

OXFORD CAMBRIDGE AND RSA EXAMINATIONS
Advanced Subsidiary GCE
CHEMISTRY
2812

Chains and Rings

Thursday

10 JUNE 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

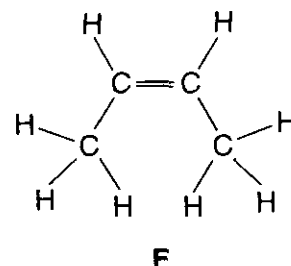
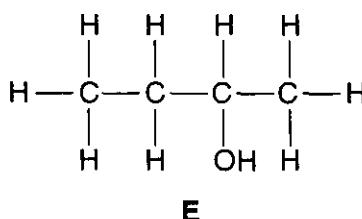
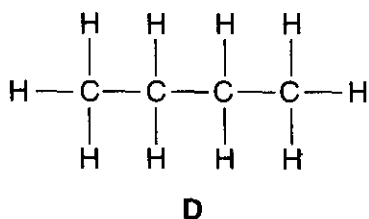
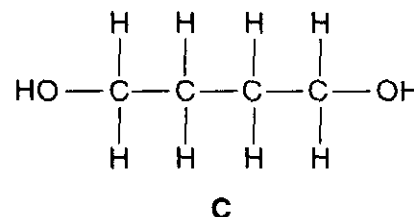
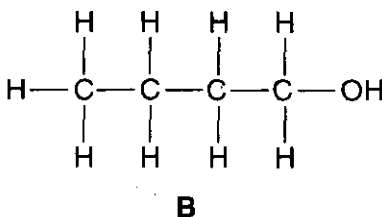
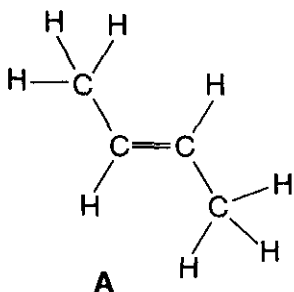
- Write your name in the space above.
- Write your Centre number and Candidate number in the boxes above.
- Answer **all** the questions.
- Write your answers in the spaces provided on the question paper.
- Read each question carefully and make sure you know what you have to do before starting your answer.

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	7	
2	18	
3	14	
4	12	
5	9	
TOTAL	60	

This question paper consists of 11 printed pages and 1 blank page.

Answer **all** the questions.1 This question is about the compounds **A–F** below.(a) Answer the following questions by referring to the compounds **A–F**.(i) What is the molecular formula of compound **D**?

.....[1]

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

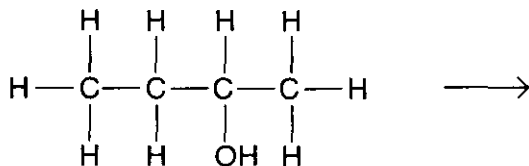
.....[1]

(iii) Which two compounds are structural isomers of each other?

..... and[1]

(iv) Which two compounds are *cis-trans* isomers of each other?

..... and[1]

(b) Compound **E** can be dehydrated to form compound **A**. Complete a balanced equation for this reaction.

[1]

(c) 1-Chlorobutane can also react with OH^- ions to form but-1-ene.

(i) State a suitable solvent for this reaction.

.....[1]

(ii) Name the type of reaction.

.....[1]

(iii) Draw the structure of but-1-ene.

[1]

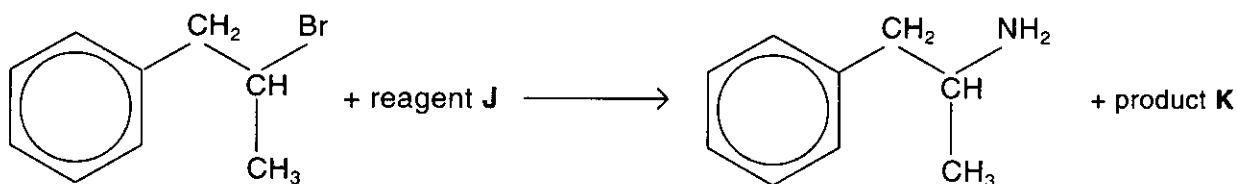
(iv) Write a balanced equation for the reaction.

