

**OXFORD CAMBRIDGE AND RSA EXAMINATIONS**  
**Advanced Subsidiary GCE**

**CHEMISTRY**

**2812**

Chains and Rings

Wednesday

**4 JUNE 2003**

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	15	
2	12	
3	12	
4	6	
5	15	
<b>TOTAL</b>	<b>60</b>	

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

Answer **all** the questions.

1 Compound **A** is an alcohol with the following percentage composition by mass:

C, 60.0%; H, 13.3%; O, 26.7%.

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

[2]

(ii) The relative molecular mass of compound **A** is 60. Show that this agrees with the molecular formula  $C_3H_8O$ .

[1]

(b) Compound **A** is one of two possible isomers that are both alcohols. Draw the structure of each isomer.

--	--

[2]

(c) Compound **A** was refluxed with an excess of an oxidising agent to form compound **B**.

(i) State a suitable oxidising agent for this reaction.

..... [1]

(ii) State the colour change you would see during this oxidation.

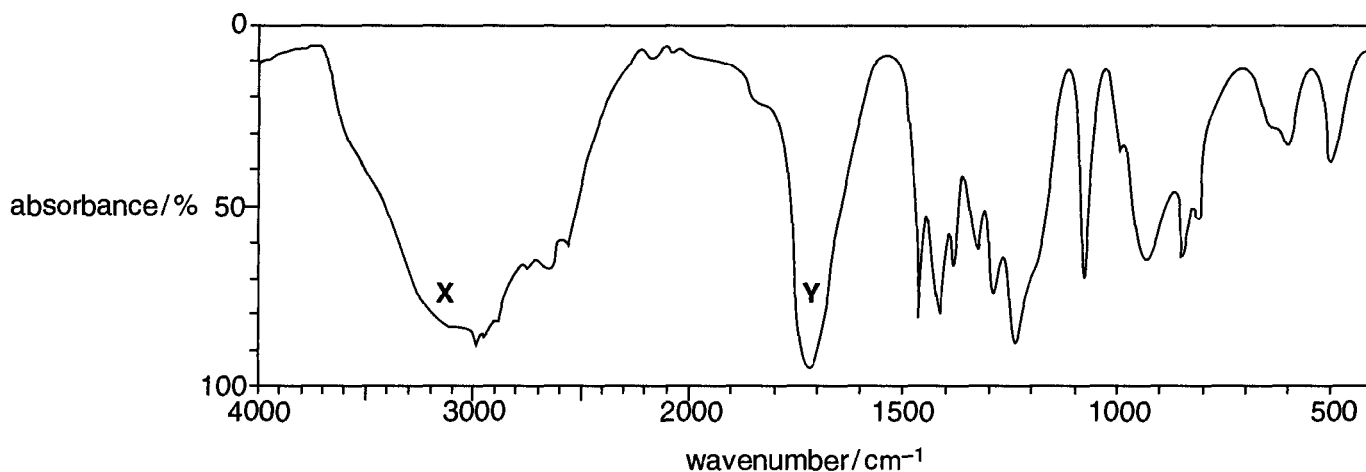
From ..... to ..... [2]

(iii) Explain what is meant by the term *reflux*.

.....

..... [1]

(d) The infra red spectrum of compound **B** is shown below.



Identify

(i) the absorption responsible for peak **X**

..... [1]

(ii) the absorption responsible for peak **Y**

..... [1]

(iii) the functional group present in compound **B**.

..... [1]

(e) Using your answer to (d), explain which of the isomers in (b) is compound **A**.

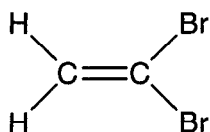
.....  
..... [1]

(f) Write a balanced equation for the oxidation of compound **A** to form compound **B**.  
Use [O] to represent the oxidising agent.

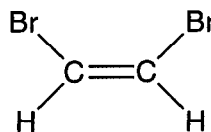
..... [2]

[Total: 15]

- 2 Dibromoethene,  $C_2H_2Br_2$ , has two structural isomers **C** and **D**, shown below.



**C**



**D**

- (a) (i) Name compound **C**.

..... [1]

- (ii) What is the empirical formula of compound **D**?

..... [1]

- (b) The reaction between either **C** or **D** and  $Br_2$  can be used to show the presence of the  $C=C$  double bond.

- (i) State what you would see when isomer **C** reacts with  $Br_2$ .

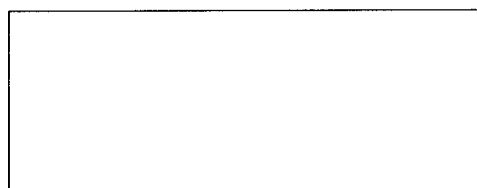
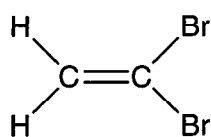
..... [1]

- (ii) State the type of mechanism for the reaction between isomer **C** and  $Br_2$ .

..... [2]

- (c) Isomers **C** and **D** can both behave as alkenes. For each of the following reactions, state the conditions, if any, and identify the organic products that can be formed.

- (i) Isomer **C** reacts with  $H_2$ .



