OCR
RECOGNISING ACHIEVEMENT

ADVANCED SUBSIDIARY GCE **2812/01**

CHEMISTRY

Chains and Rings

WEDNESDAY 6 JUNE 2007 Morning

Time: 1 hour

Additional materials: Scientific calculator
Data Sheet for Chemistry (Inserted)

Candidate Name

Centre Number

Candidate Number

INSTRUCTIONS TO CANDIDATES

- Write your name, Centre number and Candidate number in the boxes above.
- Answer **all** the questions.
- Use blue or black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure you know what you have to do before starting your answer.
- Do **not** write in the bar code.
- Do **not** write outside the box bordering each page.
- WRITE YOUR ANSWER TO EACH QUESTION IN THE SPACE PROVIDED. ANSWERS WRITTEN ELSEWHERE WILL NOT BE MARKED.

INFORMATION FOR CANDIDATES

- The number of marks for each question 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.
- A copy of the *Data Sheet for Chemistry* is provided as an insert with this question paper.
- You are advised to show all the steps in any calculations.

FOR EXAMINER'S USE		
Qu.	Max.	Mark
1	14	
2	15	
3	7	
4	9	
5	15	
TOTAL	60	

This document consists of **11** printed pages, **1** blank page and a *Data Sheet for Chemistry*.

  [Turn over

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Answer **all** the questions.

1 Bromine can react with both alkanes and alkenes. The type of reaction depends on whether the Br–Br bond breaks by homolytic or heterolytic fission.

(a) (i) Write a balanced equation to show the **homolytic** fission of the Br–Br bond.

..... [1]

(ii) Write a balanced equation to show the **heterolytic** fission of the Br–Br bond.

..... [1]

(iii) Each product of the fission of the Br–Br bond may be an electrophile, a free radical or a nucleophile.

Choose from the products in parts **(i)** and **(ii)**

a free radical, ...

a nucleophile. .....

[2]

(b) Hexane reacts with Br_2 in the presence of ultraviolet light.

$$C_6H_{14} + Br_2 \rightarrow C_6H_{13}Br + HBr$$

(i) State the type of reaction.

..... [1]

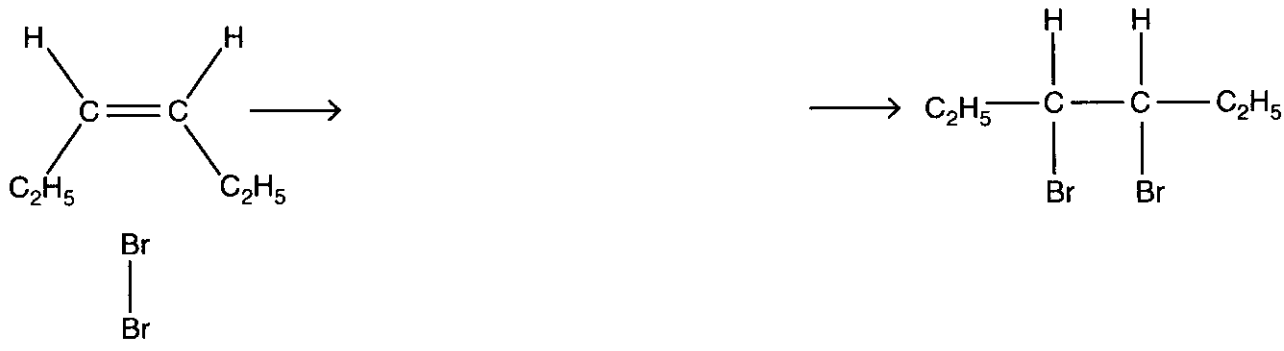
(ii) Identify the three possible structural isomers of the product, $C_6H_{13}Br$, that could be formed from this reaction with hexane.

[3]

(c) Hex-3-ene reacts with Br_2 to produce 3,4-dibromohexane.

Describe, with the aid of curly arrows, the movement of the electrons in the mechanism.

Show the intermediate, any relevant dipoles and lone pairs of electrons.



intermediate **3,4-dibromohexane**

[4]

(d) The mechanism in **(c)** shows *cis*-hex-3-ene reacting with Br_2. *Trans*-hex-3-ene also reacts with Br_2 to produce 3,4-dibromohexane.

