

OXFORD CAMBRIDGE AND RSA EXAMINATIONS

Advanced GCE

CHEMISTRY

2815/04

Methods of Analysis and Detection

Tuesday

28 JUNE 2005

Morning

50 minutes

Candidates answer on the question paper.

Additional materials:

Data Sheet for Chemistry

Scientific calculator

Candidate Name	Centre Number	Candidate Number										
	<table border="1" style="display: inline-table;"> <tr> <td style="width: 15px; height: 15px;"></td> <td style="width: 15px; height: 15px;"></td> <td style="width: 15px; height: 15px;"></td> <td style="width: 15px; height: 15px;"></td> <td style="width: 15px; height: 15px;"></td> </tr> </table>						<table border="1" style="display: inline-table;"> <tr> <td style="width: 15px; height: 15px;"></td> <td style="width: 15px; height: 15px;"></td> <td style="width: 15px; height: 15px;"></td> <td style="width: 15px; height: 15px;"></td> <td style="width: 15px; height: 15px;"></td> </tr> </table>					

TIME 50 minutes

INSTRUCTIONS TO CANDIDATES

- Write your name in the space above.
- Write your Centre number and Candidate number in the boxes above.
- Answer **all** the questions.
- Write your answers in the spaces provided on the question paper.
- Read each question carefully and make sure you know what you have to do before starting your answer.

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets [] at the end of each question or part question.
- You will be awarded marks for the quality of written communication where this is indicated in the question.
- You may use a scientific calculator.
- You may use the *Data Sheet for Chemistry*.
- You are advised to show all the steps in any calculations.

FOR EXAMINER'S USE		
Qu.	Max.	Mark
1	15	
2	8	
3	7	
4	6	
5	9	
TOTAL	45	

This question paper consists of 10 printed pages and 2 blank pages.

Answer **all** the questions.

1 This question concerns the separation techniques of chromatography and electrophoresis.

(a) Amino acids may be separated using paper chromatography. When this is carried out, the R_f values of the amino acids can vary, depending on the pH of the solvent.

(i) Outline the principles of paper chromatography.

.....

[3]

(ii) State what is meant by the R_f value.

.....[1]

(b) The diagrams below show the paper chromatograms of a mixture of amino acids.

Diagram 2.1 shows the chromatogram after using solvent 1 alone.

Diagram 2.2 shows the two-way chromatogram obtained by using solvent 1 followed by solvent 2.

Diagram 2.1

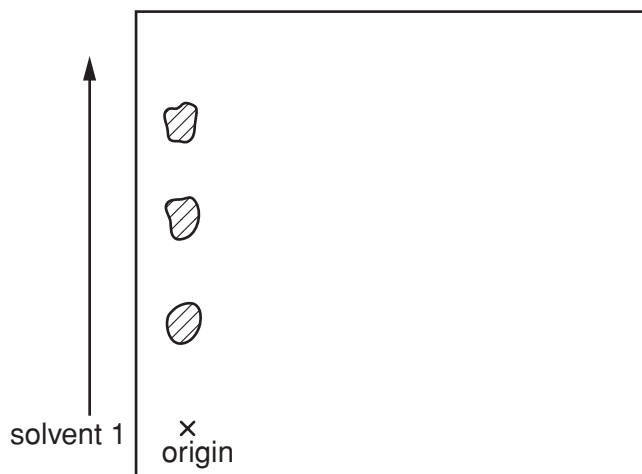
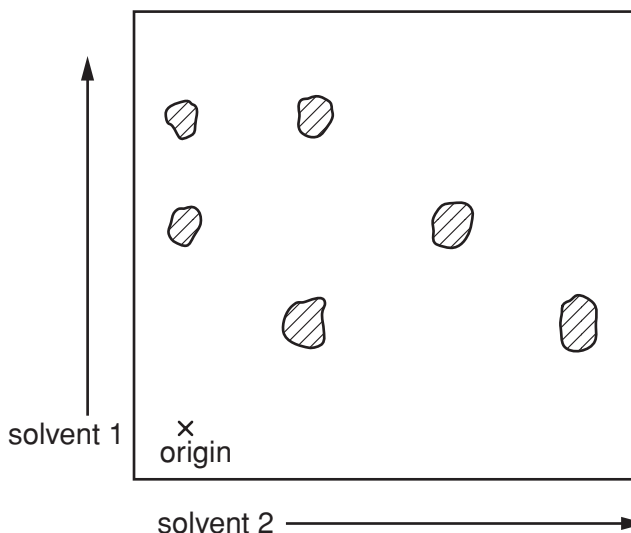


