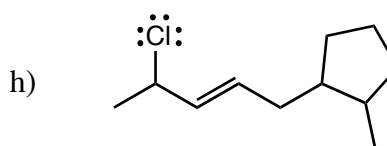
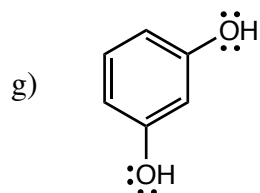
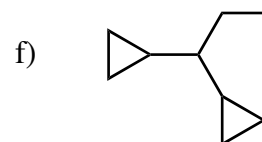
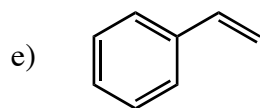
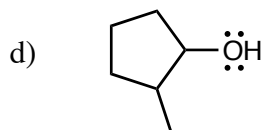
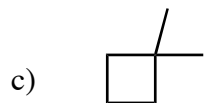
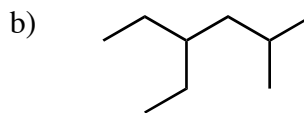
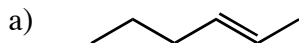


Homework - Chapter 5
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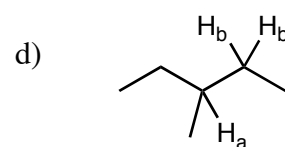
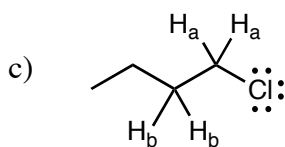
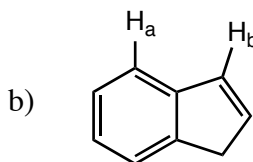
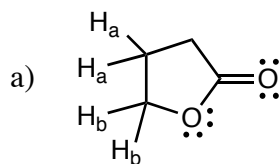
Name _____

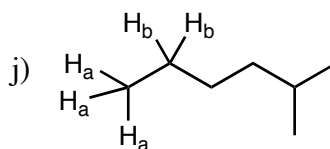
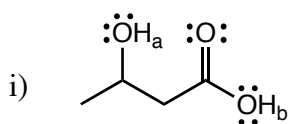
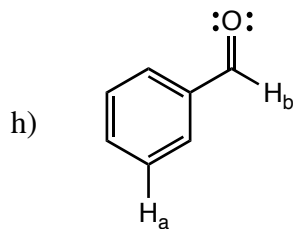
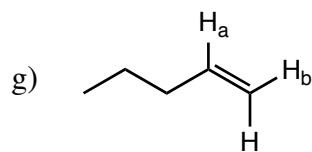
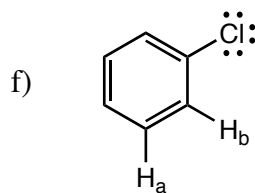
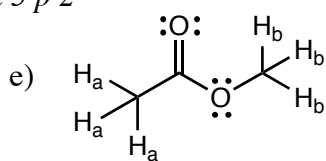
II. Distinguishing Equivalent Hydrogens

1. Draw in all of the H's on the compounds below. Then circle the sets of equivalent H's in each one, and give the number of sets.



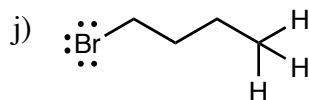
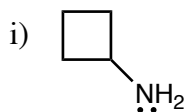
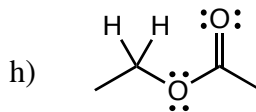
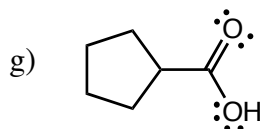
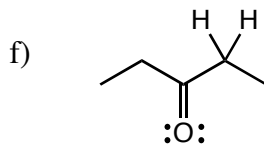
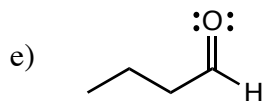
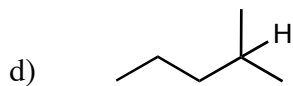
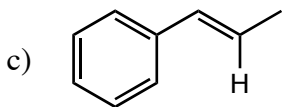
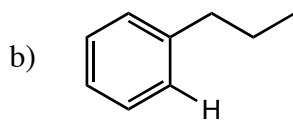
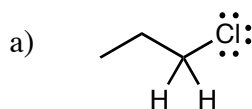
2. Which of the labeled H's would you expect to appear furthest upfield? Explain in a word or two why.



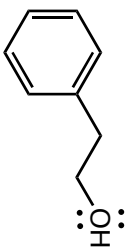
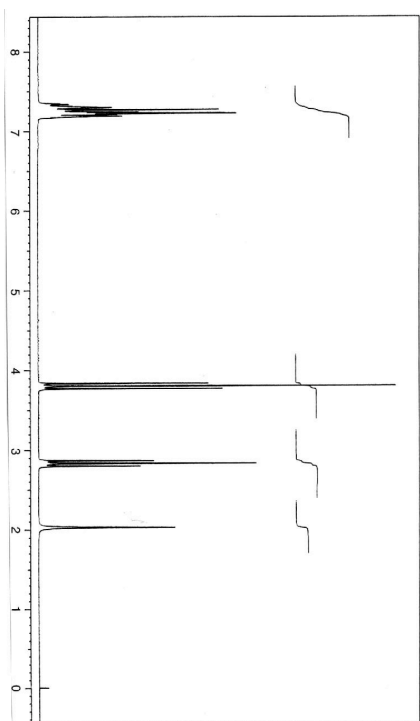
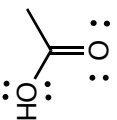
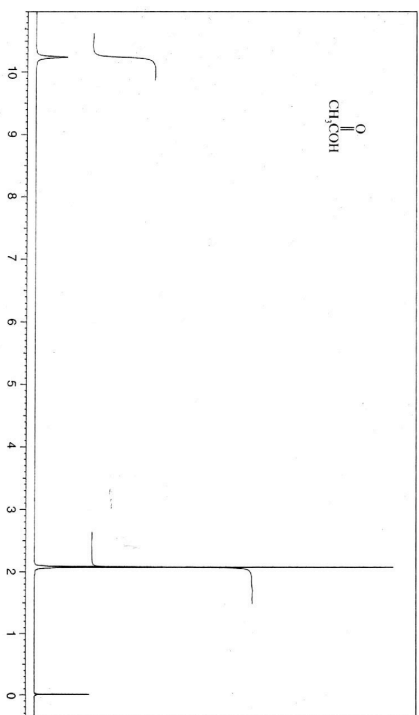
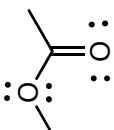
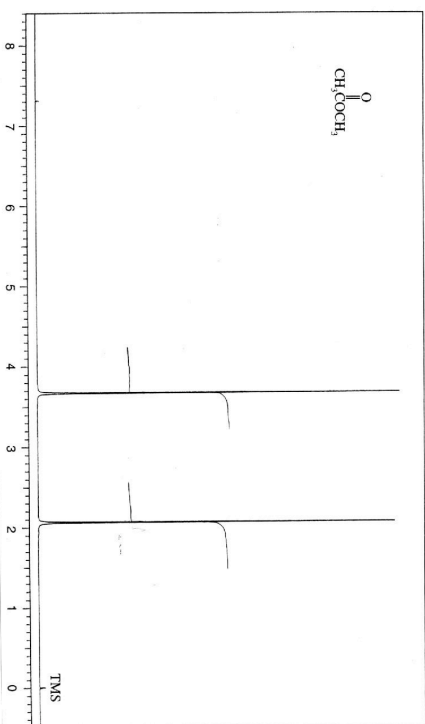
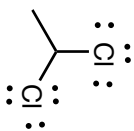
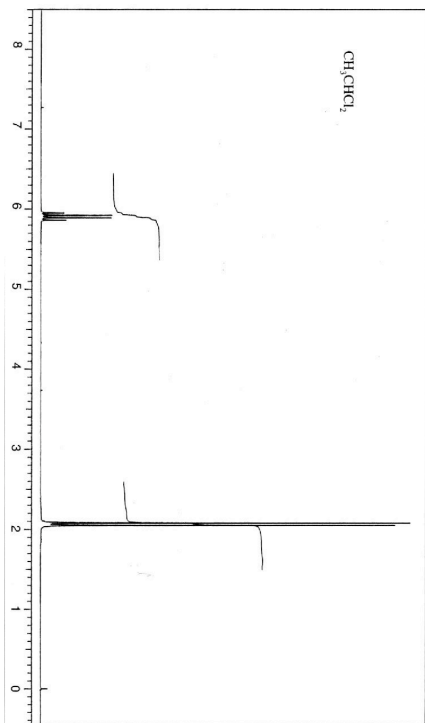


