

**ADVANCED GCE****CHEMISTRY**

Methods of Analysis and Detection

2815/04

Candidates answer on the question paper

OCR Supplied Materials:

- *Data Sheet for Chemistry* (Inserted)

Other Materials Required:

- Scientific calculator

Thursday 18 June 2009
Morning

Duration: 50 minutes

Candidate Forename		Candidate Surname	
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Centre Number						Candidate Number				
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INSTRUCTIONS TO CANDIDATES

- Write your name clearly in capital letters, your Centre Number and Candidate Number in the boxes above.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure that you know what you have to do before starting your answer.
- Answer **all** the questions.
- Do **not** write in the bar codes.
- Write your answer to each question in the space provided, however additional paper may be used if necessary.

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets [] at the end of each question or part question.
- The total number of marks for this paper is **45**.
- You will be awarded marks for the quality of written communication where this is indicated in the question.
- You may use a scientific calculator.
- A copy of the *Data Sheet for Chemistry* is provided as an insert with this question paper.
- You are advised to show all the steps in any calculations.
- This document consists of **12** pages. Any blank pages are indicated.

FOR EXAMINER'S USE		
Qu.	Max.	Mark
1	9	
2	12	
3	11	
4	13	
TOTAL	45	

Answer **all** the questions.

1 (a) Gas/liquid chromatography, GLC, can be used to separate the components in a mixture.

(i) Identify the mobile and the stationary phase in GLC.

mobile phase

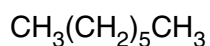
stationary phase [2]

(ii) Explain the term *retention time*.

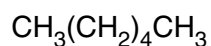
.....

..... [1]

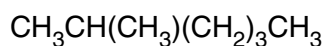
(b) GLC was used to separate a mixture of the hydrocarbons shown below.



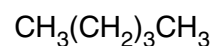
heptane



hexane



2-methylhexane



pentane

The chromatogram obtained is shown below.

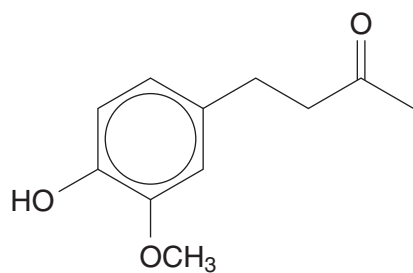


Suggest the identity of the hydrocarbon responsible for each of peaks **1** and **2**.

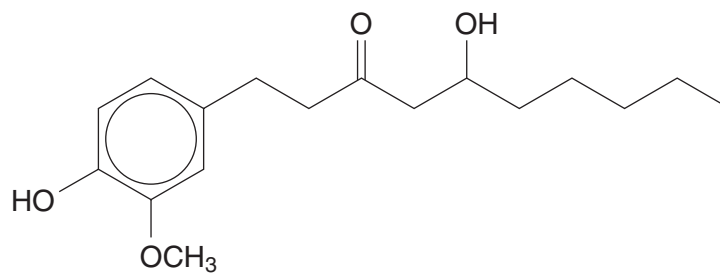
peak **1**

peak **2** [2]

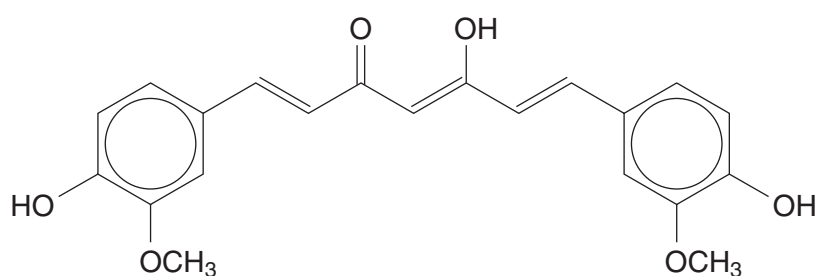
- (c) A piece of clothing with a curry stain was analysed by a forensic scientist. The curry stain was found to contain a mixture of **three** compounds, shown below.



zingerone



gingerol



curcumin

The yellow colour of the curry powder is largely due to curcumin because it contains chromophores.

- (i) What is meant by the term *chromophore*?

.....
 [1]

- (ii) Explain why curcumin is more likely to be responsible for the colour than zingerone.

.....

 [3]

[Total: 9]

2 Atomic emission spectra consist of several series of lines.

(a) Why do emission spectra consist of lines?

.....

.....

