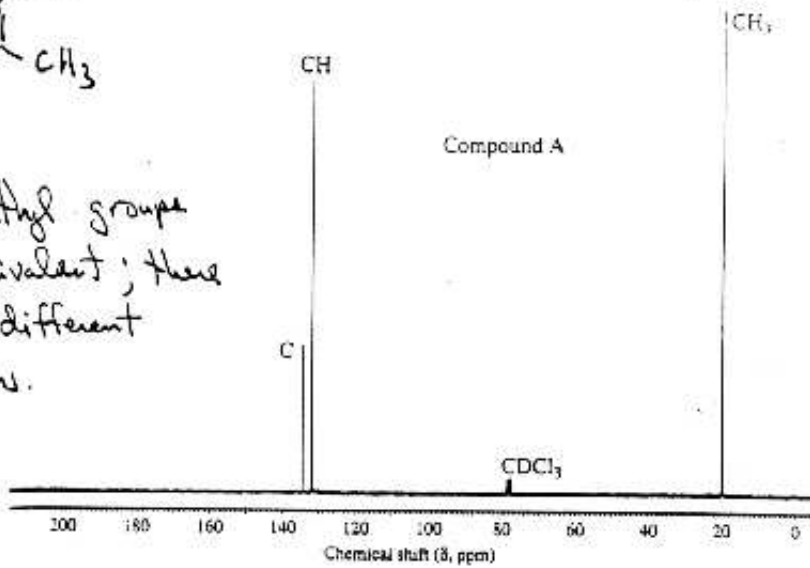


2. (10 pts) Compounds A and B are isomers with the molecular formula $C_{10}H_{14}$. Identify each one on the basis of the ^{13}C NMR spectra shown below. Explain your reasoning.

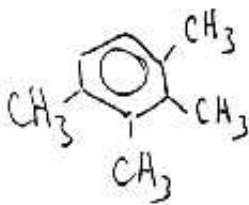
The formula tells you that an aromatic ring is present.



All methyl groups are equivalent; there are 3 different carbons.

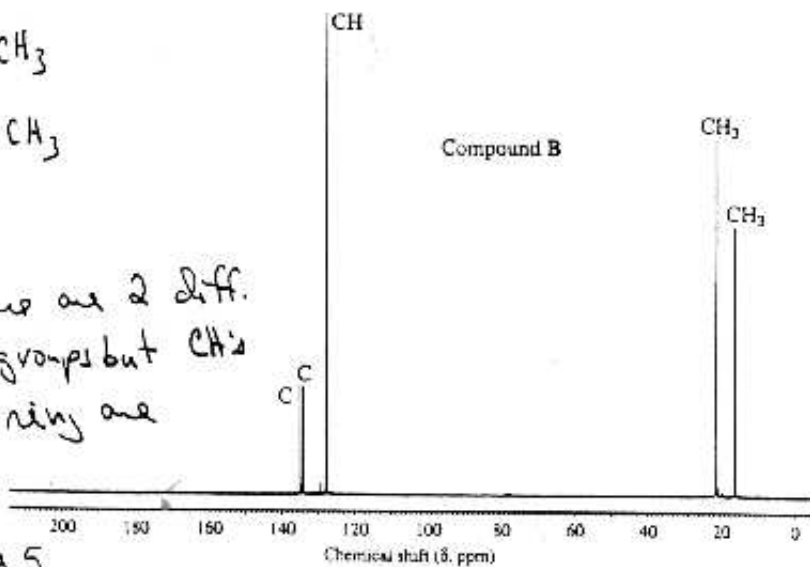


(a)

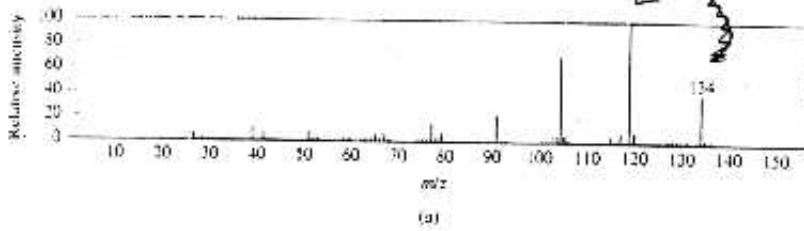


Here there are 2 diff. methyl groups but CH_3 on the ring are equivalent.

