

OXFORD CAMBRIDGE AND RSA EXAMINATIONS

Advanced Subsidiary GCE

CHEMISTRY

2812

Chains and Rings

Friday

9 JANUARY 2004

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

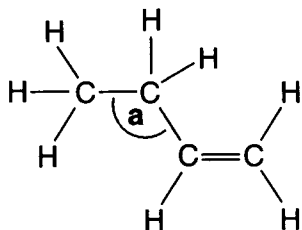
- The number of marks is given in brackets [] at the end of each question or part question.
- You will be awarded marks for the quality of written communication where this is indicated in the question.
- You may use a scientific calculator.
- You may use the *Data Sheet for Chemistry*.
- You are advised to show all the steps in any calculations.

FOR EXAMINER'S USE		
Question Number	Max.	Mark
1	15	
2	16	
3	9	
4	8	
5	12	
TOTAL	60	

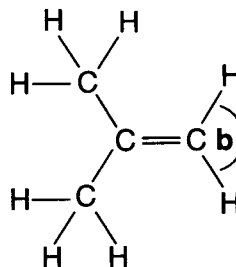
This question paper consists of 10 printed pages and 2 blank pages.

Answer **all** the questions.

- 1 (a) Alkenes are unsaturated hydrocarbons. The structures of but-1-ene and methylpropene are shown below.



but-1-ene



methylpropene

- (i) What is meant by the terms *unsaturated* and *hydrocarbon*?

unsaturated

hydrocarbon[2]

- (ii) Suggest values for the bond angle **a** in but-1-ene and the bond angle **b** in methylpropene.

angle **a** angle **b** [2]

- (iii) Explain, with the aid of a sketch, how p-orbitals are involved in the formation of the C=C double bond.

.....

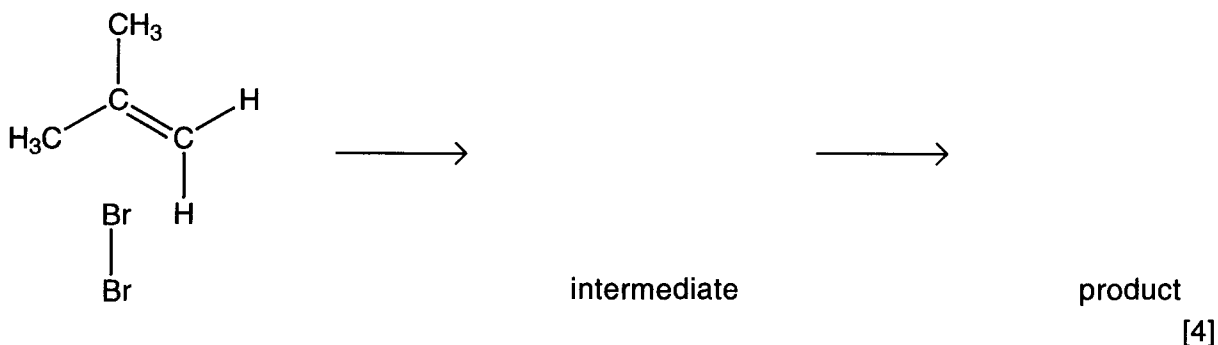
.....[2]

(b) Alkenes undergo electrophilic addition reactions to form saturated compounds.

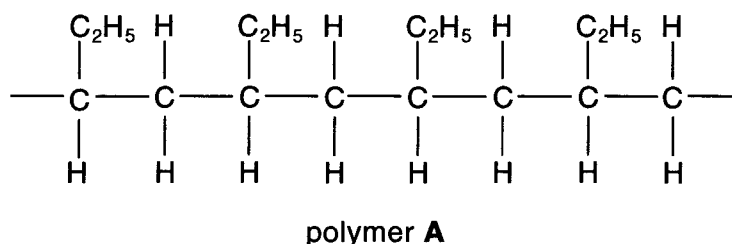
(i) Define the term *electrophile*.

.....[1]

(ii) The reaction between bromine and methylpropene is an electrophilic addition. Describe, with the aid of curly arrows, the mechanism for this reaction. Show the intermediate and the product along with any relevant dipoles and lone pairs of electrons.



(c) Polymer A, shown below, can be formed from an alkene.



(i) State the type of polymerisation involved in the formation of polymer A.

.....[1]

(ii) Draw a circle around the repeat unit of polymer A.

[1]

(iii) Identify the monomer that formed polymer A.

[1]

(iv) Name polymer A.

.....[1]

[Total: 15]

2 Butan-1-ol, $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$, reacts with sodium.

(a) (i) State what you would see when butan-1-ol reacts with sodium.

.....[1]

(ii) Sodium butoxide is formed in this reaction. Write the formula of sodium butoxide.

.....[1]

(iii) There are four structural isomers of $\text{C}_4\text{H}_{10}\text{O}$ that are alcohols. One of the isomers has been drawn for you.

Complete the table below to show the other structural isomers.

