Chapter 8 Analysis

Print out and complete this worksheet to generate a summary for Chapter 8.

Chromatography

1 a This question is about thin-layer chromatography, TLC, and gas chromatography, GC. Identify the mobile and the stationary phases.

(i) TLC:

Mobile phase:

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Stationary phase:

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(ii) GC:

Mobile phase:

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Stationary phase:

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b Explain what is meant by:

(i) R_f value

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(ii) retention time

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c Explain the limitations of chromatography alone as an analytical tool.

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d (i) Explain the benefit of using gas chromatography in conjunction with mass spectrometry, i.e. GC–MS.

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(ii) State two uses of GC–MS.

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Nuclear magnetic resonance spectroscopy, NMR

2 a Identify the region of the electromagnetic spectrum that is used in NMR spectroscopy.

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b Describe the use of tetramethylsilane in NMR. Give three reasons why it is suitable for its role.

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c Explain why ^{13}C and ^{1}H can both be detected by NMR.

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d Explain the need to use deuterated solvents such as $CDCl_3$ when running an NMR spectrum.

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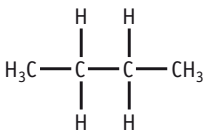
^{13}C-NMR

e Identify the number of peaks you would expect in the ^{13}C NMR spectrum of each of the following compounds:

(i)



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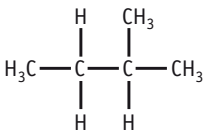
(ii)



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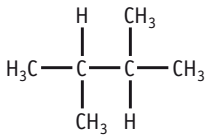
(iii)



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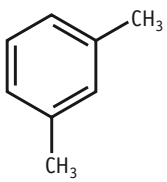
(iv)



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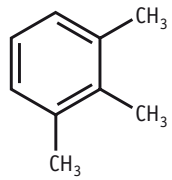
(v)



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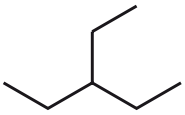
(vi)



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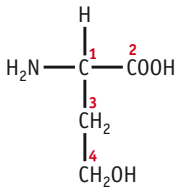
f Predict the chemical shift values/ranges for each carbon atom in the following compound:



C_1: ..... ppm

C_2: ..... ppm

C_3: ..... ppm

C_4: ..... ppm

^{1}H NMR

g Explain what is meant by:

(i) chemical shift

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(ii) the (n + 1) rule

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(iii) relative peak areas

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(iv) labile protons

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h Identify **three** different functional groups that have labile protons.

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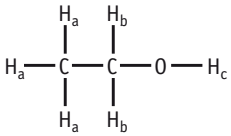
i Complete the table below, identifying the chemical shift range for each of the protons in bold.

Chemical environment	C**H**$_3$ in C**H**$_3$CH$_2$CH$_3$	C**H**$_3$ in C$_6$H$_5$C**H**$_3$	C**H**$_3$ in C**H**$_3$CHO	C**H**$_3$ in C**H**$_3$COOH
δ/ppm (range)				
Chemical environment	**H** in CH$_3$CH$_2$O**H**	**H** in C**H**$_3$COCH$_2$CH$_3$	**H** in CH$_3$COO**H**	**H** in C$_6$H$_5$O**H**
δ/ppm (range)				
Chemical environment	C**H**$_2$ in CH$_3$C**H**$_2$CH$_3$	C**H**$_2$ in CH$_3$C**H**$_2$OH	C**H**$_2$ in CH$_3$COOC**H**$_2$CH$_3$	C**H**$_2$ in CH$_3$C**H**$_2$CHO
δ/ppm (range)				
Chemical environment	**H** in CH$_3$C**H**O	C**H**$_3$ in C**H**$_3$OH	**H** in C$_6$**H**$_6$	**H** in CH$_3$CON**H**$_2$
δ/ppm (range)				

j The different hydrogen environments in ethanol have been labelled H_a, H_b and H_c. Relevant data are given in the table and on the OCR data sheet.



	Relative peak area	Splitting	Chemical shift/δ/ppm (range)
H_a	3	Triplet	0.7–1.6
H_b	2	Quartet	3.3–4.3
H_c	1	Singlet	1.0–5.3

(i) Draw the structure of butan-2-ol, label the different hydrogen environments as H_a, H_b etc., and then complete the table.

	Relative peak area	Splitting	Chemical shift/δ/ppm (range)
H_a			

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(ii) Draw the structure of propyl methanoate, label the different hydrogen environments as H_a, H_b etc., and then complete the table.

	Relative peak area	Splitting	Chemical shift/δ/ppm (range)
H_a			

(iii) Draw the structure of 3-ethylpentane, label the different hydrogen environments as H_a, H_b etc., and then complete the table.

	Relative peak area	Splitting	Chemical shift/δ/ppm (range)
H_a			

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(iv) Draw the structure of penta-1,4-diene, label the different hydrogen environments as H_a, H_b etc., and then complete the table.

	Relative peak area	Splitting	Chemical shift/δ/ppm (range)
H_a			