

**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	
<b>TOTAL</b>	<b>60</b>	

**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%.

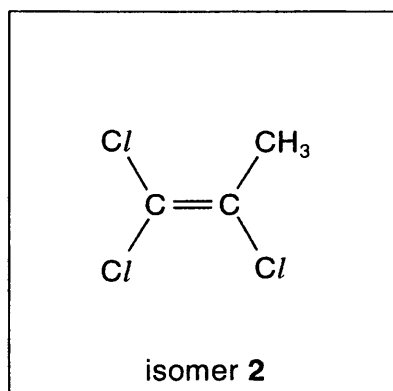
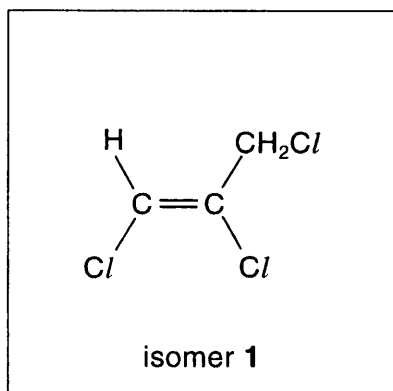
(a) (i) Calculate the empirical formula of compound **A**. Show your working.

[2]

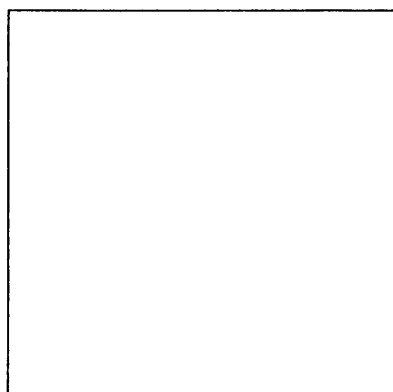
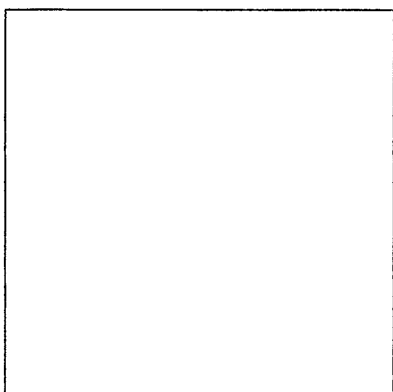
(ii) The relative molecular mass of compound **A** is 145.5. Show that the molecular formula is  $C_3H_3Cl_3$ .

[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.



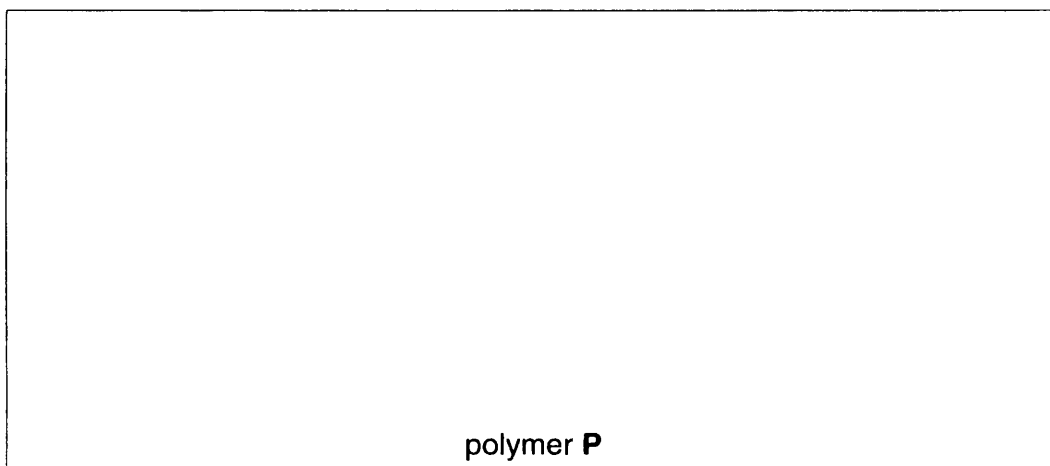
[2]

(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**.

