



ADVANCED SUBSIDIARY GCE
CHEMISTRY
 Chains and Rings

2812/01

Candidates answer on the question paper

OCR Supplied Materials:

- *Data Sheet for Chemistry* (Inserted)

Other Materials Required:

- Scientific calculator

Friday 9 January 2009
Afternoon

Duration: 1 hour



Candidate Forename		Candidate Surname	
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Centre Number						Candidate Number				
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INSTRUCTIONS TO CANDIDATES

- Write your name clearly in capital letters, your Centre Number and Candidate Number in the boxes above.
- Use 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, however additional paper may be used if necessary.

INFORMATION FOR CANDIDATES

- The number of marks 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.
- You may use the *Data Sheet for Chemistry*.
- You are advised to show all the steps in any calculations.
- This document consists of **16** pages. Any blank pages are indicated.

FOR EXAMINER'S USE		
Qu.	Max.	Mark
1	10	
2	18	
3	10	
4	9	
5	13	
TOTAL	60	

Answer **all** the questions.

- 1** Fuels are an important part of our everyday life. Crude oil is a source of hydrocarbons such as $C_{14}H_{30}$.

$C_{14}H_{30}$ is cracked into octane which can be used as a fuel. To improve its efficiency as a fuel, octane is processed into branched chain alkanes and cycloalkanes.

- (a)** What is meant by a *hydrocarbon*?

.....
 [1]

- (b)** Write an equation for the cracking of $C_{14}H_{30}$ to form octane.

..... [1]

- (c)** Octane can be reformed into 1,2-dimethylcyclohexane, $CH_3C_6H_{10}CH_3$, and another product.

- (i)** Draw the structure of 1,2-dimethylcyclohexane.

[1]

- (ii)** Identify the other product formed.

..... [1]

- (d)** Isomerisation of octane can produce 2,2,3-trimethylpentane.

- (i)** Draw the structure of 2,2,3-trimethylpentane.

[1]

- (ii)** Write an equation for the complete combustion of 2,2,3-trimethylpentane.

..... [2]

- (e) Scientists are looking for alternatives to fossil fuels and are developing 'bio-fuels' such as ethanol. Ethanol is a renewable fuel and it is thought to be more environmentally friendly than fossil fuels.

(i) Explain why ethanol is *renewable*.

.....

.....

..... [2]

(ii) Suggest why ethanol is thought to be *environmentally friendly*.

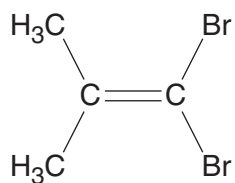
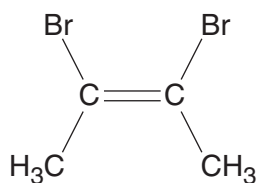
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.....

..... [1]

[Total: 10]

- 2 Compounds **A** and **B** are both dibromoalkenes with the molecular formula, $C_4H_6Br_2$. Compounds **A** and **B** are isomers.

**A****B**

- (a) (i) Name compound **A**.

..... [1]

- (ii) Calculate the percentage, by mass, of Br in compound **A**.

answer = % [2]

- (iii) Draw another structural isomer of $C_4H_6Br_2$.

[1]

- (b) The reaction between isomer **B** and Br_2 can be used to show the presence of the $C=C$ double bond.

- (i) State what you would see when isomer **B** reacts with Br_2 .

..... [1]

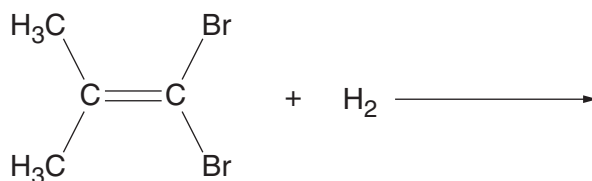
- (ii) State the type of reaction mechanism for this reaction.

..... [1]

- (iii) What is the molecular formula and the empirical formula of the organic product?

