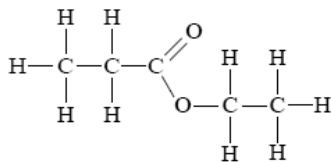


# Spectroscopy 2012 VCE

1) The species that produces the molecular ion peak in the mass spectrum of the compound below.

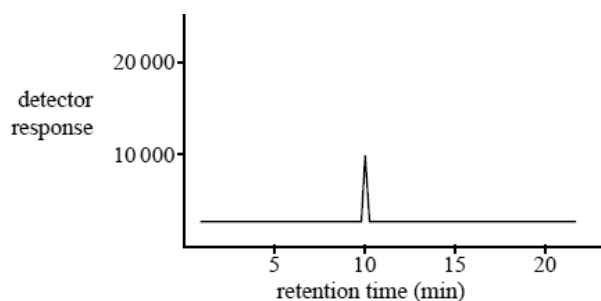


Solution will appear here

- A.  $[\text{CH}_3\text{CH}_2\text{COOCH}_2\text{CH}_3]^+$
- B.  $[\text{CH}_3\text{CH}_2\text{COOCH}_2\text{CH}_3]^{2+}$
- C.  $[\text{CH}_3\text{CH}_2\text{COOCH}_2\text{CH}_3]^-$
- D.  $\text{CH}_3\text{CH}_2\text{COOCH}_2\text{CH}_3$

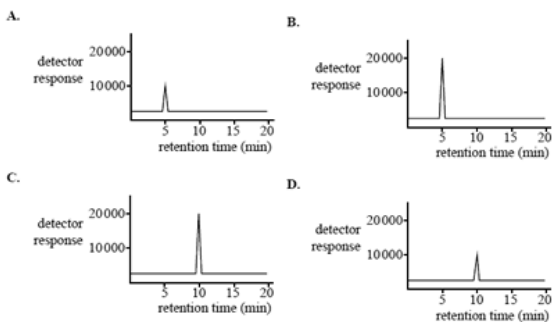
Solution

2) The following chromatogram was produced when  $0.1 \mu\text{g}$  of decane was passed through a gas chromatography column.



The chromatogram produced when  $0.2 \mu\text{g}$  of decane is passed through the same column under identical conditions is best represented by

Solution will appear here

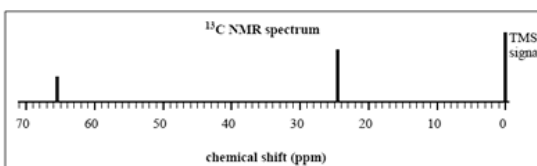
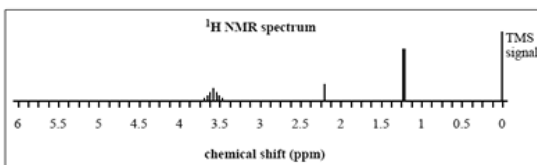


Solution

3) An organic chemist found a bottle in the laboratory that was labelled 'organic cleaning fluid,  $\text{C}_3\text{H}_8\text{O}$ '. She decided to test the liquid. The chemist obtained the following data about the compound in the cleaning fluid: the  $^1\text{H}$  NMR and  $^{13}\text{C}$  NMR spectra, and the infrared spectrum. The  $^1\text{H}$  NMR data is summarised in the table below.

Solution will appear here

Chemical shift (ppm)	Relative peak area	Peak splitting
1.2	6	doublet (2)
2.2	1	singlet (1)
3.6	1	septet (7)



a) How many different carbon environments are present in the compound?

[Solution](#)

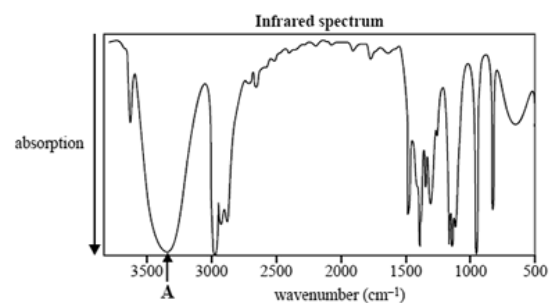
b) How many different hydrogen environments are present in the compound?