Diagram 2.2



(i) Amino acids are colourless in solution. Suggest a chemical that you could use to make the spots visible on a chromatogram.

.....[1]

(ii) How many different amino acids were present in the sample?[1]

2 This question is about the use of atomic emission spectroscopy.

(a) The hydrogen atom contains one electron only. Explain why the atomic emission spectrum of hydrogen consists of lines and why there are many of them.

.....

.....

.....

.....

.....[3]

(b) In the emission spectrum of atomic hydrogen, one line corresponds to radiation of wavelength 568 nm.

(i) Calculate the frequency of this radiation.

$$c = 3.00 \times 10^8 \text{ m s}^{-1}$$

frequency Hz [1]

(ii) Calculate the energy of a quantum of this radiation.

$$h = 6.63 \times 10^{-34} \text{ J s}$$

energy J [1]

(c) Name an element that was first discovered in the Sun, before it was found on Earth.

.....[1]

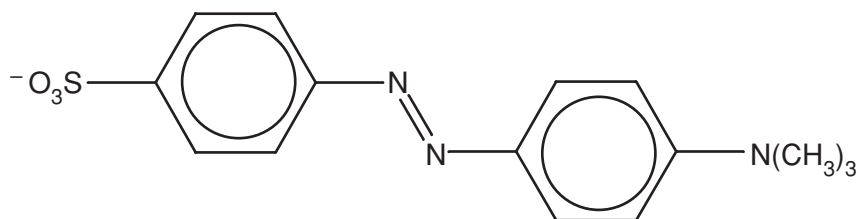
(d) Explain how flame ionisation spectroscopy may be used to determine the concentration of sodium in blood serum.

.....

.....[2]

[Total: 8]

- 3 Indicators, such as methyl orange, absorb energy and appear coloured.



Methyl orange (in alkaline solution)

- (a) Identify **three** structural features that lead to methyl orange being coloured.

.....

.....

.....

.....

.....

.....[3]

- (b) Methyl orange is yellow in alkaline solution. The colour changes to red in acid, because of a decrease in conjugation.

- (i) What do you understand by the term conjugation?

.....

.....[1]

- (ii) Explain why a decrease in conjugation causes the colour change from yellow to red.

.....

.....