There are 5 different carbons.

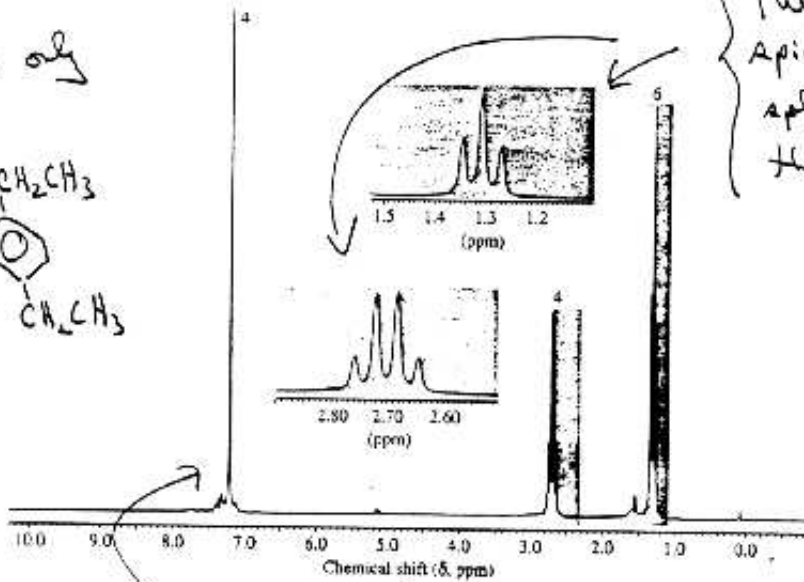


3. (10 pts) Deduce the structure of an unknown with the mass spectrum and ¹H NMR shown below. Explain your reasoning.



loss of CH₃ to produce Cc1ccccc1

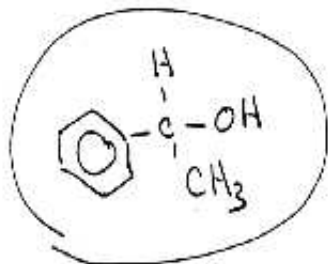
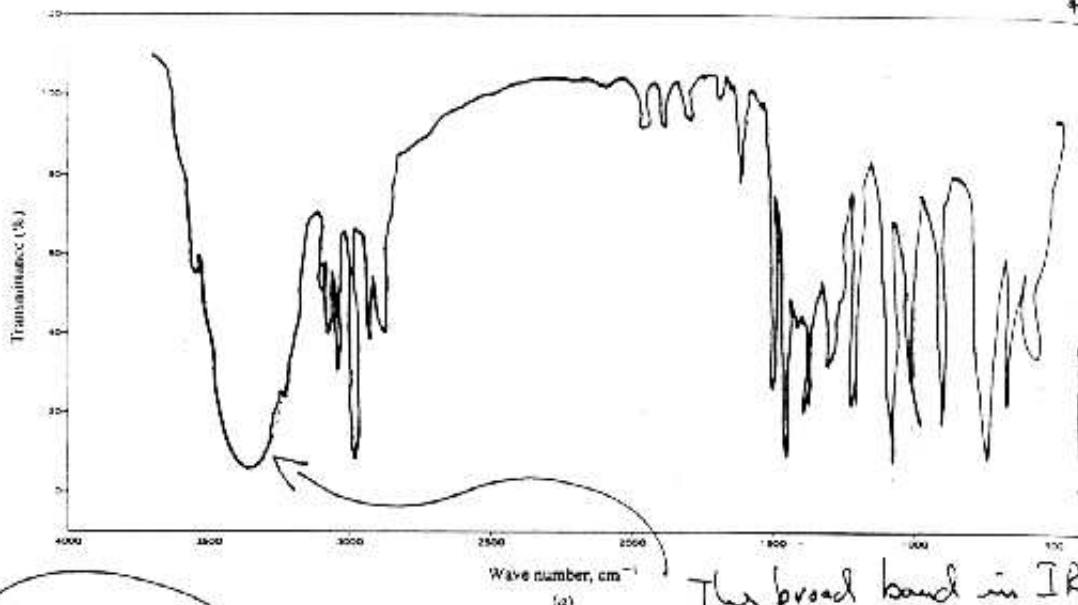
NMR can only be



