OCR
RECOGNISING ACHIEVEMENT

OXFORD CAMBRIDGE AND RSA EXAMINATIONS
Advanced Subsidiary GCE

CHEMISTRY 2812

Chains and Rings

Wednesday **29 MAY 2002** Morning 1 hour

Candidates answer on the question paper.
Additional materials:
Data Sheet for Chemistry
Scientific calculator

Candidate Name	Centre Number	Candidate Number

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 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	Mark	Mark
1	11	
2	18	
3	12	
4	6	
5	13	
TOTAL	60	

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

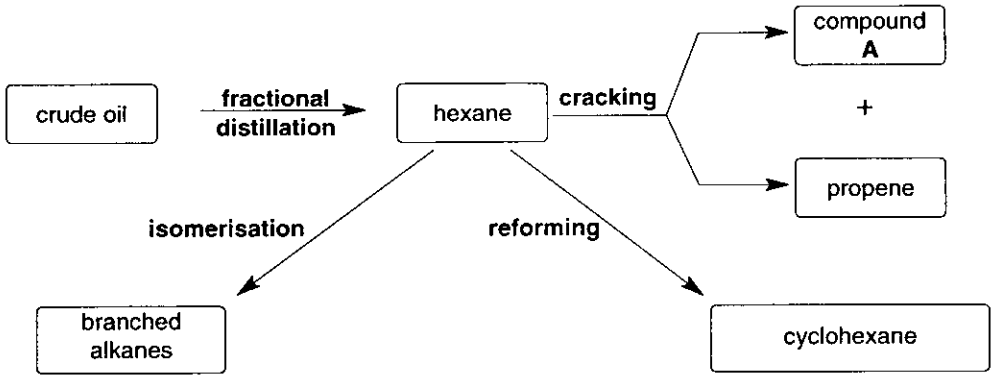
Registered Charity Number:1066969
[Turn over

For Examiner's Use

Answer **all** questions.

1 The refined fractions of crude oil are used to make many organic compounds. In turn, these compounds are used to manufacture a great variety of products.

The reaction sequence below shows the production of hexane from fractional distillation of crude oil followed by cracking, reforming and isomerisation.



(a) The cracking of hexane produces propene and compound **A**.

(i) Complete a balanced equation for this cracking of hexane.

$C_6H_{14} \longrightarrow$ ..... + ... [1]

(ii) Name compound **A**. .....[1]

(b) The reforming of hexane produces cyclohexane.

Write a balanced equation for this reforming.

.....[1]

(c) The isomerisation of hexane produces **four** branched alkanes.

In the boxes below show the structural formulae and names of **two** of these branched isomers.

name	name .....

[4]

(d) State why hydrocarbons such as hexane are both reformed and isomerised by oil companies.

.....

.....[1]

(e) Crude oil and its fractions are described as non-renewable fossil fuels. To reduce the demand for fossil fuels ethanol can be mixed with petrol. Ethanol is an example of a renewable biofuel.

(i) Explain what is meant by a *biofuel*.

.....

.....[1]

(ii) Why are fossil fuels *non-renewable* whereas ethanol is *renewable*?

.....

.....

