OCR
RECOGNISING ACHIEVEMENT

OXFORD CAMBRIDGE AND RSA EXAMINATIONS
Advanced Subsidiary GCE

CHEMISTRY 2812

Chains and Rings

Tuesday **11 JANUARY 2005** Morning 1 hour

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

Candidate Name	Centre Number	Candidate Number

TIME 1 hour

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		
Question Number	Max.	Mark
1	13	
2	10	
3	12	
4	14	
5	11	
TOTAL	60	

This question paper consists of 12 printed pages.

Registered Charity Number: 1066969
[Turn over

Answer **all** the questions.

1 Compound **A** is a chloroalkene with the percentage composition by mass: C, 24.7%; H, 2.1%; C*l*, 73.2%.

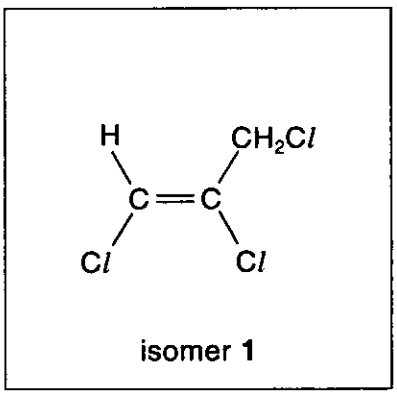
(a) (i) Calculate the empirical formula of compound **A**. Show your working.

[2]

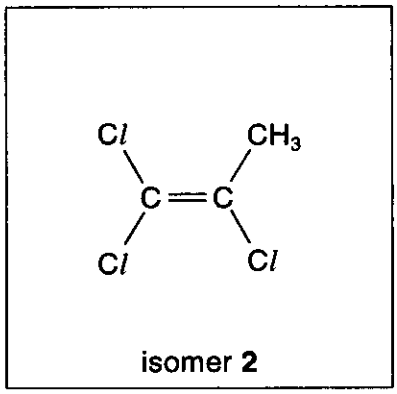
(ii) The relative molecular mass of compound **A** is 145.5. Show that the molecular formula is $C_3H_3Cl_3$.

[2]

(b) Compound **A** is one of six possible structural isomers of $C_3H_3Cl_3$ that are chloroalkenes. Two of these isomers are shown below as isomer **1** and isomer **2**.



isomer **1**



isomer **2**

(i) Draw two other structural isomers of $C_3H_3Cl_3$ that are chloroalkenes.

[2]

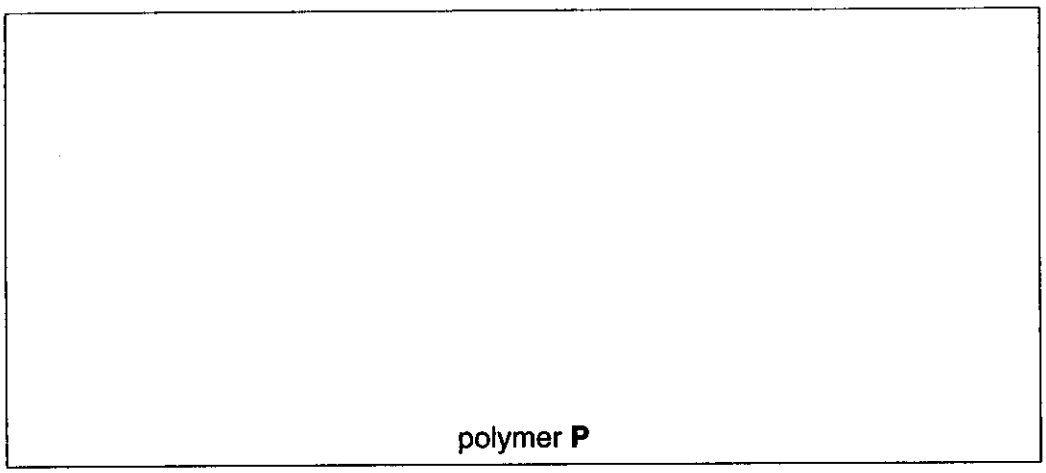
(ii) Name isomer **1**. .....[2]

For Examiner's Use

(c) All of the isomers in **(b)** readily polymerise.

(i) Draw a section of the polymer **P** that could be formed when isomer **2** polymerises.

Show two repeat units.



[2]

(ii) Addition polymers can be difficult to dispose of.

State **two** general problems in the disposal of polymers and identify an extra problem when disposing of polymer **P**.

.....

.....

.....

.....