$ \begin{array}{cccc} \text{H} & \text{H} & \text{H} & \text{H} \\ & & & \\ \text{H}-\text{C} & -\text{C} & -\text{C} & -\text{C}-\text{H} \\ & & & \\ \text{H} & \text{H} & \text{H} & \text{OH} \end{array} $			
butan-1-ol	isomer 1	isomer 2	isomer 3

[3]

(b) Butan-1-ol is oxidised by an acidified solution of potassium dichromate(VI) to form a carboxylic acid.

(i) State the colour change that you would see.

Colour changes from to [1]

(ii) Write a balanced equation for this oxidation of butan-1-ol to form a carboxylic acid. Use [O] to represent the oxidising agent.

.....[2]

(iii) Identify which of the isomers, 1, 2 or 3, in (a)(iii) could also be oxidised to form a carboxylic acid.

isomer [1]

(c) Butan-1-ol reacts with hot concentrated sulphuric acid to form compound **B**.

(i) Compound **B** has an empirical formula of CH_2 and a relative molecular mass of 56. Use this information to deduce the molecular formula of compound **B**. Show your working.

[2]

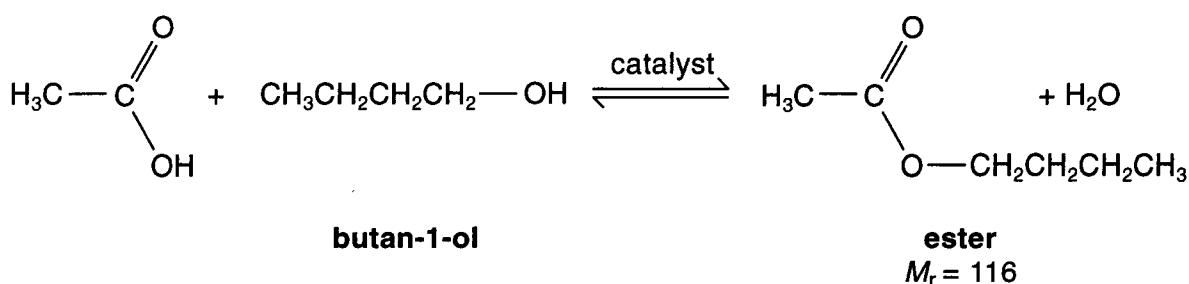
(ii) Write a balanced equation to show the conversion of butan-1-ol into compound **B**.

.....[1]

(iii) One of the isomers, **1**, **2** or **3**, in (a)(iii) also reacts with hot concentrated sulphuric acid to form compound **B**.

Identify which isomer. isomer [1]

(d) The ester, $\text{CH}_3\text{COOCH}_2\text{CH}_2\text{CH}_2\text{CH}_3$, was formed by reacting ethanoic acid with butan-1-ol.



(i) State a catalyst for this reaction.

.....[1]

(ii) In an experiment, 6.96 g of the ester was produced from 0.100 mol of butan-1-ol. Calculate the number of moles of ester produced.

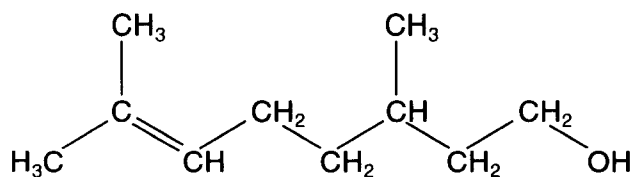
[1]

(iii) Calculate the percentage yield.

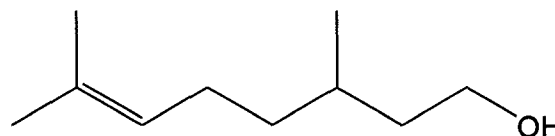
[1]

[Total: 16]

- 3 Citronellol, $C_{10}H_{20}O$, occurs naturally in both rose and geranium oils. The structural and skeletal formulae of citronellol are shown below.



structural formula



skeletal formula

- (a) Name the **two** functional groups present in citronellol.

..... and[2]

- (b) The functional groups in citronellol can be identified either by chemical tests or by infra-red spectroscopy.

- (i) State which of the two functional groups you named in (a) is:

1 identified when bromine is added to citronellol,

2 more easily identified from the infra-red spectrum.[1]