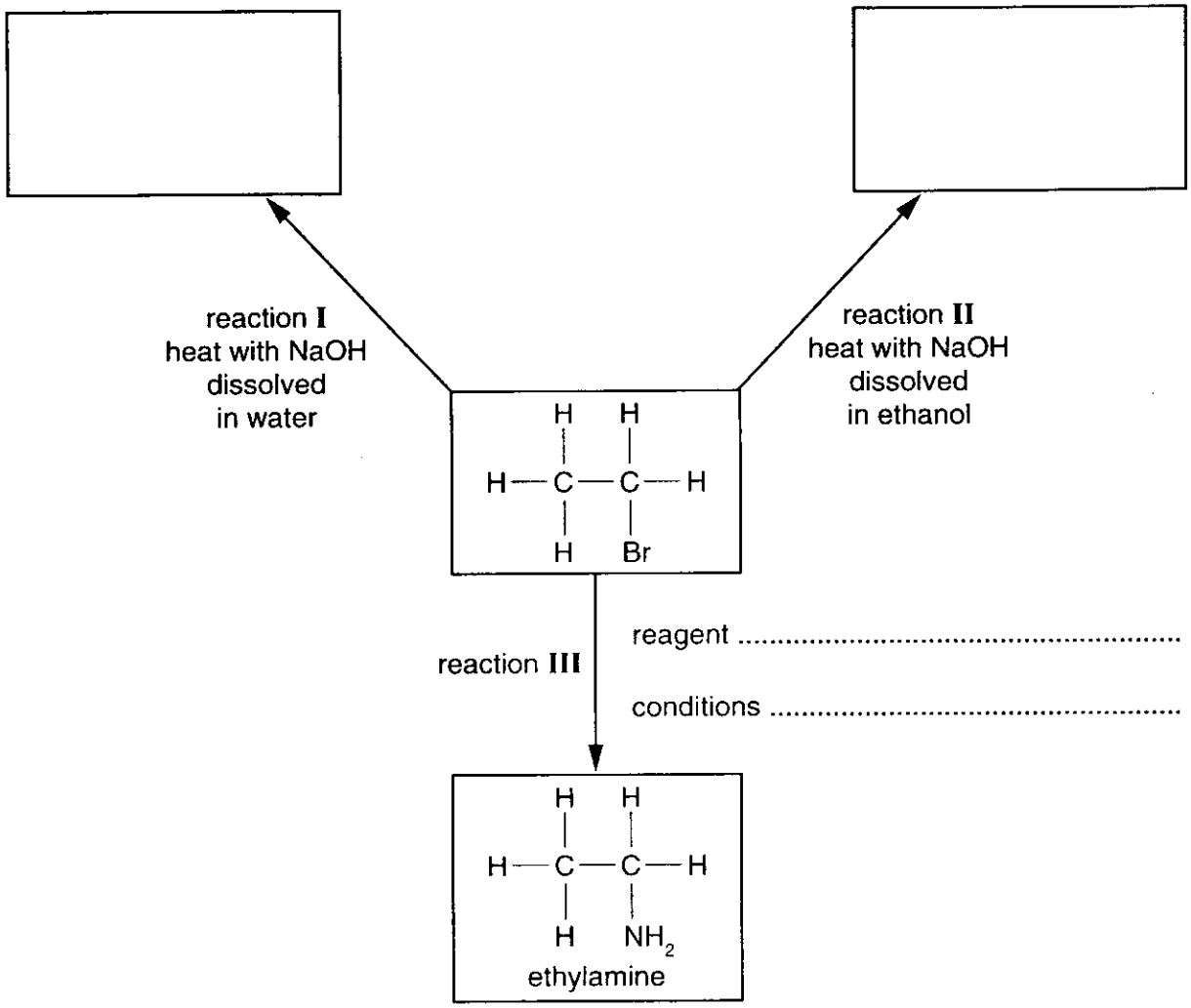
.....[2]

[Total : 11]

[Turn over

For Examiner's Use

2 Halogenoalkanes are useful synthetic reagents for the preparation of many important chemicals. Three reactions of bromoethane are shown below.



(a) **(i)** Identify the organic products in reactions **I** and **II** by writing their structural formulae in the relevant boxes. [2]

(ii) Name the **type** of reaction involved in

reaction **I**, ...

reaction **II**. .....[3]

(b) Write, in the space provided in the reaction scheme above, the reagent and conditions required to convert bromoethane into ethylamine in reaction **III**. [2]

For Examiner's Use

(c) **(i)** 2-bromobutane can react with ethanolic NaOH to form **two** structural isomers, each with a molecular formula of C_4H_8.

Draw and name each of the isomers.

isomer		
name	.....	.....

[4]

(ii) One of the isomers in **(c) (i)** can have *cis* and *trans* forms. In the boxes below, draw these *cis* and *trans* isomers.

cis isomer	*trans* isomer

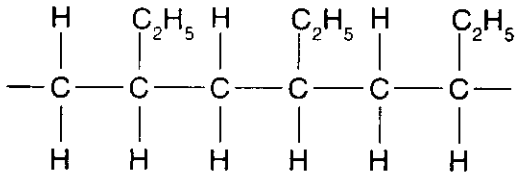
[2]

(iii) State **two** key structural features required for *cis-trans* isomerism to exist.

1. .....

2. .....[2]

(d) Each of the isomers drawn in **(c)(i)** can form a long-chain polymer. The structure below shows a section of one of these polymers.



(i) Draw a circle around the repeat unit. [1]

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

(iii) Identify which of the isomers in **(c)(i)** formed the polymer.

.....[1]

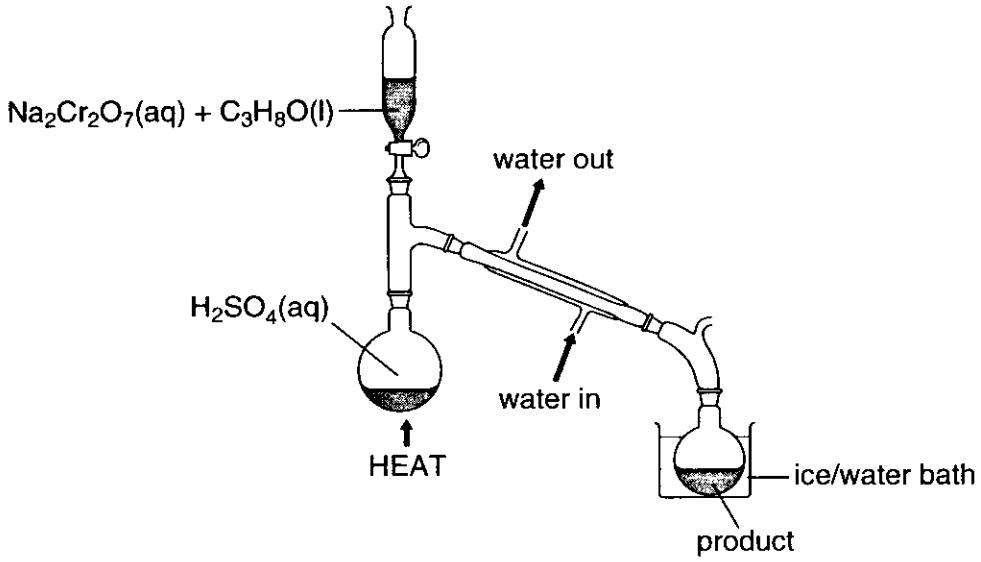
[Total : 18]

