THIS IS A LEGACY SPECIFICATION

OCR
RECOGNISING ACHIEVEMENT

ADVANCED GCE

CHEMISTRY

Methods of Analysis and Detection

2815/04

Candidates answer on the Question Paper
A calculator may be used for this paper

OCR Supplied Materials:
- *Data Sheet for Chemistry* (inserted)

Other Materials Required:
- Scientific calculator

Monday 28 June 2010
Morning

Duration: 50 minutes

OCE/13495

2815045

Candidate Forename		Candidate Surname	

Centre Number						Candidate Number				

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.

Examiner's Use Only:			
1			
2			
3			
4			
Total			

SHW 00165 2/08 13495/2

Answer **all** the questions.

1 Mass spectrometry is an important technique used in drug testing and to determine the structure of organic compounds.

(a) Aspirin, $C_9H_8O_4$, and paracetamol, $C_8H_9NO_2$, are two very common painkillers.

(i) How would the M peaks of aspirin and paracetamol differ?

.....

..... **[1]**

(ii) What causes the (M + 1) peak in a mass spectrum?

..... **[1]**

(iii) The relative height of the (M + 1) peak for paracetamol is 0.33.

Calculate the relative height of the M peak for paracetamol.

[2]

(b) Bromochloromethane, CH_2BrCl, can be used for fumigating grain to prevent insect attack. The mass spectrum of bromochloromethane has an M peak, an (M + 2) peak and an (M + 4) peak.

(i) Calculate the *m*/*e* value for the M peak of bromochloromethane.

..... **[1]**

(ii) Which **two** molecular ions give rise to the (M + 2) peak?

..... **[2]**

(iii) In the mass spectrum of CH_2BrCl there is a peak at *m*/*e* = 132.

Identify this peak.

..... **[1]**

(c) Three isomers, **A**, **B** and **C**, each have the molecular formula C_3H_6O. The table below shows the *m*/*e* values of the major peaks in the mass spectrum of each isomer.

	A	**B**	**C**
m/*e* values	15	15	14
	43	28	27
	58	29	31
		43	41
		58	58

Identify isomers **A**, **B** and **C**.

Show your reasoning.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... **[6]**

[Total: 14]

2 **(a)** Gas liquid chromatography, glc, and paper chromatography both use partition to separate the components of a mixture.

(i) State what is meant by *partition*.

.....