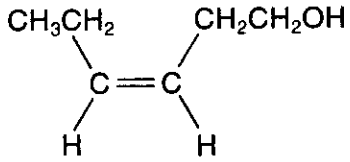
.....[3]

[Total: 13]

[Turn over

For Examiner's Use

2 *Cis*-hex-3-en-1-ol is a colourless liquid also known as leaf alcohol. It has a powerful smell of newly cut grass and it occurs naturally in a variety of plants, such as geranium, thyme and tea. The structural formula of leaf alcohol is shown below.



leaf alcohol

(a) Draw the organic product(s) formed when leaf alcohol reacts with

(i) hydrogen in the presence of a suitable catalyst,

[1]

(ii) sodium,

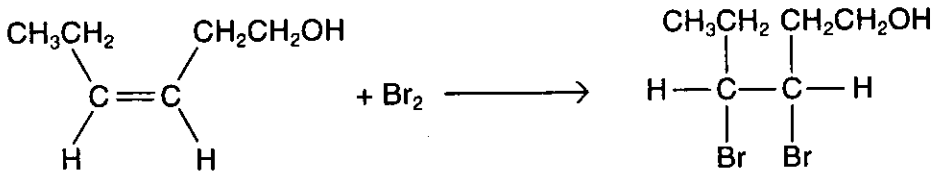
[1]

(iii) **excess** hydrogen bromide.

[3]

For Examiner's Use

(b) Leaf alcohol reacts with bromine as shown in the equation below.



(i) State what you would **see** when bromine reacts with leaf alcohol.

.....[1]

(ii) Complete, with the aid of curly arrows, the mechanism involved in the reaction between leaf alcohol and bromine. Show any relevant dipoles, charges and lone pairs of electrons.

[4]

[Total: 10]

[Turn over

3 **(a)** Part of the label from a 'Body Spray' deodorant is shown below.

Ingredients:
butane,
2-methylpropane,
propane,
methyl-1-ethyl myristate.

Does not contain CFCs which damage ozone.

Extremely Flammable

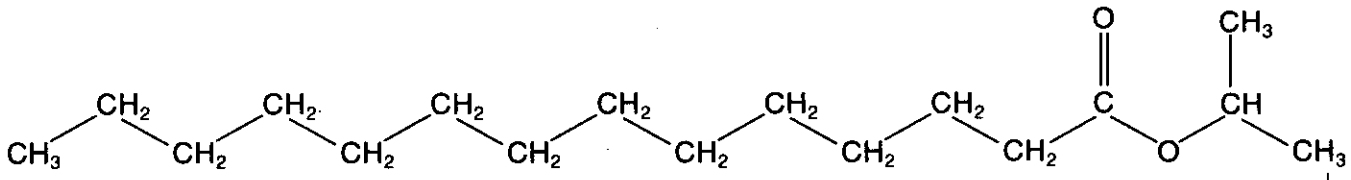
The alkanes act as the propellant and are nowadays commonly used as alternatives to CFCs. The alkanes are highly flammable.

(i) What is the **molecular** formula of 2-methylpropane? .....[1]

(ii) Write a balanced equation for the complete combustion of butane.

.....[2]

Methyl-1-ethyl myristate is an ester and can be made by reaction of an alcohol with a carboxylic acid. The structure of methyl-1-ethyl myristate is shown below.



(iii) Identify the alcohol used.

[1]

For Examiner's Use

(b) Trifluorochloromethane, CF_3Cl, is an example of a chlorofluorocarbon, CFC, that was commonly used as a propellant in aerosols. Nowadays, CFCs have limited use because of the damage caused to the ozone layer.

(i) Draw a diagram to show the shape of a molecule of CF_3Cl.

[1]

(ii) Predict an approximate value for the bond angles in a molecule of CF_3Cl.

bond angle ..... [1]

(iii) Suggest a property that made CF_3Cl suitable as a propellant in an aerosol.

.....[1]

(iv) When CFCs are exposed to strong ultraviolet radiation in the upper atmosphere, homolytic fission takes place to produce free radicals.

Explain what is meant by the term *homolytic fission*.

.....

.....[2]

(v) Suggest which bond is most likely to be broken when CF_3Cl is exposed to ultraviolet radiation. Explain your answer.

bond .....

reason .....

.....[1]

(vi) Identify the **two** free radicals most likely to be formed when CF_3Cl is exposed to ultraviolet radiation.

..... and .....[2]

[Total: 12]

[Turn over

For Examiner's Use

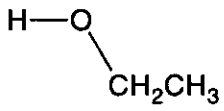
4 Ethanol, C_2H_5OH, can be produced by the fermentation of glucose, $C_6H_{12}O_6$.

(a) Write a balanced equation for the fermentation of glucose.

.....[2]

(b) Ethanol has a relatively high boiling point. This can be explained in terms of intermolecular hydrogen bonds.