.....

.....

.....

.....

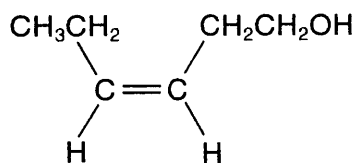
.....

.....

[3]

[Total: 13]

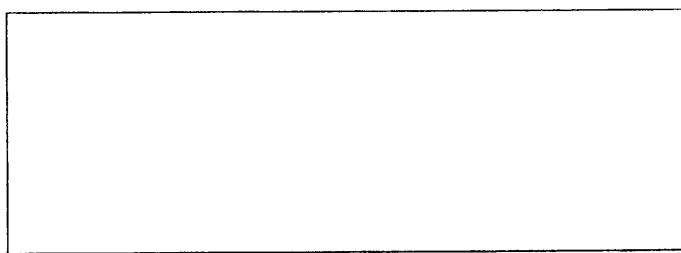
- 2 *Cis*-hex-3-en-1-ol is a colourless liquid also known as leaf alcohol. It has a powerful smell of newly cut grass and it occurs naturally in a variety of plants, such as geranium, thyme and tea. The structural formula of leaf alcohol is shown below.



**leaf alcohol**

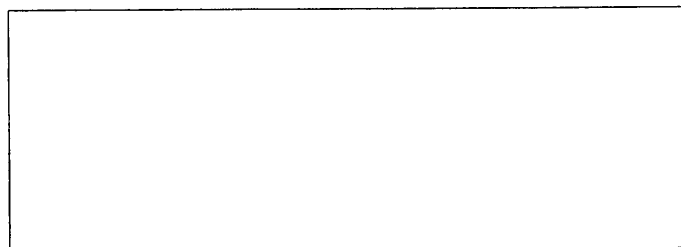
- (a) Draw the organic product(s) formed when leaf alcohol reacts with

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



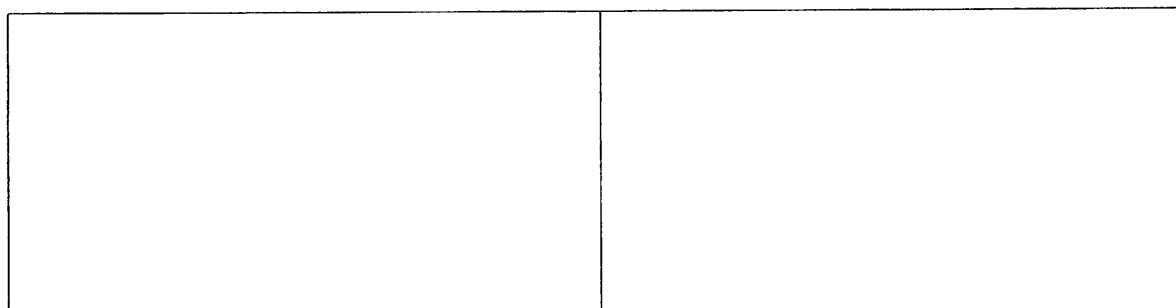
[1]

- (ii) sodium,



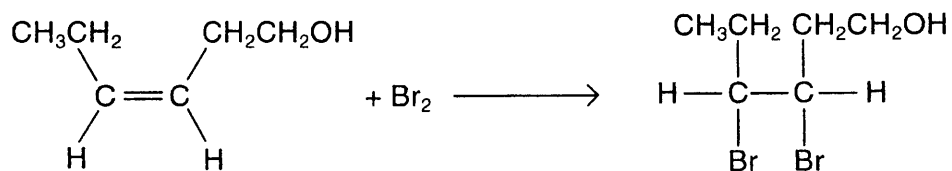
[1]

- (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]



(b) Trifluorochloromethane,  $\text{CF}_3\text{Cl}$ , 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  $\text{CF}_3\text{Cl}$ .

[1]

(ii) Predict an approximate value for the bond angles in a molecule of  $\text{CF}_3\text{Cl}$ .

bond angle .....

