OCR
RECOGNISING ACHIEVEMENT

ADVANCED SUBSIDIARY GCE **2812/01**

CHEMISTRY

Chains and Rings

THURSDAY 10 JANUARY 2008 Morning

Time: 1 hour

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

*C U P / T 2 8 4 2 3 *

Candidate Forename		Candidate Surname	

Centre Number						Candidate Number				

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.
- Do **not** write outside the box bordering each page.
- 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	**10**	
2	**10**	
3	**18**	
4	**13**	
5	**9**	
TOTAL	**60**	

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

[Turn over

Answer **all** the questions.

1 **(a)** The alkanes in crude oil can be separated because they have different boiling points.

The table below shows the boiling points of some alkanes.

alkane	boiling point/°C	M_r
butane	0	58
pentane	36	72
hexane	69	86
2-methylbutane	28	72
dimethylpropane	10	72
3-methylpentane		86
2,3-dimethylbutane	58	86

(i) Explain the trend in boiling points of the straight chain alkanes.

.....

.....

.....[2]

(ii) Explain the difference in the boiling points of the three isomers with M_r = 72.

.....

.....

.....[2]

(iii) Use the data in the table to predict the boiling point of 3-methylpentane.

.....[1]

(b) In industry, alkanes are processed by isomerisation and by reforming.

(i) Use skeletal formulae to write an equation for the isomerisation of pentane into dimethylpropane.

[2]

(ii) Write an equation to show how pentane can be reformed.

[2]

(iii) State why straight chain alkanes are processed by isomerisation and reforming.

.....

.....[1]

[Total: 10]

2 Alkanes are unreactive and do not react with either nucleophiles or electrophiles.

(a) Explain the lack of reactivity in an alkane such as propane.

.....

.....

.....

.....[2]

(b) Under certain conditions propane reacts with halogens to form halogenoalkanes.
An example is shown below.

$$CH_3CH_2CH_3 + Cl_2 \longrightarrow CH_3CH_2CH_2Cl + HCl$$

The reaction is described as a free-radical substitution reaction. It is initiated by the fission of the bond in Cl_2.

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

.....[1]

(ii) State the type of fission that takes place when the bond in Cl_2 breaks.

.....[1]

(iii) State the conditions necessary for the fission of the bond in Cl_2.

.....[1]

(iv) The reaction mechanism for the reaction above involves two propagation steps.

Write equations to show the two propagation steps.

step 1 .....[1]

step 2 .....[1]

(v) Free-radical reactions are difficult to control and often result in a complex mixture of organic products. In the reaction of propane with chlorine some hexane is also formed.

Suggest how hexane could have been formed.

.....[1]

(c) Propane can be used as a fuel in cookers whilst camping.

(i) Write a balanced equation for the complete combustion of propane.

.....[1]

(ii) Explain why propane cookers should only be used in a well-ventilated space.

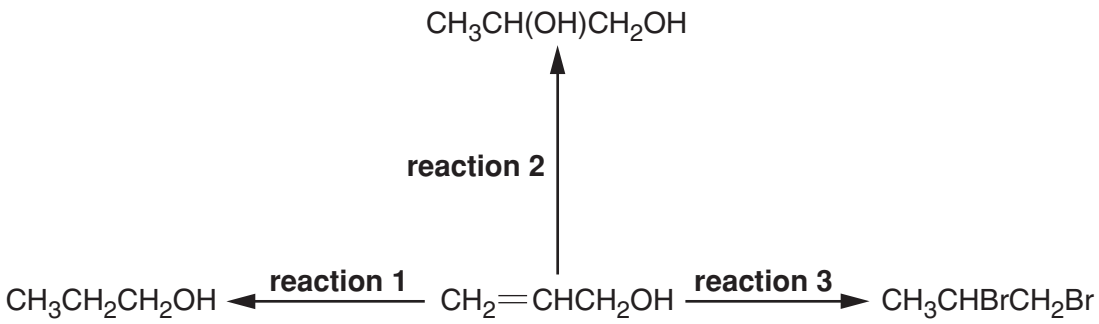
.....

.....[1]

[Total: 10]

3 Prop-2-en-1-ol, $CH_2{=}CHCH_2OH$, is a colourless liquid with a pungent smell. It is produced in industry to make resins, plasticisers and many other chemicals.

(a) The reaction scheme below shows how prop-2-en-1-ol can be used for the production of a variety of chemicals.



State the reagent(s) and catalyst, if any, for each of **reactions 1**, **2** and **3**.

(i) **reaction 1** reagent(s) .....

catalyst ..... [2]

(ii) **reaction 2** reagent(s) .....

catalyst ..... [2]

(iii) **reaction 3** reagent(s) ..... [1]

(b) $CH_2{=}CHCH_2OH$ also reacts with bromine to form $CH_2BrCHBrCH_2OH$.

Describe, with the aid of curly arrows, the mechanism involved. Show any relevant dipoles.

[4]

(c) Prop-2-en-1-ol polymerises rapidly.

(i) Show three repeat units and draw a circle around one repeat unit.

[2]

(ii) Write a balanced equation for this polymerisation.

[2]

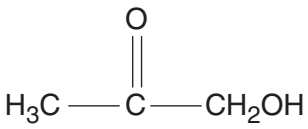
(iii) Name the polymer. .....[1]

(d) The products from **reactions 1** and **2** are $CH_3CH_2CH_2OH$ and $CH_3CH(OH)CH_2OH$, respectively. Both undergo oxidation reactions with acidified dichromate ions, $H^+/Cr_2O_7^{2-}$.

(i) Write a balanced equation for the reaction of $CH_3CH_2CH_2OH$ with excess $H^+/Cr_2O_7^{2-}$ under reflux.
Use [O] to represent the oxidising mixture.

