

Degree of Unsaturation =

$$\frac{\# \text{H's if sat} - \# \text{H's}}{2} = \frac{(2n+2) - \# \text{H's}}{2}$$

A.

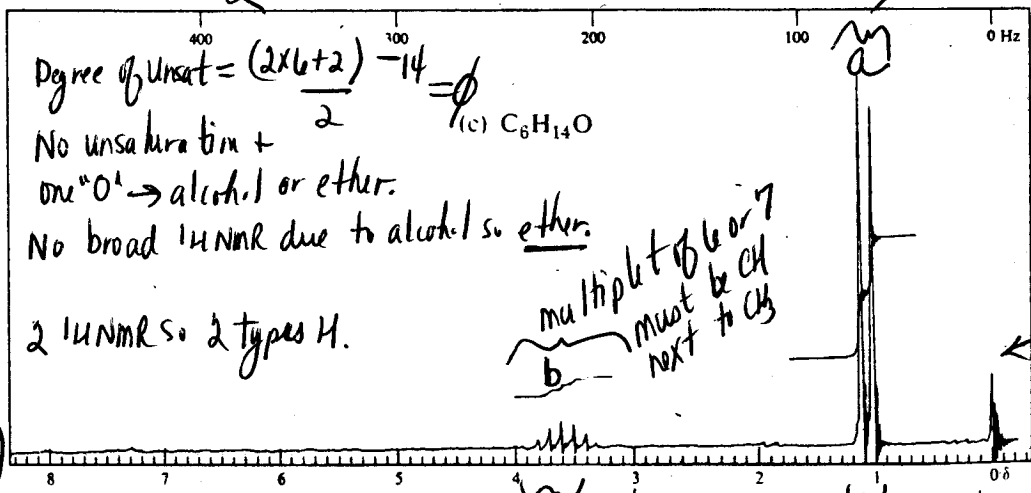
- 1.
- 2.
- 3.
- 4.

Degree of Unsat = $\frac{(2 \times 6 + 2) - 14}{2} = 0$ (c) $\text{C}_6\text{H}_{14}\text{O}$

No unsaturation + one "O" → alcohol or ether.
 No broad 1H NMR due to alcohol so ether.
 2 1H NMRs so 2 types H.

multiplet of 6 or 7 must be CH next to CH₃

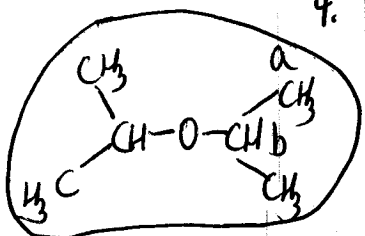
next to -CH-



TMS reference

Position indicates C bonded to "O"

Position indicates methyl (-CH₃) Splitting indicates next to -CH.



B.

- 1.
- 2.
- 3.
- 4.

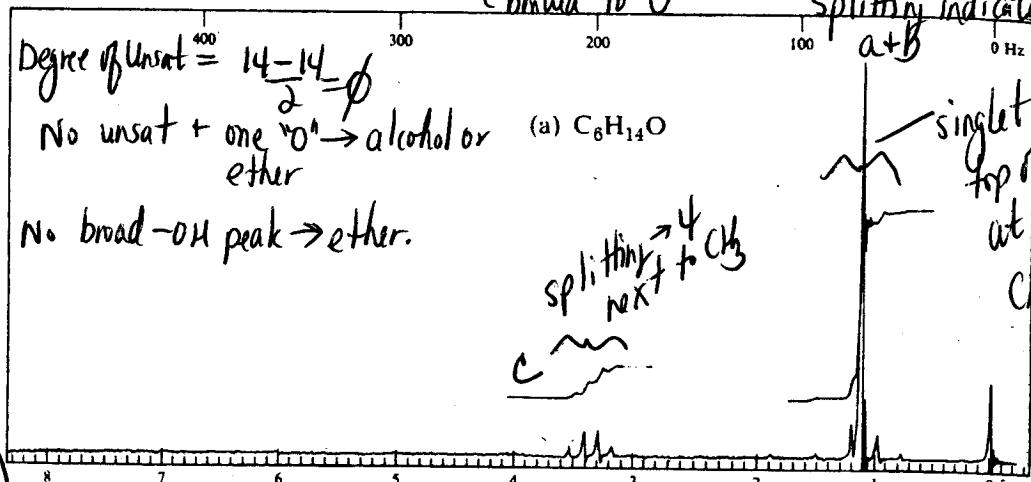
Degree of Unsat = $\frac{14 - 14}{2} = 0$ (a) $\text{C}_6\text{H}_{14}\text{O}$

No unsat + one "O" → alcohol or ether

No broad -OH peak → ether.