[1]

(iii) Suggest a property that made  $\text{CF}_3\text{Cl}$  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  $\text{CF}_3\text{Cl}$  is exposed to ultraviolet radiation. Explain your answer.

bond .....

reason .....

.....[1]

(vi) Identify the **two** free radicals most likely to be formed when  $\text{CF}_3\text{Cl}$  is exposed to ultraviolet radiation.

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

[Total: 12]

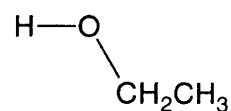
4 Ethanol,  $C_2H_5OH$ , can be produced by the fermentation of glucose,  $C_6H_{12}O_6$ .

(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).

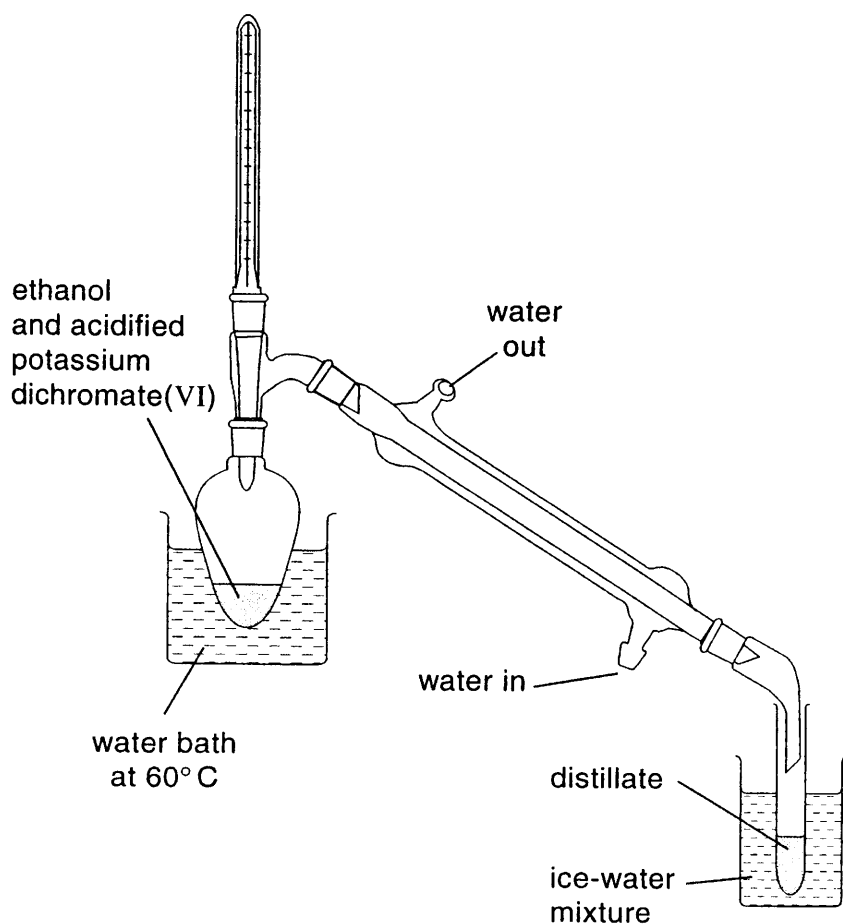


Fig. 4.1

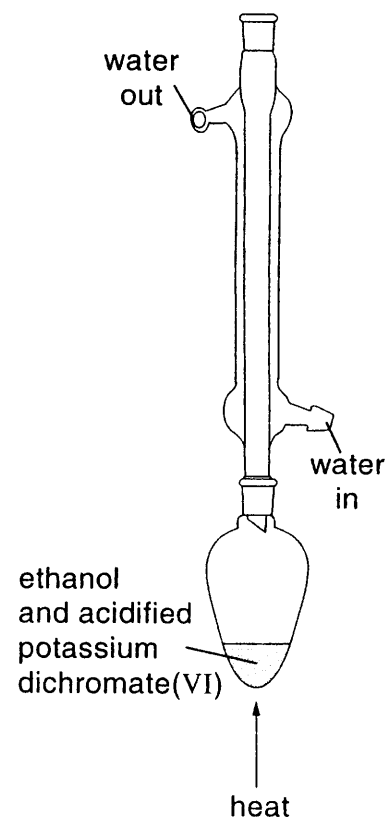


Fig. 4.2



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

	$\text{CH}_3\text{CH}_2\text{OH}$	$\text{CH}_3\text{CHO}$	$\text{CH}_3\text{COOH}$
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.

