

**ADVANCED SUBSIDIARY GCE
CHEMISTRY**

Chains and Rings

WEDNESDAY 4 JUNE 2008

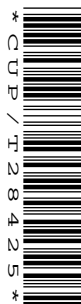
2812/01

Morning
Time: 1 hour

Candidates answer on the question paper

Additional materials (enclosed): *Data Sheet for Chemistry* (Inserted)

Additional materials (required):
Scientific calculator



Candidate
Forename

Candidate
Surname

Centre
Number

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Candidate
Number

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INSTRUCTIONS TO CANDIDATES

- Write your name in capital letters, your Centre Number and Candidate Number in the boxes above.
- Use blue or black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure that you know what you have to do before starting your answer.
- Answer **all** the questions.
- Do **not** write in the bar codes.
- Write your answer to each question in the space provided.

INFORMATION FOR CANDIDATES

- The number of marks for each question is given in brackets [] at the end of each question or part question.
- The total number of marks for this paper is **60**.
- 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.

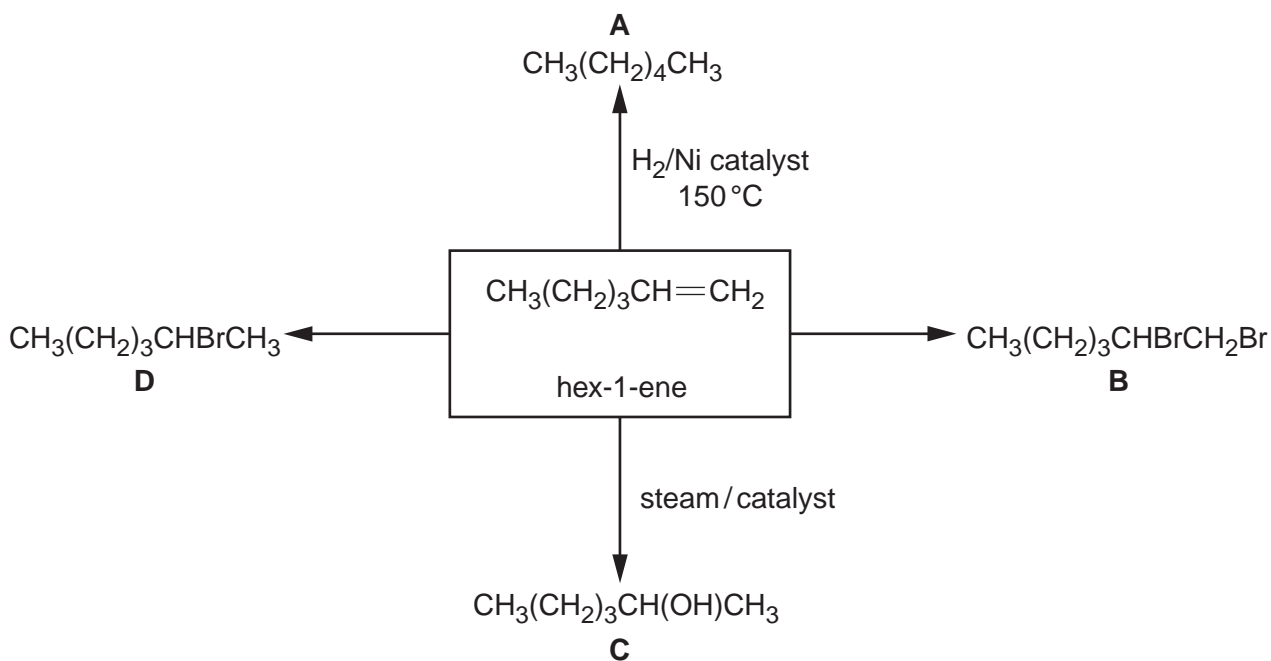
FOR EXAMINER'S USE

Qu.	Max.	Mark
1	13	
2	16	
3	5	
4	12	
5	14	
TOTAL	60	

This document consists of **12** printed pages and a *Data Sheet for Chemistry*.

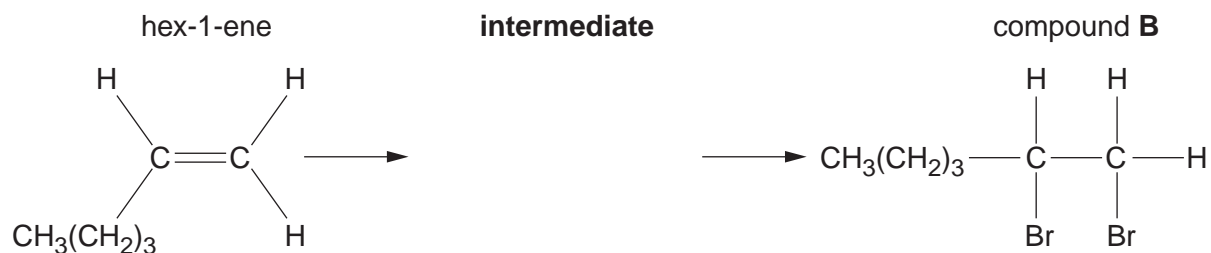
Answer **all** the questions.