III. Chemical Shift

3. In what chemical shift range would you expect H's shown in the compounds below to occur?

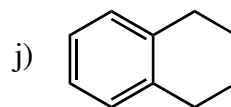
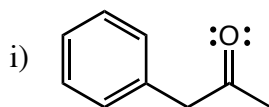
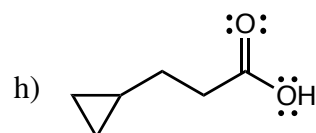
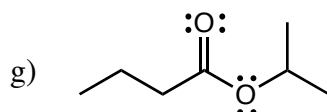
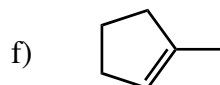
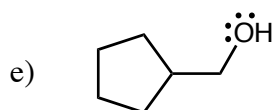
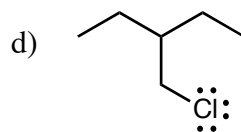
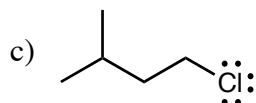
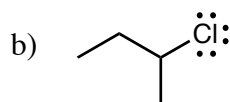
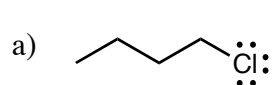


4. Match the H's in the following compounds to the peaks in the NMR spectra using their chemical shifts.

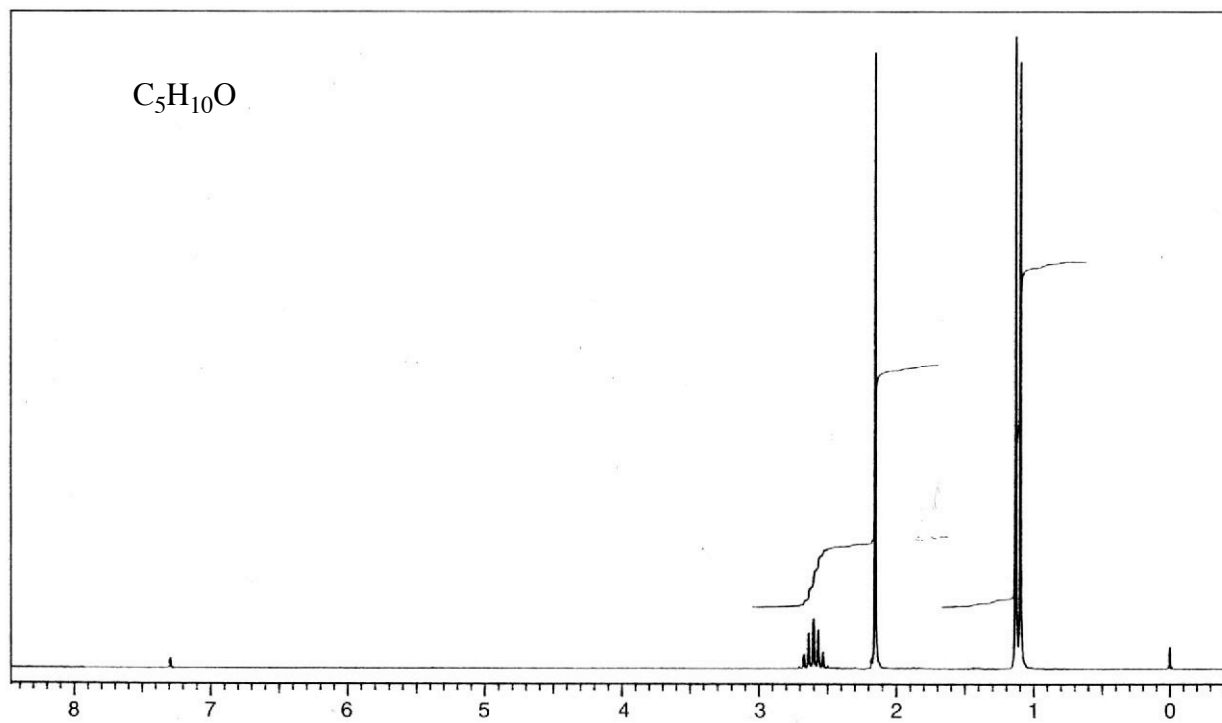


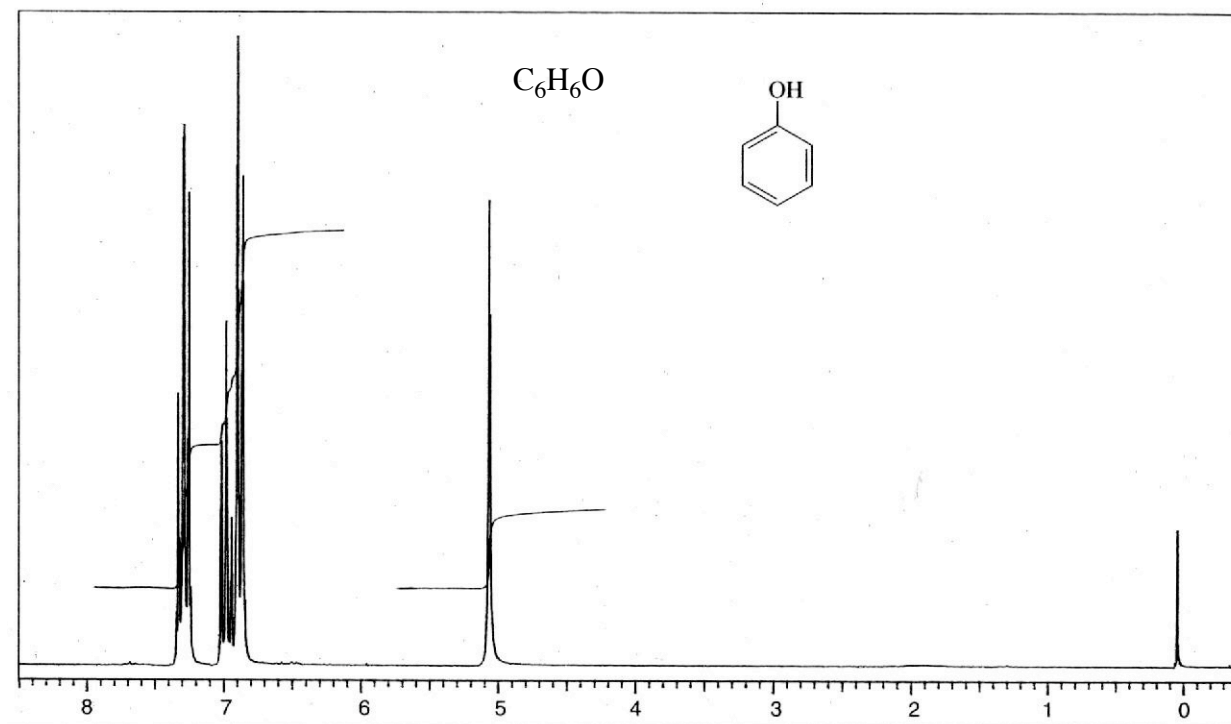
IV. Integration

5. Predict the integration ratios for each of the following compounds.



6. Measure the integration in each of the following spectra, and figure out how many H's are in each peak, given their molecular formula.

