

The National University of Lesotho

Faculty of Science and Technology

Department of Chemistry and Chemical Technology

C6535 – Advanced Organic Spectroscopic Techniques Final Examination

Time: 03H00

13 June 2023

Marks:100

Instructions:

- Attempt any FIVE questions.
- Explicitly show the question number ABOVE each answer.
- Each answer should be commenced on a new page.

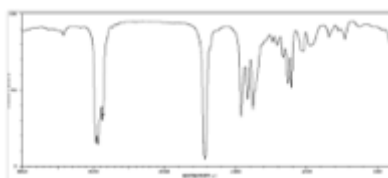
N.B.: The question paper consists of fourteen (14) printed pages.

Question 1

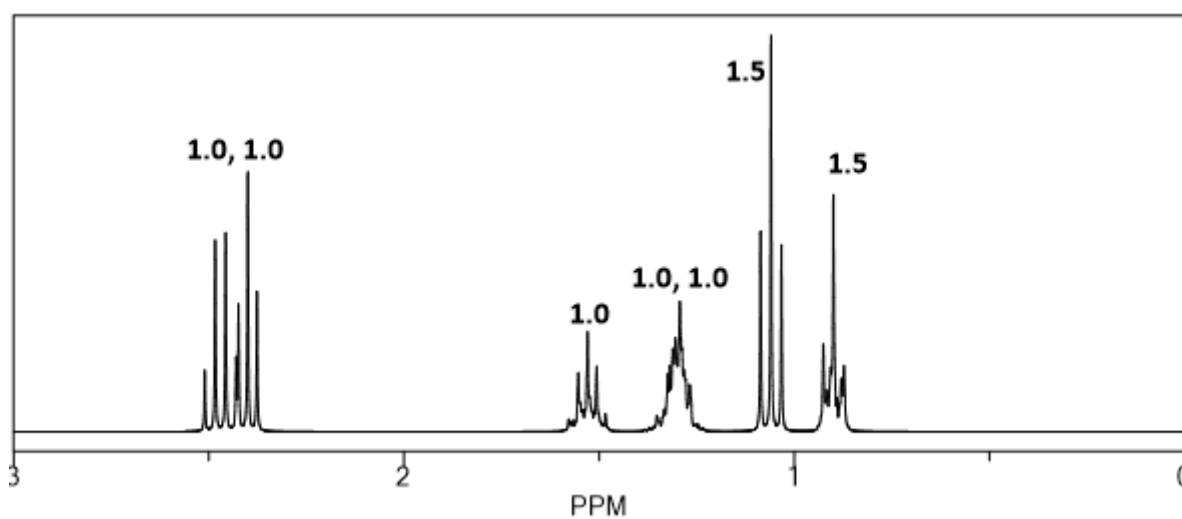
[20 Marks]

1.1 Comprehensively explain how the provided spectra below would aid towards elucidation of the structure with formula C_8H_{10} .