- 1 Hex-1-ene, $\text{CH}_3(\text{CH}_2)_3\text{CH}=\text{CH}_2$, reacts as shown below.



- (a) (i) What is the molecular formula of compound **A**? [1]
- (ii) What is the empirical formula of compound **B**? [1]
- (iii) Name compound **C**. [1]
- (iv) State a suitable reagent(s) for converting hex-1-ene into compound **D**.
 [1]

- (b) (i) Describe, with the aid of curly arrows, the mechanism for the formation of compound **B** from hex-1-ene.
Show any relevant dipoles and lone pairs of electrons.



[4]

- (ii) Name this type of reaction.

..... [1]

- (iii) State what you would see during this reaction.

..... [1]

- (c) Hex-1-ene, $\text{CH}_3(\text{CH}_2)_3\text{CH}=\text{CH}_2$, can form a polymer.

- (i) Write a balanced equation for the polymerisation of hex-1-ene.

[2]

- (ii) Name the polymer. [1]

[Total: 13]

2 There are **four** structural isomers of $C_4H_{10}O$ that are alcohols.

(a) What is meant by *structural isomers*?

.....
[1]

(b) Alcohols can be classified as either primary, secondary or tertiary.

Draw, name and classify each of the **four** structural isomers of $C_4H_{10}O$ by completing the boxes in the table below. Some have been completed for you.

alcohol	name	classification
$ \begin{array}{ccccccc} & H & H & H & H & & \\ & & & & & & \\ H - O - & C & - C & - C & - C & - H \\ & & & & & & \\ & H & H & H & H & & \end{array} $	butan-1-ol	primary
	butan-2-ol	
$ \begin{array}{ccccccc} & H & & CH_3 & & & \\ & & & & & & \\ H - O - & C & - C & - CH_3 \\ & & & & & & \\ & H & H & & & & \end{array} $		
		tertiary

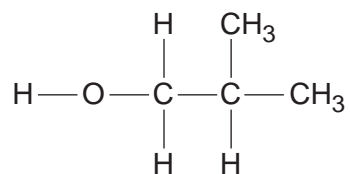
[6]

- (c) Alcohols such as butan-1-ol have high boiling points due to the presence of hydrogen bonds.

Draw two molecules of butan-1-ol linked by a hydrogen bond. Include any relevant dipoles and lone pairs of electrons.

[3]

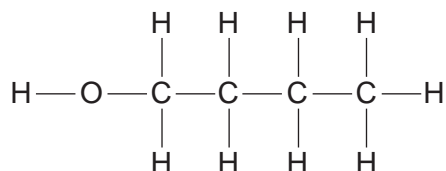
- (d) An ester is formed when ethanoic acid, CH_3COOH , reacts with the alcohol shown below.



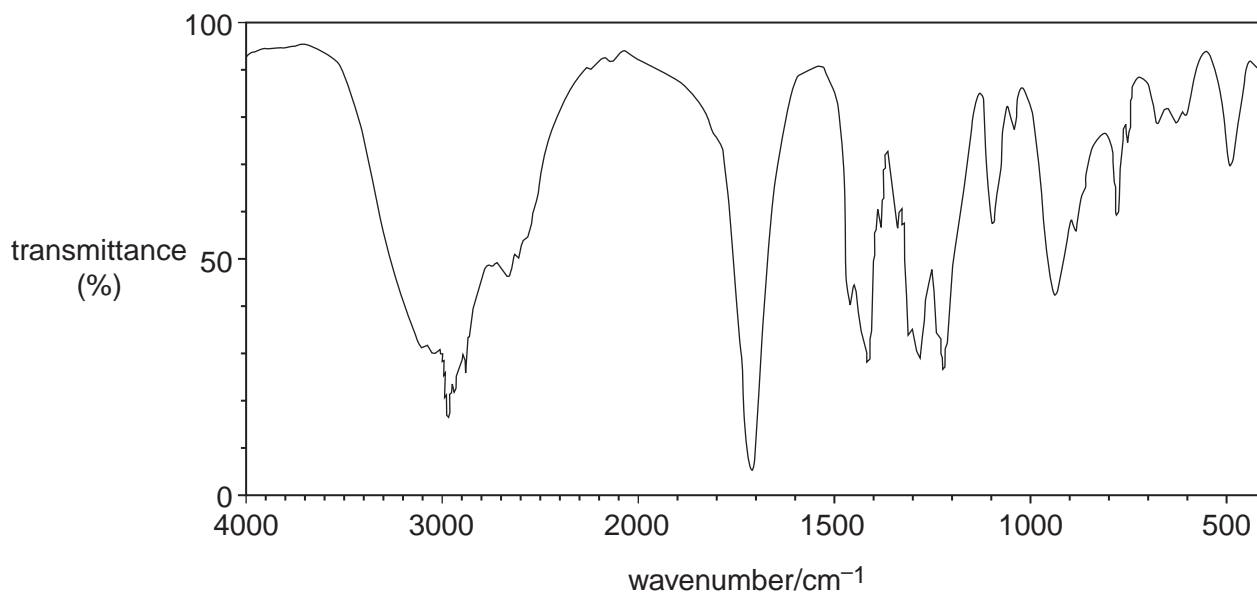
Draw the ester formed.