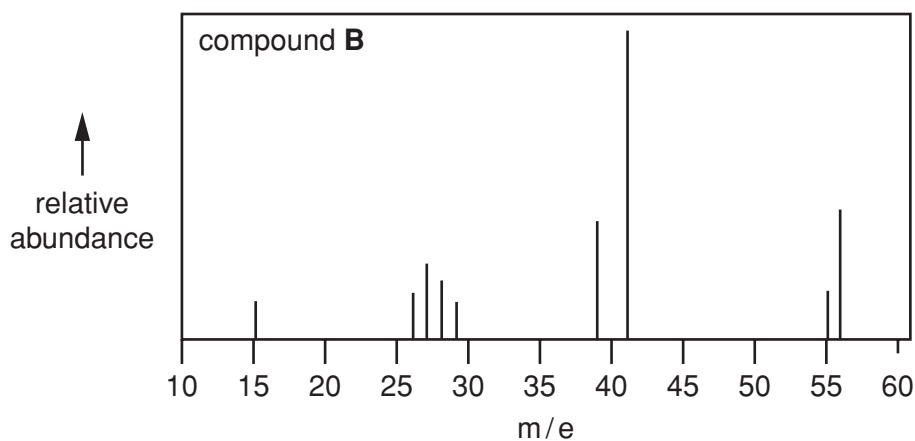
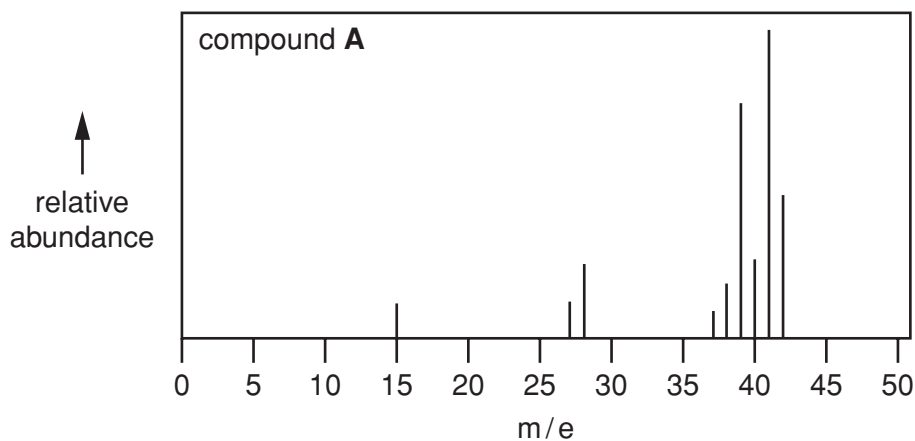
.....

.....[3]

[Total :7]

4 This question is about the use of spectrometry in helping to gain information about the structure of organic molecules.

(a) The major peaks in the mass spectra of two hydrocarbons **A** and **B** are shown below. Compounds **A** and **B** have the same empirical formula.



(i) Deduce the molecular formula of each compound.

Compound **A**

Compound **B**

[2]

(ii) Draw the structural formula of compound **A**.

[1]

- (iii) Suggest the species responsible for the peak at m/e 41 in the spectrum of compound **B**.