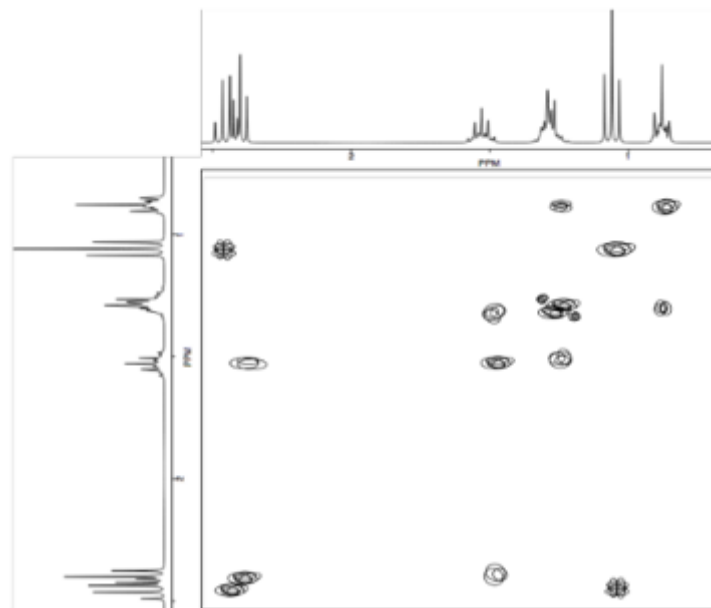
Infrared Spectrum



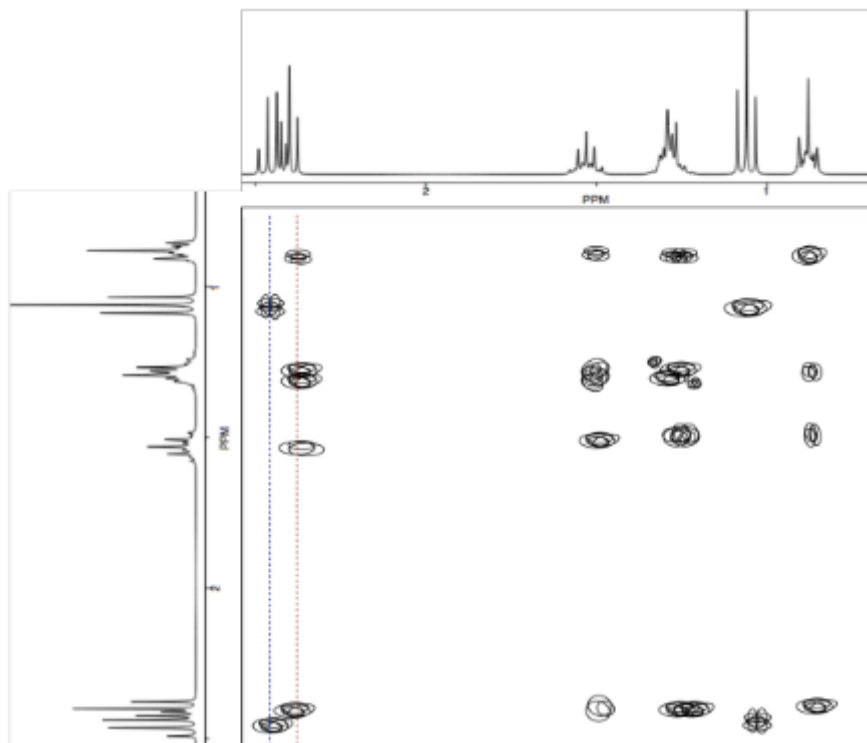
¹H NMR Spectrum



COSY Spectrum

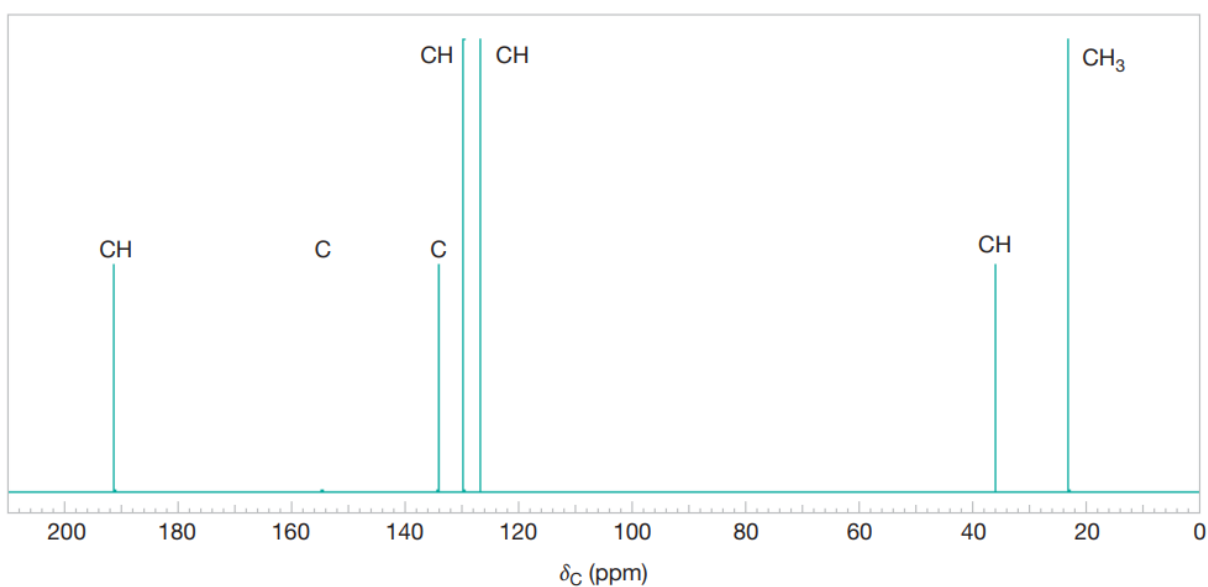
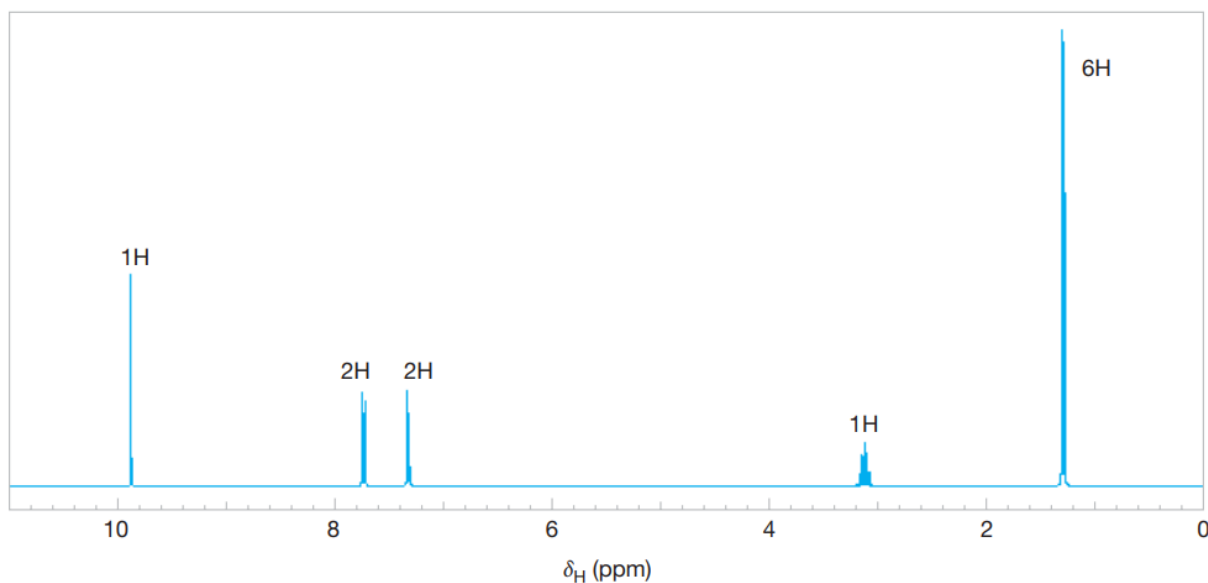