.....[1]

(d) But-1-ene can undergo polymerisation. Draw a section of the polymer that can be formed from but-1-ene. Show **two** repeat units.

[2]

(e) Amphetamine is a pharmaceutical that acts as a stimulant. It increases the heart rate and dilates the air passages in the lungs. A possible reaction scheme for the preparation of amphetamine is shown below.



(i) Identify reagent J.

.....[1]

(ii) Identify product K.

.....[1]

(iii) Suggest suitable conditions for this reaction.

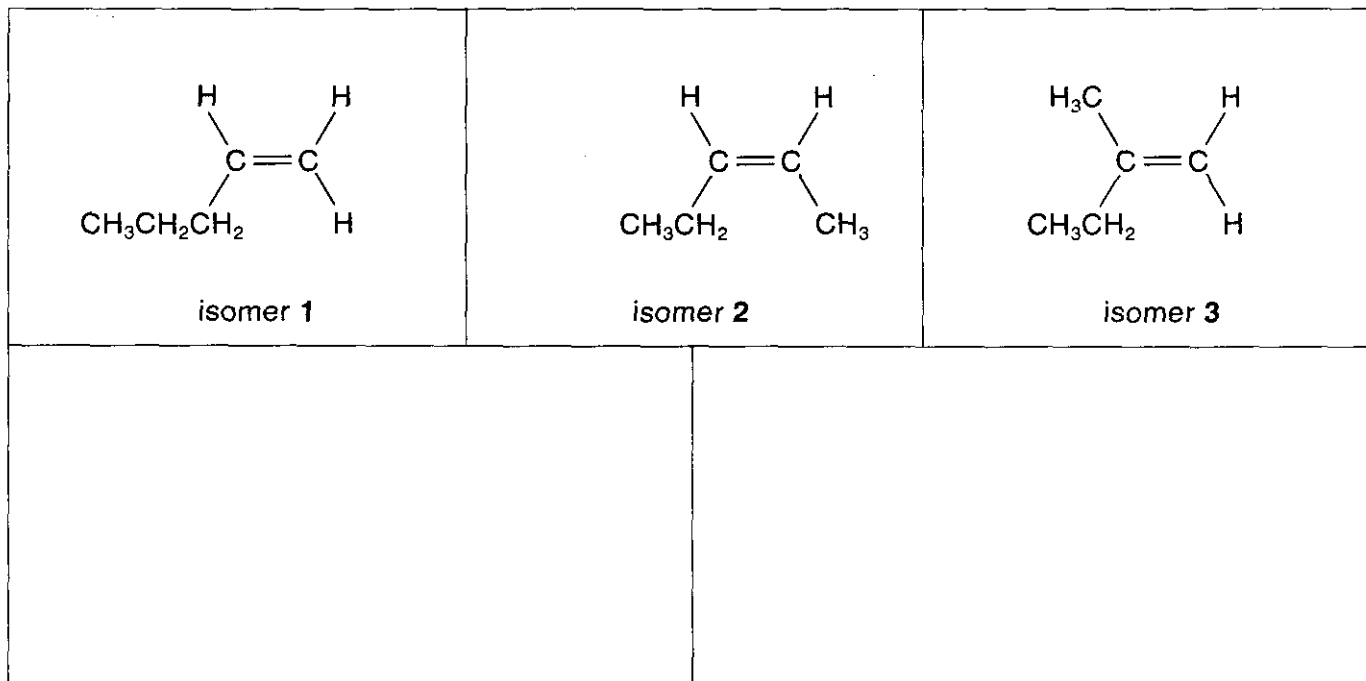
.....[1]

[Total: 18]

- 3 (a) Many organic molecules show structural isomerism. State what is meant by the term *structural isomerism*.