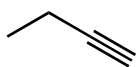




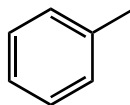
V. Spin-spin Splitting

7. Predict the splitting for each set of equivalent H's (singlet, doublet, triplet, quartet, multiplet). Assume no peaks overlap.

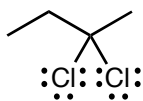
a)



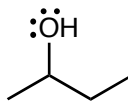
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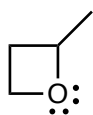
c)



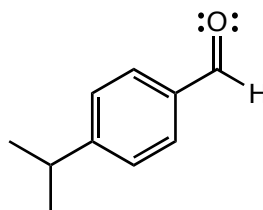
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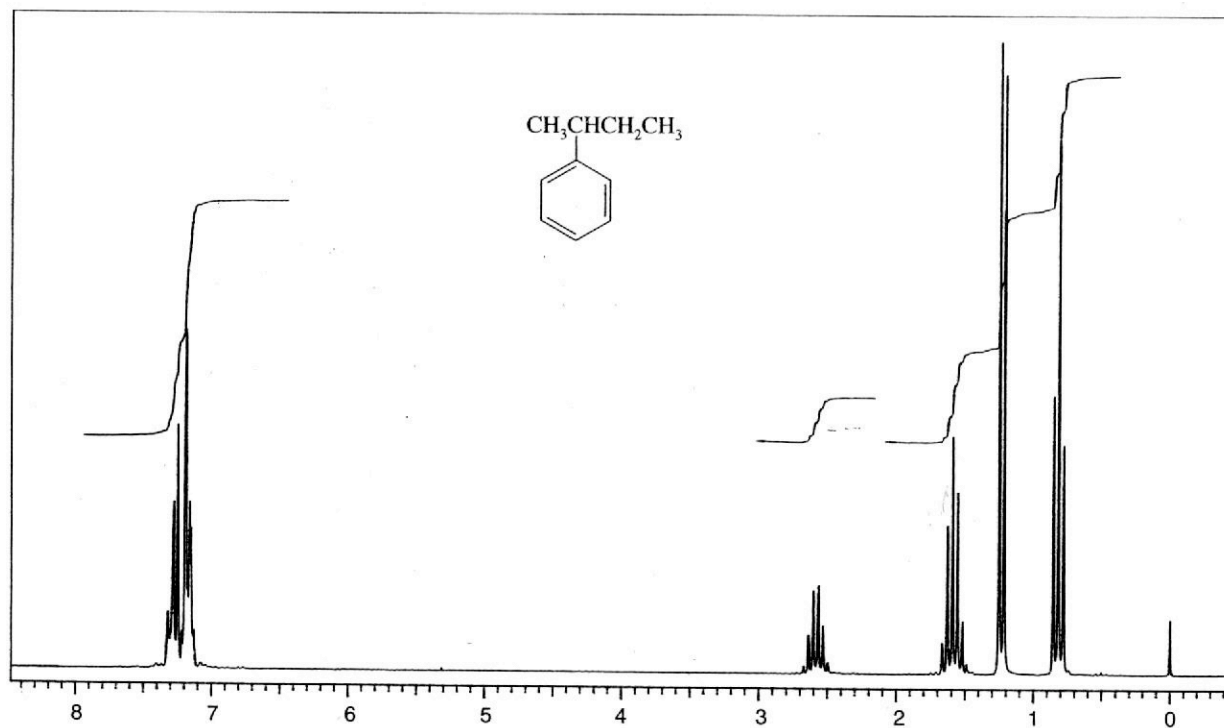
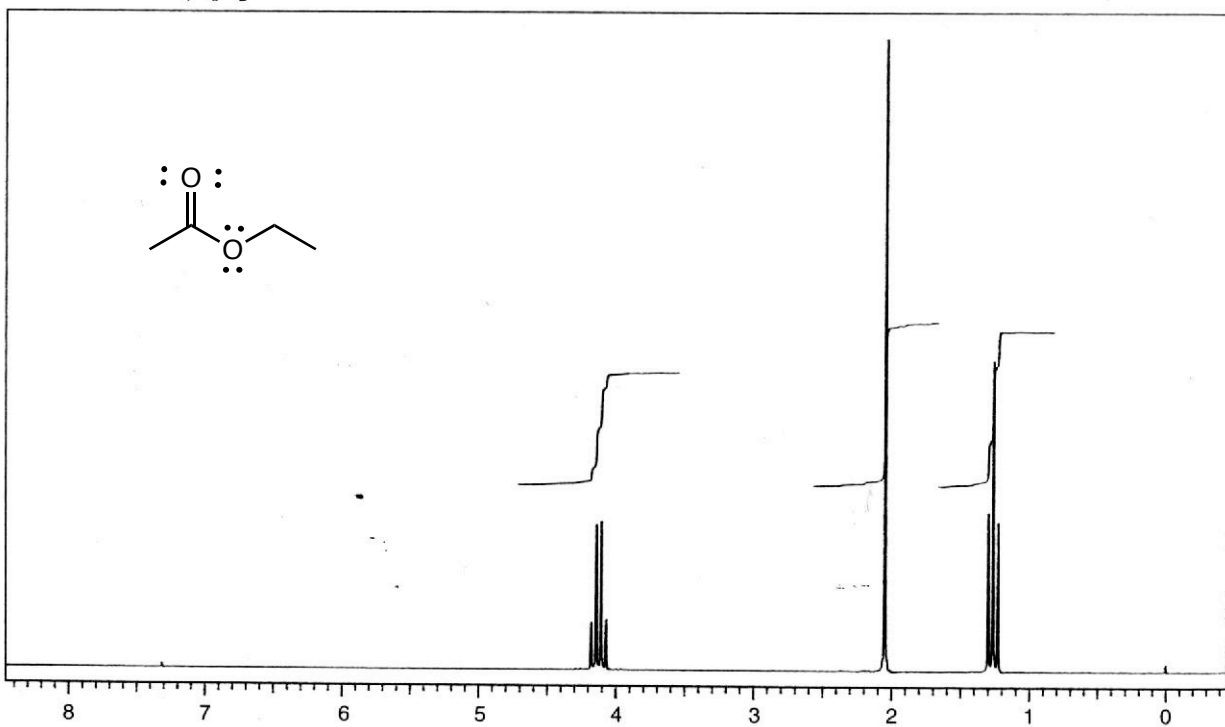
e)



f)