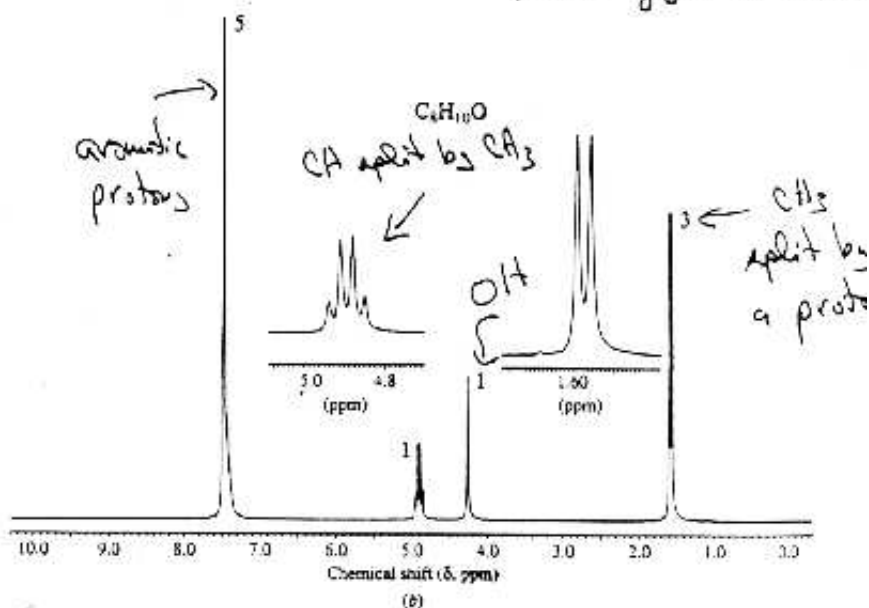
These are spin-spin splitting from the ethyl group.

Aromatic protons

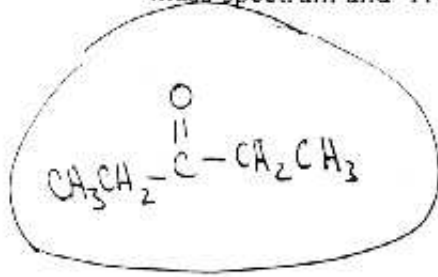
4. (10 pts) Deduce the structure of an unknown ($C_8H_{10}O$) with the infrared spectrum and 1H NMR shown below. Explain your reasoning.