Draw a second molecule of ethanol alongside the one drawn below and show how a hydrogen bond could be formed. Clearly show any relevant dipoles and lone pairs of electrons.



[3]

(c) When ethanol is heated with acidified potassium dichromate(VI) solution, it can be oxidised to form either ethanal, CH_3CHO (Fig. 4.1), or ethanoic acid, CH_3COOH (Fig. 4.2).

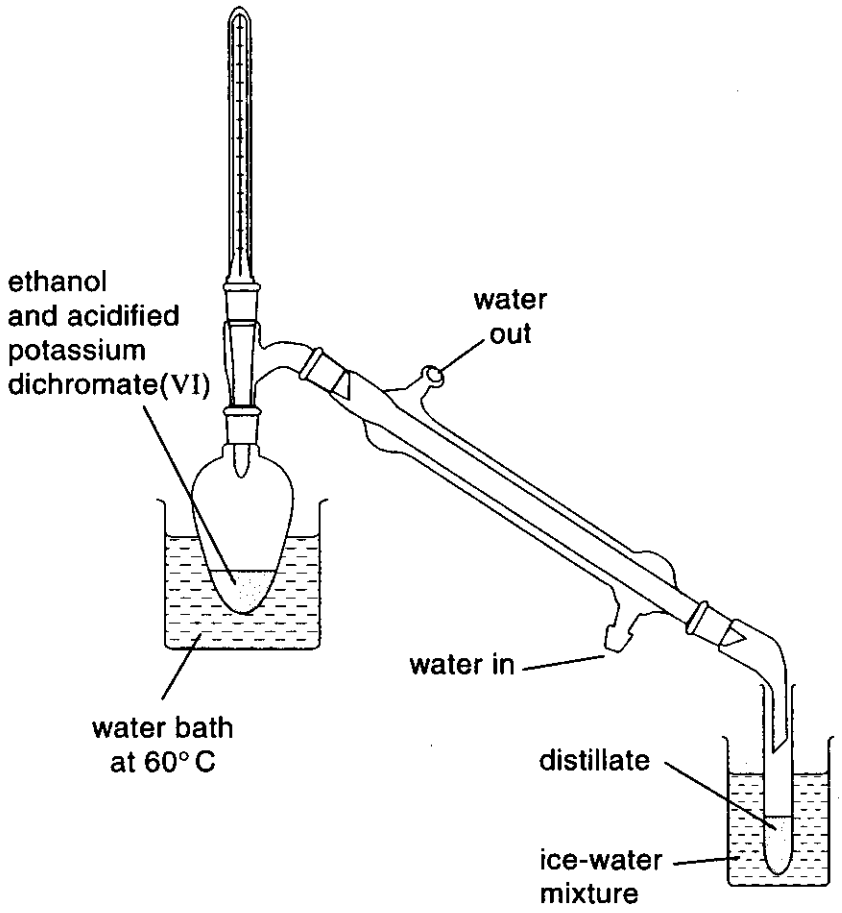


Fig. 4.1

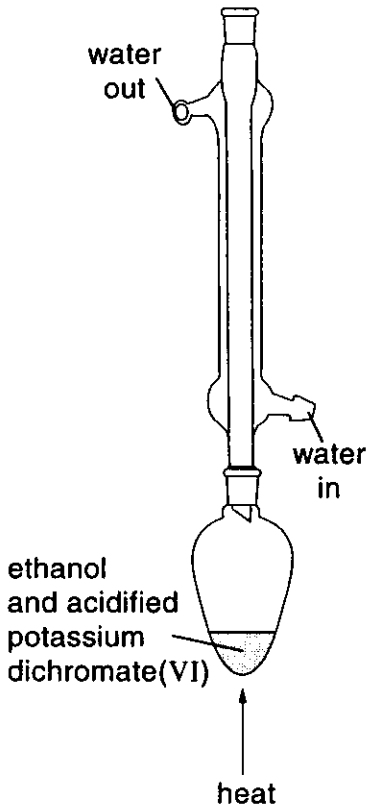


Fig. 4.2

The boiling points of ethanol, ethanal and ethanoic acid are given in the table below.

	CH_3CH_2OH	CH_3CHO	CH_3COOH
boiling point / °C	78	21	118

Use this table of boiling points to explain

(i) why the organic product is likely to be ethanal if the apparatus shown in Fig. 4.1 is used,

.....

.....[2]

(ii) why the organic product is likely to be ethanoic acid if the apparatus shown in Fig. 4.2 is used.

.....

.....[2]

(d) Write a balanced equation for the oxidation of ethanol to ethanoic acid. Use [O] to represent the oxidising agent.