..... [2]

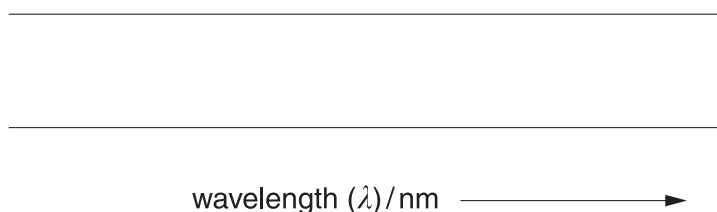
(b) The lines within a series in an emission spectrum converge.

(i) Explain why the lines converge.

.....

..... [1]

(ii) Sketch an emission spectrum to show how lines converge in an emission spectrum. Label the convergence limit, **C**. Show a minimum of six lines.



[2]

- (c) One line in the emission spectrum of sodium corresponds to an energy transition of 3.38×10^{-22} kJ.

Calculate the wavelength, λ , in nm, of this line.

Give your answer to **three** significant figures.

$$1 \text{ nm} = 1 \times 10^{-9} \text{ m}; \quad c = 3.00 \times 10^8 \text{ m s}^{-1}; \quad h = 6.63 \times 10^{-34} \text{ J s}$$

answer = nm [4]

- (d) Describe how flame emission spectroscopy could be used to determine the amount of sodium ions in blood serum.

.....

.....

.....

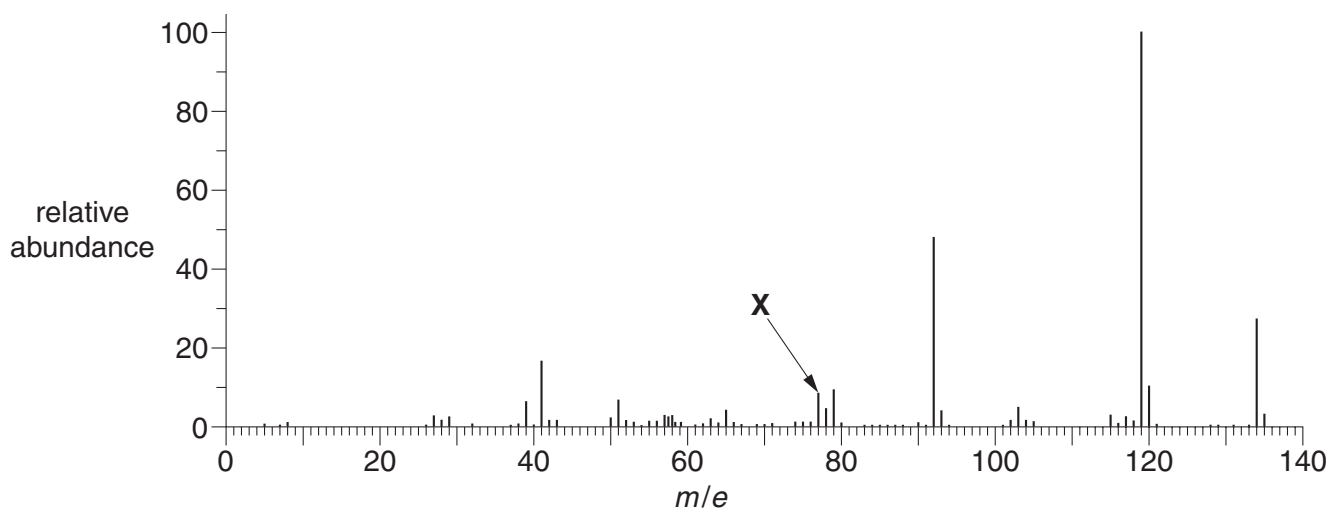
.....

.....

..... [3]

[Total: 12]

3 Compound **A** contains carbon and hydrogen only. The mass spectrum of **A** is shown below.



(a) The ratio of the $M : (M + 1)$ peaks is 29.1 : 3.2.

(i) What is responsible for the $M + 1$ peak?

..... [1]

(ii) Determine the number of carbon atoms in compound **A**.