(i) How does the structure of *trans*-hex-3-ene differ from that of *cis*-hex-3-ene?

.....

..... [1]

(ii) Explain why both *cis* and *trans* hex-3-ene react with Br_2 to produce the same structural isomer.

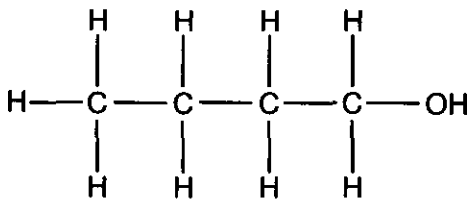
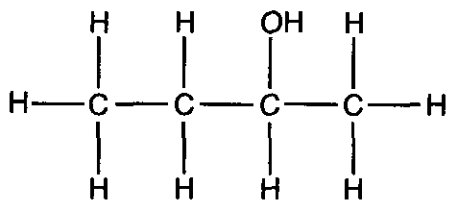
.....

.....

..... [1]

[Total: 14]

2 Four possible structural isomers of $C_4H_{10}O$ are alcohols. Two are shown below.

	
butan-1-ol	butan-2-ol

(a) (i) Draw the other two structural isomers of $C_4H_{10}O$ that are alcohols.

isomer 1	isomer 2

[2]

(ii) Name isomer 1. ..... [1]

(b) Butan-2-ol can be dehydrated to produce a mixture of three alkenes each with a molecular formula C_4H_8.

Draw the displayed formula for each of the three alkenes.

[3]

(c) Butan-1-ol reacts with sodium. One of the products is a sodium alkoxide.

(i) Write a balanced equation for this reaction.

[1]

(ii) State what you would see during this reaction.

..... [1]

(d) Butan-1-ol can be oxidised to form butanal.

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

..... [2]

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

from ..... to ..... [1]

(e) A sample of the butanal from **(d)** was analysed using infra-red spectroscopy. The infra-red spectrum contained an absorption in the region 1680–1750 cm^{-1} but did **not** contain a broad absorption in the region 2500–3300 cm^{-1}.

Refer to the Data Sheet for Chemistry provided.

(i) What does the absorption in the region 1680–1750 cm^{-1} indicate?

..... [1]

(ii) What does the absence of a broad absorption in the region 2500–3300 cm^{-1} indicate?

..... [1]

(iii) The reaction in **(d)** was carried out using distillation and **not** reflux.

Explain why.

.....

.....

..... [2]

[Total: 15]

3 Halogenoalkanes such as chloroethane, CH_3CH_2Cl, are useful reagents for making a variety of other chemicals.

(a) Chloroethane reacts with NaOH to produce either ethanol or ethene. The product depends on the solvent used.

(i) State the solvent required to produce ethanol.

..... [1]

(ii) State the type of reaction. ..... [1]

(iii) State the solvent required to produce ethene.

..... [1]

(iv) State the type of reaction. ..... [1]

(b) When ammonia reacts with chloroethane, the ammonia behaves as a nucleophile. The reaction is shown below.

$$H_3C{-}CH_2{-}Cl \xrightarrow{NH_3} H_3C{-}CH_2{-}NH_2$$

(i) State what is meant by the term *nucleophile*.

..... [1]

(ii) In the above reaction chloroethane is replaced with bromoethane.

Suggest what would happen to the rate of the reaction. Explain your reasoning.

.....

.....

..... [2]

[Total: 7]

4 In this question, one mark is available for the quality of spelling, punctuation and grammar.

The fractions from crude oil can be processed by cracking, reforming and isomerisation.

- Outline these processes with the aid of suitable equations.
- State clearly the industrial importance of the products formed in each process.