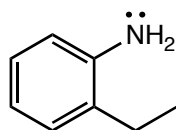
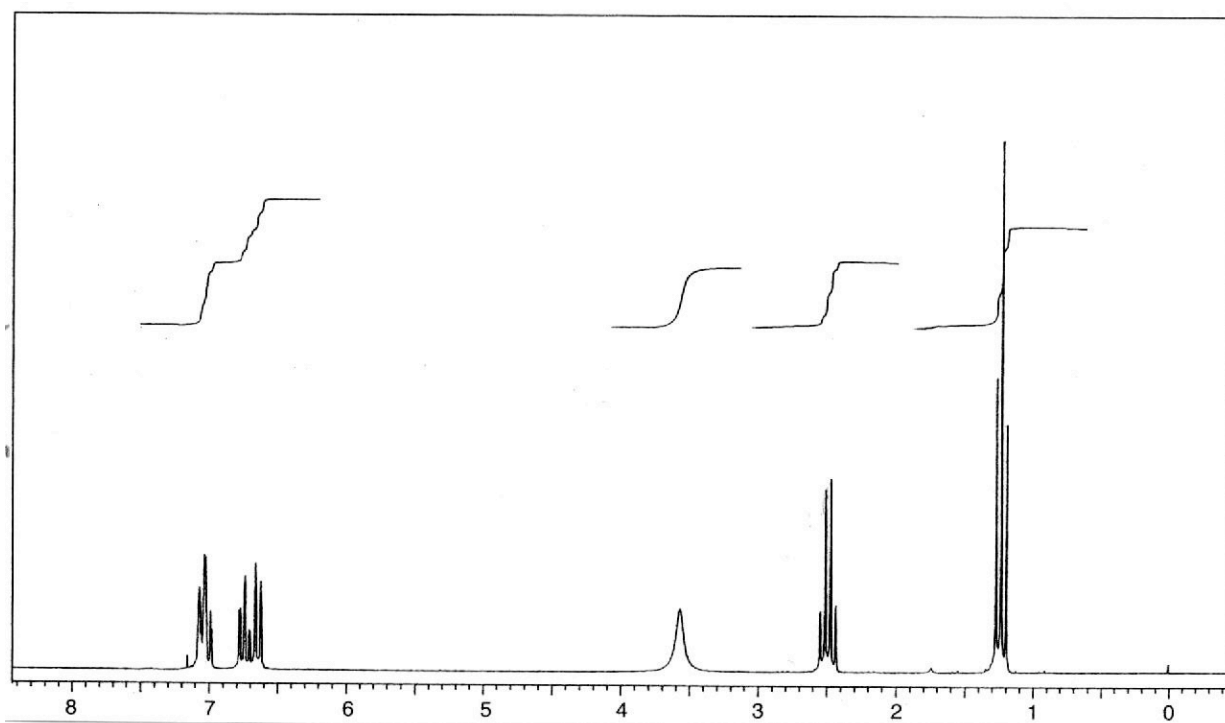
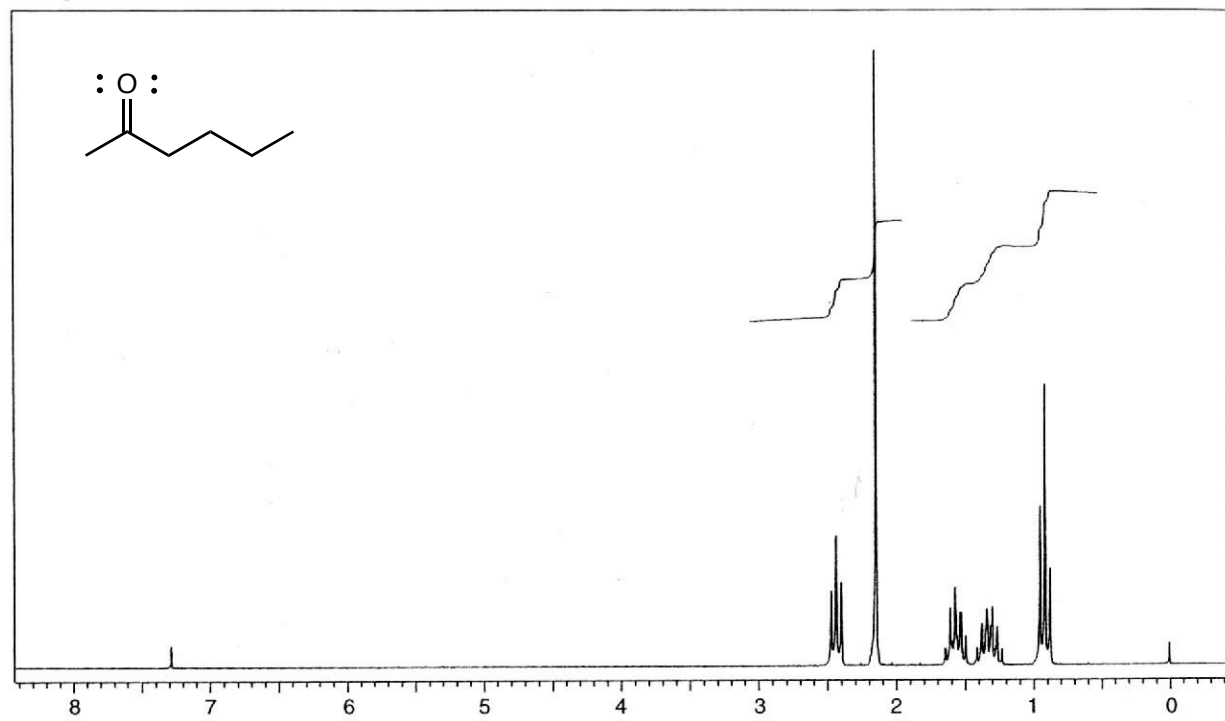
8. Label the splitting for each peak in the following spectra, then each set of equivalent H's in the compound. Then match them up.