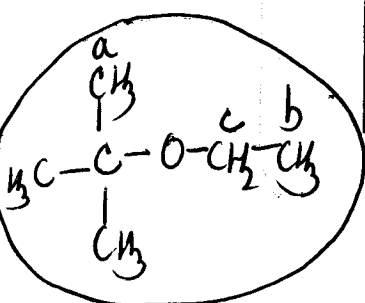
splitting → 4 next to CH₃

singlet on top of triplet → at least one CH₃ is next to a CH₂. other CH₂'s not next to any CH₃ groups because unsplit.

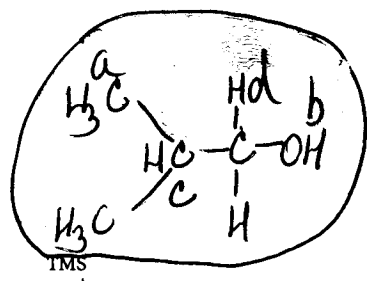
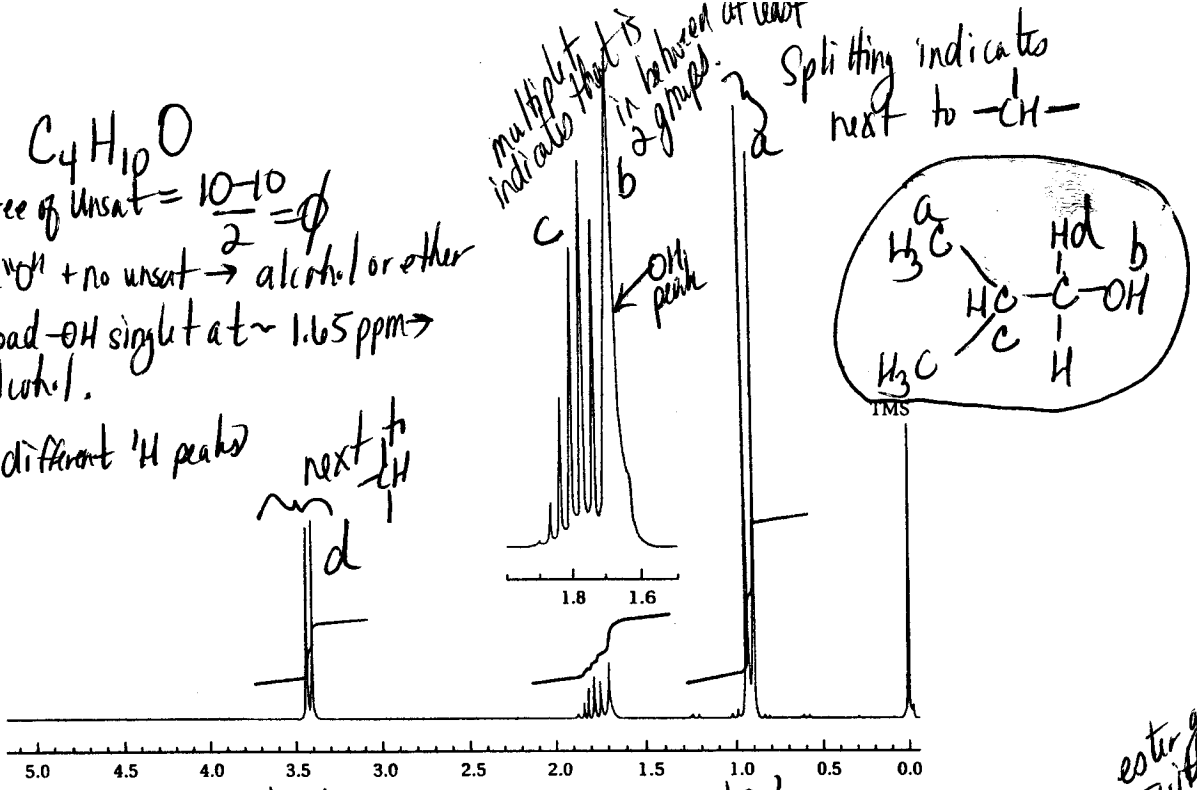


