

**OXFORD CAMBRIDGE AND RSA EXAMINATIONS**

**Advanced Subsidiary GCE**

**CHEMISTRY**

**2812**

**Chains and Rings**

Friday

**17 JANUARY 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**

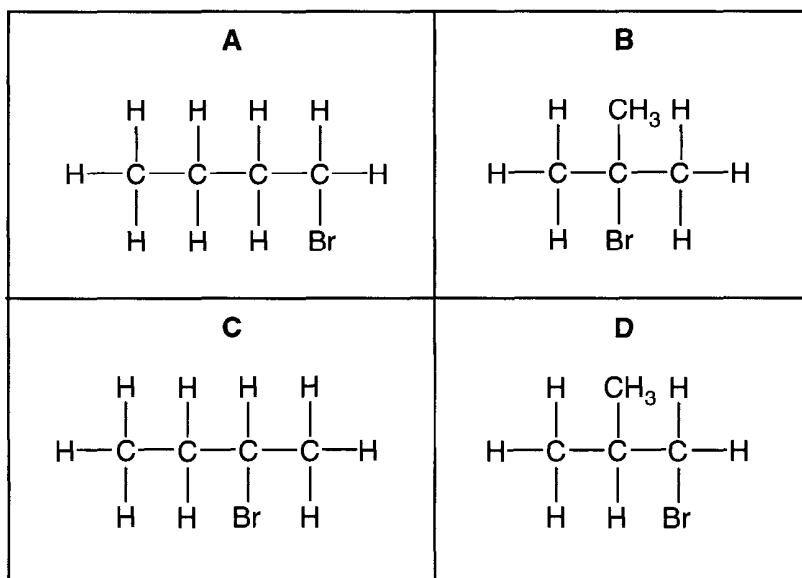
- The number of marks is given in brackets [ ] at the end of each question or part question.
- You will be awarded marks for the quality of written communication where this is indicated in the question.
- You may use a scientific calculator.
- You may use the *Data Sheet for Chemistry*.
- You are advised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

FOR EXAMINER'S USE		
Question Number	Max.	Mark
1	12	
2	11	
3	11	
4	7	
5	11	
6	8	
<b>TOTAL</b>	<b>60</b>	

**This question paper consists of 12 printed pages.**

Answer **all** the questions.

1 This question is about halogenoalkanes **A** to **D**, shown below.



(a) Answer the questions that follow by using the appropriate letter **A**, **B**, **C** or **D**. Each letter may be used once, more than once or not at all.

(i) Which is 2-bromo-2-methylpropane?

..... [1]

(ii) Which could react with hot aqueous sodium hydroxide to produce butan-2-ol?

..... [1]

(iii) Which could react with hot aqueous sodium hydroxide to produce a tertiary alcohol?

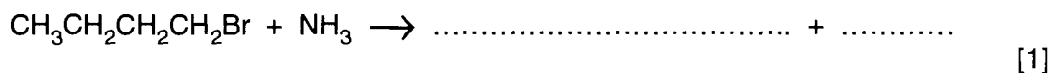
..... [1]

(iv) Which **two** could react with hot ethanolic sodium hydroxide to produce but-1-ene?

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

(b) Compound **A** can react with ammonia to produce an amine.

(i) Complete the equation for this reaction.



(ii) Name the organic product.

..... [1]

(iii) State a suitable solvent for this reaction.

..... [1]

(c) Compound **D** can react with aqueous hydroxide ions  $\text{OH}^-$ . The hydroxide ion is a nucleophile.

(i) Define the term *nucleophile*.

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

(ii) Draw a 'dot-and-cross' diagram of the  $\text{OH}^-$  ion. Show outer shell electrons only.

[2]

(iii) Identify the organic product formed when compound **D** reacts with aqueous  $\text{OH}^-$  ions.

[1]

[Total: 12]