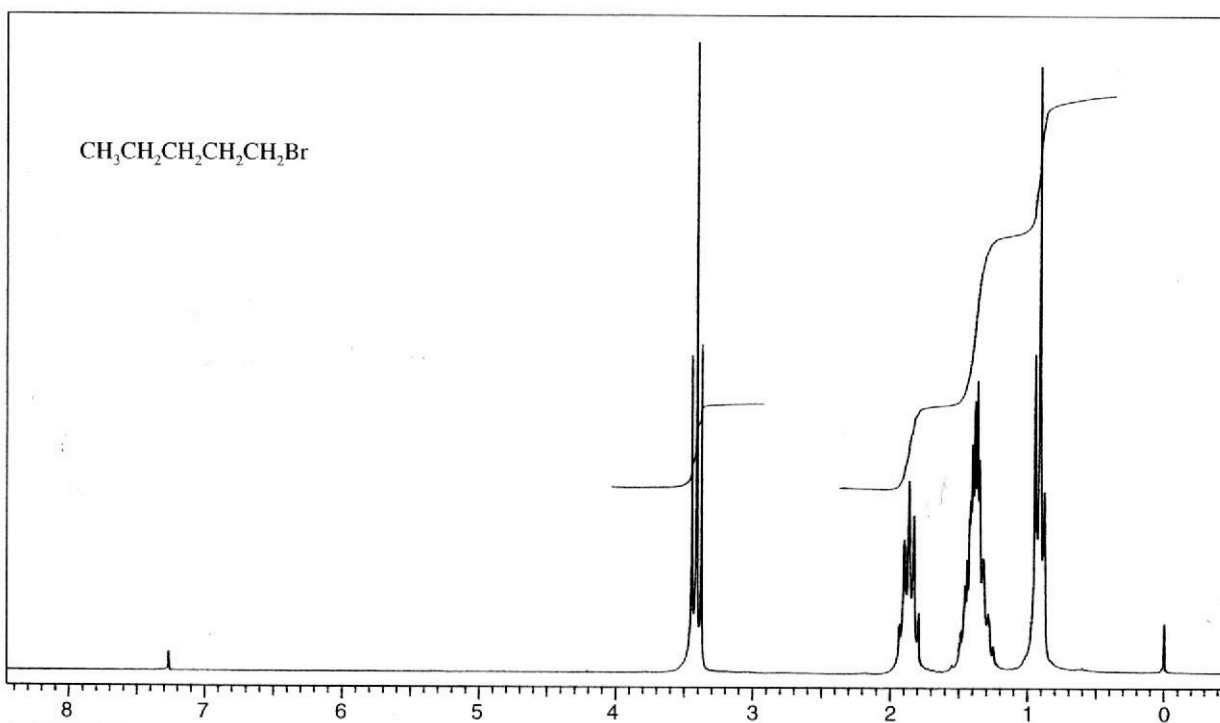
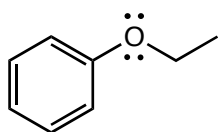
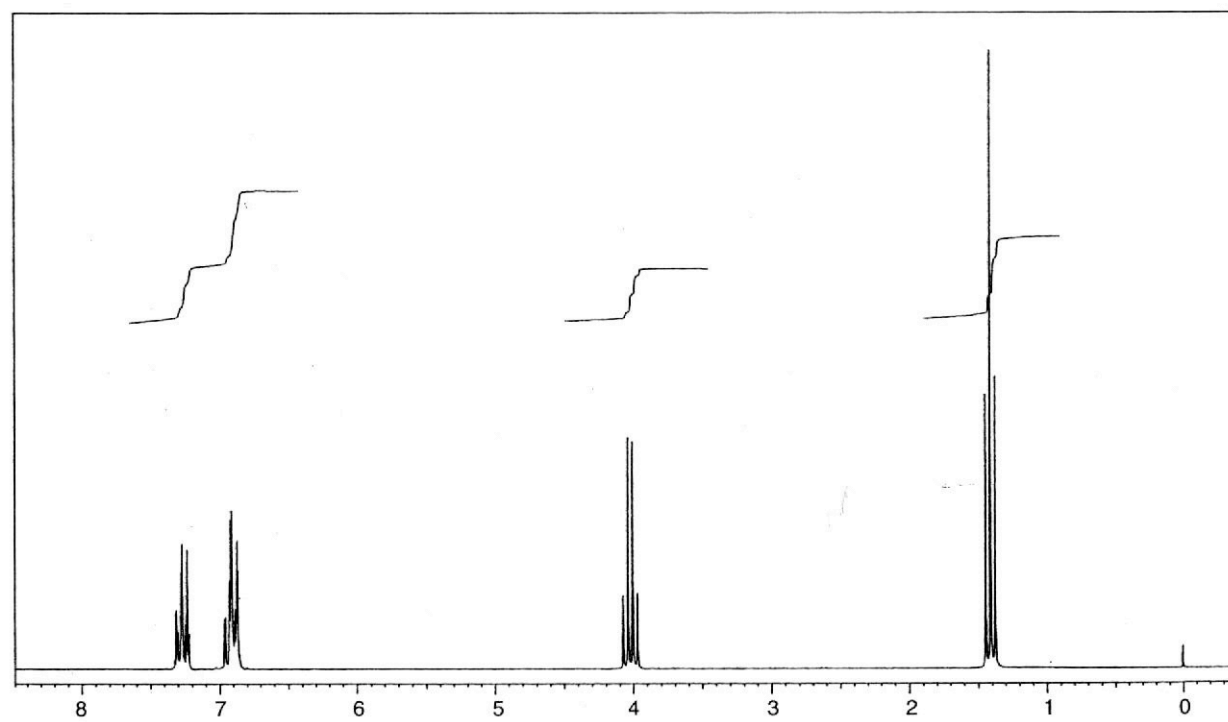


VIII. Practice with NMR Spectra

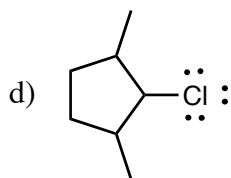
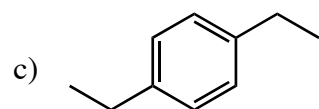
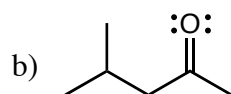
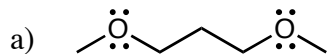
HW Ch 5 p 7

9. Using chemical shift, integration, and splitting, match up the peaks in each spectrum with the sets of equivalent H's in each compound.

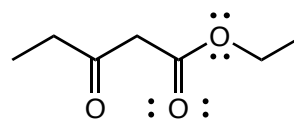
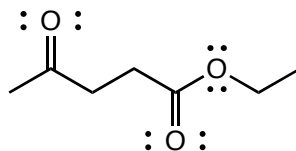
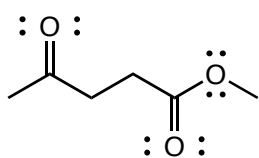
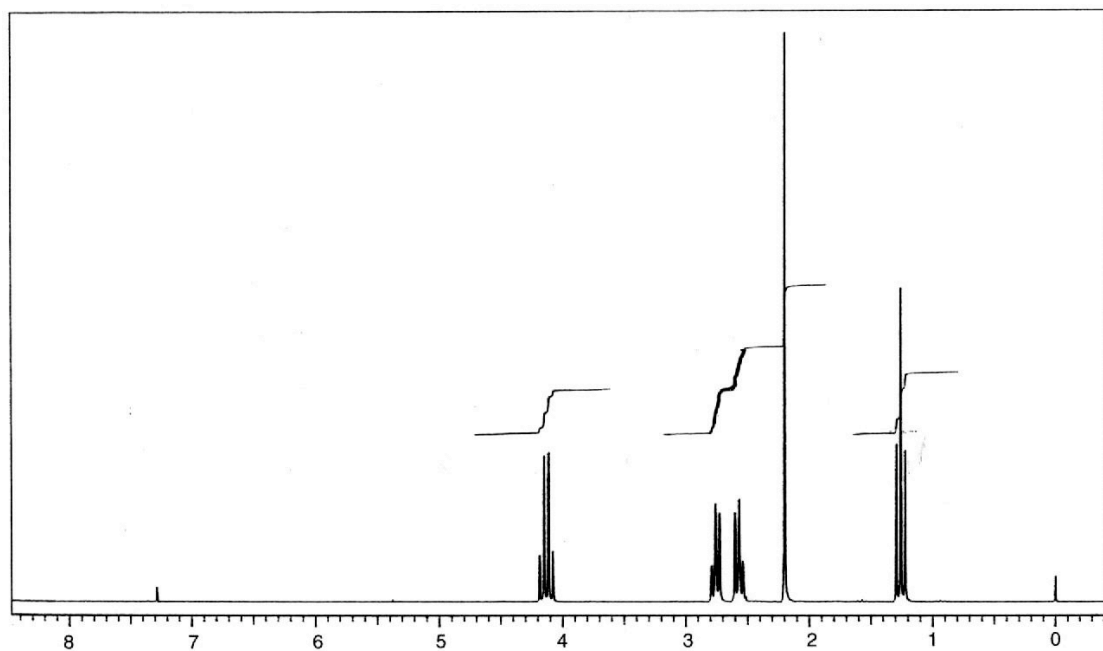