.....
[2]

- (b) Isomers 1, 2 and 3, shown below, are unsaturated structural isomers of C_5H_{10} .



- (i) Complete the boxes by drawing two other unsaturated structural isomers of C_5H_{10} .

[2]

- (ii) Name isomer 3.

.....[1]

- (iii) Draw the skeletal formula of isomer 2.

[1]

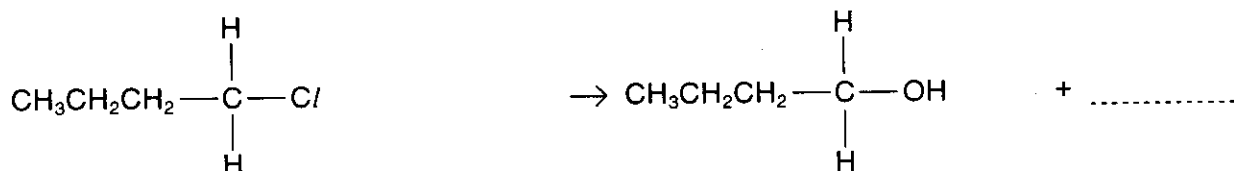
- (c) Compound **C** can be dehydrated to form a new compound, **G**, with the molecular formula, C_4H_6 . Suggest a structural formula and a name for **G**.

name[2]

[Total: 7]

- 2 Halogenoalkanes, such as 1-chlorobutane, are hydrolysed with hot aqueous alkali, $\text{OH}^{-}(\text{aq})$, to form alcohols.

(a) Describe, with the aid of curly arrows, the mechanism of the hydrolysis of 1-chlorobutane with $\text{OH}^{-}(\text{aq})$ ions to produce butan-1-ol. Show any relevant lone pairs of electrons and dipoles.



[4]

- (b) Another halogenoalkane, **H**, has a relative molecular mass of 127 and has the following composition by mass:
C, 37.8%; H, 6.3%; Cl, 55.9%.

(i) Show that the empirical formula of compound **H** is $\text{C}_2\text{H}_4\text{Cl}$.

[2]

(ii) Deduce the molecular formula of compound **H**.

[1]

(iii) Compound **H** can also be hydrolysed with hot aqueous alkali to form butane-1,3-diol. Draw the structure of butane-1,3-diol.

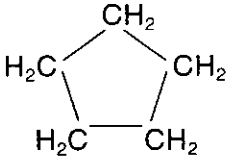
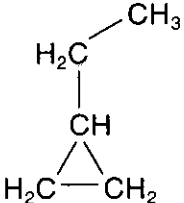
[1]

(iv) Deduce the structure of compound **H**.

[1]

(c) There are several **cycloalkanes** that are structural isomers of C_5H_{10} .

(i) Complete the boxes by drawing two other structural isomers of C_5H_{10} that are also **cycloalkanes**.

			
isomer L		ethylcyclopropane	

[2]

(ii) Name isomer L drawn in (c)(i).

.....[1]

(iii) Draw the skeletal formula of isomer L.

[1]

(d) Isomer L, C_5H_{10} , reacts with Cl_2 in the presence of UV light to produce the organic product C_5H_9Cl . The reaction takes place in three stages: initiation, propagation and termination.

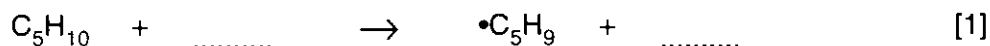
(i) The reaction is initiated by the fission of Cl_2 . State the type of fission involved.

.....[1]

(ii) Write an equation to illustrate the fission of Cl_2 in (d)(i).

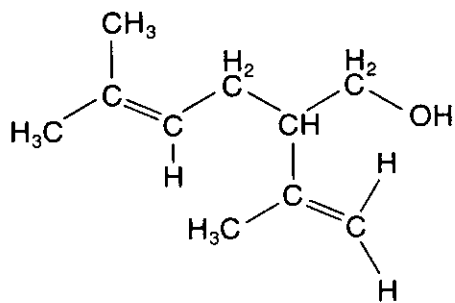
.....[1]

(iii) The fission of Cl_2 leads to a chain reaction involving two propagation steps. Complete the equations for the two propagation steps.