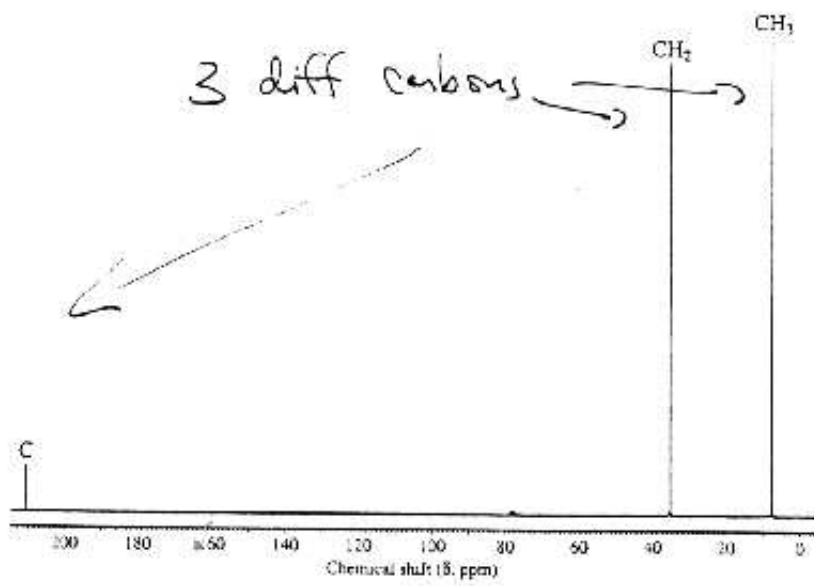
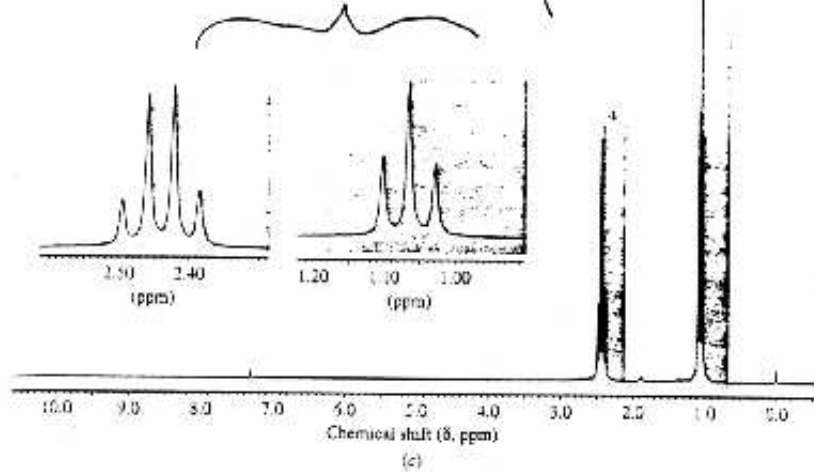
The broad band in IR tells you an alcohol



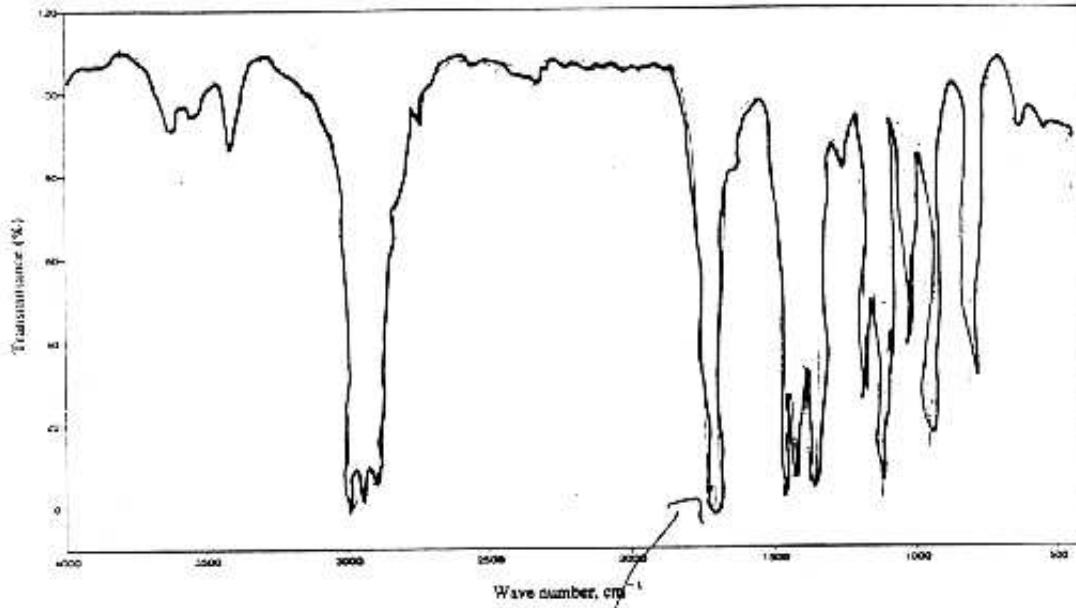
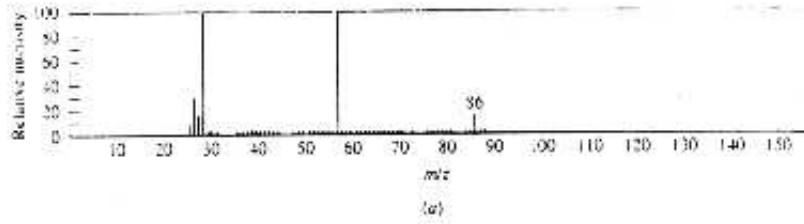
5. (10 pts) Deduce the structure of an unknown with the infrared spectrum, mass spectrum and ¹H & ¹³C NMR shown below. Explain your reasoning.