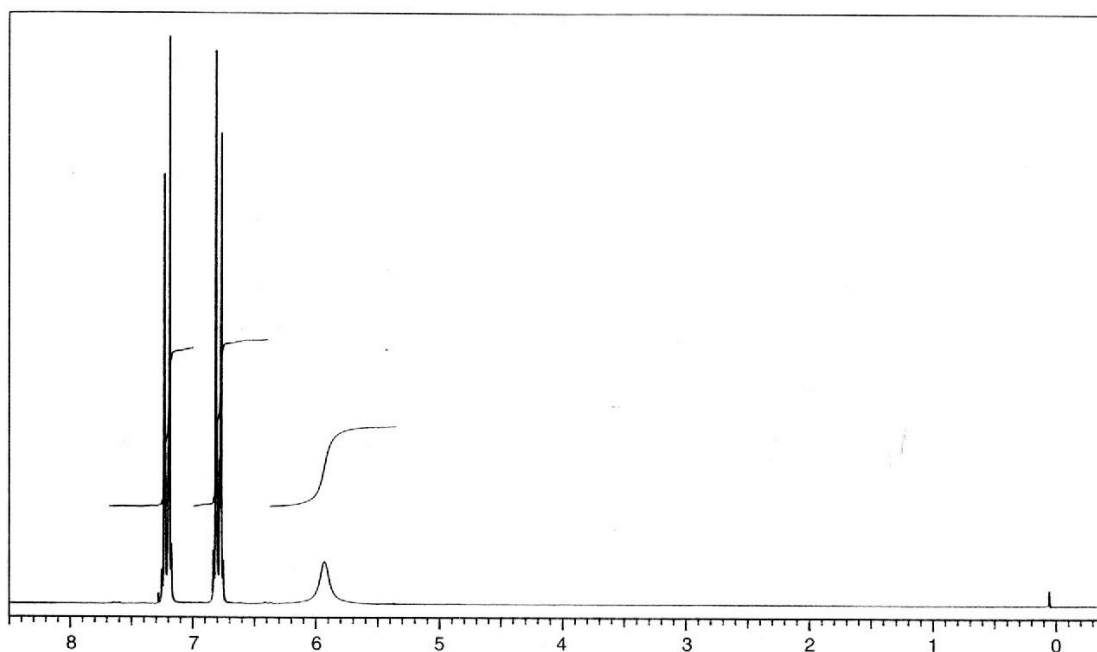
9. Label the equivalent H's in the following compounds a, b, c, etc and draw a table with chemical shift, integration, and splitting for each. Then sketch a proton NMR spectrum for each compound. Place the peaks at around the correct chemical shift, and draw in an integration line which shows how many H's are in each peak.

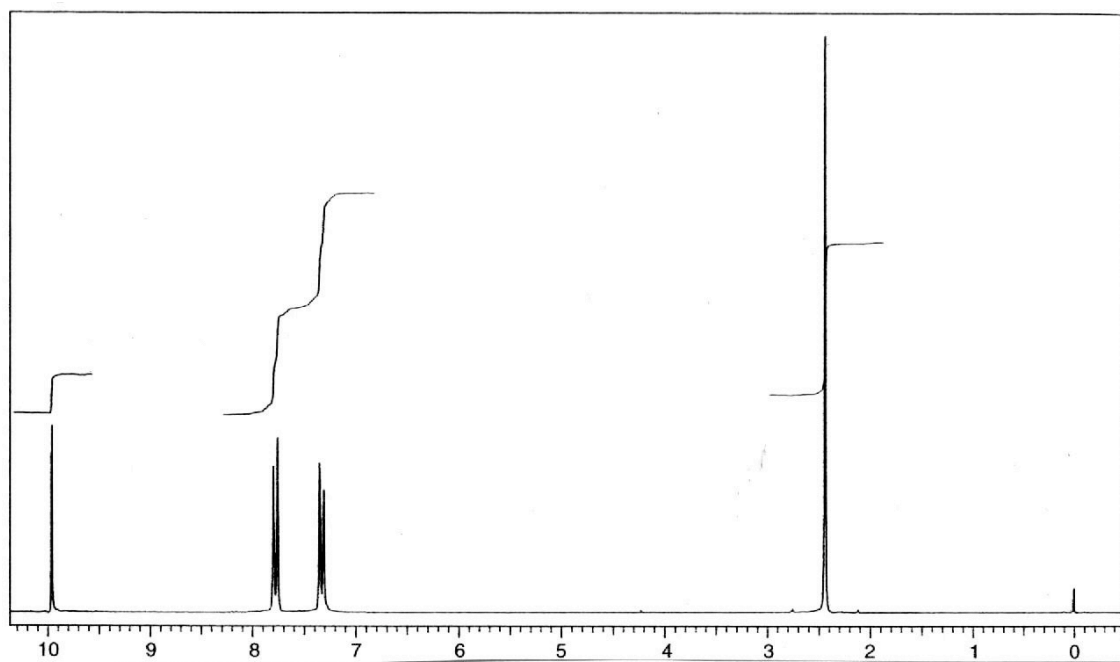
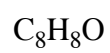
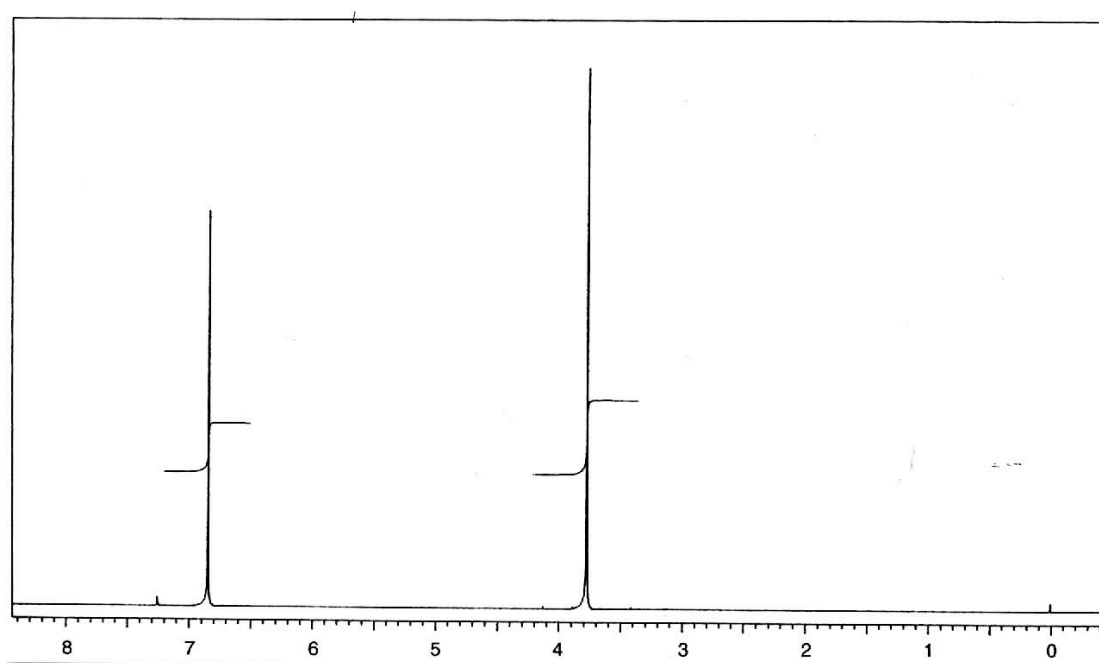
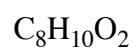