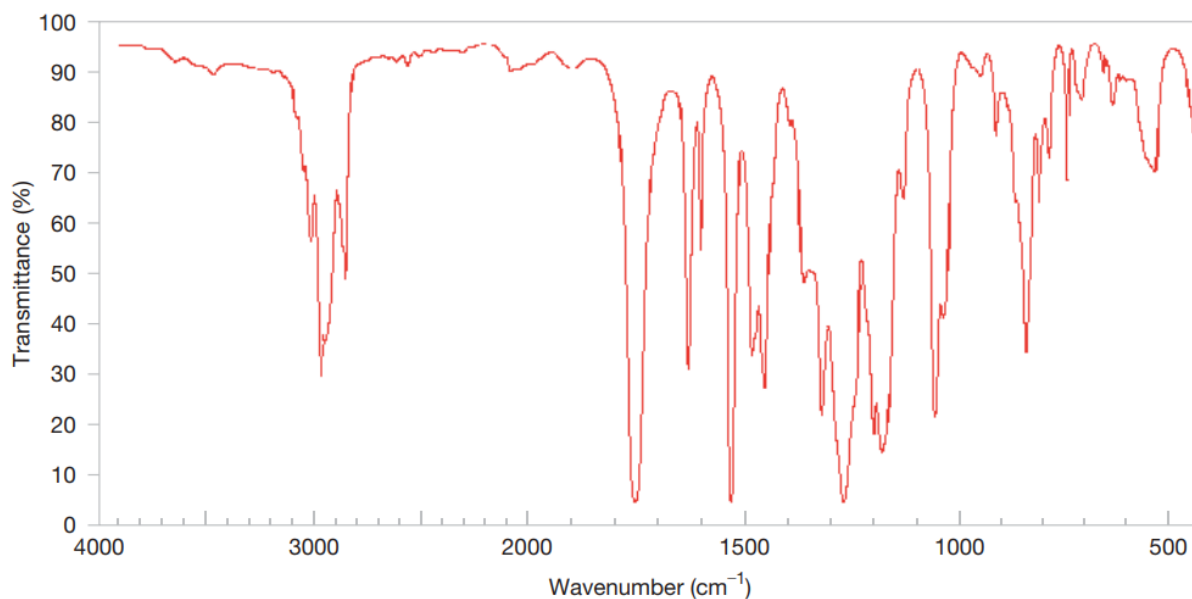
TOCSY Spectrum



Question 2**[20 Marks]**

2.1 Deduce the structure of the compound that gives the following ^1H , ^{13}C , and IR spectra. Assign all aspects of the ^1H and ^{13}C spectra to the structure you propose. Use letters to correlate protons with the signals in the ^1H NMR spectrum, and numbers to correlate carbons with the signals in the ^{13}C spectrum. The mass spectrum of this compound shows the molecular ion at m/z 148.





Question 3

[20 Marks]

3.1 Deduce the structure of the compound that gives the following ^1H , ^{13}C , and IR spectra. Assign all aspects of the ^1H and ^{13}C spectra to the structure you propose. Use letters to correlate protons with signals in the ^1H NMR spectrum, and numbers to correlate carbons with signals in the ^{13}C spectrum. The mass spectrum of this compound shows the molecular ion at m/z 204.

