

**ADVANCED GCE
CHEMISTRY**

Methods of Analysis and Detection

THURSDAY 24 JANUARY 2008

2815/04

Afternoon

Time: 50 minutes

Candidates answer on the question paper.

Additional materials: Scientific calculator
Data Sheet for Chemistry (Inserted)

Candidate
Forename

Candidate
Surname

Centre
Number

--	--	--	--	--

Candidate
Number

--	--	--	--

INSTRUCTIONS TO CANDIDATES

- Write your name in capital letters, your Centre Number and Candidate Number in the boxes above.
- Use blue or black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure you know what you have to do before starting your answer.
- Answer **all** the questions.
- Do **not** write in the bar code.
- Do **not** write outside the box bordering each page.
- Write your answer to each question in the space provided.

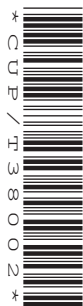
INFORMATION FOR CANDIDATES

- The number of marks for each question 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.

FOR EXAMINER'S USE

Qu.	Max.	Mark
1	12	
2	13	
3	8	
4	12	
TOTAL	45	

This document consists of **10** printed pages, **2** blank pages and a *Data Sheet for Chemistry*.



Answer **all** the questions.

- 1** Chromatography is the separation of the components of a mixture. There are several different types of chromatography but there is always a mobile phase and a stationary phase. The components in the mixture are separated either by adsorption or by partition.

(a) (i) Complete the table below. Some parts have been done for you.

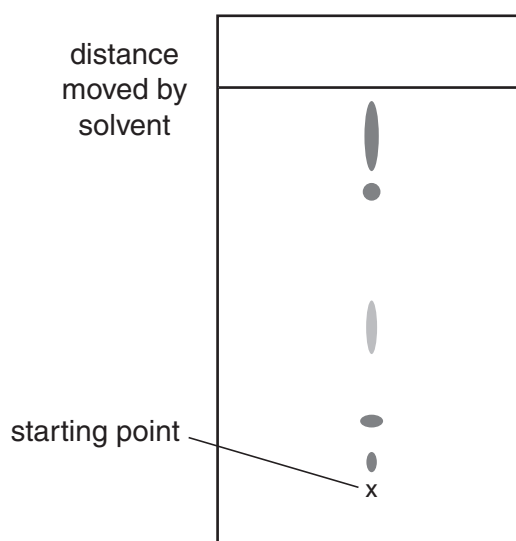
	paper chromatography	thin-layer chromatography	gas/liquid chromatography
mobile phase		solvent	
stationary phase			a non-volatile solvent on a solid support
method of separation	partition		

[6]

- (ii)** In both paper and thin-layer chromatography, components of a mixture can be identified by measuring R_f values. What is meant by R_f value?

[1]

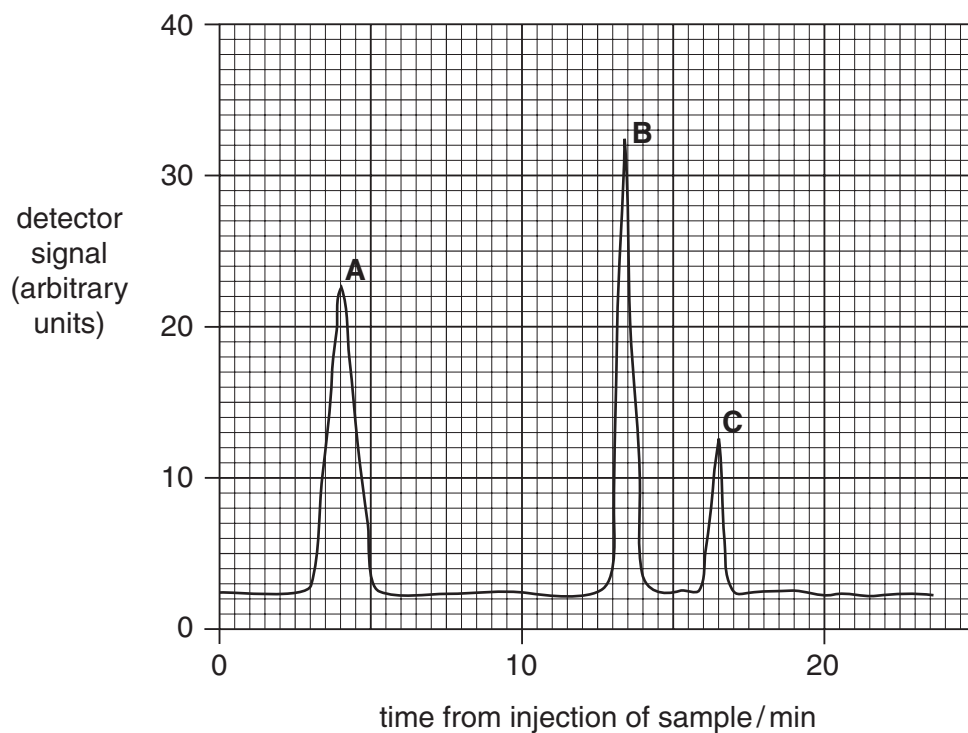
- (iii)** A chromatogram is shown below.



