
UNIVERSITI SAINS MALAYSIA

Final Examination
Academic Session 2008/2009

April 2009

JIK 319 – ORGANIC CHEMISTRY SPECTROSCOPY
[SPEKTROSKOPI KIMIA ORGANIK]

Duration : 3 hours
[Masa : 3 jam]

Please ensure that this examination paper contains **TEN** printed pages before you begin the examination.

Answer **FIVE** questions. You may answer **either** in Bahasa Malaysia or in English.

All answers must be written in the answer booklet provided.

Each question is worth 20 marks and the mark for each sub question is given at the end of that question.

*Sila pastikan bahawa kertas peperiksaan ini mengandungi **SEPULUH** muka surat yang bercetak sebelum anda memulakan peperiksaan ini.*

*Jawab **LIMA** soalan. Anda dibenarkan menjawab soalan **sama ada** dalam Bahasa Malaysia atau Bahasa Inggeris.*

Setiap jawapan mesti dijawab di dalam buku jawapan yang disediakan.

Setiap soalan bernilai 20 markah dan markah subsoalan diperlihatkan di penghujung subsoalan itu.

1. Using a suitable example explain the following terms :

- (a) chromophore (in UV)
- (b) bathochromic shift (in UV)
- (c) finger print region (in IR)
- (d) in-plane bending vibrations (in IR)
- (e) M + 1 and M + 2 peaks (in MS).

Dengan menggunakan contoh yang sesuai, terangkan istilah-istilah berikut :

- (a) kromofor (dalam UV)
- (b) anjakan batokromik (dalam UV)
- (c) kawasan cap jari (dalam IR)
- (d) getaran pelenturan dalam satah (dalam IR)
- (e) puncak M + 1 dan M + 2 (dalam MS).

[20 marks]

2. (a) How could IR spectroscopy be used to distinguish between the following pair of compounds?

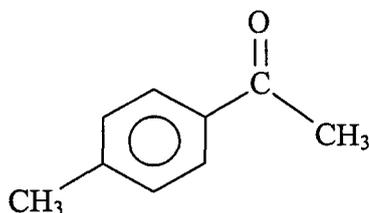
Bagaimanakah spektroskopi IR dapat digunakan untuk membezakan di antara pasangan sebatian berikut?



[5 marks]

(b) How many signals would you expect to see in the $^1\text{H-NMR}$ spectrum of the following compound?

Berapakah bilangan signal yang anda jangka dapat diperhatikan dalam spektrum $^1\text{H-NMR}$ bagi sebatian berikut?



[5 marks]

...3/-

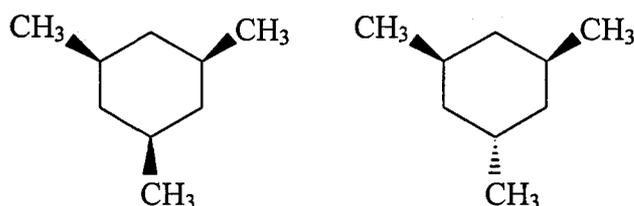
- (c) How might the proton spectrum of ultrapure dimethylamine, $(\text{CH}_3)_2\text{NH}$, differ from the spectrum of this compound to which D_2O has been added?

Bagaimanakah spektrum proton dimetilamina yang tulen lampau, $(\text{CH}_3)_2\text{NH}$, berbeza daripada spektrumnya yang mengandungi D_2O ?

[5 marks]

- (d) How might the two trimethylcyclohexane isomers shown below be most readily distinguished using ^{13}C -NMR?

Bagaimanakah dua isomer trimetilsikloheksana di bawah dapat dibezakan antara satu dengan lain menggunakan spektroskopi ^{13}C -NMR?



[5 marks]

3. (a) Deduce a possible structure for the compound with the IR absorptions below :

Ramalkan struktur bagi sebatian yang mempunyai penyerapan IR di bawah :



[5 marks]

- (b) Deduce the identity of the following compound from the spectral data given.

$\text{C}_4\text{H}_8\text{O}_2$: ^1H NMR ; δ 1.23 (3H, triplet), 2.00 (3H, singlet), 4.02 (2H, quartet),
IR ; 2980, 1740 cm^{-1} .