next to e- / drawing oxygen

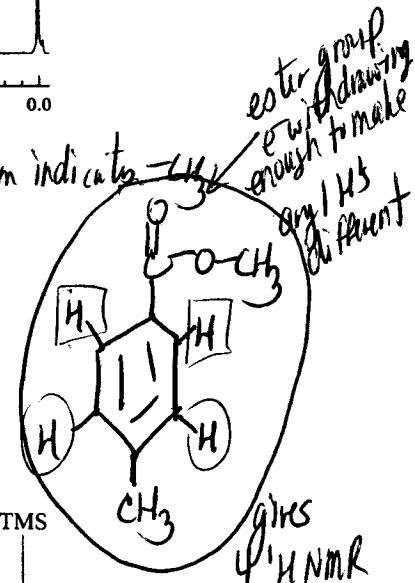
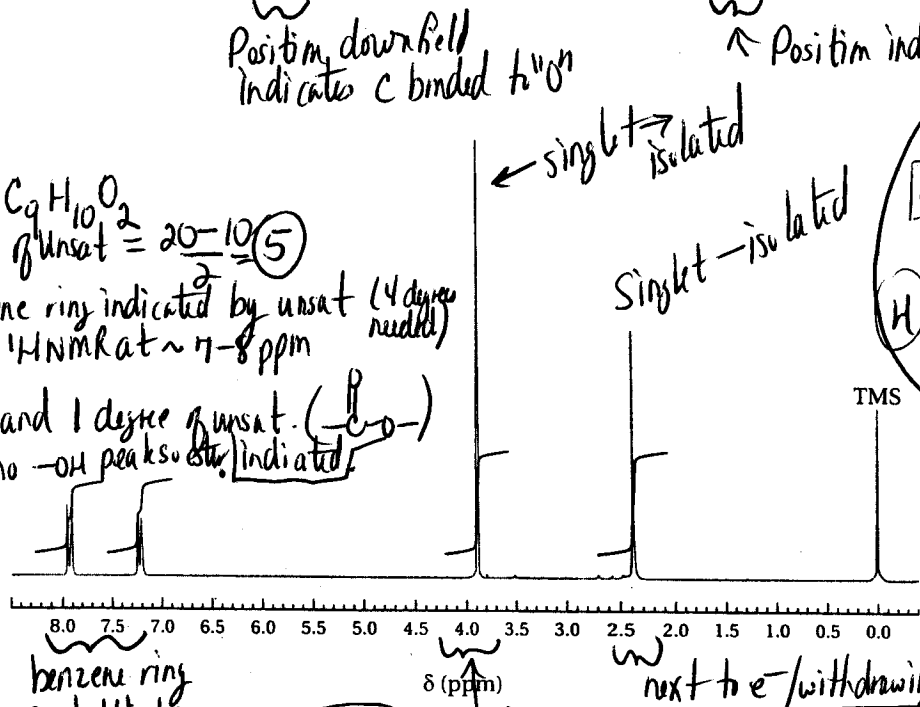
position indicates -CH₃ groups



- C.
- Degree of Unsat = $\frac{10-10}{2} = 0$
 - 2°OH + no unsat \rightarrow alcohol or ether
 - Broad OH singlet at ~ 1.65 ppm \rightarrow alcohol.
 - \neq different ^1H peaks