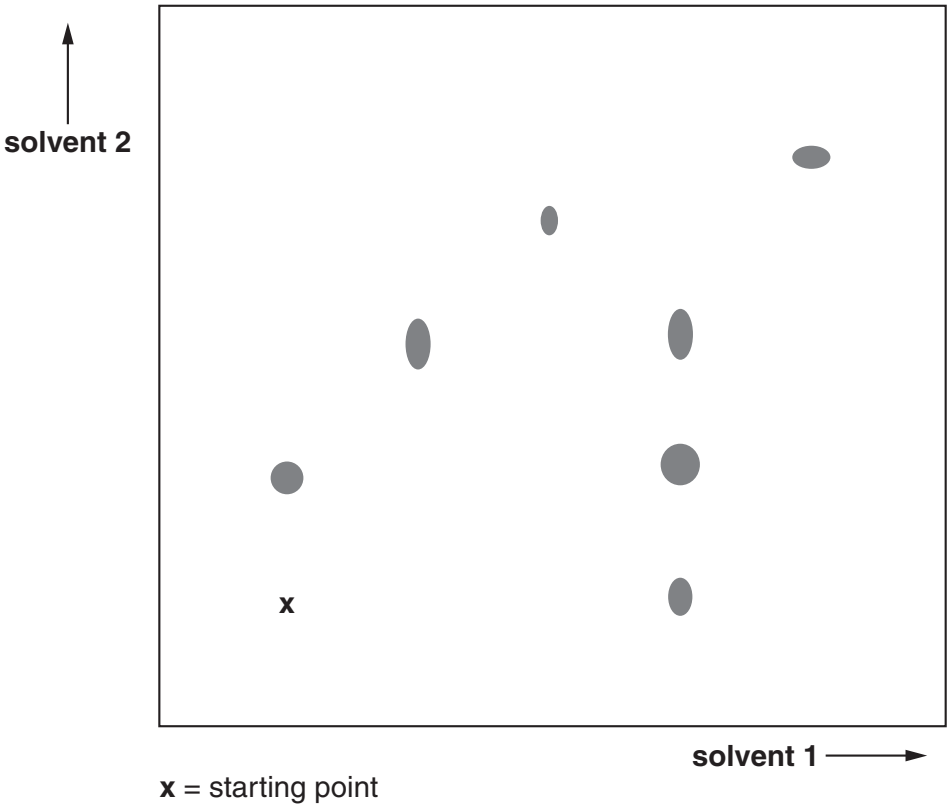
..... **[1]**

(ii) Identify the phases used in partition in each method.

method	stationary phase	mobile phase
glc		
paper		

[2]

(b) The chromatogram below shows the results of two-way chromatography on a mixture of **seven** dyes.



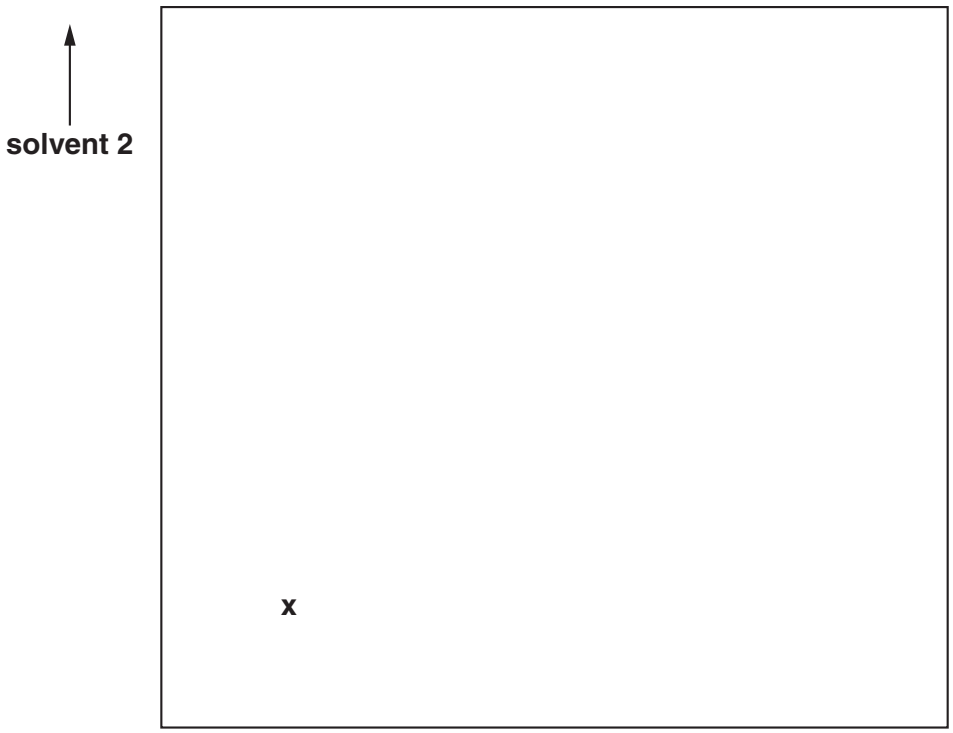
x = starting point

(i) Label, with the letter **D**, the dye that did not move in **solvent 1**. **[1]**

(ii) How many dyes were completely separated by **solvent 1**?

..... **[1]**

(iii) Complete the diagram below to show the chromatogram that would have been obtained using **solvent 2** alone.



x = starting point

[2]

(c) In this question, one mark is available for the quality of spelling, punctuation and grammar.