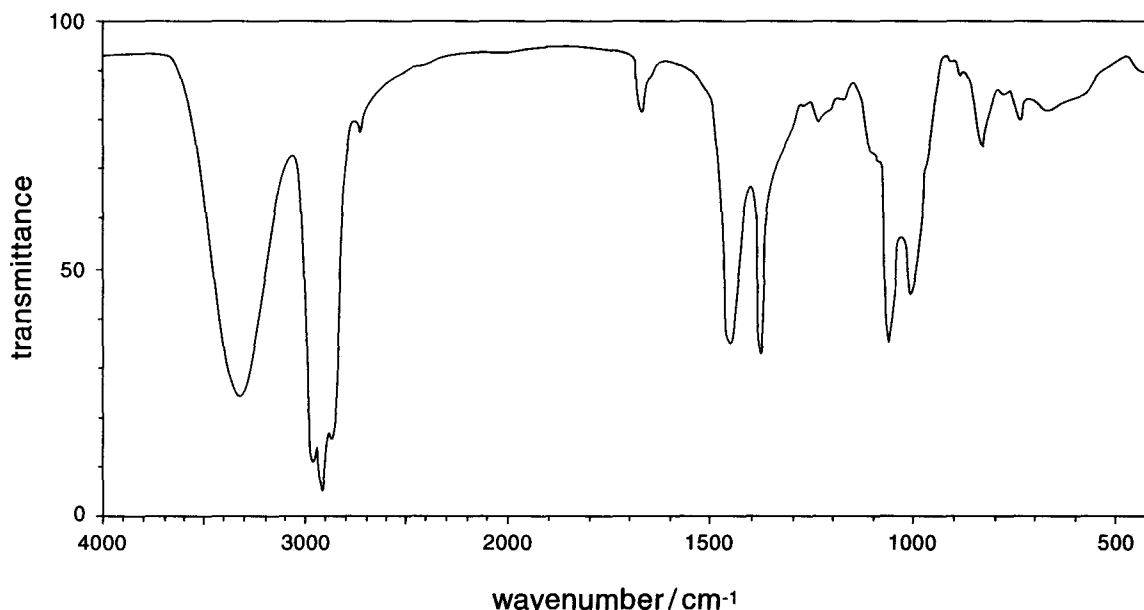
- (ii) State what you would **see** when bromine is added to citronellol.

.....[1]

- (iii) Draw the skeletal formula of the organic product formed when bromine is added to citronellol.

[1]

- (iv) The infra-red spectrum of citronellol is shown below. Mark on this spectrum, with the letter **X**, the absorption that confirms the presence of the functional group that is most easily identified from this spectrum.



[1]

- (c) Reaction of a sample of citronellol, $C_{10}H_{20}O$, with hydrogen in the presence of a catalyst results in the formation of a saturated compound **C**.

- (i) Suggest a catalyst for this reaction.

.....[1]

- (ii) Determine the molecular formula of the saturated compound **C**.

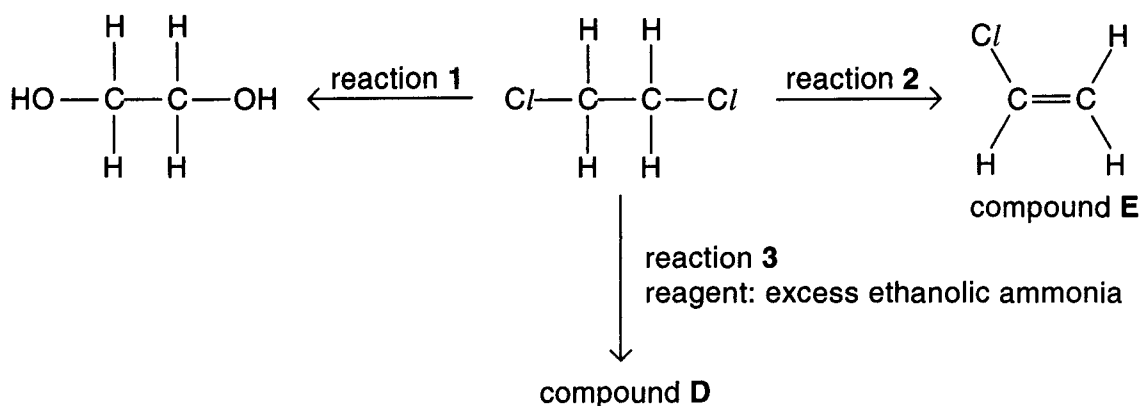
.....[1]

- (iii) Construct a balanced equation for this reaction.

.....[1]

[Total: 9]

- 4 Halogenoalkanes are useful synthetic reagents for the preparation of many important chemicals. Three reactions of 1,2-dichloroethane are shown below.



- (a) The reagent and condition used in reactions 1 and 2 are the same, but the solvents are different.

(i) State the reagent for reactions 1 and 2.

.....[1]

(ii) State the condition for reactions 1 and 2.

.....[1]

(iii) State the solvent for reaction 1.

.....[1]

(iv) State the solvent for reaction 2.

.....[1]

(v) What type of reaction is reaction 1?

.....[1]

(vi) What type of reaction is reaction 2?

.....[1]

- (b) Draw the structure of compound D, formed in reaction 3.

[1]

- (c) Compound E, under the same condition as reaction 2, reacts to form a hydrocarbon with empirical formula CH.

Suggest the identity of this hydrocarbon by drawing the **displayed** formula.

[1]

[Total: 8]

5 (a) Write an equation for the combustion of ethanol.

.....[2]

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

Describe, with the aid of equations, the industrial manufacture of ethanol from glucose, $C_6H_{12}O_6$, and from ethene, C_2H_4 . Name each type of reaction and state all essential conditions.

Future supplies of ethanol are likely to come from glucose rather than from ethene. Explain why.

.....[9]

Quality of Written Communication [1]

[Total: 12]

END OF QUESTION PAPER