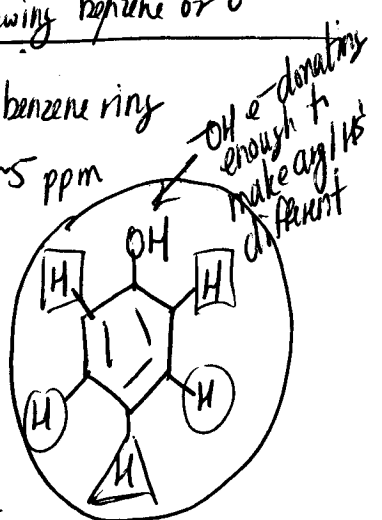
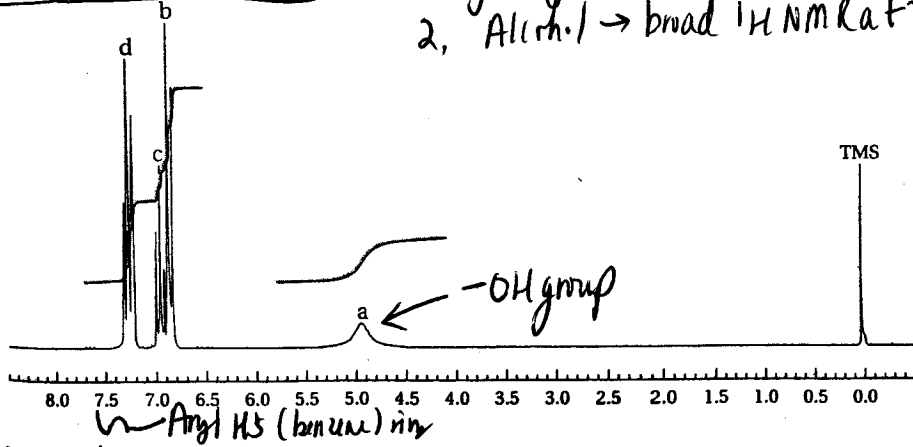


- D.
- Degree of Unsat = $\frac{20-10}{2} = 5$
 - Benzene ring indicated by unsat (4 degrees needed) + by $^1\text{H NMR}$ at $\sim 7-8$ ppm
 - 2°O and 1 degree of unsat. (C=O) but no OH peaks so ester indicated.