The composition of a mixture of amino acids may be determined by electrophoresis.

- Outline the principles of electrophoresis.
- Explain how pH affects the structure of amino acids and why it is essential to control pH during the electrophoresis of the mixture of amino acids.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

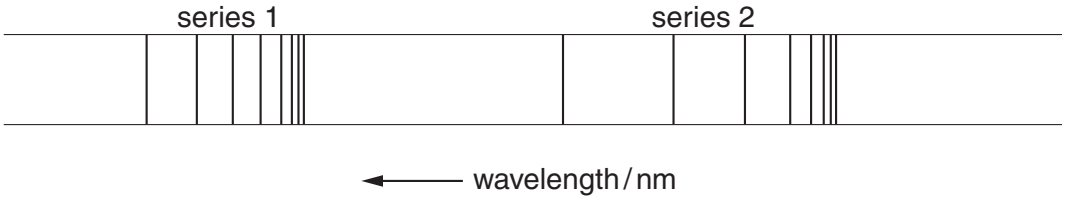
.....

..... **[6]**

Quality of Written Communication **[1]**

[Total: 14]

3 The diagram below shows part of the atomic emission spectrum of hydrogen.



(a) Describe the process which produces the lines in the spectrum.

.....

.....

.....

..... **[2]**

(b) The section of the emission spectrum shown above consists of two separate series of lines.

Why does the emission spectrum contain more than one series?

.....

..... **[1]**

(c) In both series the lines get closer together and converge.

Why do the lines converge?

.....

..... **[1]**

(d) One of the lines in the emission spectrum is produced by an energy transition of 4.85×10^{-19} J.

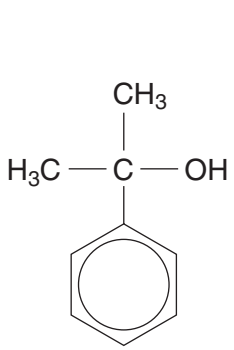
Calculate the wavelength, in **nm**, of the line.

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

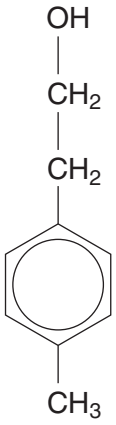
wavelength = ... nm **[3]**

[Total: 7]

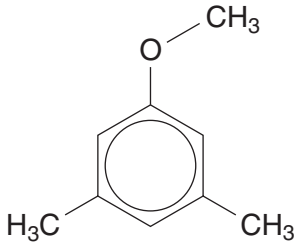
4 Compounds **E**, **F** and **G** are all isomers of $C_9H_{12}O$.



E



F



G

(a) Explain which isomer could most easily be distinguished from the other two by infra-red spectroscopy.

.....

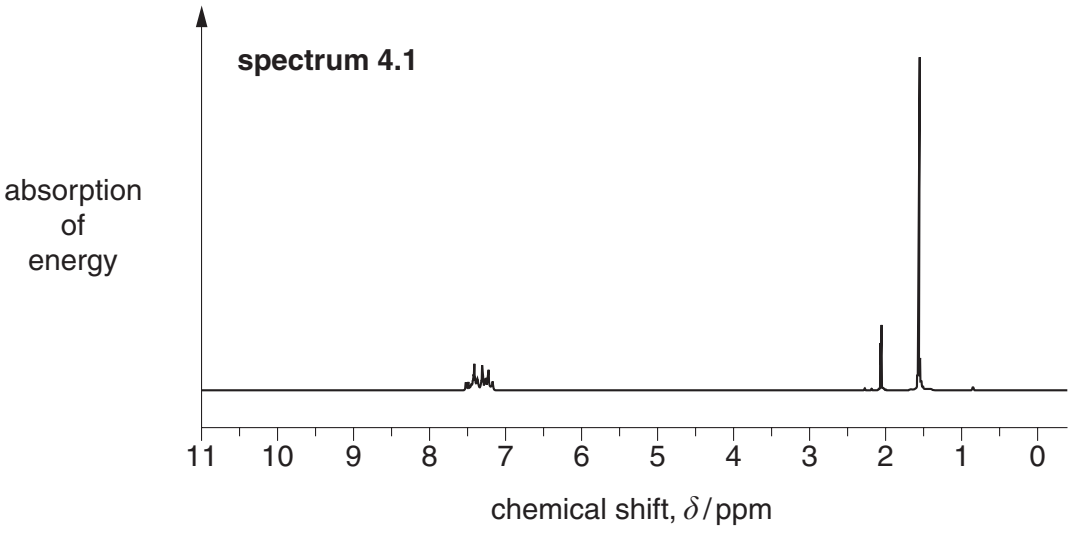
.....