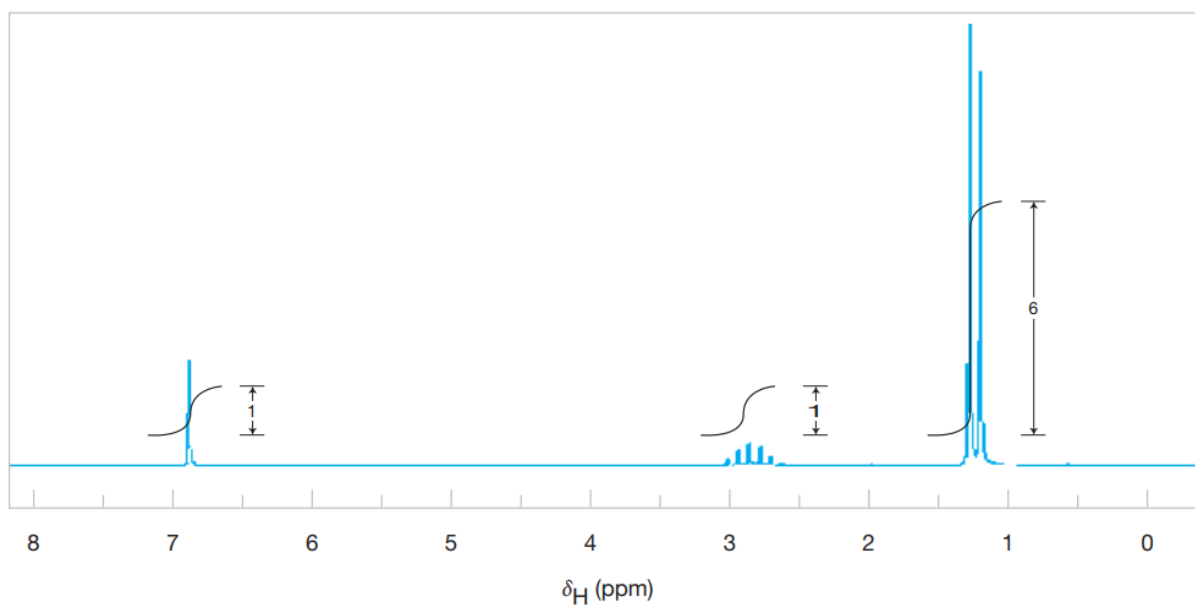


Figure 7: ^1H NMR spectrum

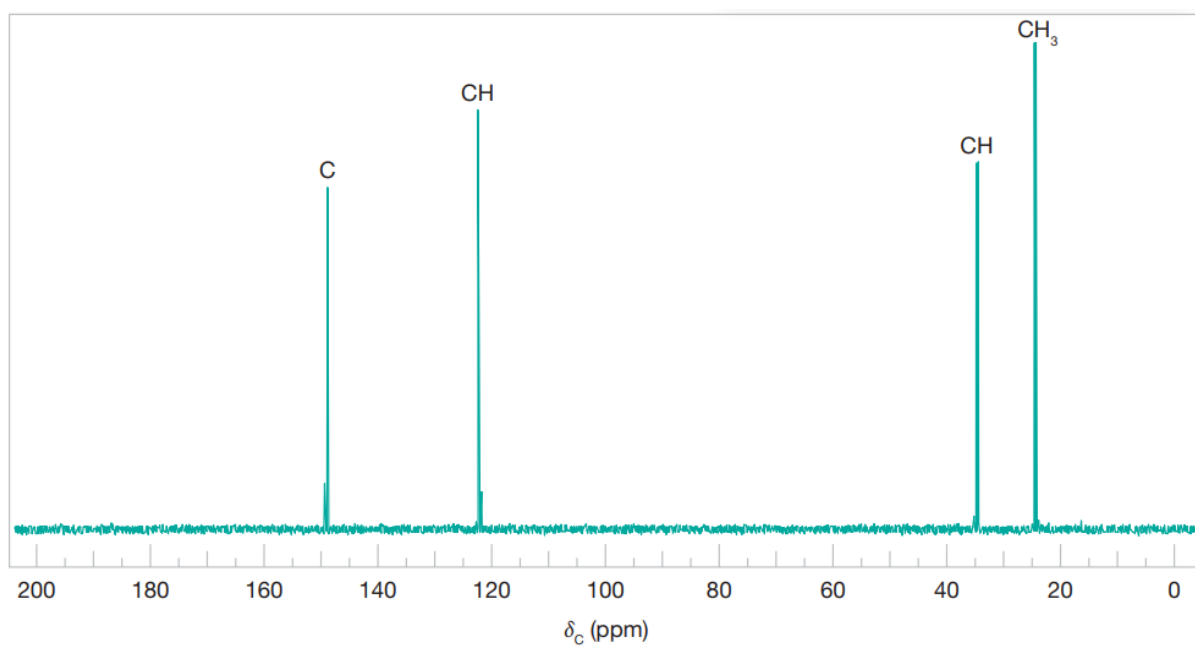


Figure 8: ^{13}C NMR spectrum