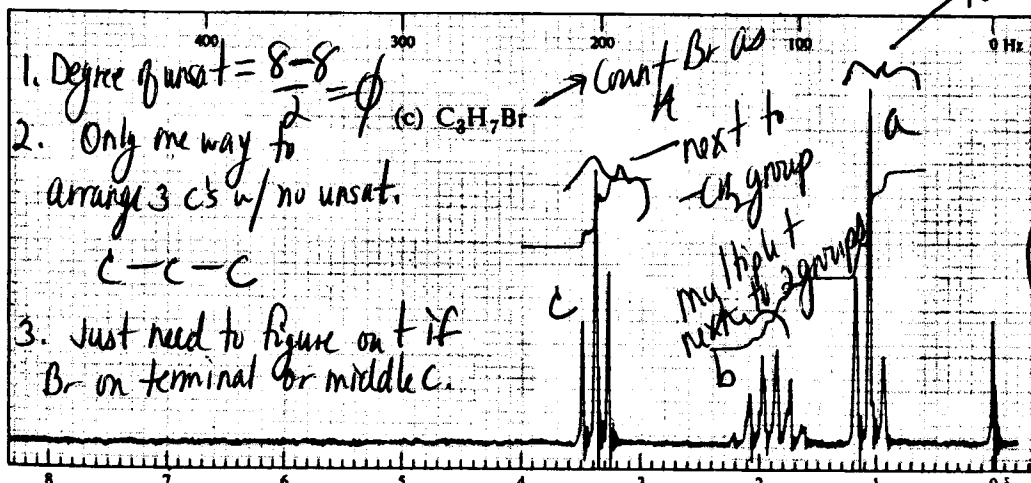
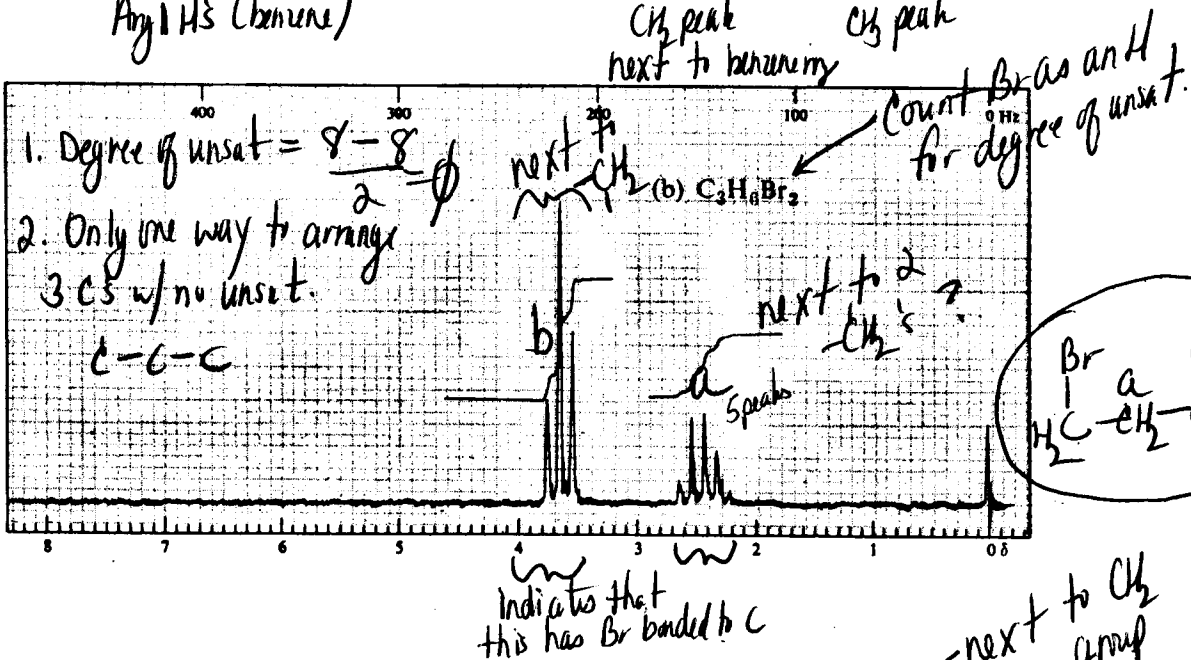
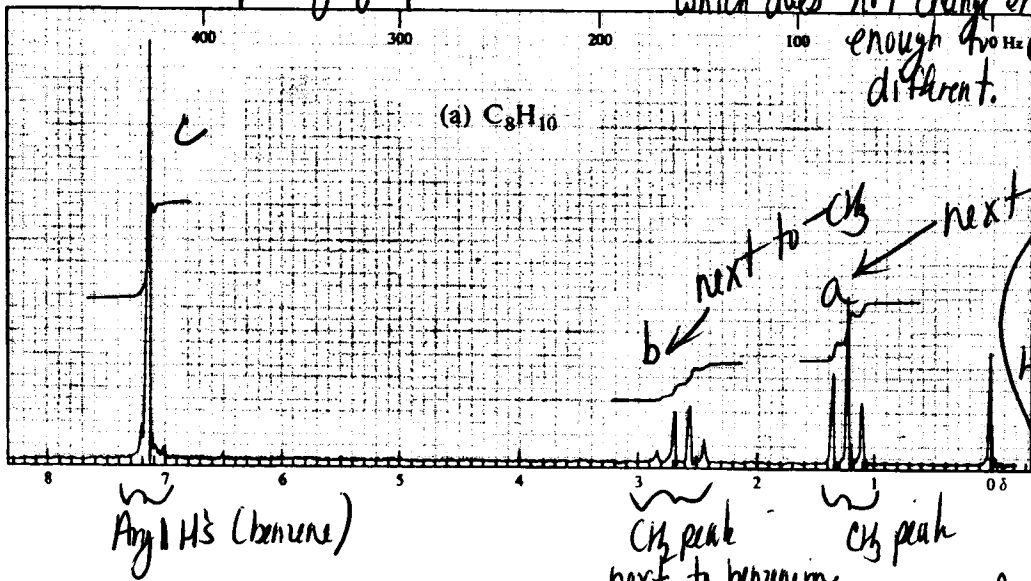


- E.
- benzene ring anyl-H's + two different types $\text{C}_6\text{H}_6\text{O}$ (disubstituted ring?)