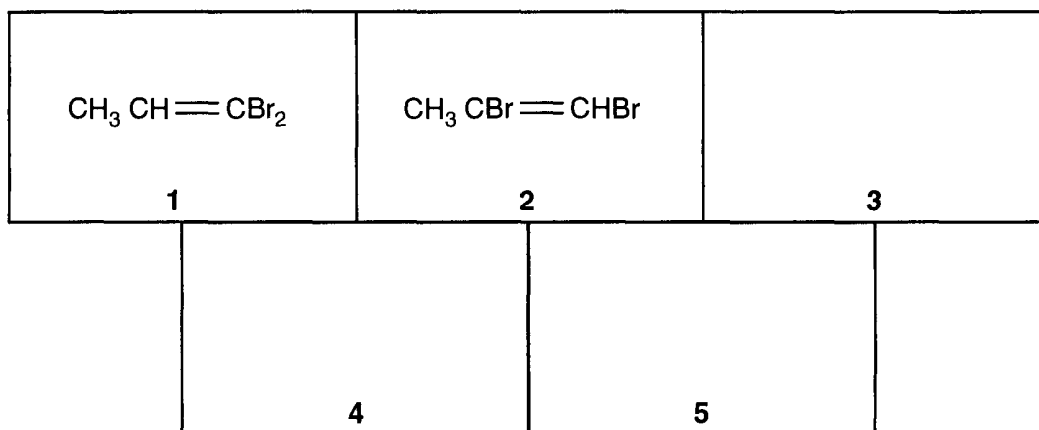
- 2 (a) (i) The brominated alkene,  $C_3H_4Br_2$ , has five possible structural isomers.

What is meant by the term *structural isomer*?

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

- (ii) Two of the structural isomers of  $C_3H_4Br_2$  are drawn below.

Draw the other three **structural** isomers.



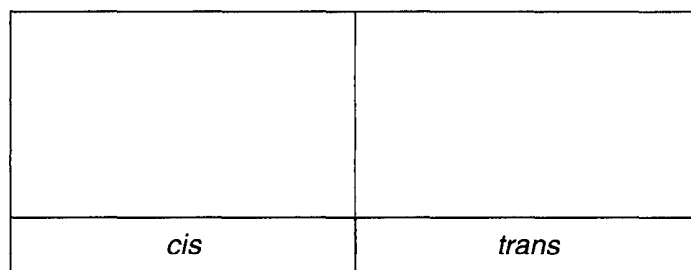
[3]

- (iii) Name isomer 1

..... [1]

- (b) Isomer 2 in (a)(ii) shows *cis-trans* isomerism.

- (i) Draw the *cis* and *trans* isomers of isomer 2.



[2]

(ii) State the approximate bond angle around each carbon atom involved in the C=C double bond of these *cis-trans* isomers.

..... [1]

(iii) Isomer 1 does **not** show *cis-trans* isomerism. Explain why not.

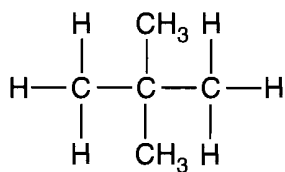
.....  
..... [1]

(iv) Identify **one** of your isomers, 3, 4 or 5, in (a)(ii) that **does** show *cis-trans* isomerism.

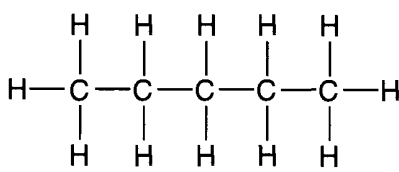
Isomer ..... **does** show *cis-trans* isomerism. [1]

[Total: 11]

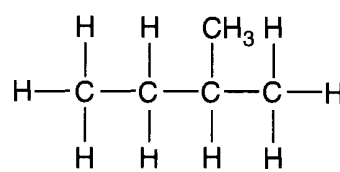
3 Each of the compounds, **G**, **H** and **I**, has the molecular formula  $C_5H_{12}$ .



**G**



**H**



**I**

(a) (i) Which compound has the highest boiling point?

..... [1]

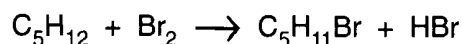
(ii) Which compound is most likely to be a gas at room temperature?

..... [1]

(iii) State the type of intermolecular forces present in all three compounds.

..... [1]

(b) **G**, **H** and **I** all react with bromine as shown below.



The reaction is initiated by the formation of bromine free-radicals.

(i) What is meant by the term *free-radical*?

..... [1]

(ii) Write an equation to show the formation of bromine free-radicals.

..... [1]

(iii) State the type of bond breaking involved in the formation of bromine free-radicals.

..... [1]

(iv) Write equations to show the **two** propagation steps that lead to the formation of  $C_5H_{11}Br$ .

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

- (c) Each of the compounds, **G**, **H** and **I** can react with bromine to form a mono-bromo compound,  $C_5H_{11}Br$ .

Deduce the number of possible structural isomers, each with formula  $C_5H_{11}Br$ , that could be made by the reaction of bromine with

(i) compound **G** .....

(ii) compound **H** .....

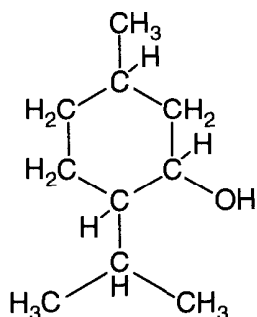
(iii) compound **I**. .....