Circle the component that has an R_f value of approximately 0.2.

[1]

- (b) The diagram below shows a gas/liquid chromatogram obtained from a mixture containing three components, **A**, **B** and **C**.



- (i) Which component is the most volatile? Explain your reasoning.

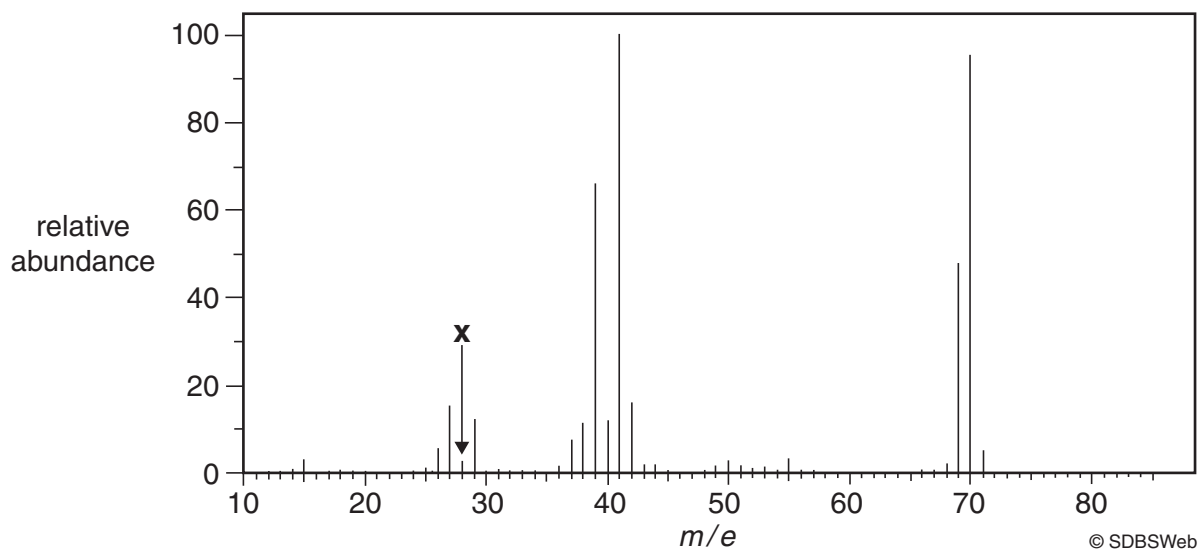
The most volatile component is component because
 [1]

- (ii) Calculate the percentage abundance of component **B** in the mixture.

answer = [3]

[Total: 12]

- 2 Compound **D** contains carbon, hydrogen and oxygen only. The mass spectrum of **D** is shown below.



- (a) The ratio of the $M : (M + 1)$ peaks is 95.3 : 4.2.

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

..... [1]

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

[2]

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

[3]

- (b) Compound **D** contains both a $C=C$ double bond and a $C=O$ double bond. The ion responsible for peak **X**, in the mass spectrum above, is CH_3CH^+ .

Deduce the structural formula of compound **D**.