- Degree of unsat = $\frac{14-6}{2} = 4$ \leftarrow benzene ring
- Alcohol \rightarrow broad $^1\text{H NMR}$ at ~ 5 ppm



- Degree of unsat = $\frac{18-10}{2} = 4$ ← Indicates benzene ring
- No splitting of peak at ~ 7.2 ppm thus ring is substituted by a CH_2 group which does not change environment of aryl H's enough to cause them to be different.

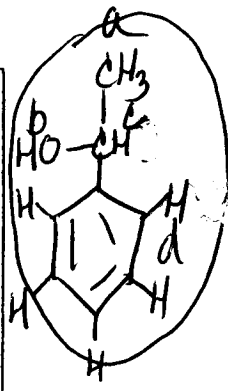
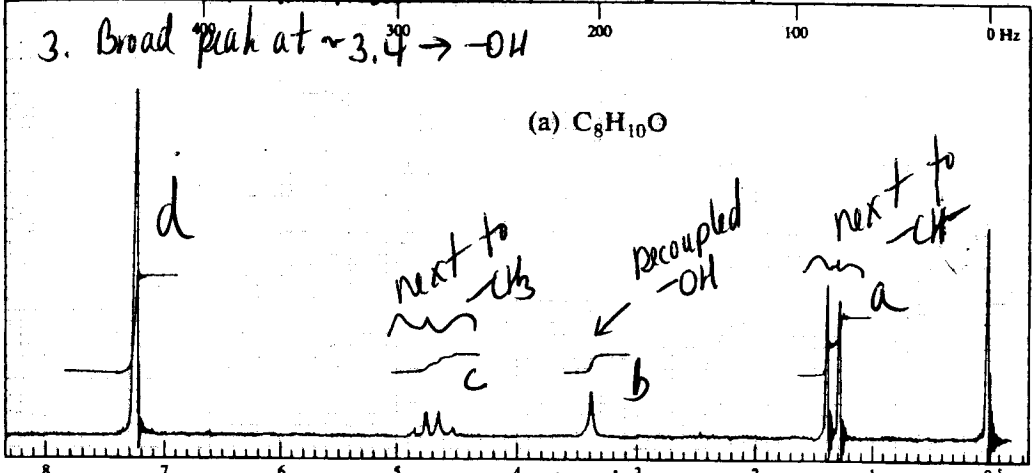


- 3 different H peaks thus Br must be on terminal C.
 because $\text{H}_3\text{C}-\underset{\text{H}}{\overset{\text{Br}}{\text{C}}}-\text{CH}_3$ would give 2 peaks
 position indicates that Br bonded to C
 position indicates CH_3

1. Degree of unsat = $\frac{18-10}{2} = 4$ ← Benzene



2. One "O" no unsat left → ether or alcohol
 3. Broad peak at ~3.4 → -OH



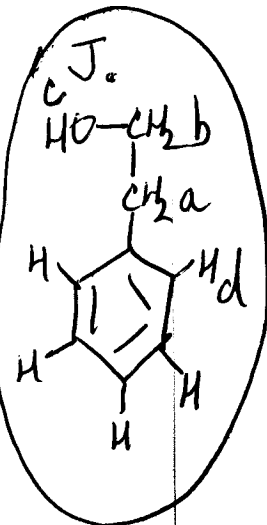
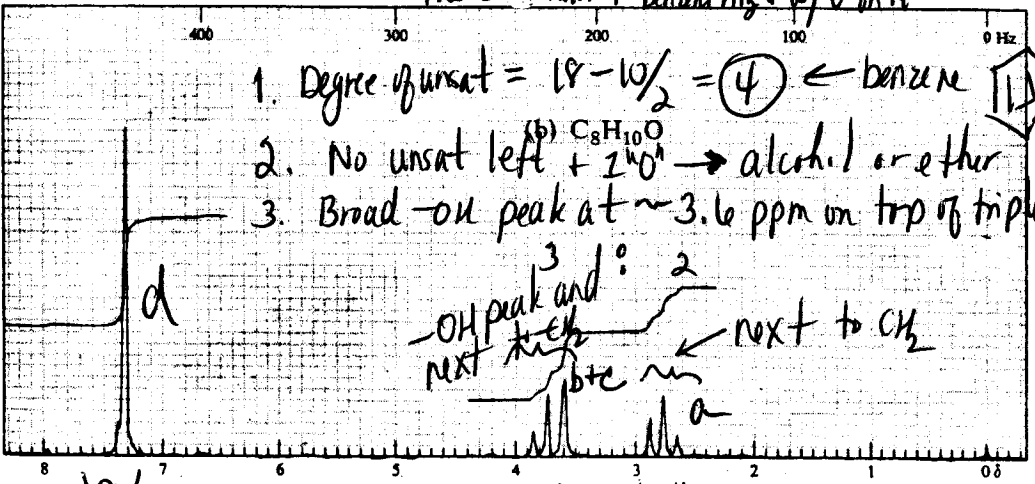
I.