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.... [8]

Quality of Written Communication [1]

[Total: 9]

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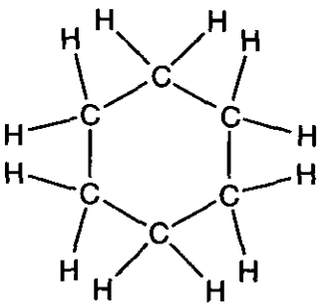
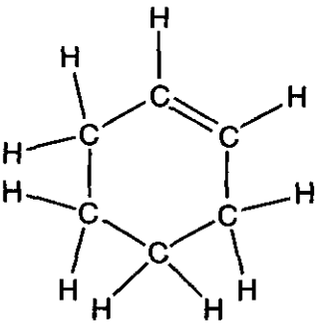
5 Cylcohexane and cyclohexene are both cyclic hydrocarbons.



cyclohexane



cyclohexene

(a) (i) What is the molecular formula of cyclohexene? ..... [1]

(ii) What is the empirical formula of cyclohexene? ..... [1]

(iii) Calculate the percentage, by mass, of carbon in cyclohexene. Give your answer to **two** significant figures.

answer ..... [2]

(b) Cyclohexene can be converted into cyclohexane.

cyclohexene **cyclohexane**

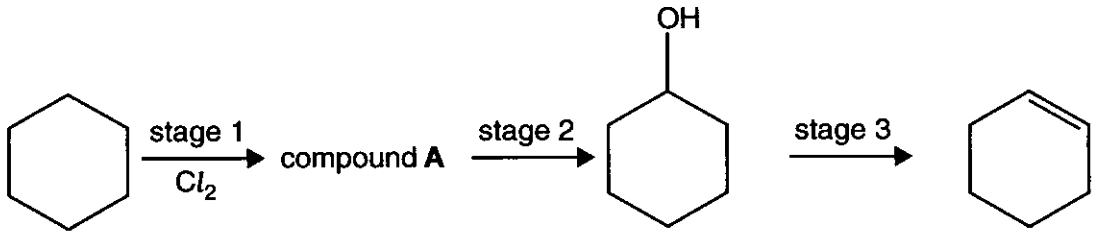
Suggest suitable reagents and conditions for this reaction.

reagents .....

conditions .....

[2]

(c) Cyclohexane can be converted into cyclohexene via a three-stage synthesis.



cyclohexane **cyclohexanol** **cyclohexene**

(i) In stage 1, cyclohexane reacts with chlorine to form the organic product, compound **A**.

Show the structure of compound **A**.

[1]

(ii) Stage 3 involves the dehydration of an alcohol.

State a suitable reagent for dehydrating an alcohol.

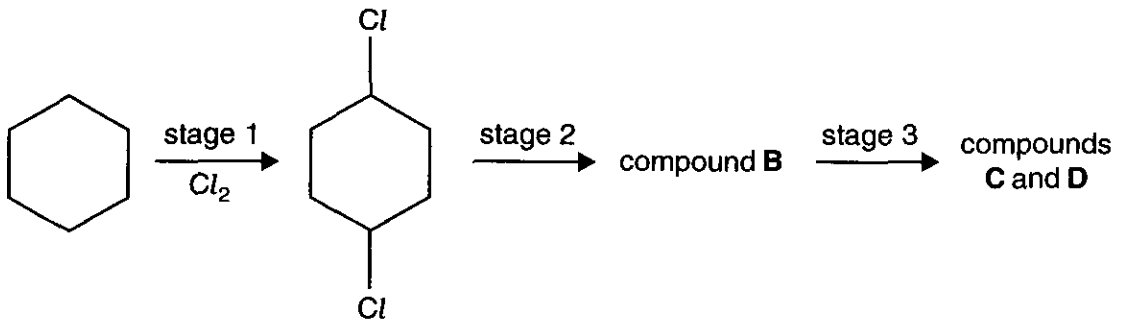
..... [1]

(iii) Write a balanced equation for the dehydration of cyclohexanol, $C_6H_{11}OH$.

[1]

TURN OVER FOR PART (d)

(d) The reaction in stage 1 is difficult to control. One other possible chlorinated product is 1,4-dichlorocyclohexane. This is shown below.



cyclohexane **1,4-dichlorocyclohexane**

1,4-Dichlorocyclohexane reacts in the same way as compound **A** in stages 2 and 3.

(i) Suggest the structure of compound **B**.

[1]

(ii) Two cyclic alkenes, **C** and **D** are formed in stage 3. **C** and **D** are structural isomers. Suggest the structures of **C** and **D**.

[2]

(e) Cyclohexene can undergo polymerisation.

(i) State the type of polymerisation. ..... [1]

(ii) Draw a section of the polymer. Show **two** repeat units.

[2]

[Total: 15]

END OF QUESTION PAPER

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