Ramalkan identiti (struktur) sebatian berikut daripada data-data spektrum yang diberikan.

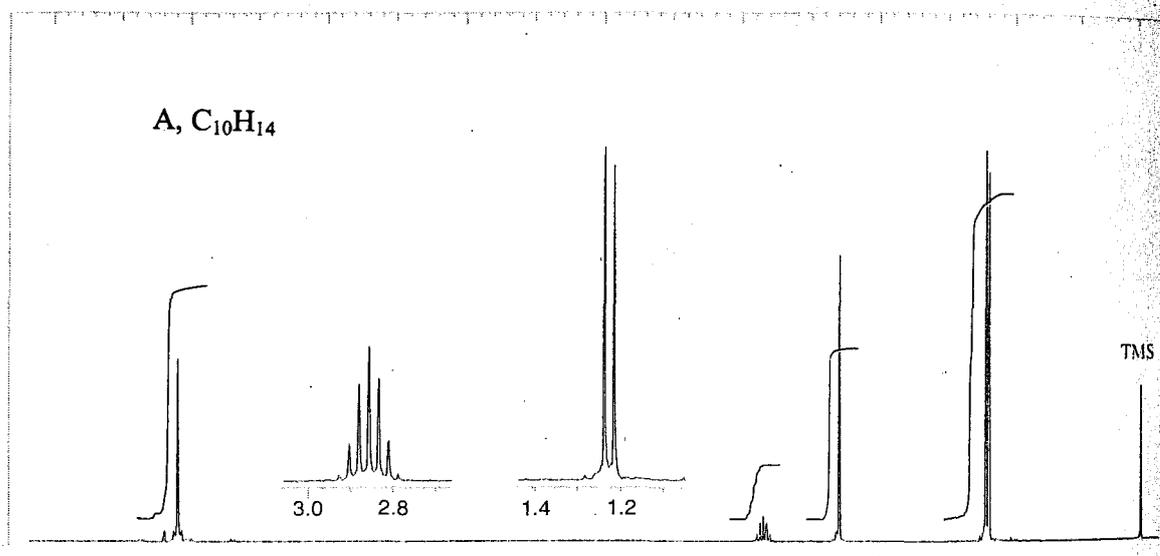
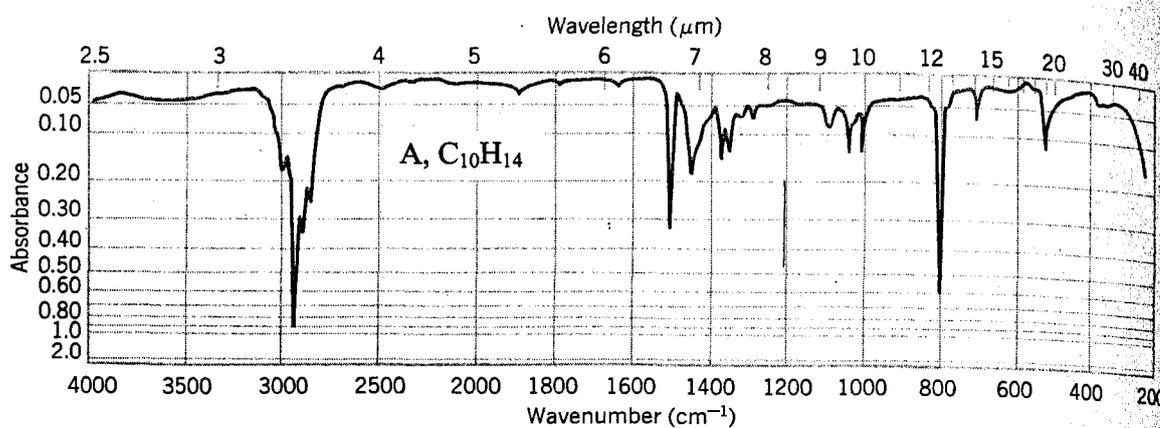
$\text{C}_4\text{H}_8\text{O}_2$: ^1H NMR ; δ 1.23 (3H, triplet), 2.00 (3H, singlet), 4.02 (2H, quartet),
IR ; 2980, 1740 cm^{-1} .