¹H NMR tells you that you only have an ethyl group
Characteristic spin-spin splitting



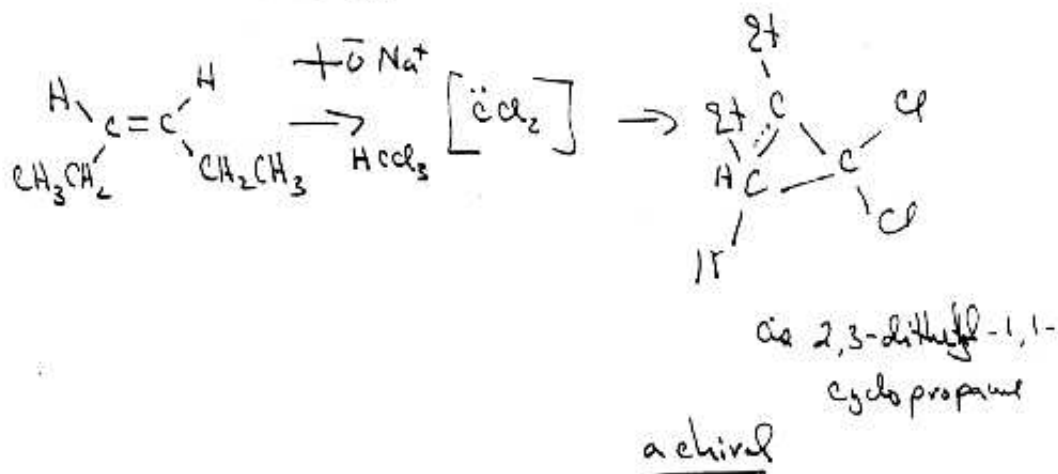
m/z 86 = paint penk



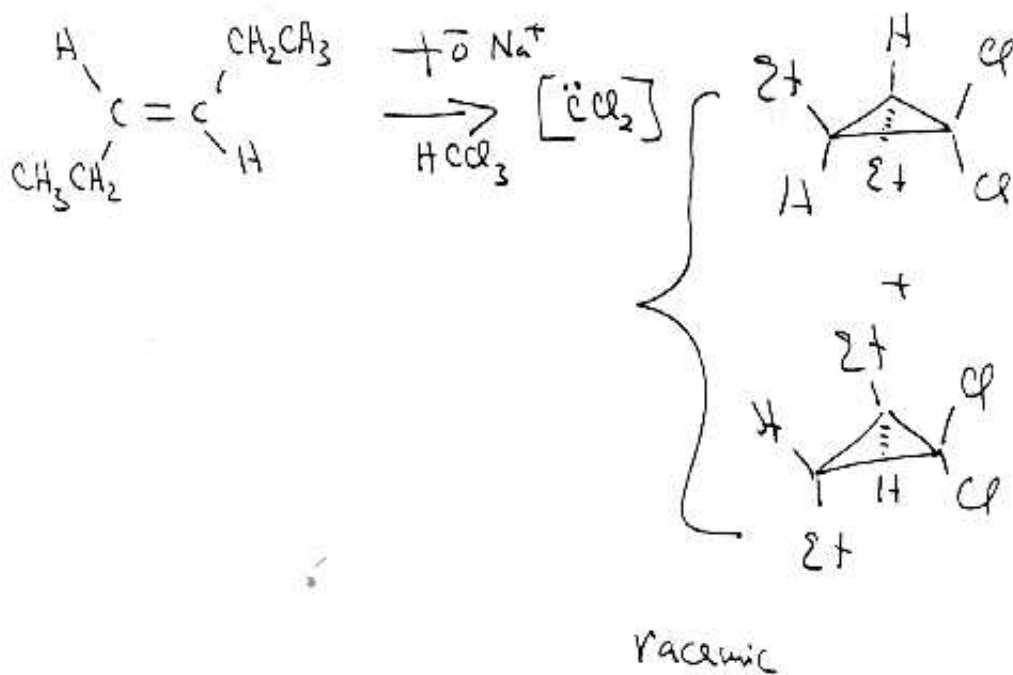
$C=O$ stretch here

6. (15 pts) What are the products of the addition of the following reactions? Which