[1]

(e)

**butan-1-ol**

Butan-1-ol was oxidised using acidified potassium dichromate. The organic product was analysed by infra-red spectroscopy. The infra-red spectrum obtained is shown below.



(i) Use the spectrum to identify the organic product. Explain your reasoning.

.....

.....

.....

.....

..... [3]

(ii) Write a balanced equation for this oxidation. Use [O] to represent the oxidising agent.

..... [2]

[Total: 16]

3 Compound **X** is a hydrocarbon containing 85.7% C by mass.

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

empirical formula =[2]

(ii) The relative molecular mass of compound **X** is 56. Show that the molecular formula of compound **X** is C_4H_8 .

[1]

(b) Compound **X** is a *cis* isomer.

Draw the **skeletal** formulae of compound **X** and its *trans* isomer.

compound X	<i>trans</i> isomer

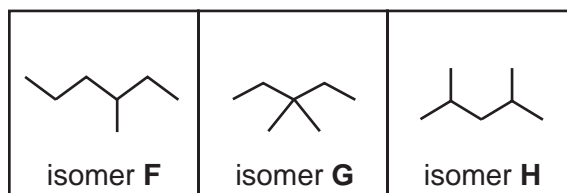
[2]

[Total: 5]

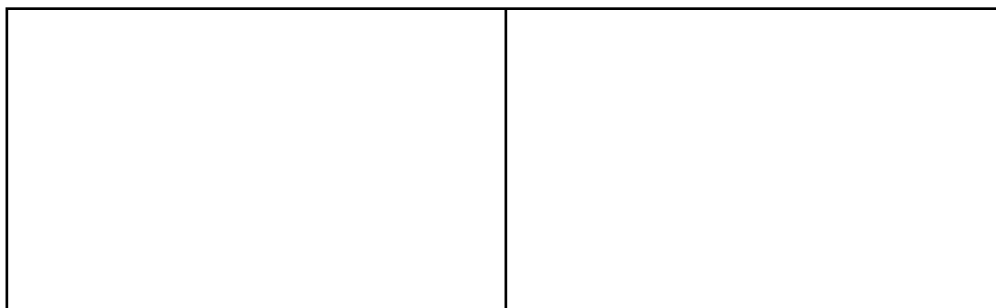
- 4 Petrol is a blend or mixture of many different hydrocarbons.

Oil companies use a variety of techniques such as isomerisation and reforming to produce the hydrocarbons which can be mixed together to give the correct blend.

- (a) Isomerisation of heptane, C_7H_{16} , produces a mixture of branched structural isomers, three of which are shown in the boxes below.



- (i) Draw, using skeletal formulae, **two** other branched structural isomers of heptane.



[2]

- (ii) Name isomer **G**.[1]

- (iii) Isomers **F**, **G** and **H** have different boiling points.
Which of the three isomers has the highest boiling point?

.....[1]

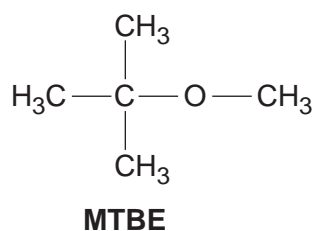
- (b) Heptane can be reformed to produce methylcyclohexane as one of the products.

Write a balanced equation for the reforming of heptane into methylcyclohexane.

[2]

- (c) Oxygen-containing compounds can be added to improve the efficiency and performance of fuels.

A commonly used oxygen-containing compound is MTBE, shown below.



- (i) Calculate the percentage, by mass, of oxygen in MTBE. Give your answer to three significant figures.

answer =[2]

- (ii) Write a balanced equation for the complete combustion of MTBE.

[2]

- (d) The compounds in petrol have high volatility.

- (i) What is meant by *high volatility*?

.....
 [1]

- (ii) Suggest **one** disadvantage if the volatility of a petrol is too high.

.....
 [1]

[Total: 12]

Give an example of each of these conversions including reagents, conditions and balanced equations.

.....[9

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- (b) Describe the mechanism for the preparation of an alcohol from a halogenoalkane. Use curly arrows to show the movement of electrons. Show any relevant dipoles and lone pairs of electrons.

[4]

[Total: 14]

END OF QUESTION PAPER

PLEASE DO NOT WRITE ON THIS PAGE

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Q.2 Infra-red spectrum © the National Institute of Advanced Industrial Science and Technology, www.aist.go.jp/RIODB/SDBS

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