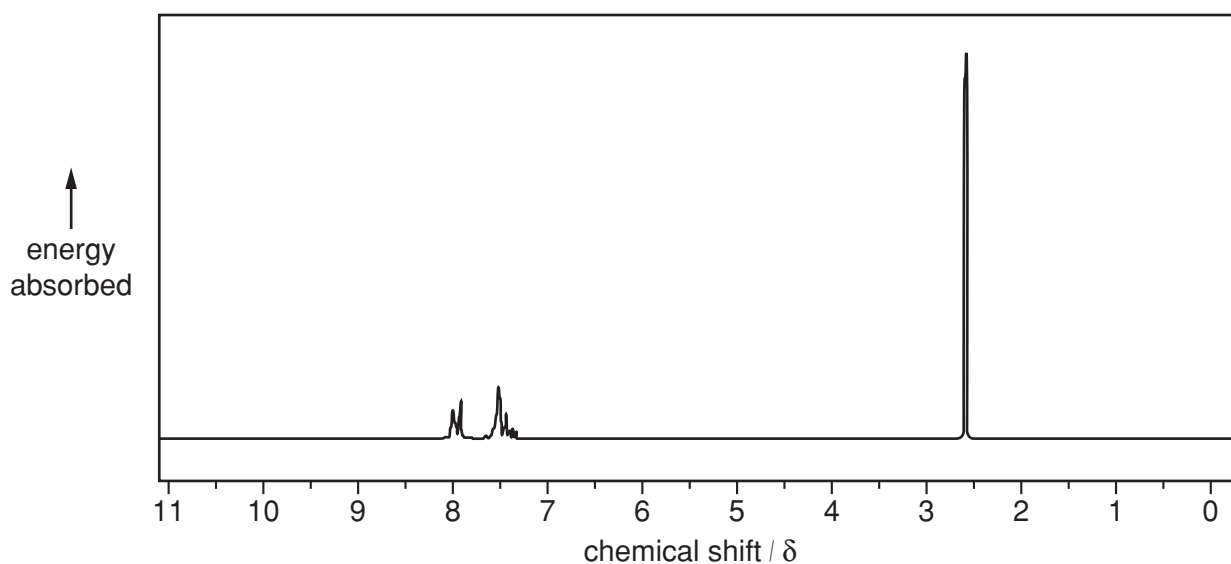
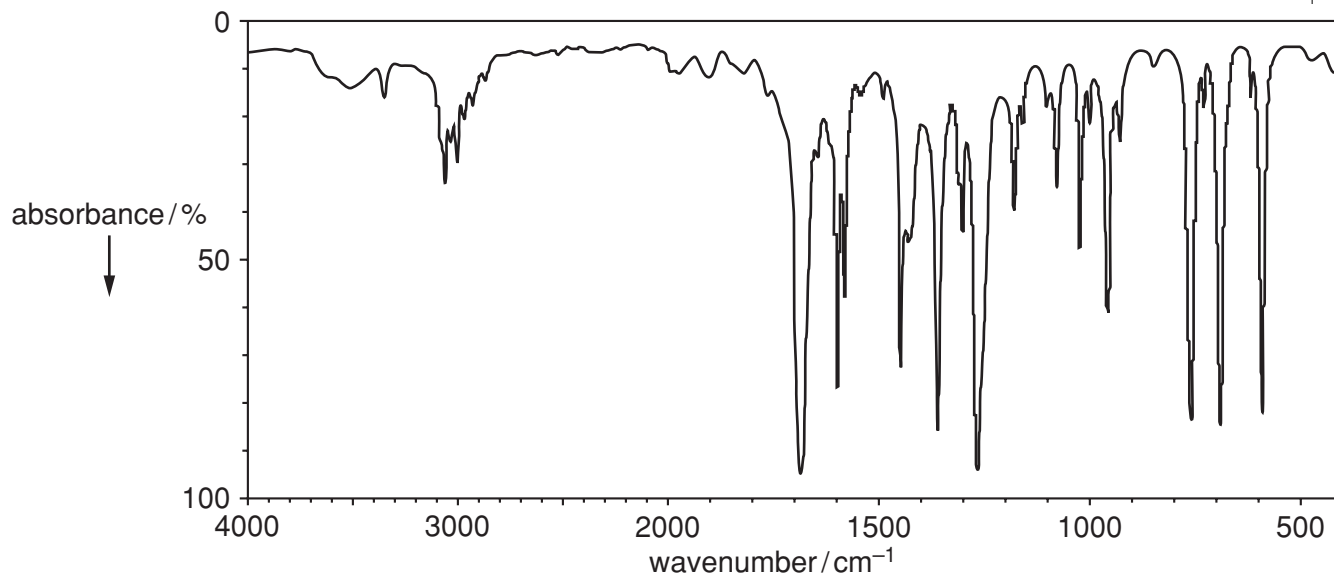
.....[2]

- (b) Each of the compounds **A** and **B** can be reacted with hydrogen chloride to form a monochloro compound with two molecular ion peaks, M and $M+2$. State the ratio of the M and $M+2$ peaks.

.....[1]

[Total: 6]

- 5 In this question, you will need to use data from the spectra given below to identify the compound **G** that produced them.



- (a) Compound **G** has the formula $\text{C}_x\text{H}_y\text{O}$, and its relative molecular mass is 120. In the mass spectrum of **G**, the $M : M+1$ peak height ratio is 4.5 : 0.4. Use this information to deduce the values of x and y , showing how you arrive at your answer.

[3]

Permission to reproduce items where third-party owned material protected by copyright is included has been sought and cleared where possible. Every reasonable effort has been made by the publisher (OCR) to trace copyright holders, but if any items requiring clearance have unwittingly been included, the publisher will be pleased to make amends at the earliest possible opportunity.

OCR is part of the Cambridge Assessment Group. Cambridge Assessment is the brand name of University of Cambridge Local Examinations Syndicate (UCLES), which is itself a department of the University of Cambridge.