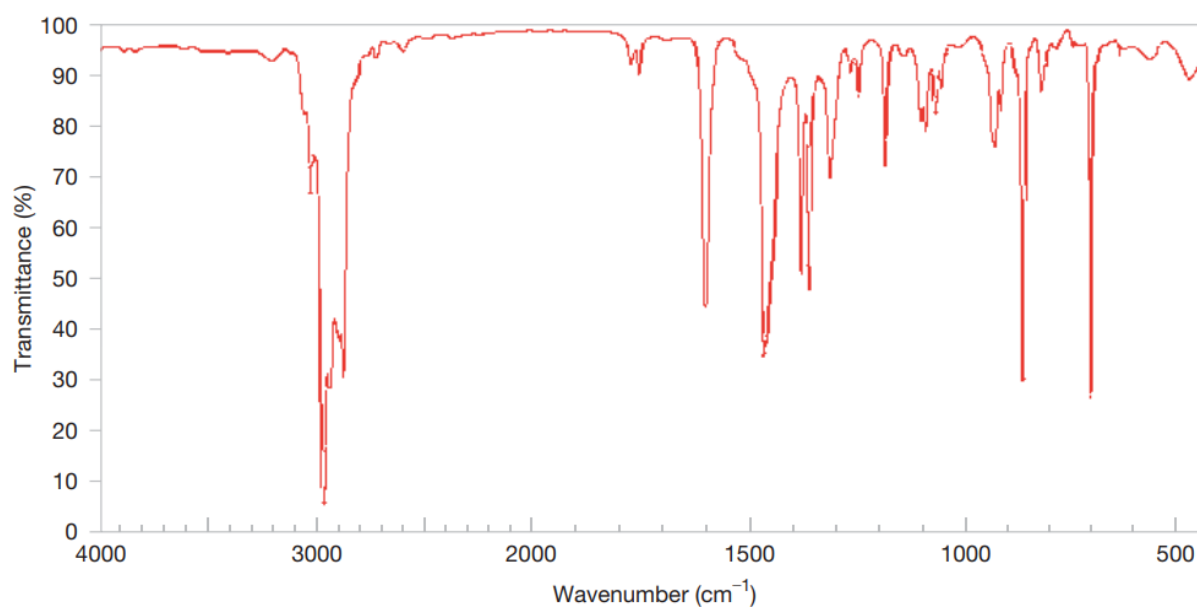
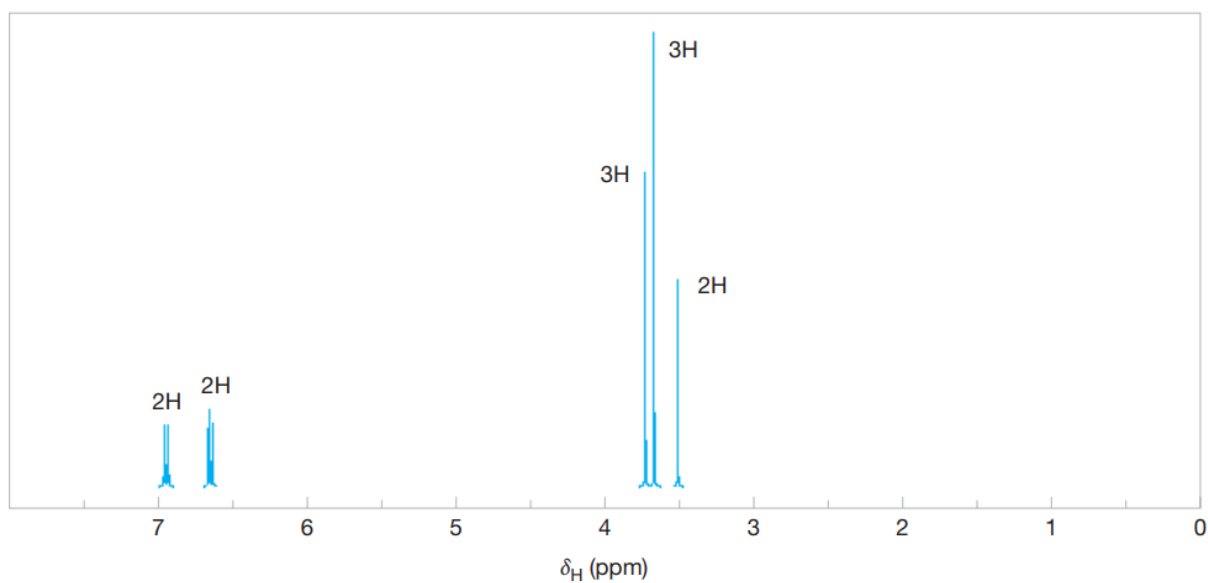
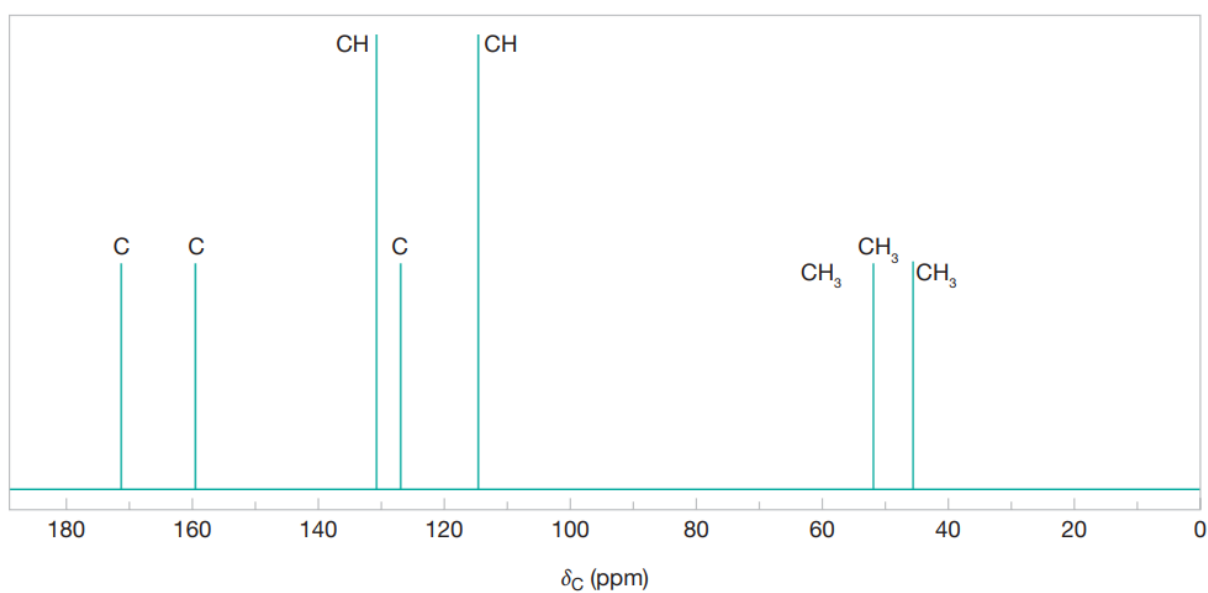