[7 marks]

...4/-

- (c) Give the structure for compound A ($C_{10}H_{14}$) that is consistent with the following 1H -NMR and IR spectra.

Berikan struktur sebatian A ($C_{10}H_{14}$) yang sepadan (secocok) dengan spektrum 1H -NMR dan IR berikut.

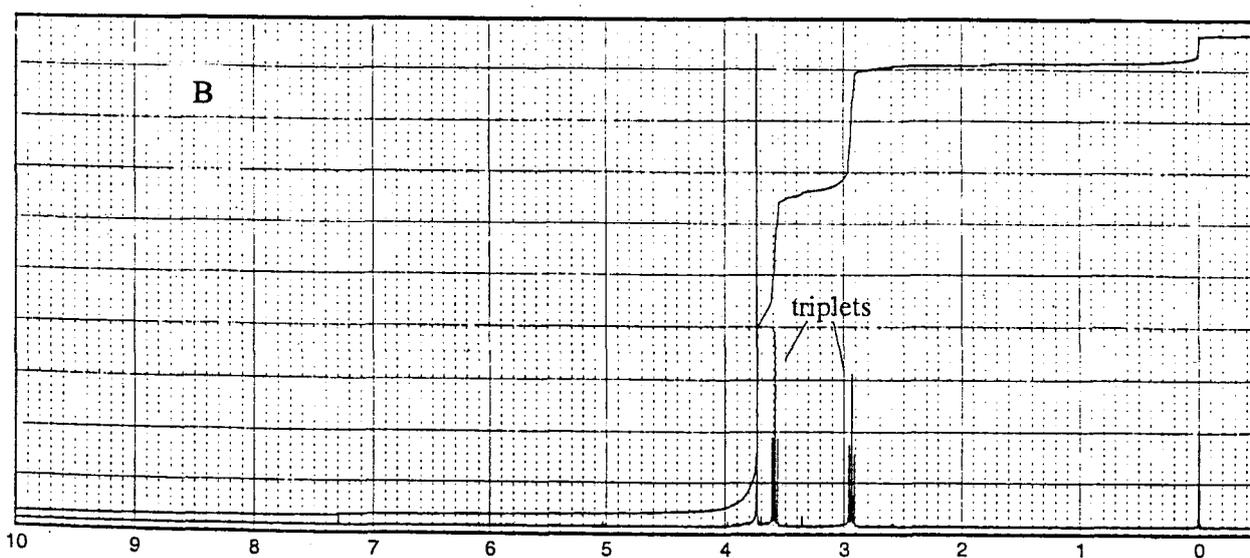
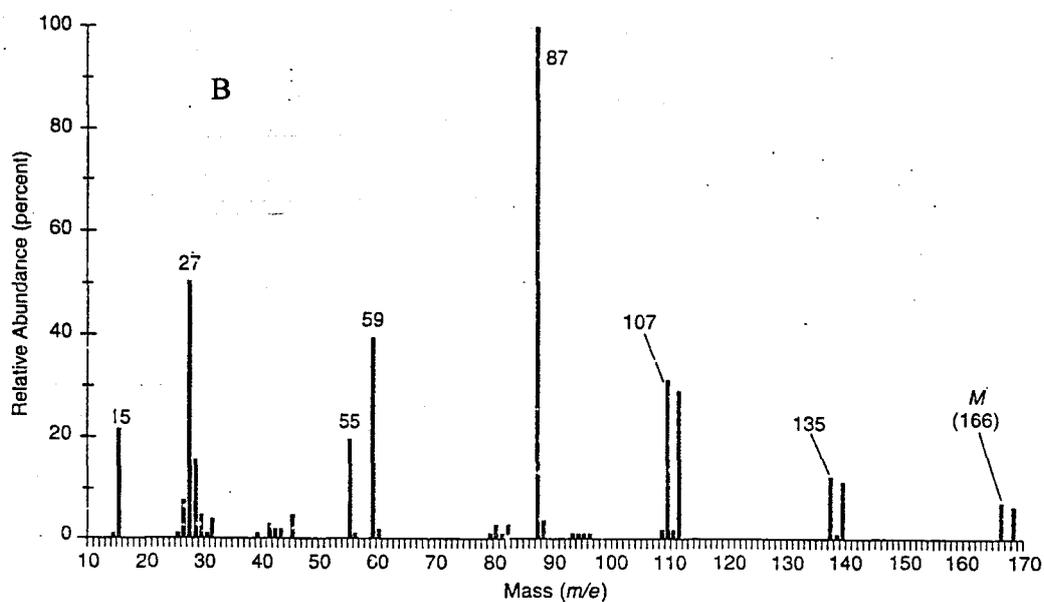