Aryl H's → benzene must be -OH group must be the CH next to benzene ring w/ "O" on it

1. Degree of unsat = $\frac{18-10}{2} = 4$ ← benzene

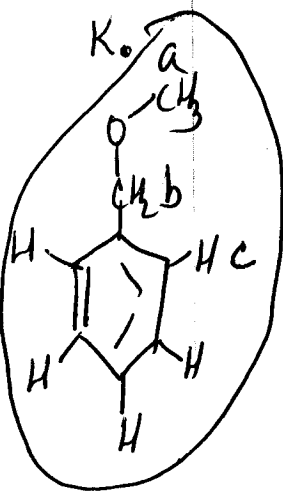
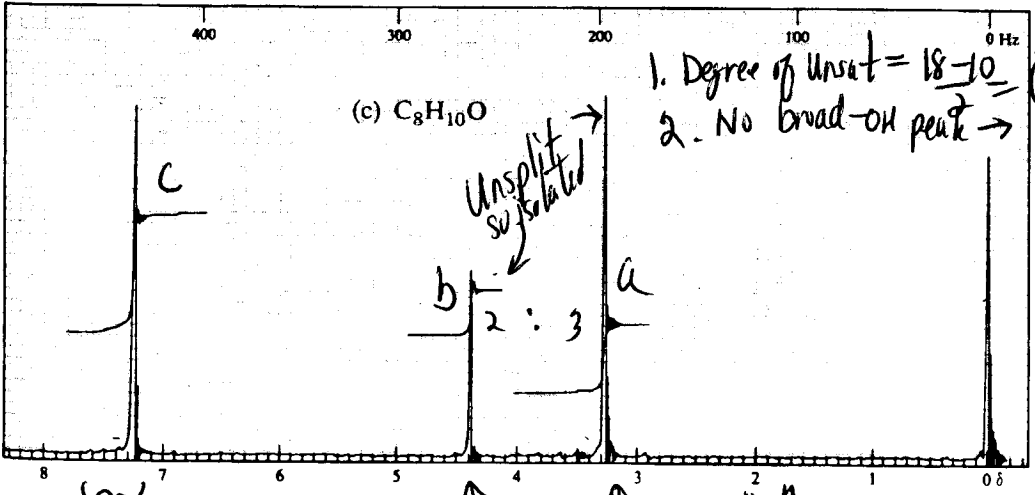


2. No unsat left + 2 "O" → alcohol or ether
 3. Broad -OH peak at ~3.6 ppm on top of triplet. (Alcohol)



Aryl H's probably monosubstituted next to "O" benzylic CH

1. Degree of unsat = $\frac{18-10}{2} = 4$ ← Benzene
 2. No broad-OH peak → ether

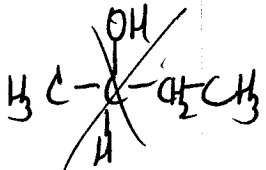


Aryl H's probably monosubstituted next to -O- ring next to "O"

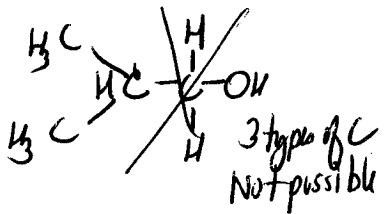
^{13}C NMR of $\text{C}_4\text{H}_{10}\text{O}$

1. Degree of unsat = $\frac{10-10}{2} = 0$

2. 2 types of C only



4 types of C
Not possible.



This compd could be either t-butanol or diethyl ether. More data (^{13}C NMR or IR spectra) would be needed to decide.