Figure 9: IR spectrum

Question 4**[20 Marks]**

4.1 Deduce the structure of the compound ($C_{10}H_{10}O_3$) that gives the following 1H , ^{13}C , and IR spectra. Assign all aspects of the 1H and ^{13}C spectra to the structure you propose. Use letters to correlate protons with signals in the 1H NMR spectrum, and numbers to correlate carbons with signals in the ^{13}C spectrum.

**Figure 10:** 1H NMR spectrum**Figure 11:** ^{13}C NMR spectrum

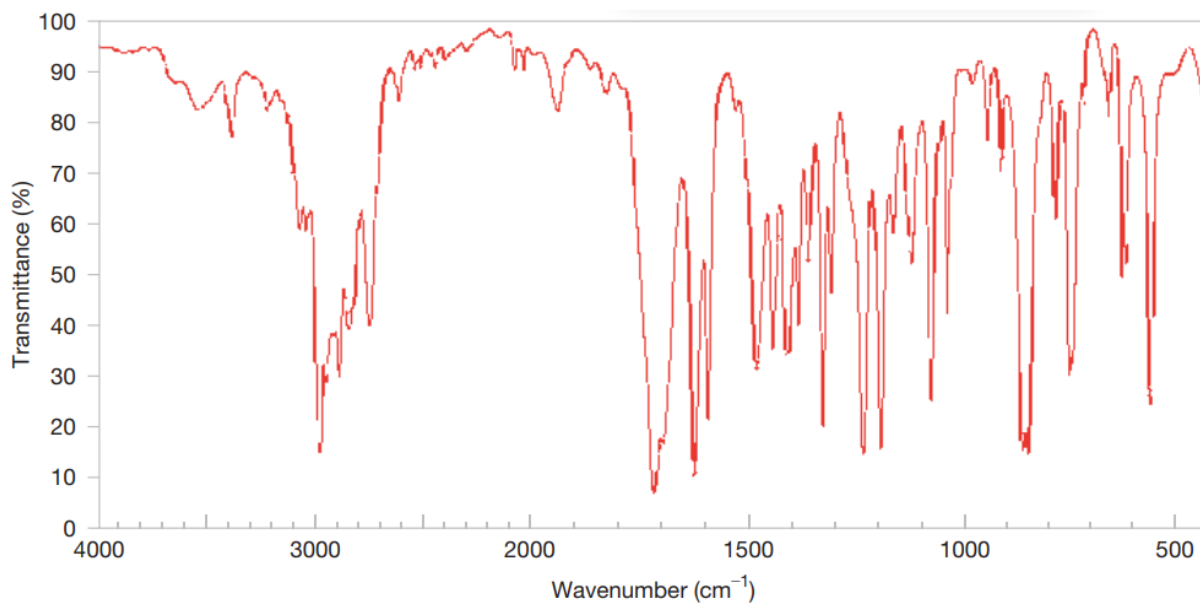


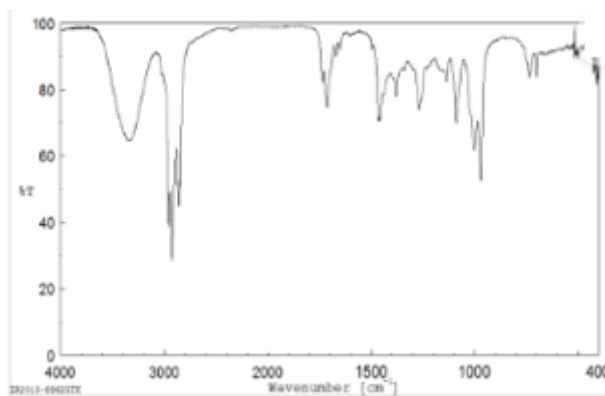
Figure 12: IR spectrum

Question 5

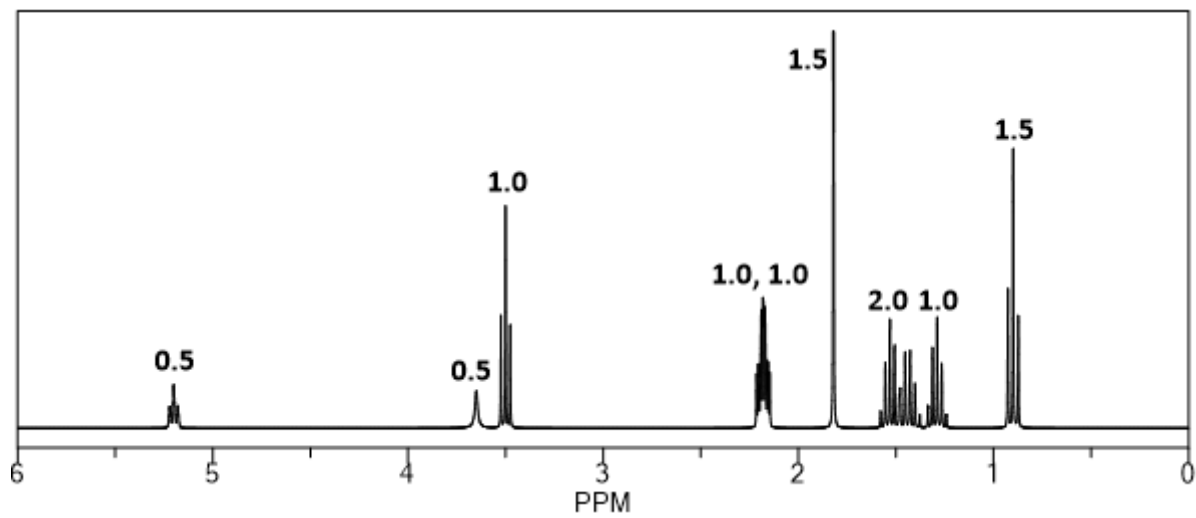
[20 Marks]

5.1 Explain how the spectra provided below would be employed to elucidate the structure of the compound with the formula $C_{10}H_{20}O$.