[8 marks]

4. (a) Use the MS and ^1H NMR spectra below to deduce the structure of the compound B, $\text{C}_4\text{H}_7\text{BrO}_2$.

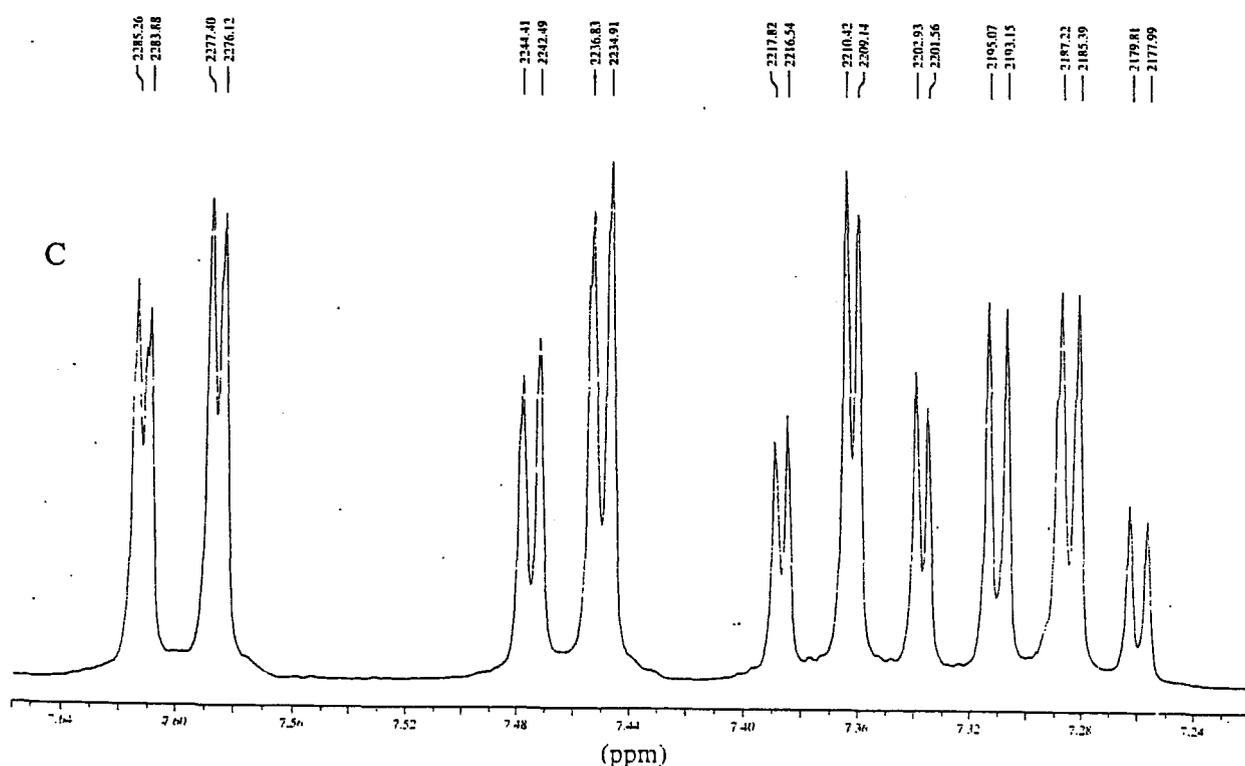
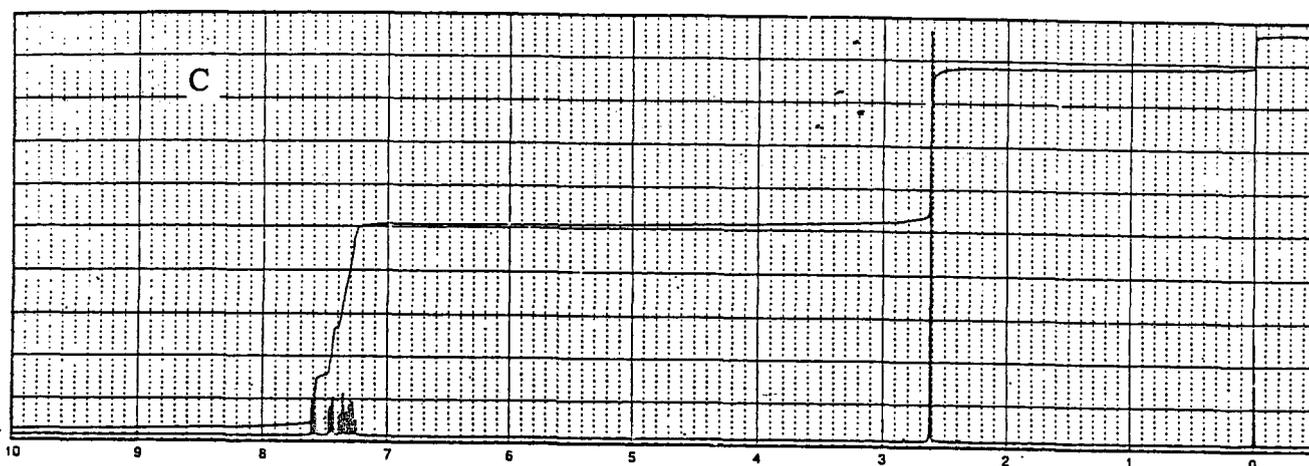
Dengan meneliti spektrum MS dan ^1H NMR di bawah ramalkan struktur sebatian B, $\text{C}_4\text{H}_7\text{BrO}_2$.