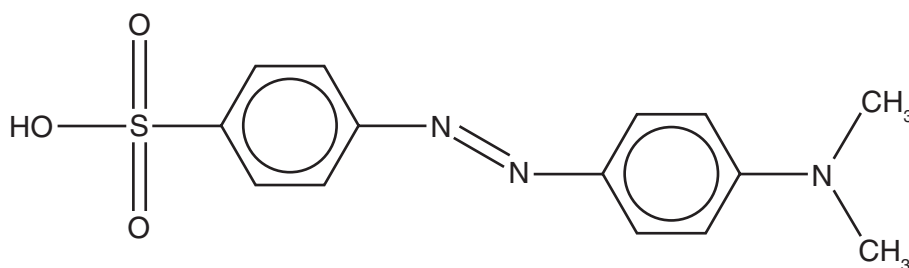
[1]

- (c) The C=C double bond and the C=O double bond in compound **D** are both chromophores.

Explain what is meant by the term *chromophore*.

.....
 [1]

- (d) Compound **D** is colourless but methyl orange, shown below, is coloured. Explain why.



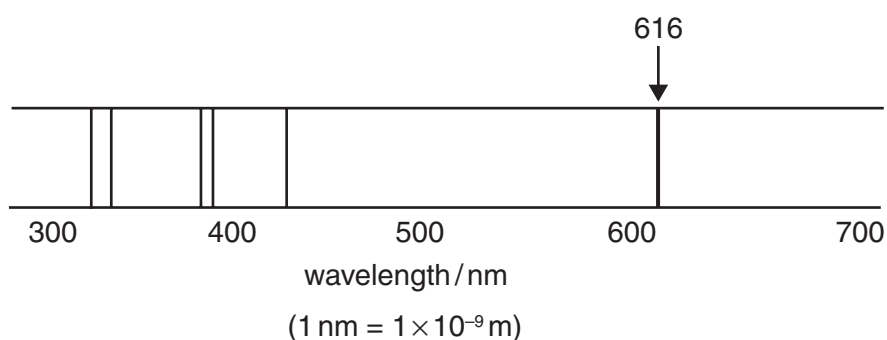
methyl orange

.....

 [3]

- (e) When a compound of calcium is heated in a flame it gives a distinctive orange-red colour.

Part of the spectrum obtained from the flame is shown below.



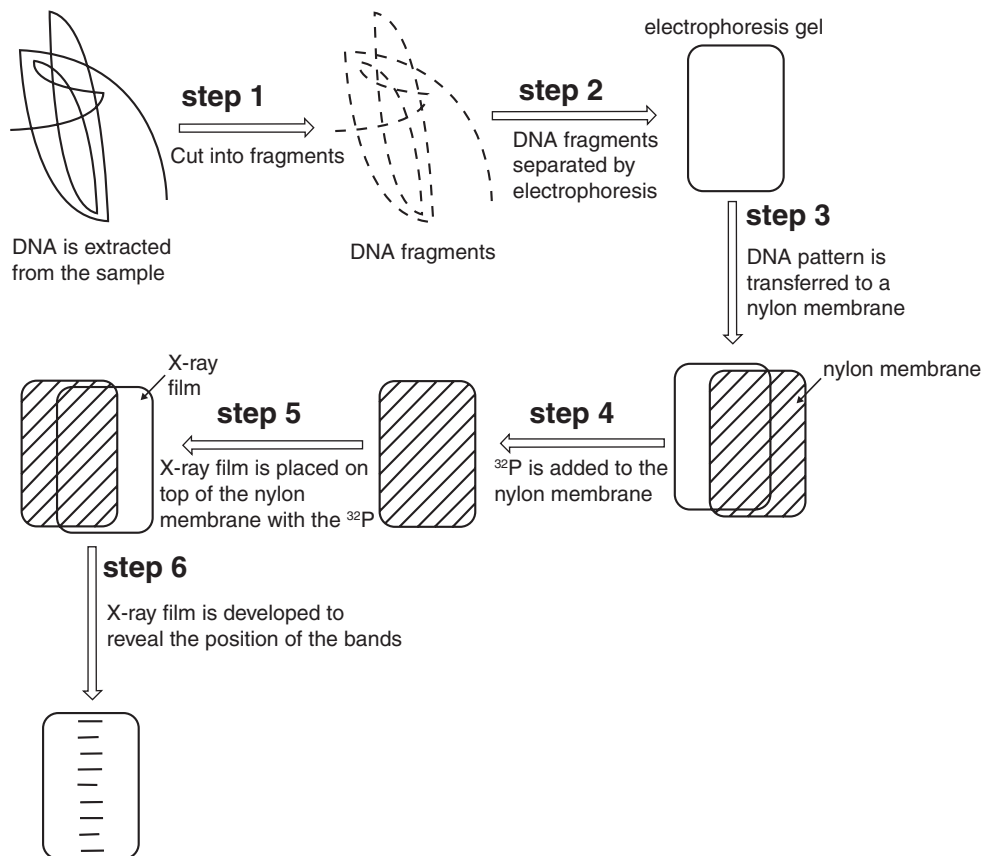
Calculate the energy of the line at 616 nm. Quote your answer to **three** significant figures.