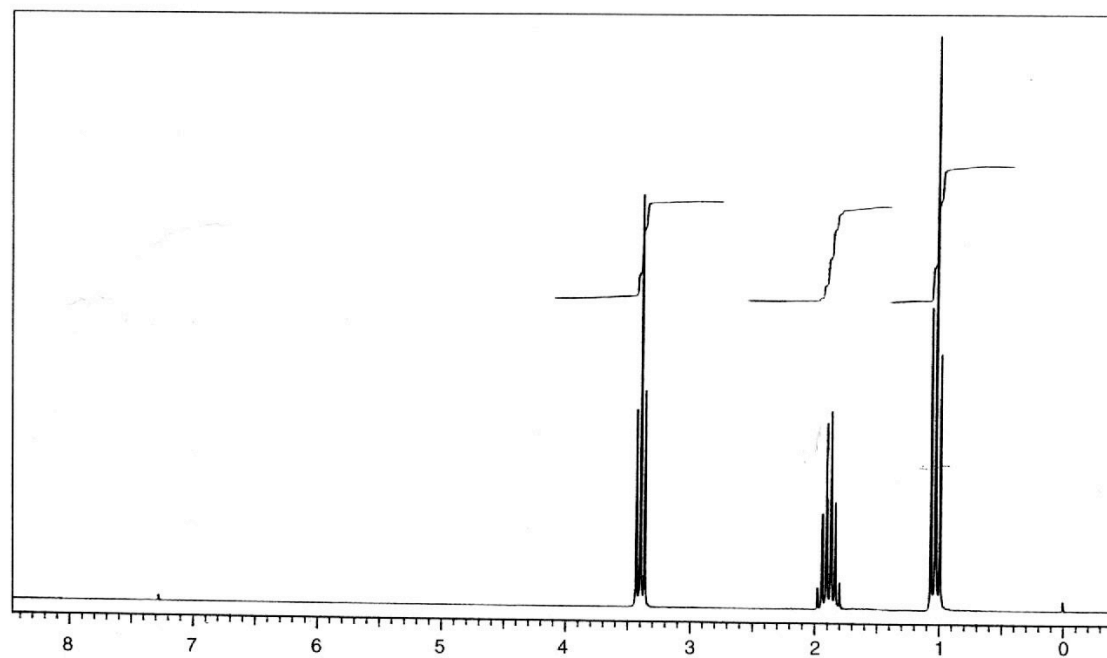
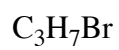
10. Circle the compound which matches the spectrum shown from the list below.



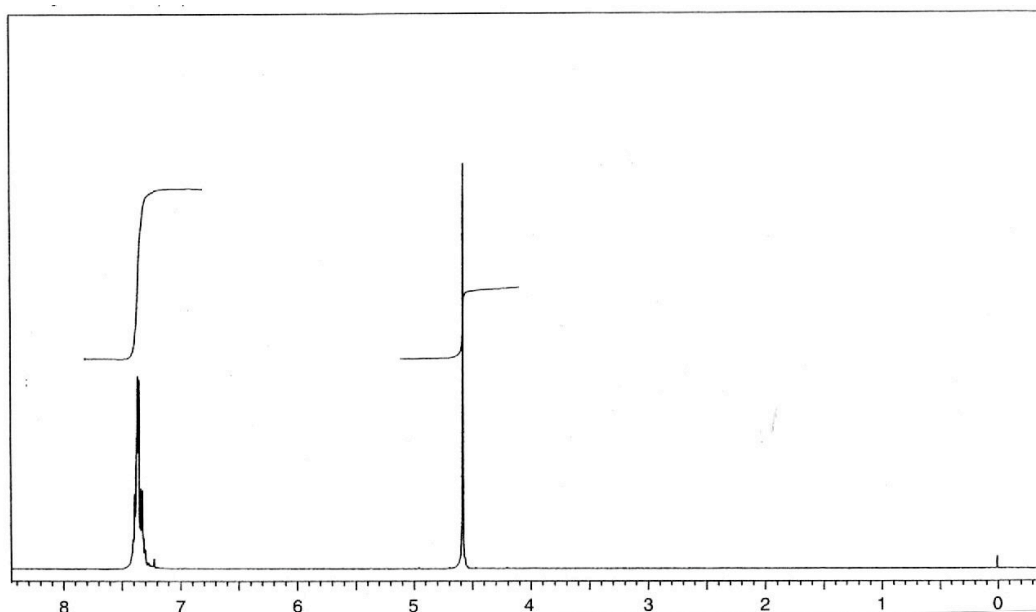
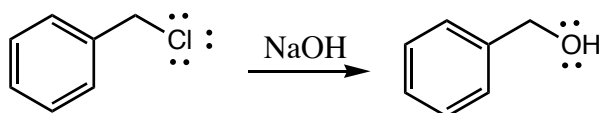
11. Deduce the structure of the following compounds, given their spectra and molecular formula. Label the compound and spectra to explain your reasoning.

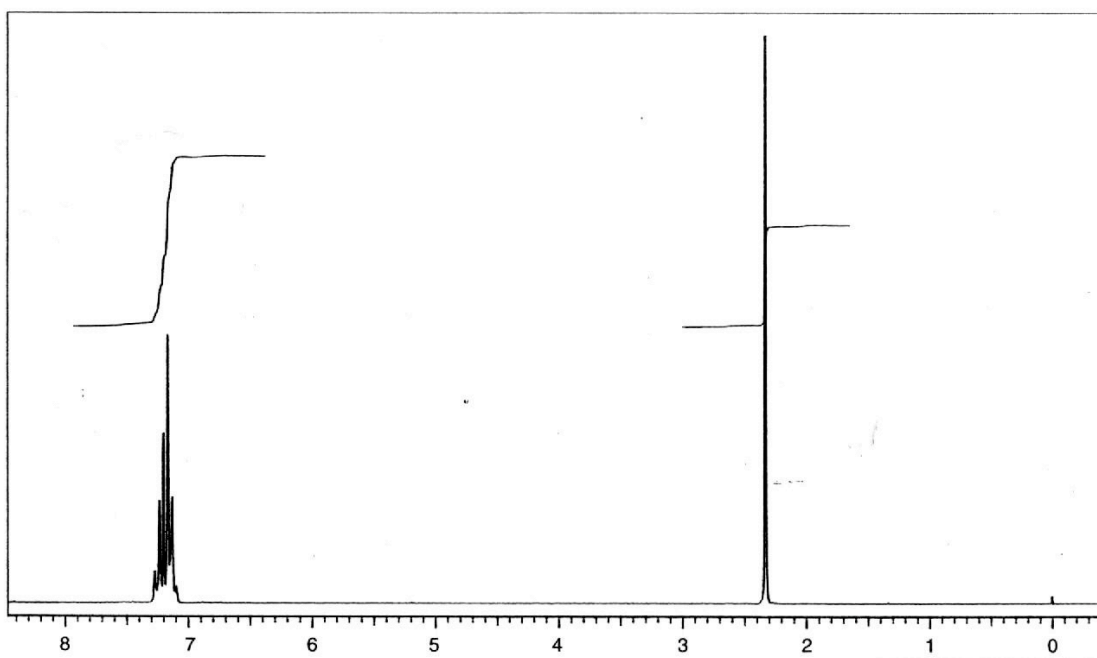
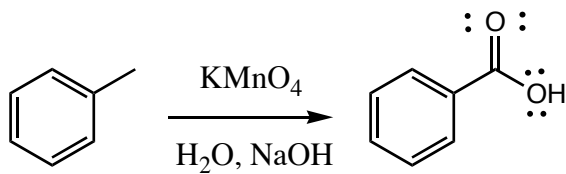
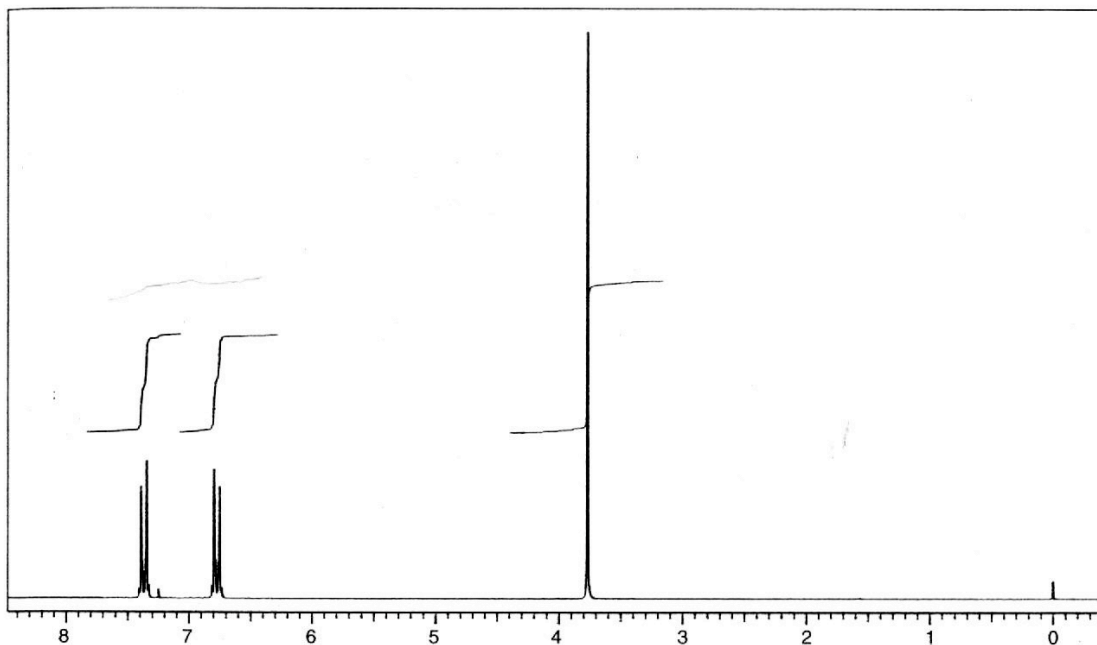
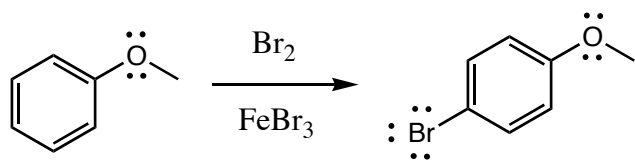