[10 marks]

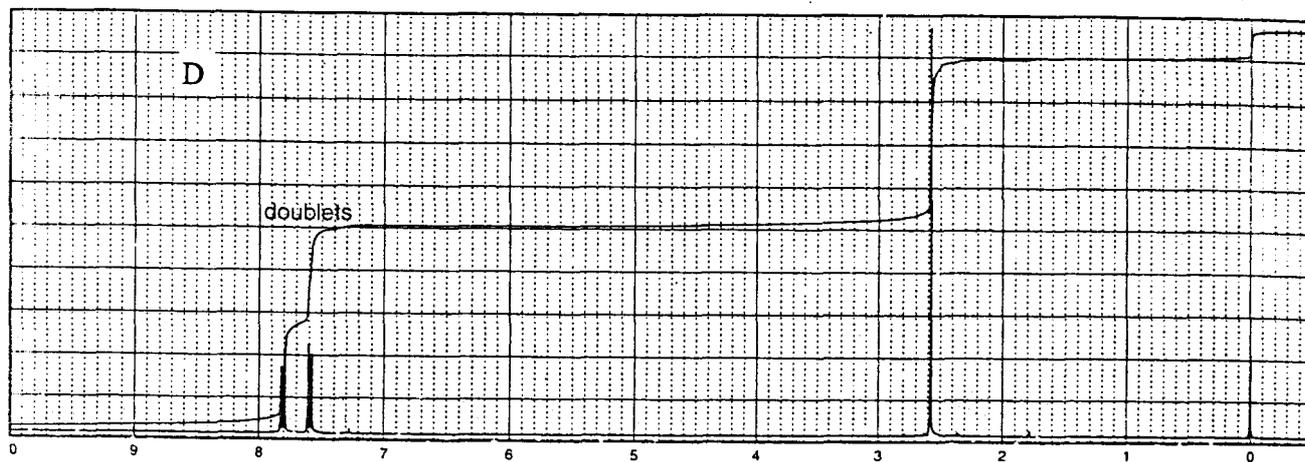


- (b) Determine the structure of the isomeric compounds, C and D, each of which has the formula C_8H_7BrO . The IR spectrum for compound C has a strong absorption band at 1698 cm^{-1} while compound D has a strong band at 1688 cm^{-1} . The proton NMR spectrum for compound C is shown along with the expansion for the region from 7.7 to 7.2 ppm. The proton NMR of D is also given.