.....[2]

(ii) When $CH_3CH(OH)CH_2OH$ is oxidised with $H^+/Cr_2O_7^{2-}$ it produces a mixture of organic products, one of which is shown below.



hydroxypropanone

Suggest the structures of **two** other possible oxidation products from this reaction.

[2]

[Total: 18]

4 A chemistry student was interested in aromatherapy and decided to investigate rose oil which can be extracted from both the flowers and the leaves of roses.

(a) The student separated an organic liquid, compound **A**, from rose oil. Compound **A** has a relative molecular mass of 154 and contains 77.9% C, 11.7% H and 10.4% O by mass.

Calculate the molecular formula of compound **A**.

molecular formula = ...[3]

(b) The student reacted compound **A** with bromine and observed that the bromine was decolourised.

(i) What conclusion can be drawn from this observation?

.....[1]

(ii) Further investigation revealed that 0.0100 mol of compound **A** reacted exactly with 3.196 g of bromine.

Calculate the number of moles of bromine, Br_2, that reacted.

answer = ... mol [2]

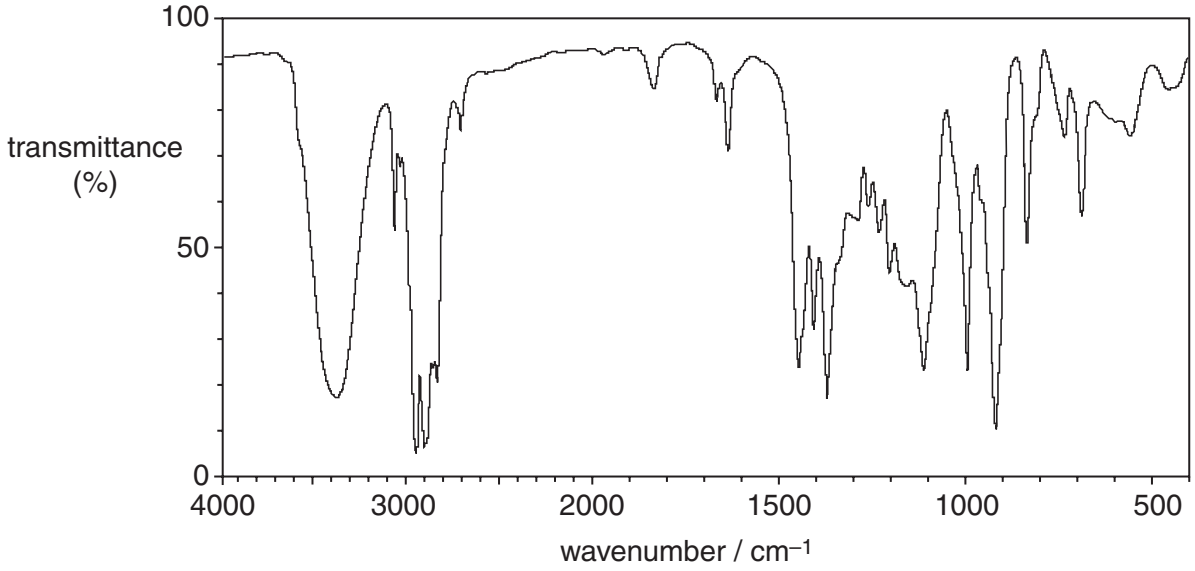
(iii) What conclusion could the student draw about compound **A** from this investigation?

.....

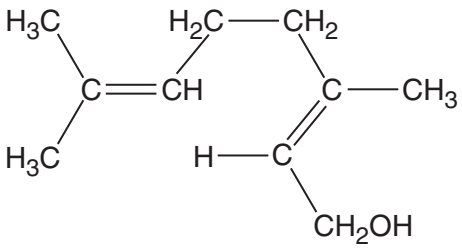
.....[1]

(c) The student analysed the infra-red spectrum of compound **A** and concluded that the compound is an alcohol.

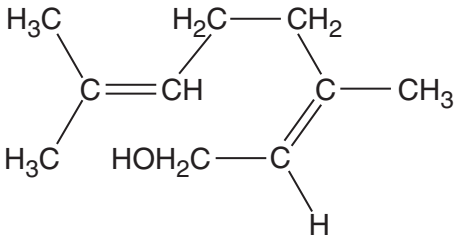
On the infra-red spectrum below label, with a letter **X**, the absorption that confirms that compound **A** is an alcohol. [1]



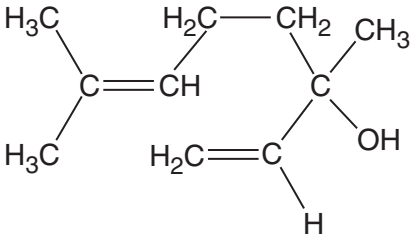
(d) After careful research the student concluded that **A** was one of the three compounds below.



geraniol



nerol



linalool

The student heated compound **A** with acidified potassium dichromate and the orange colour did **not** turn green. The student was therefore able to identify compound **A** as one of the three compounds shown above.

(i) Compound **A** is .....[1]

(ii) Explain your reasoning.

.....

.....[1]

(e) Suggest a reagent that would react with the alcohol group in compound **A** to produce a gas.

State the reagent and identify the gas and the organic product.

reagent .....

gas .....

organic product

[3]

[Total: 13]

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

The rates of hydrolysis of 1-chloropentane, 1-bromopentane and 1-iodopentane are different.

- Briefly outline how you would compare the reaction rates.
- Explain why 1-chloropentane, 1-bromopentane and 1-iodopentane react at different rates and state the order of reactivity.
- Use suitable equations in your answer.

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.....[8]

Quality of Written Communication [1]

[Total: 9]

END OF QUESTION PAPER

PLEASE DO NOT WRITE ON THIS PAGE