[2]

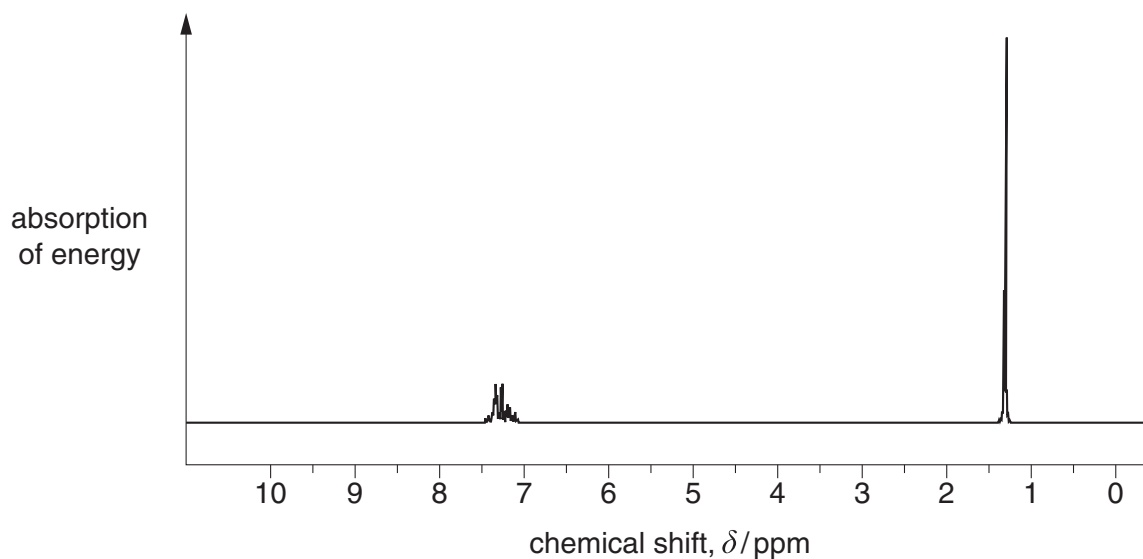
(iii) Deduce the molecular formula for compound **A**. Show your working.

[3]

(iv) Suggest the ion responsible for peak **X**.

[1]

(b) The n.m.r. spectrum of compound **A** is shown below.



(i) The peak at $\delta = 1.3$ ppm is a singlet. What does this tell you about **A**?

.....
 [1]

(ii) What type of proton is responsible for the peak at $\delta = 7.3$ ppm?

..... [1]

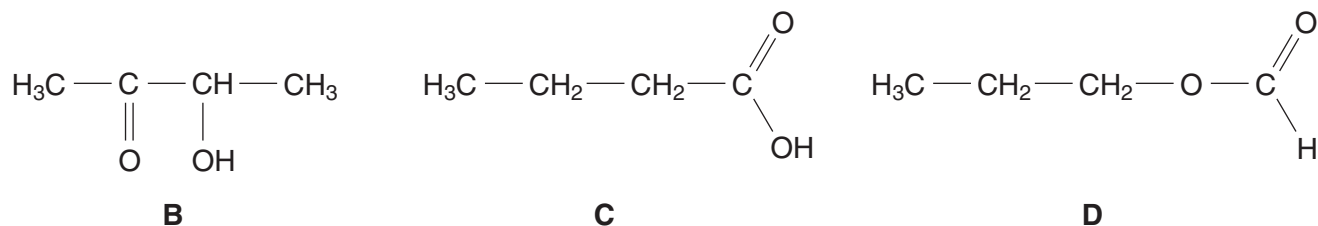
(c) Use your answers from (a) and (b) to identify compound **A**.

[2]

[Total: 11]

- 4 In this question, one mark is available for the quality of spelling, punctuation and grammar.

Compounds **B**, **C** and **D** are all isomers, each with the molecular formula $C_4H_8O_2$.



- (a) In the mass spectra of the three compounds, identify:

- (i) an ion which could cause a peak in all three spectra,

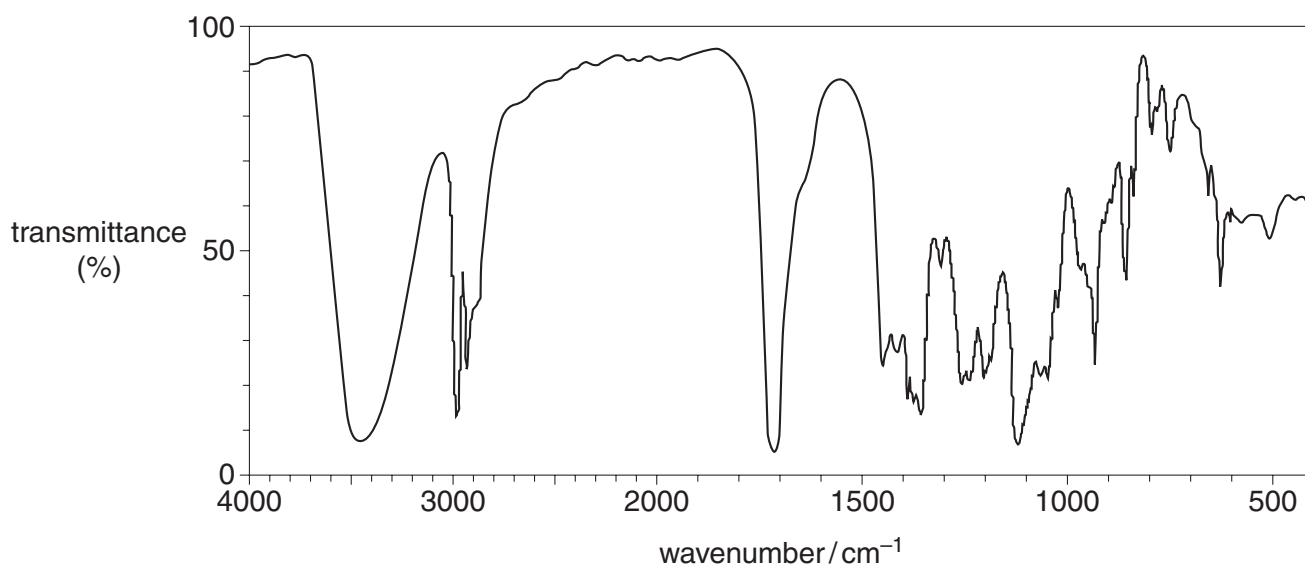
..... [1]

- (ii) an ion which could cause a peak in the mass spectra of **C** and **D** but not of **B**.

..... [1]

- (b) Infra-red spectroscopy could be used to distinguish between compounds **B**, **C** and **D**.

The infra-red spectrum of one of the three isomers is shown below.



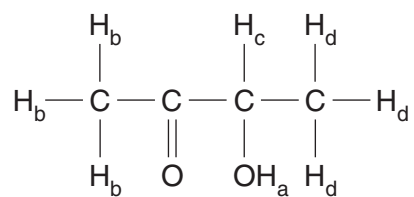
Identify the isomer. Explain your reasoning.

.....

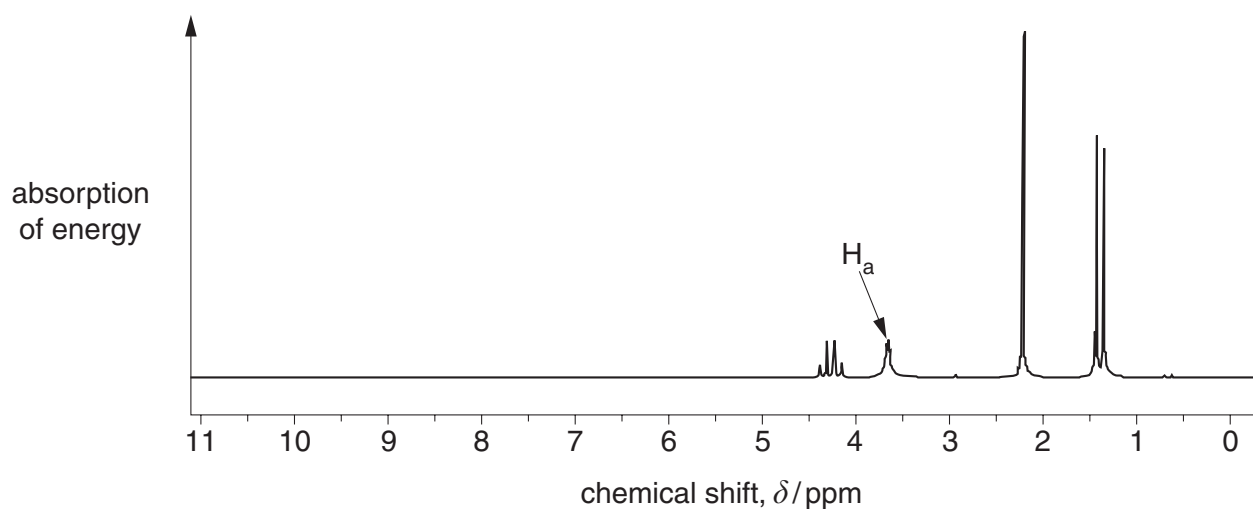
.....

..... [2]

(c) The different types of proton in isomer **B** are labelled in the diagram below.



The n.m.r. spectrum of isomer **B** is shown below. The peak at $\delta = 3.6$ ppm has been labelled H_a to show the proton responsible for the absorption.



On the n.m.r. spectrum above, label the other peaks with the appropriate label: H_b , H_c or H_d .

[2]

TURN OVER FOR QUESTION 4(d)

..... [6]

[Total: 13]

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