InkChemistry

QUESTION WORKBOOK

Proton and carbon-13 NMR spectroscopy

Organic analysis · Unit C19

AQA 3.3.15 · OCR A 6.3.2

16 questions · 49 marks

NAVY SCREEN EDITION

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SECTION A · Short, 1 to 2 marks

A1 PCN-Q7

Explain why one peak in the proton NMR spectrum of ethanol disappears when the sample is shaken with D_2O. [2]

A2 PCN-Q10

Deduce the number of hydrogens in each environment of compound V, $C_4H_8O_2$, whose integration trace has steps of 2.4 cm, 1.6 cm and 2.4 cm. [2]

A3 PCN-Q11

Deduce the ratio of peak areas in the proton NMR spectrum of 2-methylpropan-1-ol, $(CH_3)_2CHCH_2OH$. [2]

A4 PCN-Q19

Explain why hydrogens on a carbon bonded to an oxygen atom absorb at a higher chemical shift than the hydrogens of an alkyl CH_3 group. [2]

SECTION B · Standard, 3 to 5 marks

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B1 PCN-Q1

Deduce the number of peaks in the carbon-13 NMR spectrum of each of the four isomers of $C_3H_6Cl_2$: 1,1-dichloropropane, 1,2-dichloropropane, 1,3-dichloropropane and 2,2-dichloropropane. [4]

B2 PCN-Q3

Explain why a sample for proton NMR is dissolved in $CDCl_3$ rather than $CHCl_3$, why CCl_4 is sometimes used instead, and why D_2O is chosen for a sample of glucose. [4]

B3 PCN-Q5

Explain the splitting of each peak in the proton NMR spectrum of propanal, CH_3CH_2CHO, using the n + 1 rule. [4]

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B4 PCN-Q9 Describe the proton NMR spectrum of methyl butanoate, $CH_3CH_2CH_2COOCH_3$, giving the number of peaks and the shift region, splitting and integration of each. [4]

B5 PCN-Q16 Evaluate a student's conclusion that an isomer of $C_4H_{10}O$ is butan-1-ol because its carbon-13 NMR spectrum has four peaks. [4]

B6 PCN-Q2 Give three reasons why tetramethylsilane, TMS, is used as the standard in NMR spectroscopy. [3]

B7 PCN-Q4 Identify the number of peaks in the carbon-13 NMR spectrum of pentan-3-one, 2,2-dimethylpropane and butanone. [3]

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B8 PCN-Q6 Explain the splitting of the two peaks given by the ethyl group, CH_3CH_2–, in a proton NMR spectrum. [3]

B9 PCN-Q8 Suggest why the proton NMR spectrum of ethanoic acid, CH_3COOH, shows only two peaks, both singlets. [3]

B10 PCN-Q14 Explain why each carbon environment in a carbon-13 NMR spectrum gives a single line rather than a split peak. [3]

B11 PCN-Q15 Compare the information given by the carbon-13 and the proton NMR spectra of an organic compound. [3]

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B12
PCN-Q18

Suggest the structure of an isomer of C_3H_7Cl whose proton NMR spectrum has two peaks: δ 4.1, septet, 1H, and δ 1.5, doublet, 6H. [3]

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