

OXFORD CAMBRIDGE AND RSA EXAMINATIONS

Advanced Subsidiary GCE

CHEMISTRY

Chains and Rings

2812

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												
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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.

Answer **all** the questions.

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

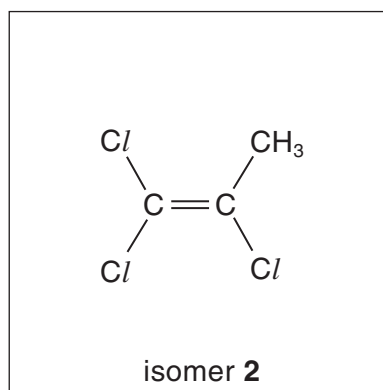
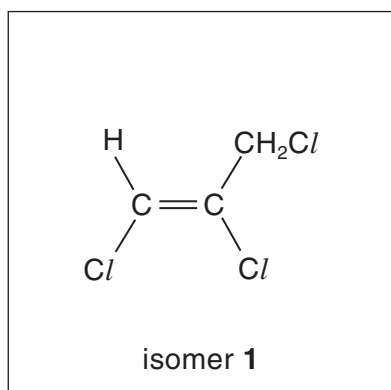
(a) (i) Calculate the empirical formula of compound **A**. Show your working.

[2]

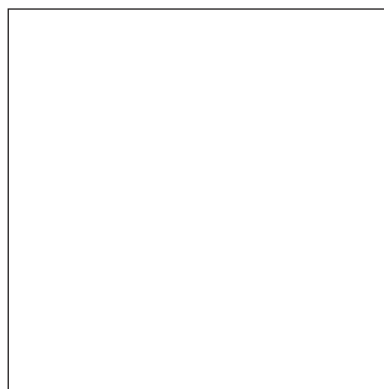
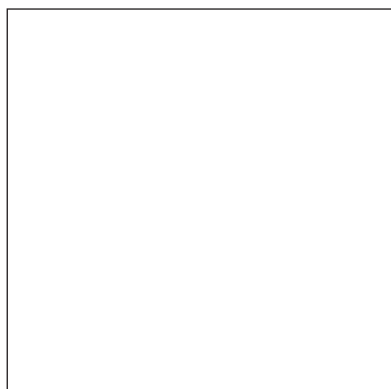
(ii) The relative molecular mass of compound **A** is 145.5. Show that the molecular formula is $C_3H_3Cl_3$.

[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.



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



[2]

(ii) Name isomer 1.[2]

(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.

polymer **P**

[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**.

.....

.....

.....

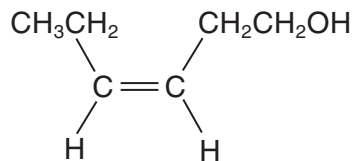
.....

.....

[3]

[Total: 13]

- 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,



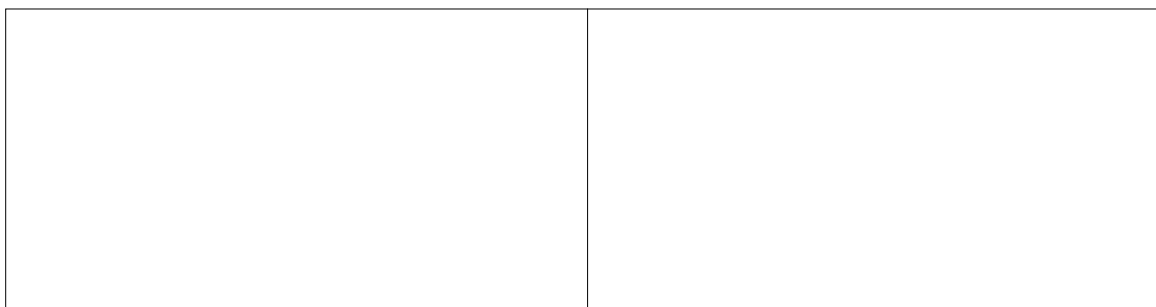
[1]

- (ii) sodium,



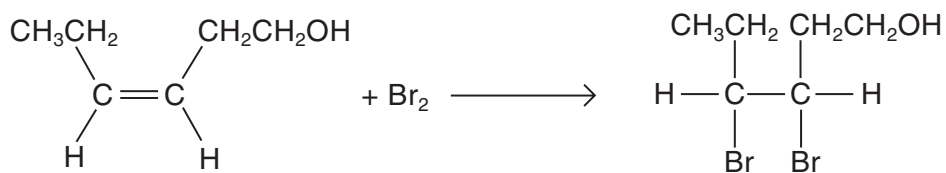
[1]

- (iii) **excess** hydrogen bromide.