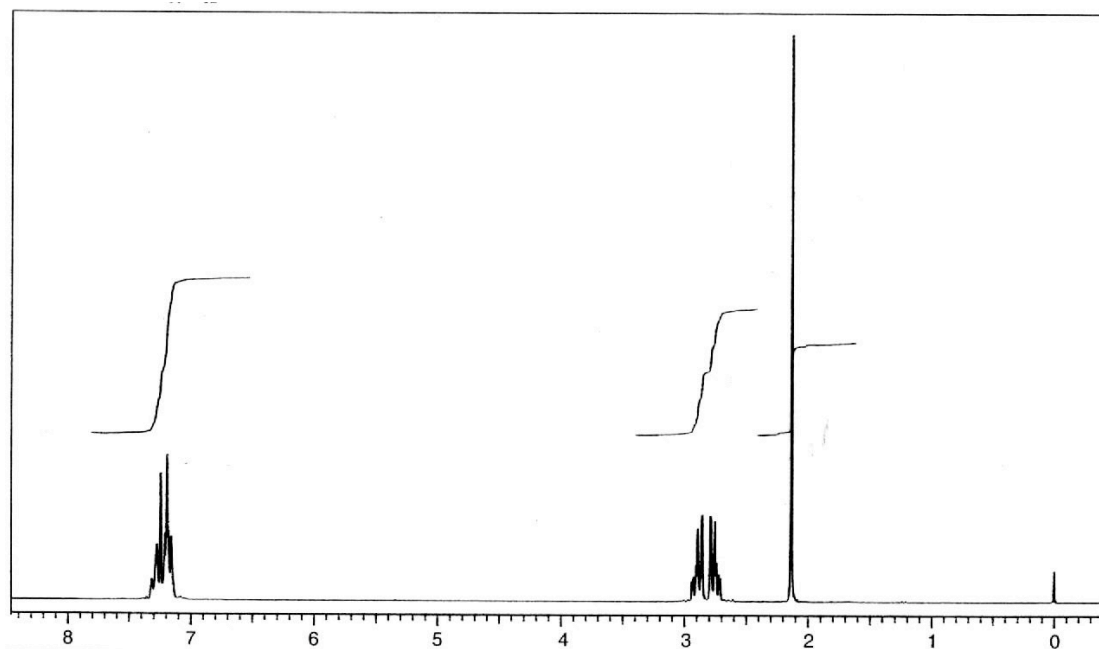
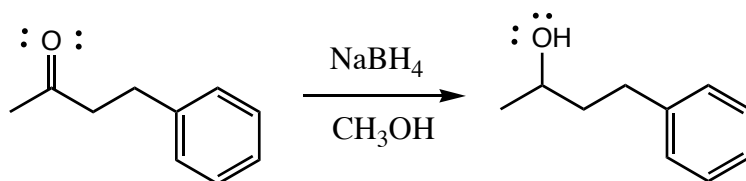




12. For each of the following reactions, determine whether or not the product was formed based on the spectrum shown. Show your reasoning!

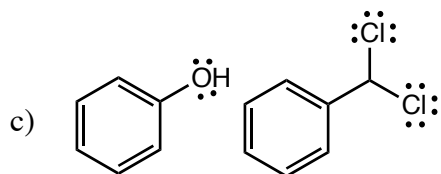
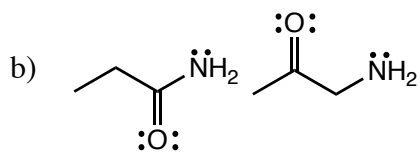
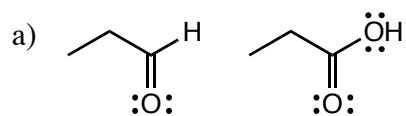




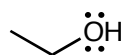


VI. Deuterium in NMR

13. Which of the following pairs of compounds can be distinguished by D₂O exchange? (Yes or no for each, then explain.)



14. Sketch the spectrum of the following compound under each set of conditions.

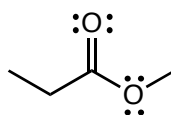
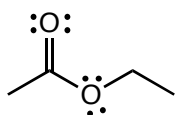


a) an ordinary sample

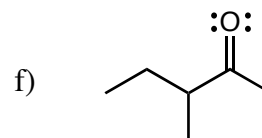
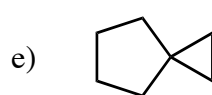
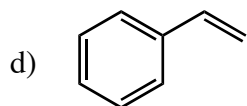
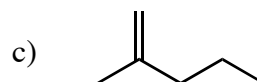
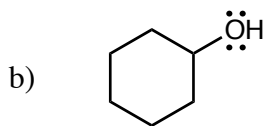
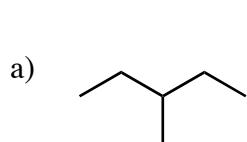
b) after shaking with D₂O

c) a dilute, very pure sample with no water or D₂O

15. The following compounds have very similar spectra, but can be distinguished by NMR. Sketch both spectra and show how they are different.



16. How many peaks should be present in the ¹³C NMR spectrum of each of the following compounds?



17. Explain why the following compounds are difficult to distinguish by IR or ¹H NMR, but easy to distinguish by ¹³C NMR.