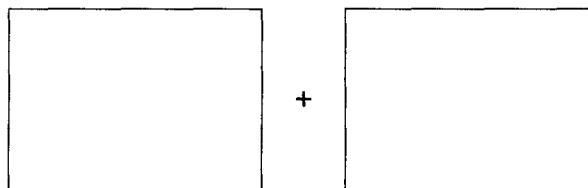
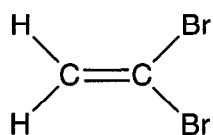
organic product

conditions ..... [2]

5

For  
Examiner's  
Use

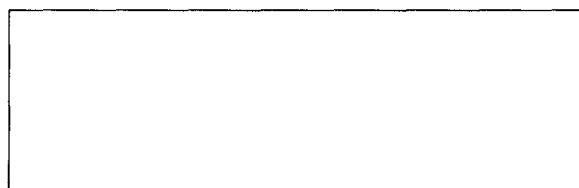
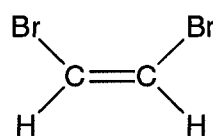
(ii) Isomer C reacts with HBr.



organic products

[2]

(iii) Isomer D reacts with H<sub>2</sub>O.



organic product

conditions .....

..... [3]

[Total: 12]

3 In this question, one mark is available for the quality of written communication.

(a) Explain why methane does not react with reagents such as nucleophiles or electrophiles.

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

(b) Name and describe the mechanism for the reaction between methane and bromine.

State the type of bond fission involved in the mechanism and explain why it is difficult to produce a single organic product.

In your answer, include any relevant equations and conditions.

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..... [9]

Quality of Written Communication [1]

[Total: 12]

4 Halogenoalkanes undergo hydrolysis with hot aqueous NaOH to form alcohols.

(a) (i) Write a balanced equation for the hydrolysis of 1-bromobutane,  $C_4H_9Br$ .

..... [1]

(ii) Describe, with the aid of curly arrows and relevant dipoles, the mechanism for the hydrolysis of 1-bromobutane with hydroxide ions,  $OH^-$ .

[3]

(b) The rates of hydrolysis of 1-chlorobutane, 1-bromobutane, and 1-iodobutane were compared by an experiment using  $AgNO_3$  solution. Aqueous  $AgNO_3$  was added to each halogenoalkane. The rates of hydrolysis were measured by timing the appearance of the silver halide precipitate.

(i) Place the three halogenoalkanes in the order of their rates of hydrolysis with the compound with the fastest rate first.

fastest .....

.....

slowest ..... [1]

(ii) Explain the order in (i).

.....

.....

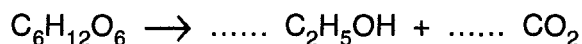
..... [1]

[Total: 6]

- 5 The question below concerns some of the chemistry involved in the brewing of beer.

Yeast ferments glucose,  $C_6H_{12}O_6$ , anaerobically (without oxygen) to produce ethanol and carbon dioxide.

- (a) Balance the following equation for the anaerobic fermentation of glucose.



[1]

- (b) A batch containing 36.0 kg of glucose,  $C_6H_{12}O_6$ , produced 2.30 kg of ethanol,  $C_2H_5OH$ .

- (i) Calculate the number of moles of glucose used.

[2]

- (ii) Use the equation in (a) to deduce the maximum number of moles of ethanol that can be produced from 36.0 kg of glucose.

$$M_r C_2H_5OH = 46$$

[1]

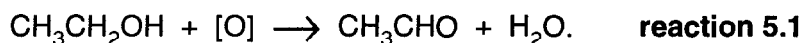
- (iii) Calculate the actual number of moles of ethanol produced by this batch fermentation.

[1]

- (iv) Calculate the percentage yield of ethanol.

[1]

- (c) The ethanol present in an alcoholic drink passes into the bloodstream and the liver is involved in breaking down the ethanol. The first stage of this breakdown involves the following reaction.



$CH_3CHO$  is then oxidised to other products.

- (i) Name the functional group present in  $CH_3CHO$ .

..... [1]

- (ii) Suggest **one** possible oxidation product that can be formed from  $CH_3CHO$ .

..... [1]



- (d) Methylated spirit contains ethanol and methanol,  $\text{CH}_3\text{OH}$ . Methylated spirit is unfit for drinking because an oxidation product of methanol causes liver damage and blindness. The methanol is oxidised in the body in a similar oxidation to that of ethanol shown in **reaction 5.1**.

Write an equation for the oxidation of methanol.

..... [2]

- (e) Methanol can be added to petrol.

(i) Write a balanced equation for the complete combustion of methanol.

..... [1]

(ii) Suggest why methanol is added to petrol.

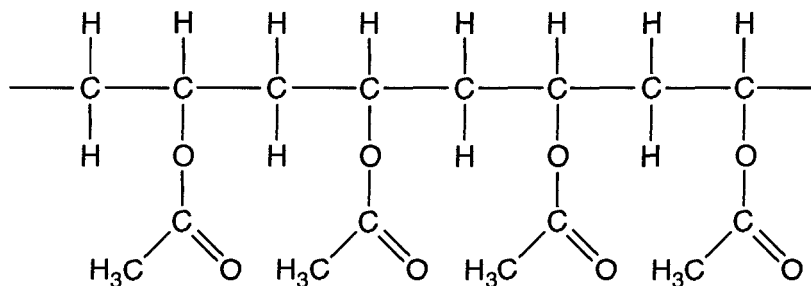
..... [1]

- (f) Methanol,  $\text{CH}_3\text{OH}$ , can be reacted with carbon monoxide to produce ethanoic acid,  $\text{CH}_3\text{COOH}$ .

Construct an equation for this reaction.

..... [1]

- (g) Much of the ethanoic acid produced is used in the manufacture of the monomer ethenyl ethanoate (vinyl acetate). The monomer is then used to produce the polymer, polyvinyl acetate (PVA), part of which is shown below.



- (i) Draw a circle around the repeat unit in PVA. [1]
- (ii) Draw the structure of the monomer ethenyl ethanoate (vinyl acetate).

[1]

[Total: 15]