$$c = 3.00 \times 10^8 \text{ ms}^{-1}; h = 6.63 \times 10^{-34} \text{ Js}$$

energy = J [2]

[Total: 13]

3 The flow diagram below outlines the steps required to obtain a genetic fingerprint.



(a) In **step 1**, the DNA is 'cut' into fragments.

State what is used to cut the DNA into fragments.

..... [1]

(b) In **step 2**, the fragments are separated using electrophoresis.

(i) Outline the process of electrophoresis.

.....

 [2]

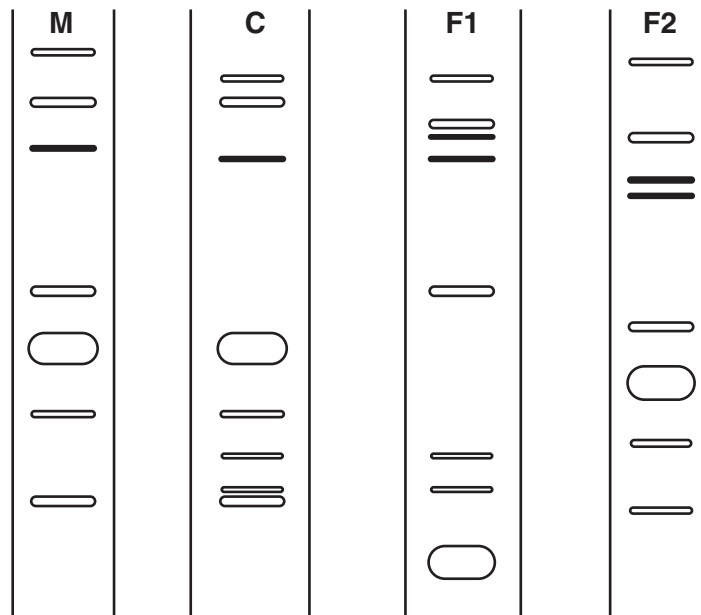
(ii) State the factors that determine how separation is achieved.

.....
 [2]

- (c)** In **step 4**, ^{32}P is added to the nylon membrane containing the DNA fragments. Explain the role of ^{32}P in **steps 4 to 6**.

..... [2]

- (d)** DNA genetic fingerprints can be used to determine parenthood. The fingerprints below show the DNA of the mother (**M**), of the child (**C**) and of the two possible fathers (**F1** and **F2**).



Use the fingerprints to identify which of **F1** or **F2** is the father.

The father is

Circle **three** bands on the father's fingerprint that you have used to help with the identification. [1]

[Total: 8]

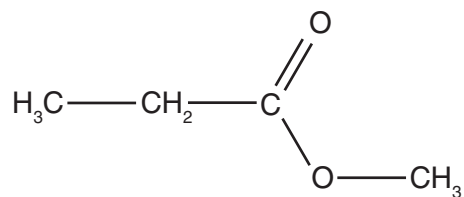


- Describe the similarities and differences in the infra-red and the mass spectra of compounds **X** and **Y**.

[8]

© OCR 2008

- (b) The n.m.r. spectrum of another compound, **Z**, shows three different proton environments. The structure of **Z** is shown below.

**Z**

Complete the table below for the protons in compound **Z**.

proton environment	chemical shift/ δ	splitting pattern	relative peak area
$-\text{O}-\text{CH}_3$			
$-\text{CH}_2-\text{CO}$			
$\text{CH}_3-\text{C}-$			

[3]

[Total: 12]

END OF QUESTION PAPER

10
BLANK PAGE

PLEASE DO NOT WRITE ON THIS PAGE

11
BLANK PAGE

PLEASE DO NOT WRITE ON THIS PAGE

PLEASE DO NOT WRITE ON THIS PAGE

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.

© OCR 2008