[3]

(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]

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

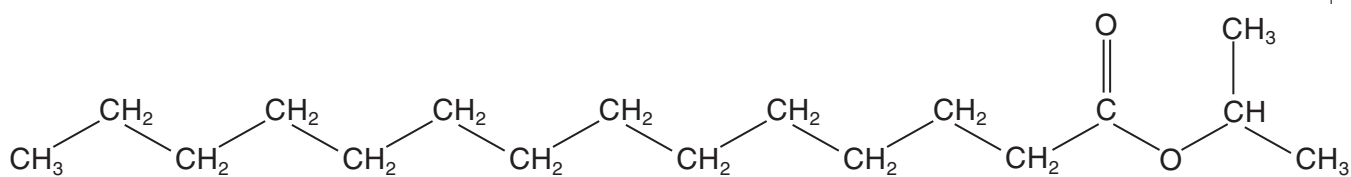
<p>Ingredients: butane, 2-methylpropane, propane, methyl-1-ethyl myristate.</p> <p>Does not contain CFCs which damage ozone.</p>	 Extremely Flammable
--	---

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]

(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]

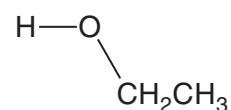
4 Ethanol, C_2H_5OH , can be produced by the fermentation of glucose, $C_6H_{12}O_6$.

(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).