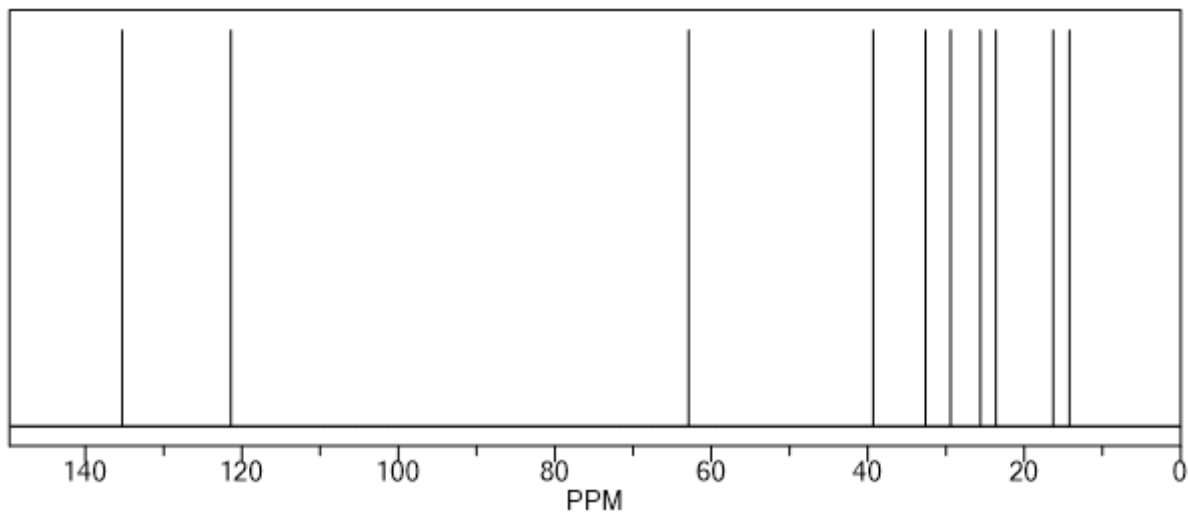
Infrared Spectrum



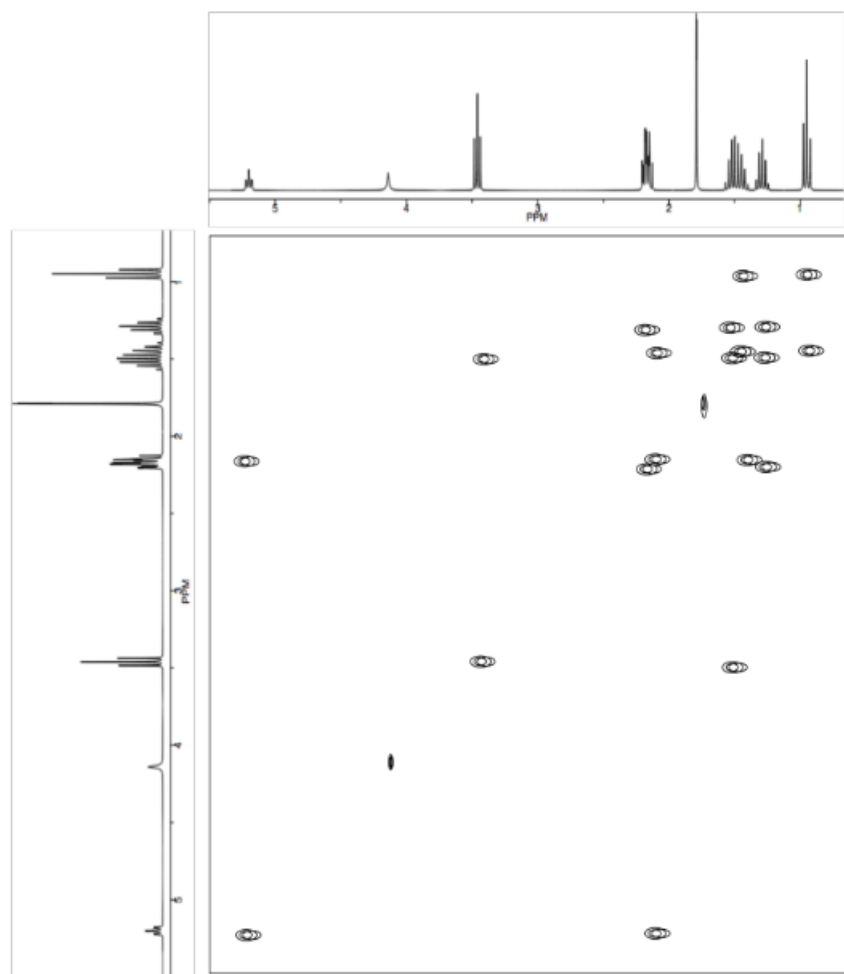
¹H NMR Spectrum



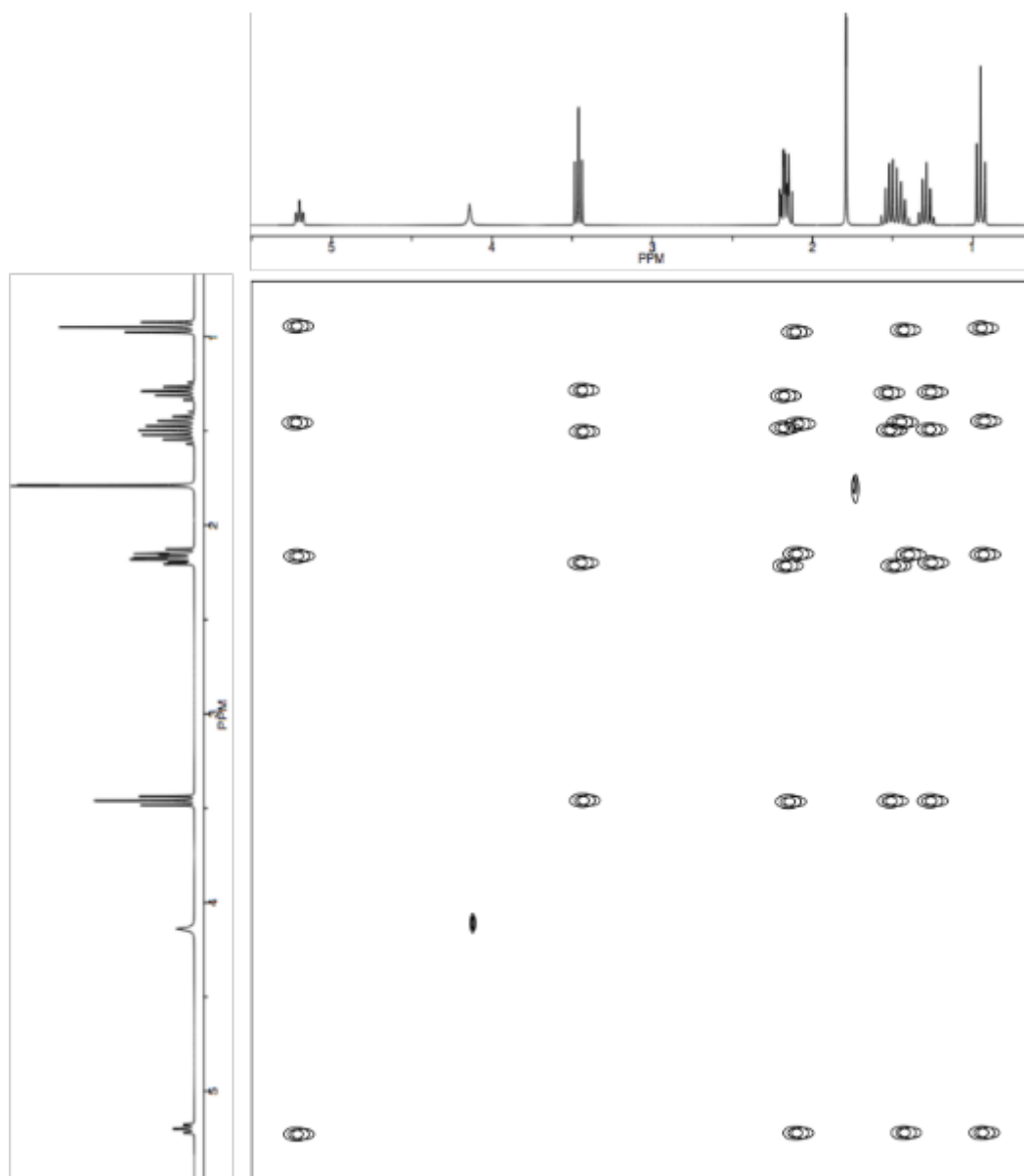
¹³C NMR Spectrum



COSY Spectrum



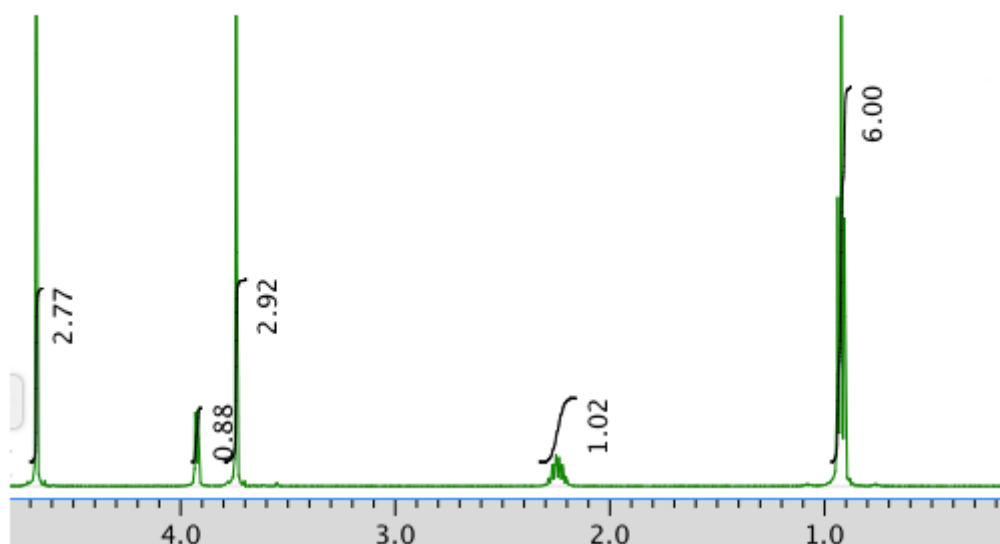
TOCSY Spectrum



Question 6

[20 Marks]