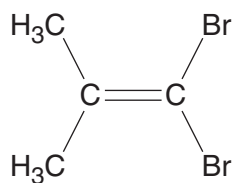
molecular formula = empirical formula = [2]

- (c) For the reaction between isomer **A** and H_2 , identify the organic product and state the conditions used.

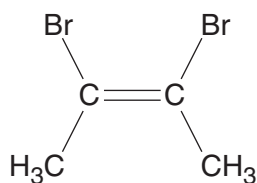


conditions..... [2]

- (d) Isomers **A** and **B**, shown below, both react with HBr .



A



B

- (i) Explain why **A** can produce two different structural isomers but **B** only one.

.....

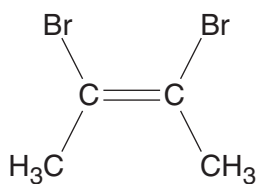
 [1]

- (ii) Identify the two structural isomers formed when **A** reacts with HBr .

--	--

[2]

- (e) Isomer **B**, shown below, can be converted into 2,3-dibromobutan-2-ol.



B

- (i) Draw the skeletal formula of 2,3-dibromobutan-2-ol.

[1]

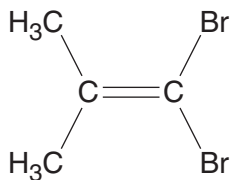
- (ii) Suggest the reagent and conditions that could be used for the conversion.

reagent

conditions

..... [2]

- (f) Isomer **A**, shown below, can form an addition polymer.



A

Draw a section of the polymer including two repeat units.

[2]

[Total: 18]

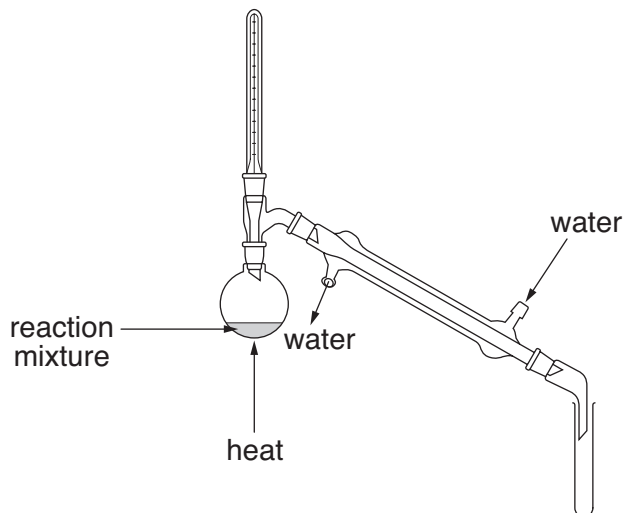
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TURN OVER FOR QUESTION 3

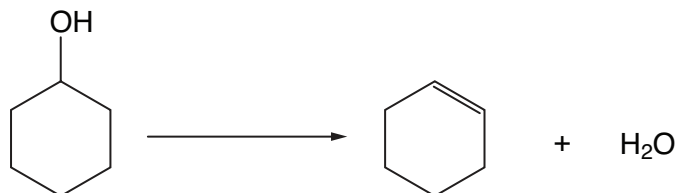
- 3 Cyclohexene, C_6H_{10} , can be prepared from cyclohexanol, $C_6H_{11}OH$, by the dehydration method described below.

A reaction mixture of 5.0 g cyclohexanol and 3.0 cm³ of concentrated sulphuric acid, H_2SO_4 , was placed in a round-bottomed flask and the apparatus arranged for distillation as shown below. An impure liquid, consisting of two immiscible layers, was collected after distillation.



The upper organic layer was separated and dried. Finally it was re-distilled to yield 1.8 g of cyclohexene.

The equation for the preparation is shown below.



- (a) (i) What is the relative molecular mass of cyclohexanol?

..... [1]

- (ii) How many moles of cyclohexanol were used in the experiment?

answer = mol [1]

- (iii) Calculate the percentage yield of cyclohexene in the experiment.

Give your answer to **two** significant figures.

% yield = [3]

- (b) It was thought that unreacted cyclohexanol was present.