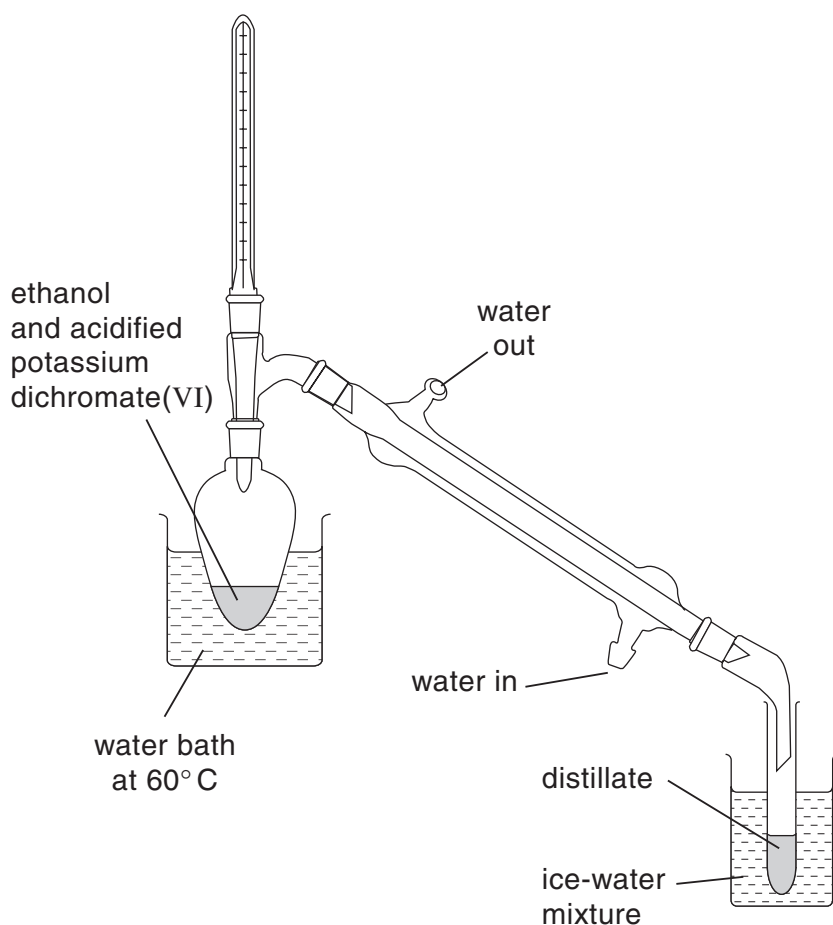


Fig. 4.1

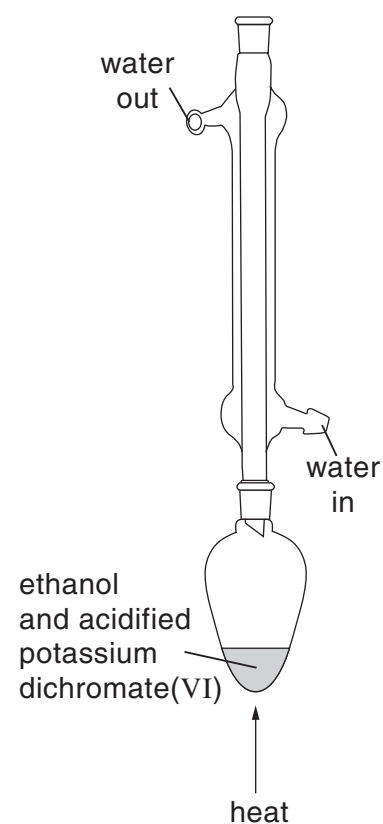


Fig. 4.2

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

	$\text{CH}_3\text{CH}_2\text{OH}$	CH_3CHO	CH_3COOH
boiling point / $^\circ\text{C}$	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.

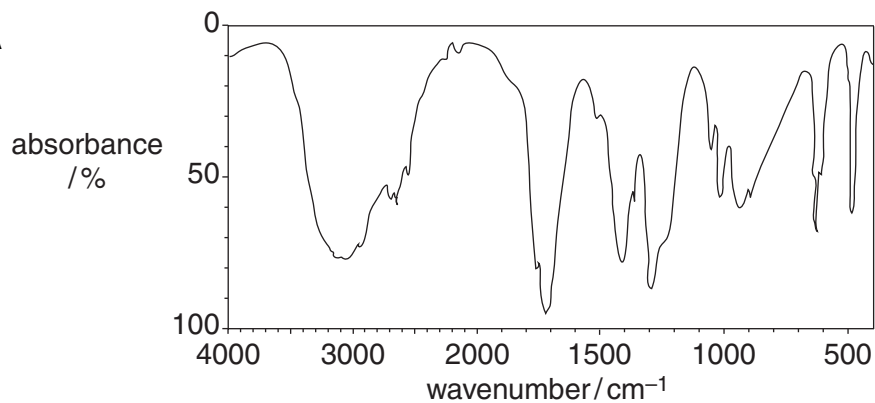
.....
.....[2]

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

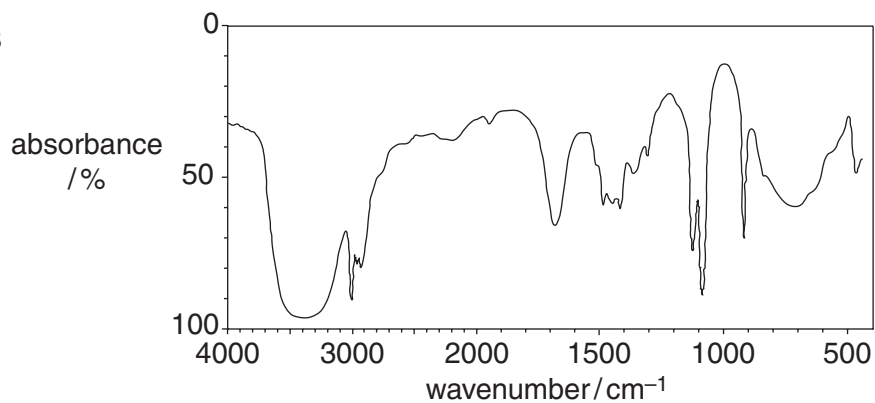
.....[2]

- (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.

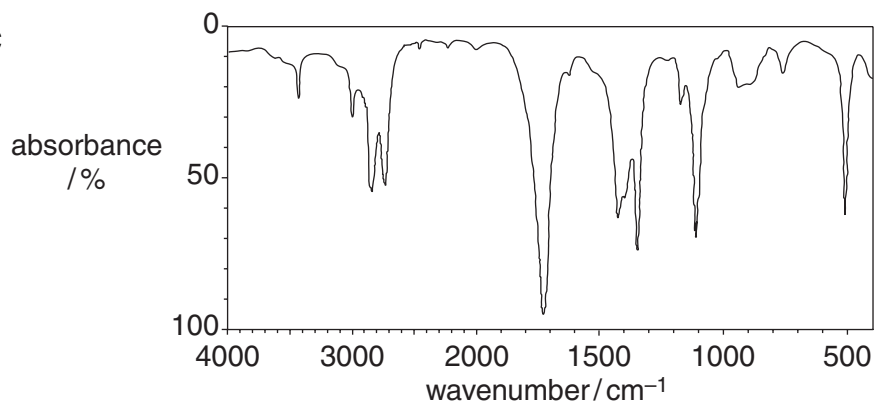
spectrum A



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]