Tentukan struktur isomer C dan D bagi suatu sebatian yang berformula C_8H_7BrO . Spektrum IR isomer C mempunyai penyerapan yang kuat pada 1698 cm^{-1} manakala isomer D menyerap dengan kuat pada 1688 cm^{-1} . Spektrum NMR proton untuk C diberikan bersama-sama dengan pembesarnya di kawasan 7.7 hingga 7.2 ppm. Spektrum NMR proton untuk D juga diberikan.



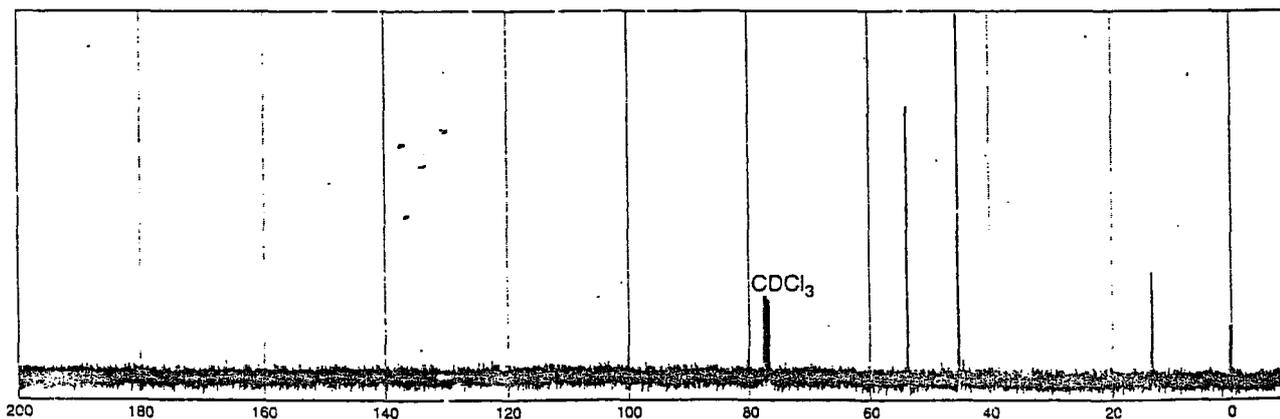
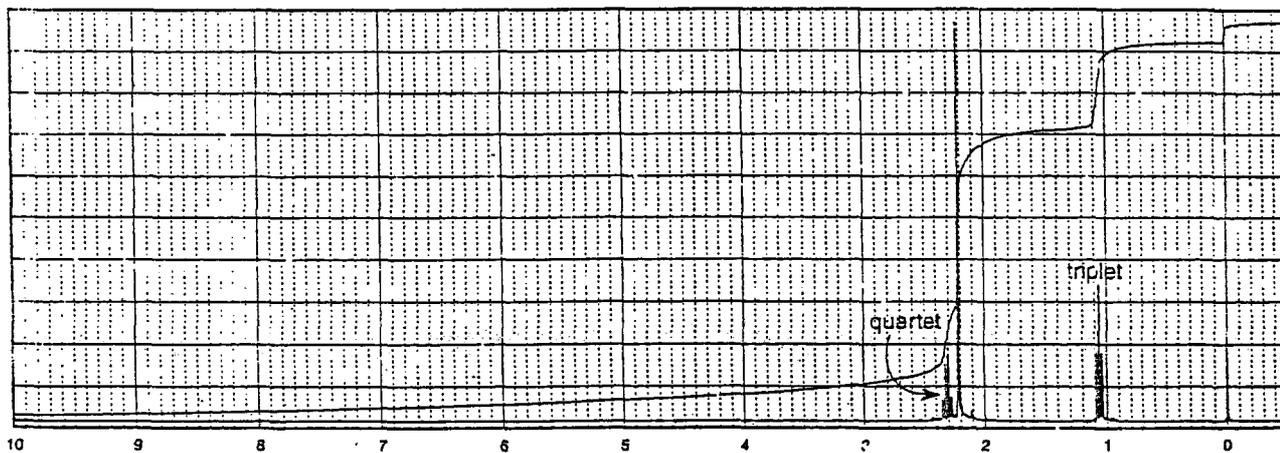
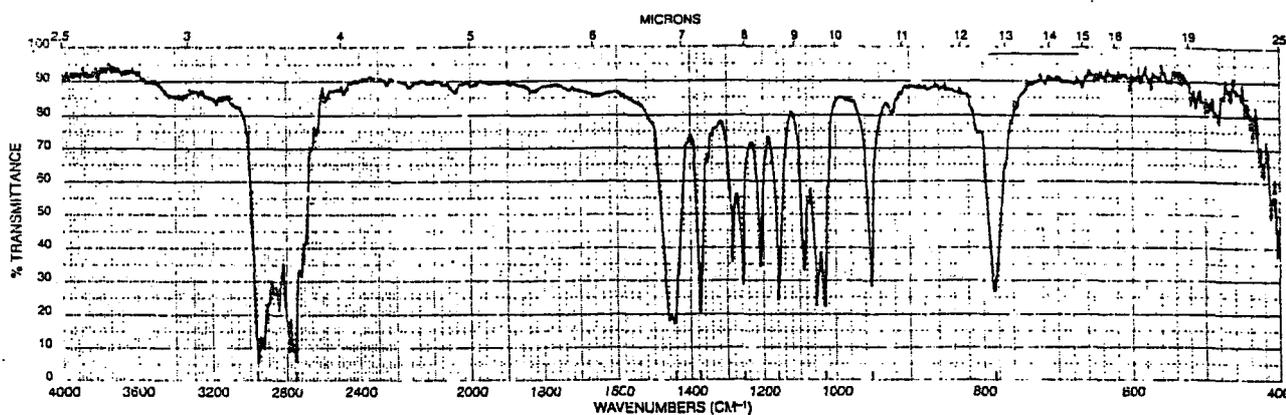
[10 marks]