products are achiral? Which is a racemic mixture?

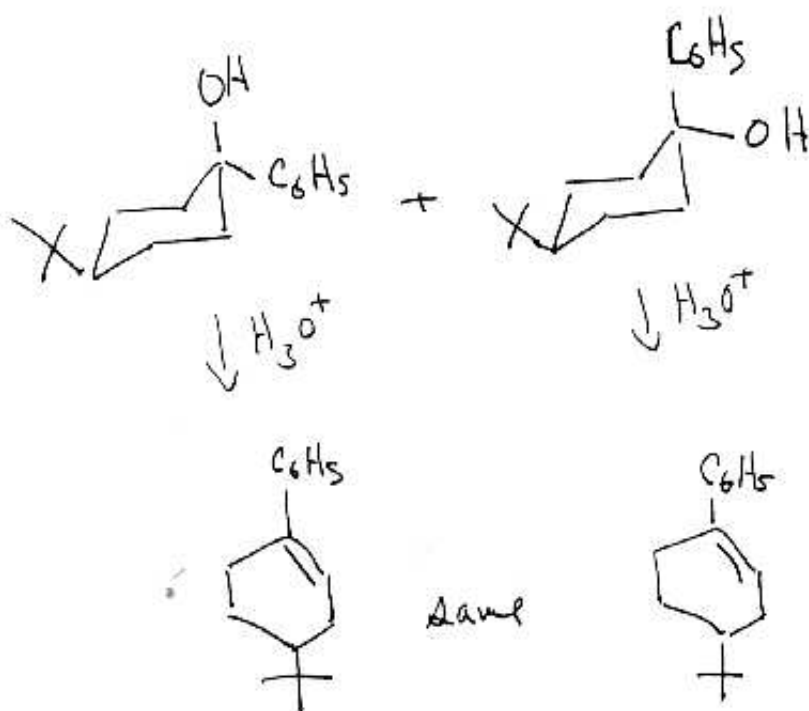
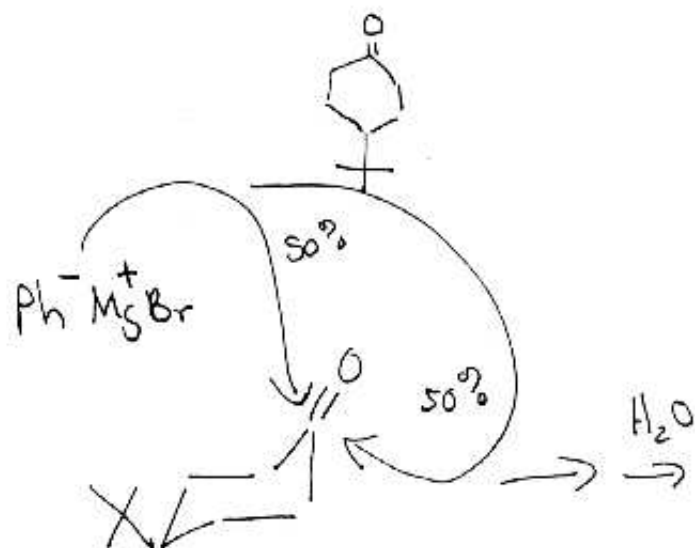
a) Z-3-hexene + $\text{HCl}_3 + (\text{CH}_3)_3\text{CO}^- \text{Na}^+ \rightarrow$



b) E-3-hexene + $\text{HCl}_3 + (\text{CH}_3)_3\text{CO}^- \text{Na}^+ \rightarrow$