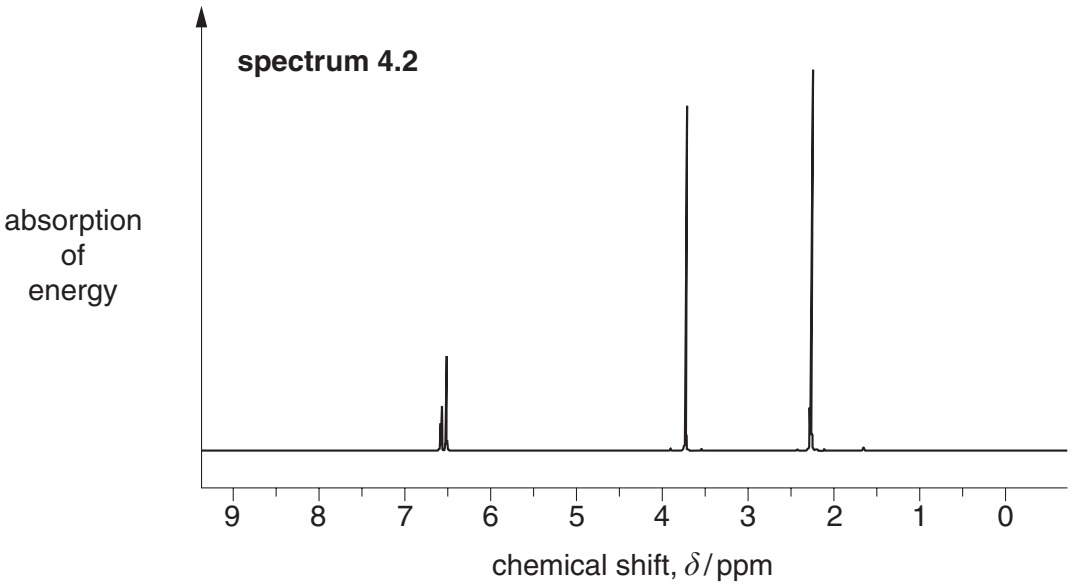
.....

..... **[2]**

(b) N.m.r. spectroscopy can be used to distinguish between isomers **E** and **G**.

The n.m.r spectra that follow are those of isomer **E** and isomer **G**, but not necessarily in that order.





(i) Use chemical shifts to identify which n.m.r. spectrum, **spectrum 4.1** or **spectrum 4.2**, is produced by isomer **E** and isomer **G**. Explain your reasoning.

.....

.....

.....

.....

..... **[3]**

(ii) How could D_2O be used to distinguish between isomer **E** and isomer **G**?

.....

.....

..... **[2]**

(c) Predict the number of peaks, and their relative peak areas, in the n.m.r. spectrum of isomer **F**. State the splitting, if any, of each peak.

.....

.....

.....

..... **[3]**

[Total: 10]

END OF QUESTION PAPER

BLANK PAGE

PLEASE DO NOT WRITE ON THIS PAGE

BLANK PAGE

PLEASE DO NOT WRITE ON THIS PAGE

PLEASE DO NOT WRITE ON THIS PAGE