5. The IR, proton NMR and ^{13}C -NMR spectra of an unknown compound with the formula $\text{C}_4\text{H}_{11}\text{N}$ are given below. Deduce its structure.

Spektrum IR, NMR proton dan ^{13}C -NMR suatu sebatian, $\text{C}_4\text{H}_{11}\text{N}$, diberikan di bawah. Tentukan struktur sebatian ini.

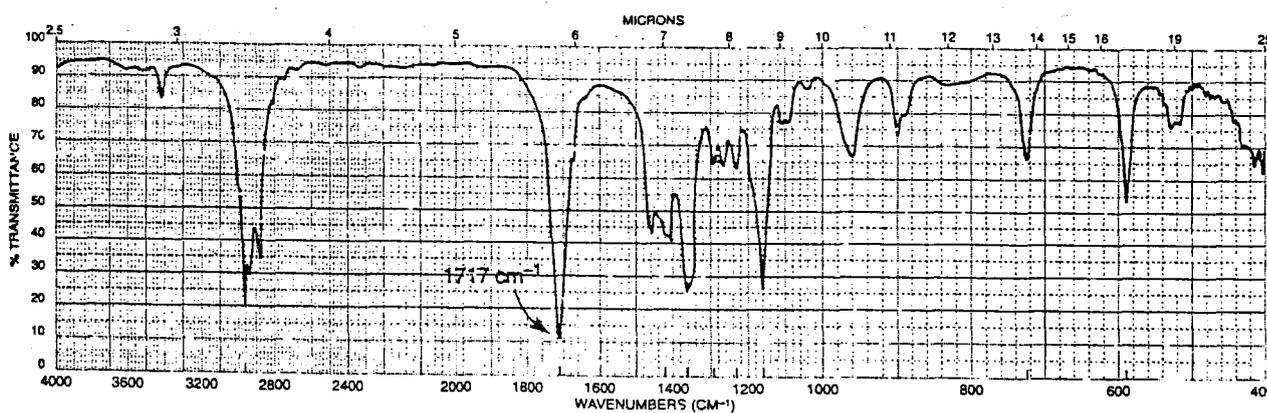
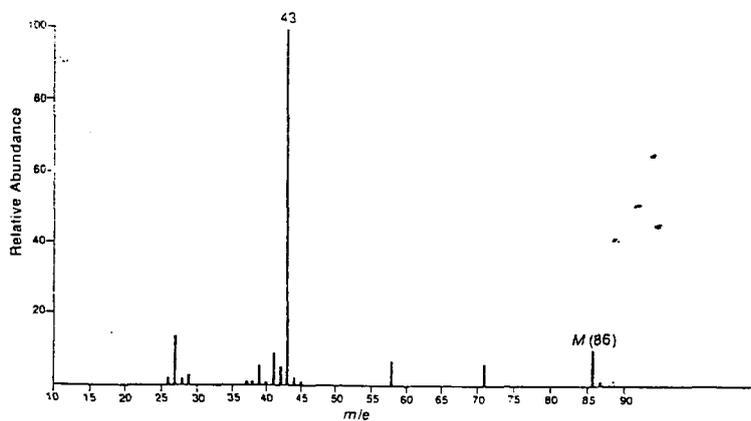
[20 marks]

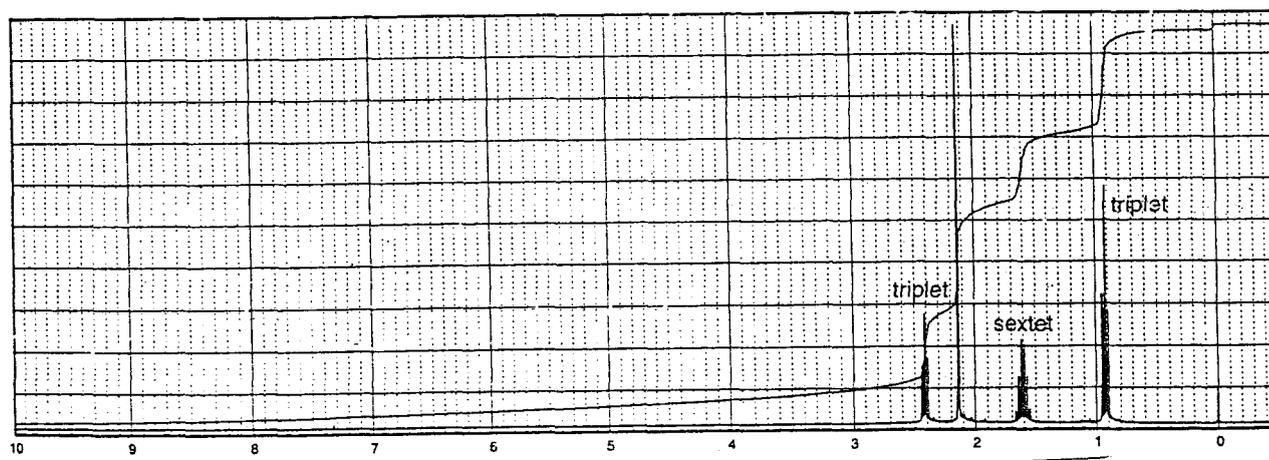


6. The UV spectrum of an unknown is determined in 95% ethanol : λ_{max} 280 nm ($\log \epsilon$ 1.3). Mass spectroscopy, infrared and proton magnetic resonance spectra of the compound are also shown below. Propose a plausible structure of the unknown.

Spektrum UV suatu sebatian yang diukur dalam etanol (95%) : λ_{max} 280 nm ($\log \epsilon$ 1.3). Spektrum MS, IR dan $^1\text{H-NMR}$ sebatian ini juga diberikan di bawah. Cadangkan struktur yang munasabah bagi sebatian ini.

[20 marks]





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