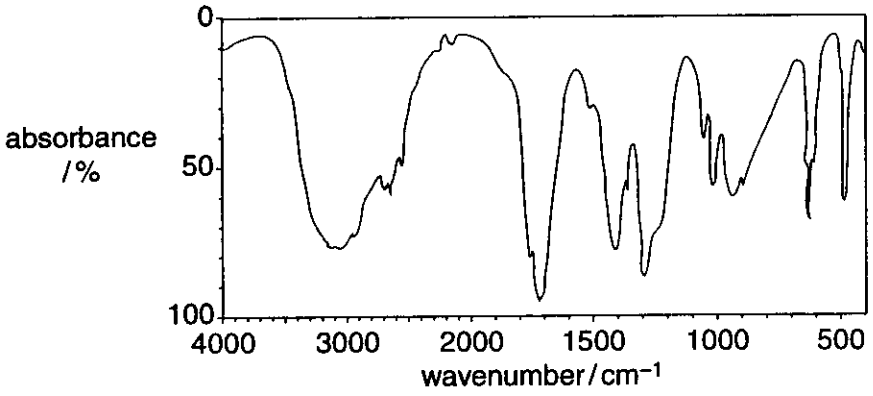
.....[2]

[Turn over

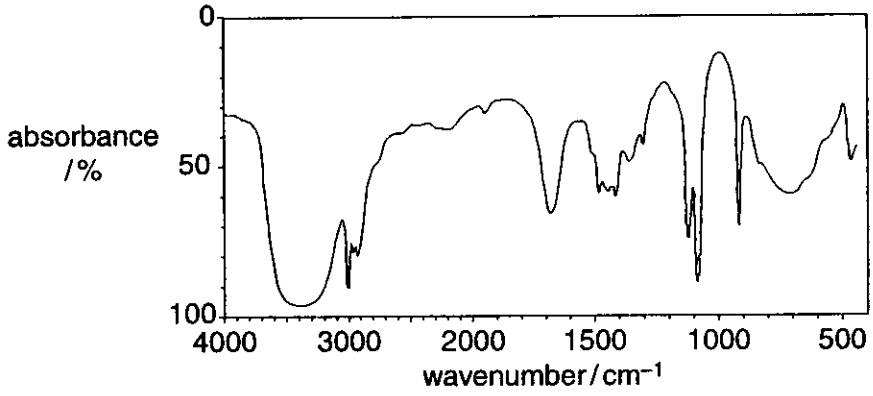
For Examiner's Use

(e) The ethanal collected using the apparatus shown in Fig. 4.1 was analysed by infra-red spectroscopy. Use your *Data Sheet* to justify which of the three spectra shown below is most likely to be that of ethanal.

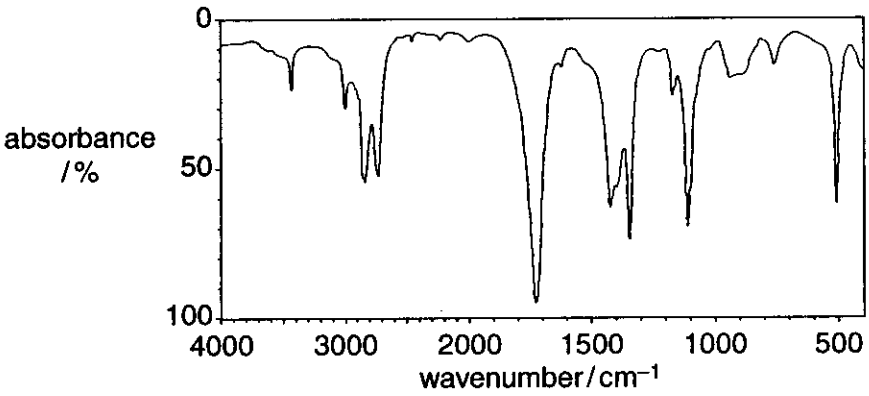
spectrum **A**



spectrum **B**



spectrum **C**



The organic product collected when using the apparatus shown in Fig. 4.1 is most likely to be that shown by spectrum ..... because.....

.....

.....[3]

[Total: 14]

For Examiner's Use

5 In this question, one mark is available for the quality of use and organisation of scientific terms.

Different cars require different grades of petrol. The first stage in the production of petrol in an oil refinery is to fractionate the crude oil. After that, refineries carry out further processes.

- Outline, with the aid of equations, **three** of these processes in the production of petrol.
- Explain why, in the long term, ethanol could replace oil-based fuels.
- Write an equation for the combustion of ethanol.

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Quality of Written Communication [1]

[Total: 11]

END OF QUESTION PAPER