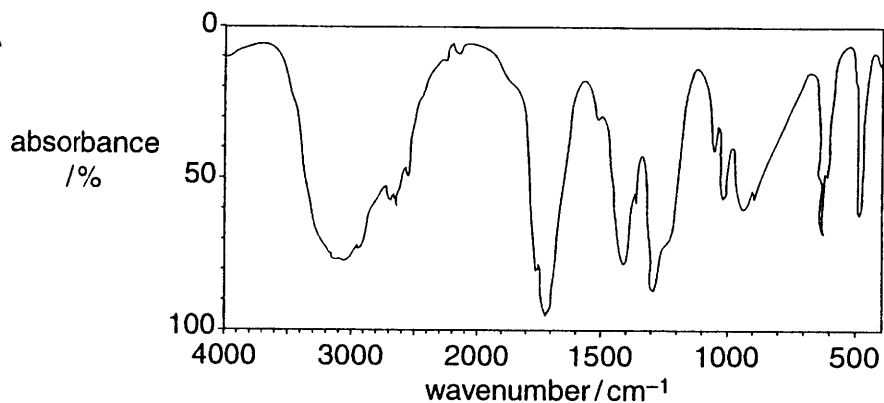
.....  
.....[2]

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

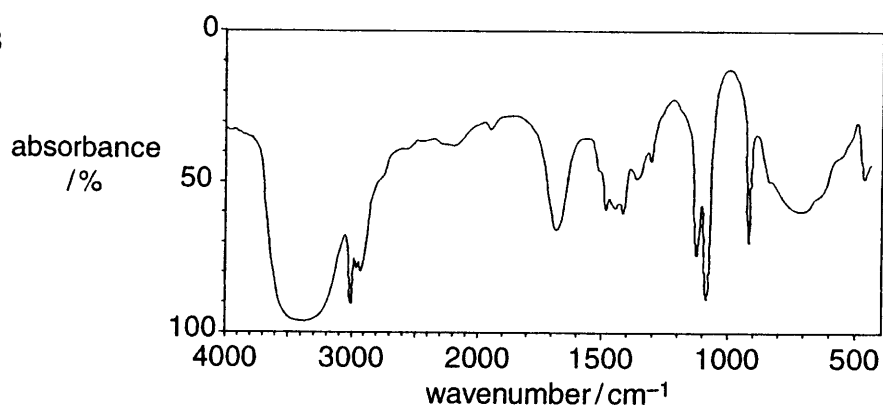
.....[2]

- (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.

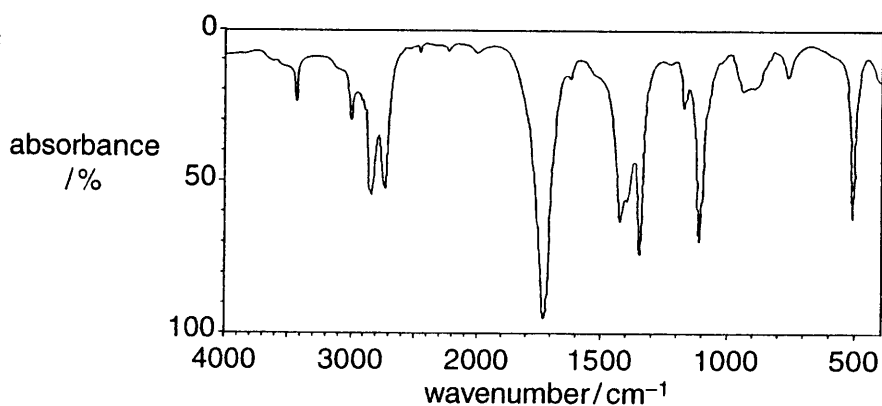
spectrum A



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]