[3]

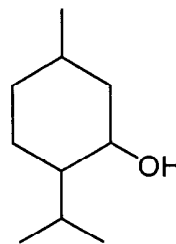
[Total: 11]

- 4 Menthol is a naturally occurring cyclic compound found in peppermint oil. It has been used in throat sprays and cough drops for many years.

The structural and skeletal formulae of menthol are shown below.



structural formula of menthol



skeletal formula of menthol

- (a) (i) What is the molecular formula of menthol?

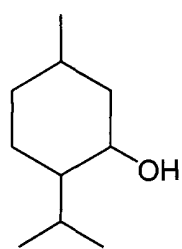
..... [1]

- (ii) Identify the functional group present in menthol and classify it as either primary, secondary or tertiary.

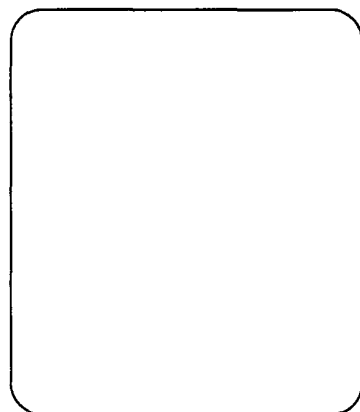
Functional group ..... Classification ..... [2]

- (b) When menthol is reacted with hot concentrated sulphuric acid,  $\text{H}_2\text{SO}_4$ , two isomeric alkenes, each with formula  $\text{C}_{10}\text{H}_{18}$ , can be formed.

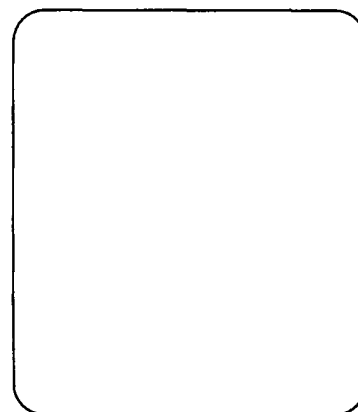
Draw the skeletal formula of each of the isomers formed.



menthol



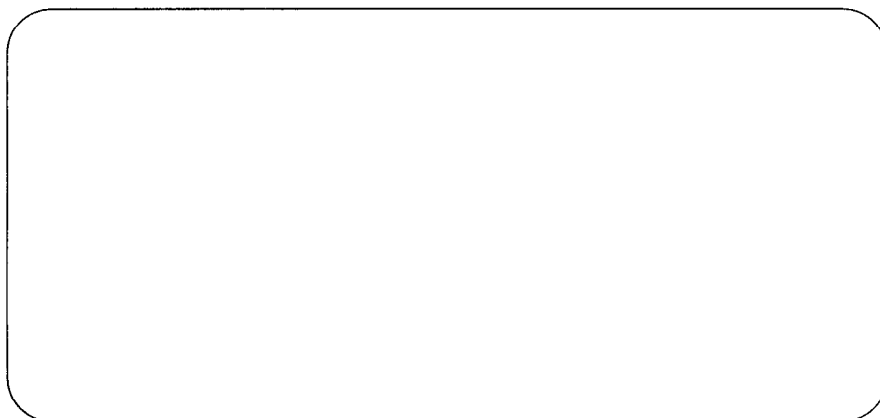
and



[2]



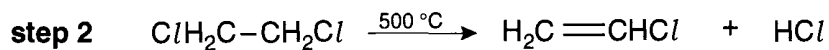
- (c) Identify the organic product formed when menthol is reacted with ethanoic acid,  $\text{CH}_3\text{COOH}$ , in the presence of an acid catalyst. Draw its structure below.



[2]

[Total: 7]

- 5 Ethene can be used to manufacture chloroethene  $\text{H}_2\text{C}=\text{CHCl}$ . This involves the following reactions.



- (a) (i) State the type of mechanism involved in **step 1**.

..... [2]

- (ii) Complete, with the aid of curly arrows, the mechanism involved in step 1. Show any relevant dipoles and charges.



[4]

- (b) The chloroethene (also known as vinyl chloride) produced can be polymerised to form poly(chloroethene) or PVC.

- (i) Draw a section of the polymer, PVC, to show **two** repeat units.

[1]

- (ii) Describe the difficulties in the disposal of polymers in general and identify a specific additional problem with the disposal of PVC.

.....  
.....  
.....  
.....  
..... [3]

- (iii) Outline the role of chemists in minimising damage to the environment during the disposal process.

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

[Total: 11]