[Turn over

For Examiner's Use

3 A student was given the following instructions for the oxidation of an alcohol, C_3H_8O.

To 20 cm^3 of water in a flask, carefully add 6 cm^3 of concentrated sulphuric acid, and set up the apparatus as shown below.



Make up a solution containing 39.3 g of sodium dichromate(VI), $Na_2Cr_2O_7$, in 15 cm^3 of water, add 18.0 g of the alcohol, C_3H_8O, and pour this mixture into the dropping funnel.

Boil the acid in the flask. Add the mixture from the dropping funnel at such a rate that the product is slowly collected.

Re-distil the product and collect the fraction that boils between 48 °C and 50 °C.

(a) Identify the possible isomers of the alcohol C_3H_8O.

[2]

(b) The balanced equation for the reaction is:

$$3C_3H_8O + Na_2Cr_2O_7 + 4H_2SO_4 \longrightarrow 3C_3H_6O + Na_2SO_4 + Cr_2(SO_4)_3 + 7H_2O$$

(i) The mass of $Na_2Cr_2O_7$ used was 39.3 g. Calculate how many moles of $Na_2Cr_2O_7$ were used. (The molar mass of $Na_2Cr_2O_7$ is 262 g mol^{-1})

Answer .....[1]

For Examiner's Use

(ii) The amount of C_3H_8O used was 0.300 mol. Explain whether C_3H_8O or $Na_2Cr_2O_7$ was in excess.

.....

.....[1]

(iii) State the colour change that the student would observe during the reaction.

from ..... to ..... [2]

(c) The student obtained 5.22 g of the carbonyl compound, C_3H_6O.

(i) Calculate how many moles of C_3H_6O were produced in the experiment.

[2]

(ii) The theoretical yield of C_3H_6O is 0.300 mol. Calculate the percentage yield of C_3H_6O obtained by the student.

Answer .....[1]

(d) An **impure** sample of C_3H_6O obtained by a student was analysed using infra-red spectroscopy. The infra-red spectrum contained an absorption between 1680 and 1750 cm^{-1}. It also contained a broad absorption in the region 2550 to 3300 cm^{-1} due to the impurity.

Refer to the Data Sheet provided.

(i) What does the absorption at between 1680 and 1750 cm^{-1} indicate?

.....[1]

(ii) What does the broad absorption in the region 2550 to 3300 cm^{-1} indicate?

.....[1]

(iii) Identify which of the alcohols in **(a)** was used by this student. Explain your answer.

The alcohol used was .....

because .....

.....[1]

[Total : 12]

[Turn over

For Examiner's Use

4 An organic compound **A** was analysed and found to have a relative molecular mass of 62 and a composition by mass: C, 38.7%; H, 9.7%; O, 51.6%.

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

[2]

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

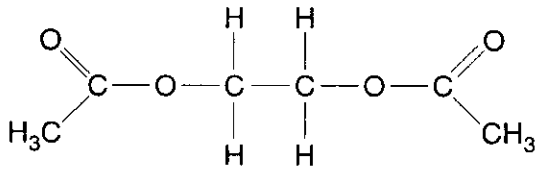
[1]

(b) The infra-red spectrum of compound **A** showed an absorption between 3230–3550 cm^{-1}.

State the functional group indicated by this absorption.

.....[1]

(c) One molecule of compound **A** can react with an excess of ethanoic acid, CH_3COOH, to produce the compound shown below.



Deduce the identity of compound **A**.

[1]

(d) Suggest why compound **A** has an unusually high boiling point of 198 °C.

.....

.....[1]

[Total : 6]

For Examiner's Use

5 Chlorine reacts readily with ethene in the dark but does not react with methane unless sunlight or another source of ultra violet light is present.

State and describe, with the aid of suitable equations,

- the mechanism of the reaction between chlorine and methane,
- the mechanism of the reaction between chlorine and ethene,
- the type of fission that the C*l*–C*l* bond undergoes in each of the mechanisms.

In this question, 1 mark is available for the quality of written communication.

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[12]

QWC [1]

[Total : 13]

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