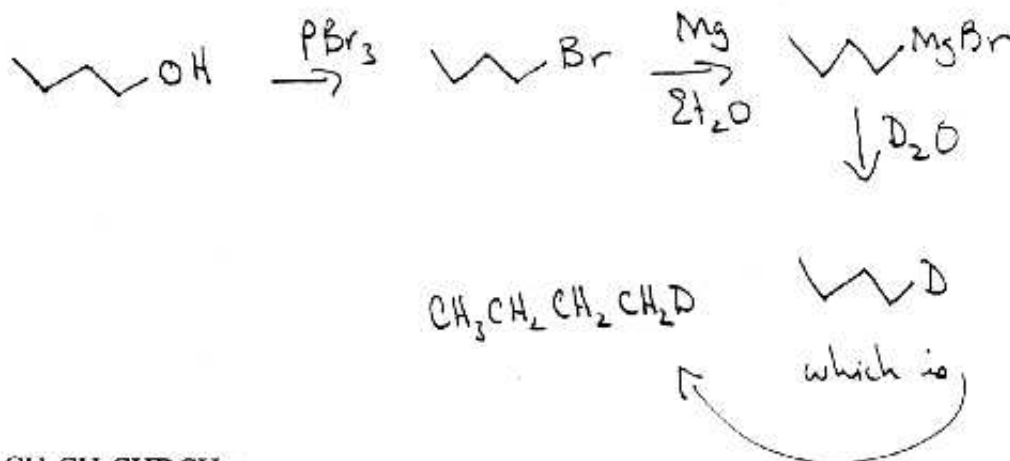


7. (10 pts) The addition of phenylmagnesium bromide to 4-*tert*-butylcyclohexanone gives two isomeric tertiary alcohols as products. Both alcohols yield the same alkene when subjected to acid-catalyzed dehydration. Suggest reasonable structures for these two alcohols.

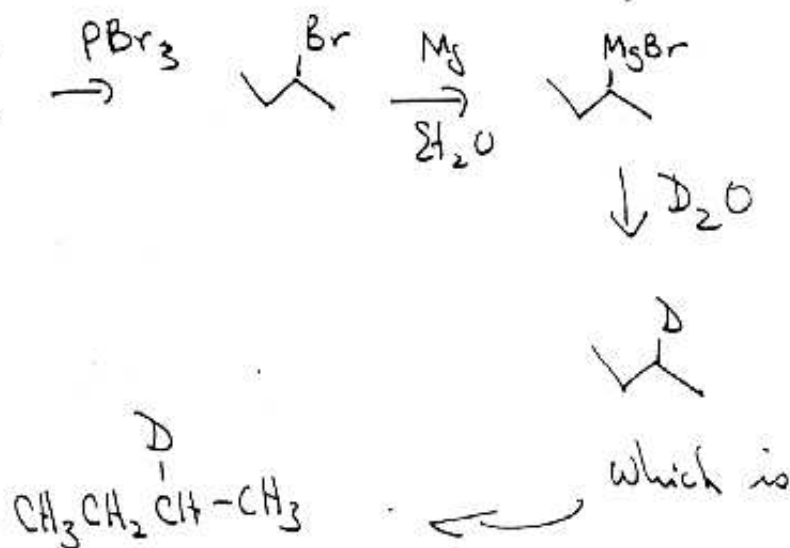


8. (10 pts) Starting with butanols of your choice and D_2O & any other inorganic reagents, prepare the following.

a) $CH_3CH_2CH_2CH_2D$



a) $CH_3CH_2CHDCH_3$



9. (20 pts) What is the principal organic product of the following reactions?