[Solution](#)

c) In the <sup>1</sup>H NMR spectrum, the signal at 3.6 ppm is split into a septet (7 peaks). What is the number of equivalent protons that are bonded to the adjacent carbon atom(s)?

[Solution](#)

d) Using the **Infrared absorption data** on page 7 of the Data Book, identify the atoms that are associated with the absorption labelled A on the infrared spectrum below.



Solution will appear here

[Solution](#)

e) Draw a structure of the compound in the cleaning fluid that is consistent with the NMR and IR data.

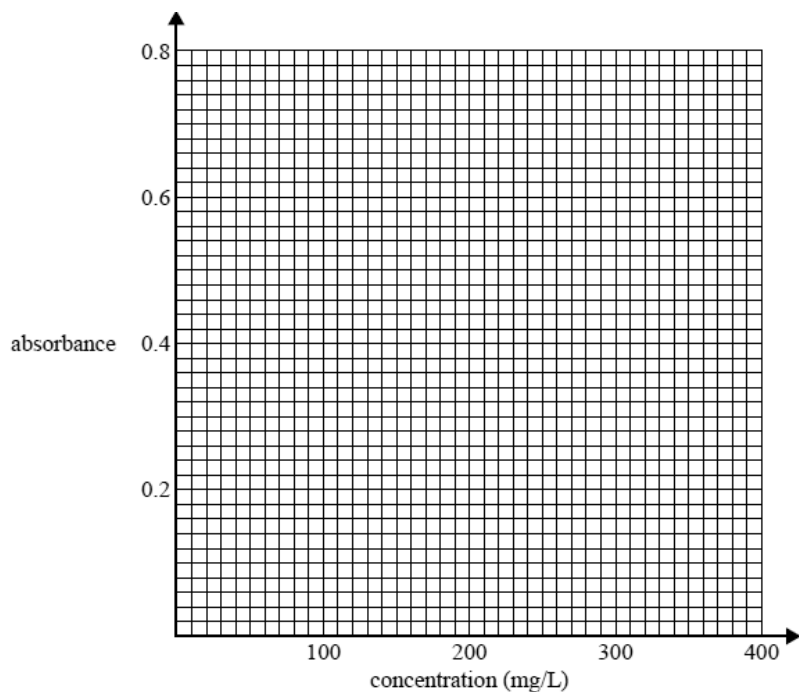
Solution will appear here

[Solution](#)

4) The iron content in multivitamin tablets was determined using atomic absorption spectroscopy. The absorbances of four standards were measured. Three multivitamin tablets were selected. Each tablet was dissolved in 100.0 mL of water. The absorbance of each of the three solutions was then measured. The following absorbances were obtained.

Solution	Concentration mg/L	Absorbance
Standard 1	0.00	0.06
Standard 2	100.0	0.16
Standard 3	200.0	0.25
Standard 4	300.0	0.36
Standard 5	400.0	0.46
Tablet 1	–	0.39
Tablet 2	–	0.42
Tablet 3	–	0.45

a) Use the grid below to construct a calibration graph of the absorbances of the standard solutions.



b) Determine the average iron content, in milligrams, of the multivitamin tablets.

**Solution**

c) Spectroscopic techniques work on the principle that, under certain conditions, atoms, molecules or ions will interact with electromagnetic radiation. The type of interaction depends on the wavelength of the electromagnetic radiation. Name one spectroscopic technique that you have studied this year.

**Solution**

Solution will appear here

d) Which part of the electromagnetic spectrum does this technique use?

**Solution**

e) How does this part of the electromagnetic spectrum interact with matter? What information does this spectroscopic technique provide?

**Solution**