OCR
RECOGNISING ACHIEVEMENT

OXFORD CAMBRIDGE AND RSA EXAMINATIONS
Advanced GCE

CHEMISTRY 2815/04

Methods of Analysis and Detection

Wednesday **29 JANUARY 2003** Afternoon 50 minutes

Candidates answer on the question paper.
Additional materials:
Data Sheet for Chemistry
Scientific calculator

Candidate Name	Centre Number	Candidate Number

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	8	
2	15	
3	12	
4	10	
TOTAL	45	

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

For Examiner's Use

Answer **all** the questions.

1 When an atom of an element such as krypton is excited, the spectrum consists of a series of lines.

(a) Why do spectra such as that of krypton consist of lines?

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.....

.....[2]

(b) **(i)** Explain what is meant by the term *convergence limit*.

.....

.....[1]

(ii) Sketch a spectrum to show a convergence limit, labelling that point.

frequency / Hz ⟶

[2]

(c) The emission spectrum of atomic krypton has a line at a wavelength of 557 nm.

Calculate the energy of the quantum of electromagnetic radiation which gives this line.
the Planck constant = 6.63×10^{-34} J s;
the velocity of light = 3.00×10^{8} m s^{-1}.

answer ..... J [2]

(d) Give **one** example of the use of atomic emission spectroscopy in modern analytical techniques.

.....[1]

[Total: 8]

2 Chromatography is the name given to a range of techniques which may be used to separate mixtures. The techniques use the principles of partition and adsorption.

(a) Give **one** example of partition chromatography and **one** of adsorption chromatography.

partition .....

adsorption .....

[2]

(b) What does the term *retention time*, as used in gas/liquid chromatography, mean?

.....

.....[1]

(c) Using gas/liquid chromatography as an example, state clearly what is meant by the following terms.

mobile phase .....

.....

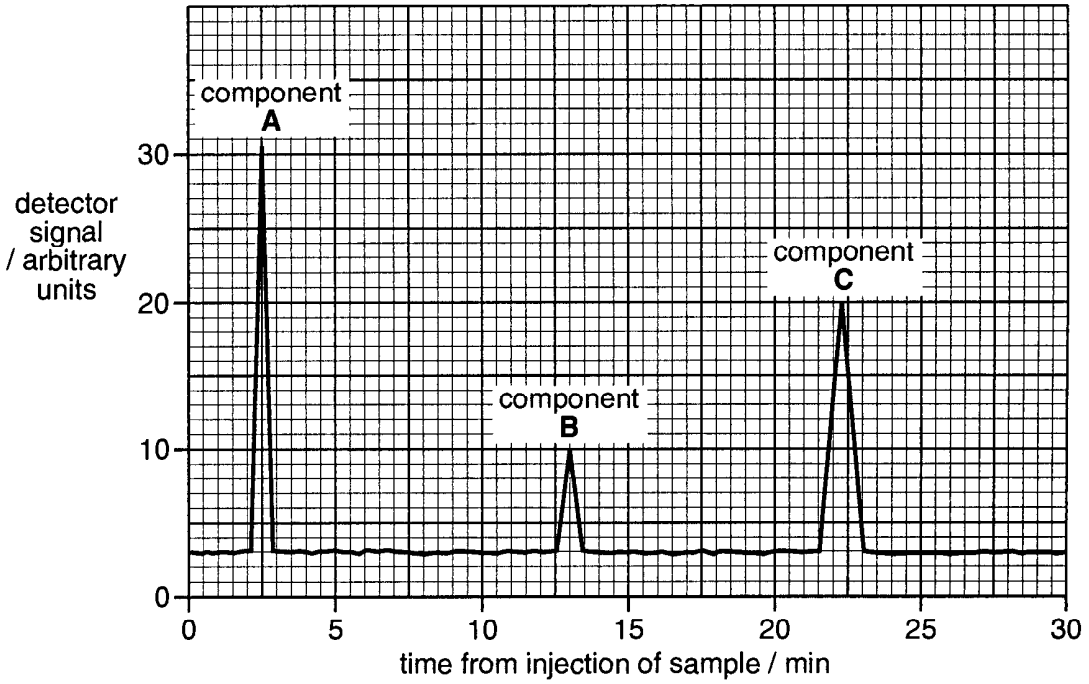
stationary phase .....