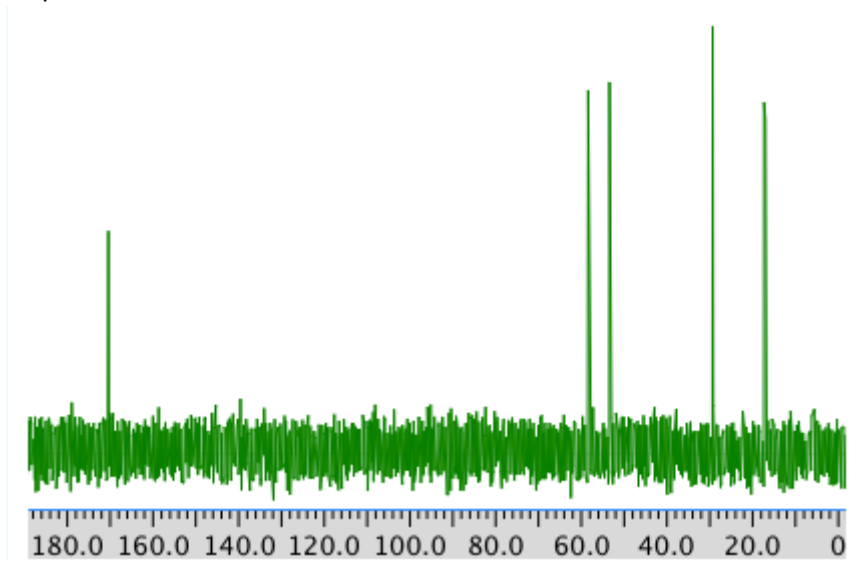
6.1 A compound with formula $C_6H_{13}NO_2$ has the spectra shown below. Present an analysis of the provided data and propose a structure the compound.



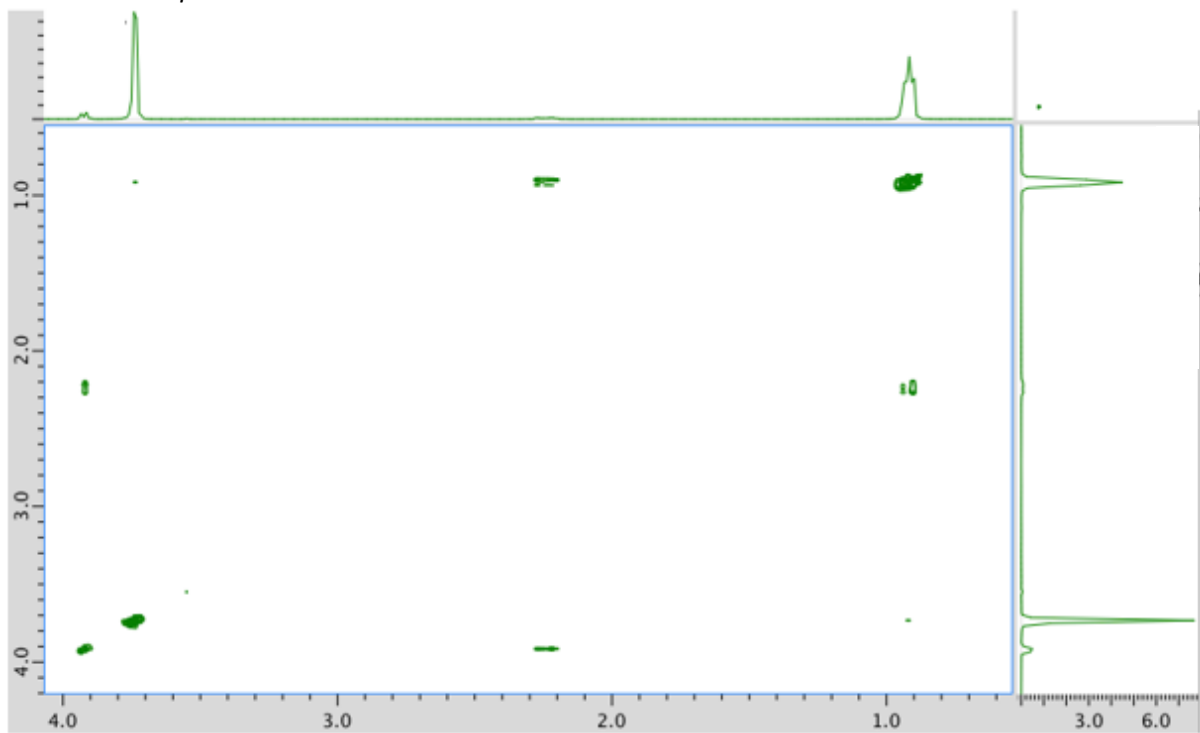
1H NMR Spectrum – Expanded



¹³C NMR Spectrum



COSY Spectrum



HMBC Spectrum