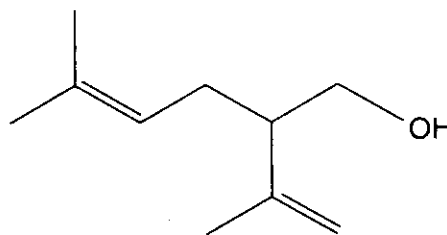


[Total: 14]

- 4 Lavandulol, $C_{10}H_{18}O$, is a fragrant oil which is found in lavender. The structural and the skeletal formulae of lavandulol are shown below.



structural formula



skeletal formula

- (a) (i) Identify **two** different functional groups in lavandulol.

..... and[2]

- (ii) Why does lavandulol **not** have *cis-trans* isomerism?

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

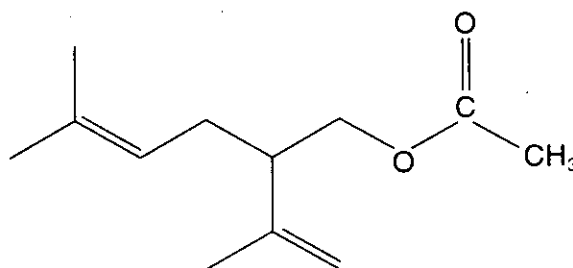
- (b) Lavandulol, $C_{10}H_{18}O$, also reacts with bromine to form a saturated organic product.

State what you would see in this reaction and deduce the molecular formula of the organic product.

observation[1]

molecular formula[2]

- (c) Lavandulol could be converted into an ester **X**, which is also found in lavender oil.

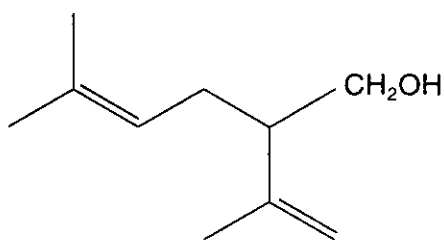
ester **X**

State a reagent and a catalyst that could be used to form ester **X** from lavandulol.

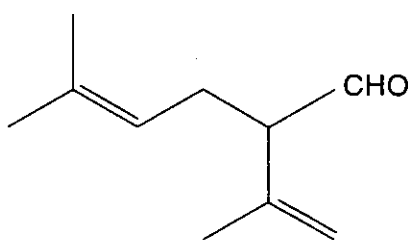
reagent[1]

catalyst[1]

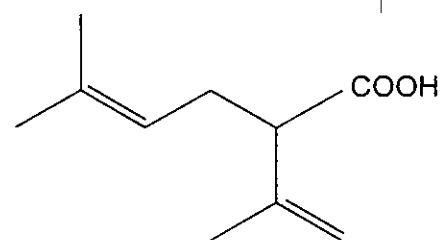
(d) Lavandulol can be oxidised to produce either compound Y or compound Z.



lavandulol
 $C_{10}H_{18}O$



compound Y
 $C_{10}H_{16}O$



compound Z
 $C_{10}H_{16}O_2$

- (i) Write a balanced equation for the oxidation of lavandulol to produce compound Z. Use the molecular formulae given above and use [O] to represent the oxidising agent.

.....[2]

- (ii) An infra-red spectrum of either compound Y or compound Z was obtained and was found to contain an absorption between $1680-1750\text{ cm}^{-1}$. However, there was no broad absorption between $2500-3300\text{ cm}^{-1}$.

By referring to your *Data Sheet*, use this information to deduce whether the infra-red spectrum was of compound Y or of compound Z. Show your reasoning.

The infra-red spectrum was of compound because

.....

.....

.....[2]

[Total: 12]