.....

[2]

For Examiner's Use

(d) The diagram shows the output from a gas/liquid chromatograph. Determine the percentage of each component in the mixture.



percentage **A** .....

percentage **B** .....

percentage **C** .....[3]

For Examiner's Use

(e) In this question, one mark is awarded for the quality of written communication.

Another separation technique is electrophoresis, which is used for separating biological molecules.

- Describe a simple experiment to illustrate electrophoresis.
- During electrophoresis, different amino acids move in different directions, or do not move at all. Explain why.

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.....[6]

Quality of Written Communication [1]

[Total: 15]

For Examiner's Use

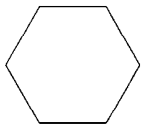
3 A large number of organic compounds absorb energy in the ultraviolet/visible region of the spectrum. This occurs as a result of transitions between electronic energy levels in molecules.

(a) Give **two** features in organic molecules which are responsible for absorptions in the ultraviolet/visible region.

feature 1 .....

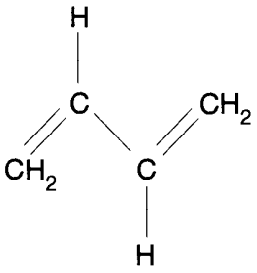
feature 2 .....[2]

(b) Predict which of the molecules shown will absorb in the ultraviolet/visible region, by circling the relevant molecules.

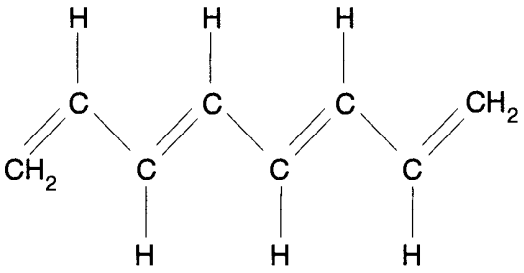
CH_3CH_2OH  CH_3CH_3 CH_3CHO

[2]

(c) Compounds **D** and **E** are shown below.



compound D



compound E

Compound **D** is colourless and absorbs in the ultraviolet region. Compound **E** is pale yellow, absorbing in the visible region of the spectrum.

Explain why there is a difference in the absorptions of the two compounds.

.....

.....

.....

.....[3]

(d) A hydrocarbon **F** absorbs in the ultraviolet region of the spectrum. When **F** reacts with bromine, a new compound **G** is formed. The original absorption disappears and a new peak appears in a different part of the ultraviolet region.

(i) Suggest what structural feature is responsible for the absorption in **F**.

.....[1]

(ii) Suggest why compound **G** shows a new absorption in the ultraviolet region.

.....

.....

.....[2]

(e) The mass spectrum of **F** shows a small (M + 1) peak, whereas that of **G** shows both a small (M + 1) peak and an (M + 2) peak.

Suggest explanations for these observations.

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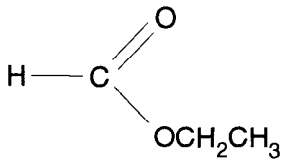
.....[2]

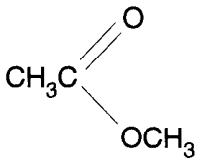
[Total: 12]

For Examiner's Use

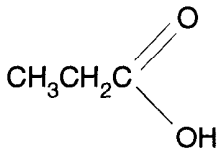
4 A compound **J** is known to have one of the structures shown below.



I



II



III

(a) (i) The infrared spectrum of **J** showed a strong broad peak at 3450 cm^{-1}. State which structure this suggests for **J**, outlining your reasoning.

.....

.....

.....[2]

(ii) The nuclear magnetic resonance spectrum of **J** includes a triplet of peaks and a quartet of peaks. Addition of D_2O to **J** causes another peak in the spectrum to disappear.

- explain which groups of protons in the molecule are responsible for the triplet and quartet of peaks.

.....

.....

.....

- explain why the other peak disappears on addition of D_2O.

.....

.....

.....[4]

(b) (i) Explain how the addition of D_2O to **J** could be used to distinguish between structures **I** and **III**.

.....

.....

.....[2]

(ii) Suggest how the mass spectrum of **J** might provide additional evidence for its structure.

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.....[2]

[Total: 10]