- (i) Explain how infra-red spectroscopy could be used to show that cyclohexanol was present. Refer to the *Data Sheet* in your answer.

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

- (ii) A chemical test could have been used to show that an alcohol was present.

State the reagent and the expected observation.

reagent

observation [2]

- (iii) Draw the structure of the organic product that would have been formed in (ii) if cyclohexanol was the alcohol.

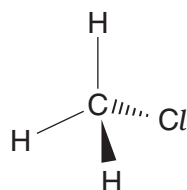
[1]

[Total: 10]

Turn over

4 Halogenoalkanes are polar molecules that react with nucleophiles.

- (a) The displayed formula of chloromethane is shown below. Label the dipole on the C–Cl bond and state the value of the H–C–Cl bond angle.

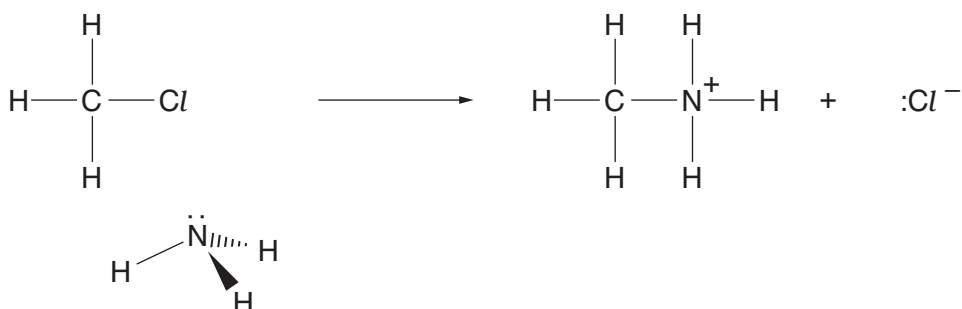


bond angle =° [2]

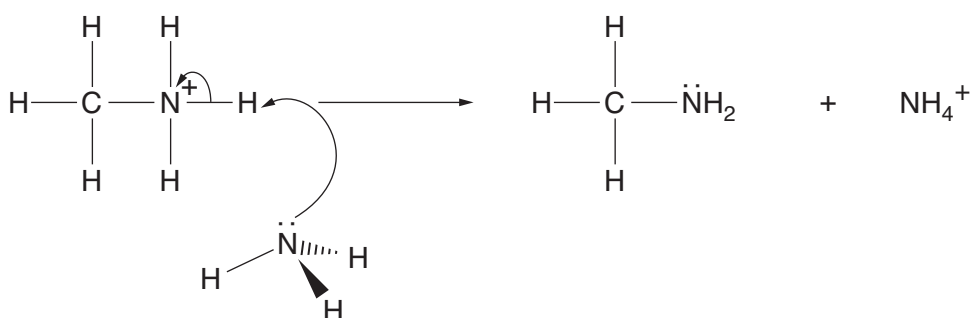
- (b) Chloromethane reacts with ammonia in a nucleophilic substitution reaction.

Part of the mechanism for this reaction is shown below.

Step 1



Step 2



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

..... [1]

- (ii) Add 'curly arrows' to **step 1** of the mechanism to show the movement of electron pairs.

[2]

(iii) Deduce a balanced equation for the **overall** reaction.

..... [1]

(iv) Name the organic product. [1]

(c) Ammonia was reacted with iodomethane rather than with chloromethane.

What would happen to the rate of reaction? Explain your answer.

.....

.....

..... [2]

[Total: 9]

TURN OVER FOR QUESTION 5

- 5 (a)** Explain why alkanes, such as pentane, do not react with reagents such as nucleophiles and electrophiles.

..... [2]

- (b)** In this question, one mark is available for the quality of use and organisation of scientific terms.

- Name and describe the mechanism for the reaction between pentane and bromine.
- State the type of bond fission involved in this mechanism.
- Explain why it is difficult to produce a single organic product.

In your answer, include any relevant equations and conditions.

..... [10]

Quality of Written Communication [1]

[Total: 13]

END OF QUESTION PAPER

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