

OXFORD CAMBRIDGE	E AND	RSA	EXAMINATIONS
Advanced Subsidiary	GCE		

CHEMISTRY

Wednesday

Chains and Rings

8 JUNE 2005

Morning

1 hour

2812

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 provided 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	Max.	Mark
1	13	
2	15	
3	13	
4	8	
5	11	
TOTAL	60	

This question paper consists of 11 printed pages and 1 blank page.

Answer all the questions.

				r		
		alkane	number of carbon atoms	molecular formula	boiling point/°C	
		butane	4	C ₄ H ₁₀	0	
		pentane	5	C ₅ H ₁₂	36	
		hexane	6		69	
		heptane	7	C ₇ H ₁₆	99	
		octane	8	C ₈ H ₁₈		
		nonane	9	C ₉ H ₂₀	152	
		decane	10	C ₁₀ H ₂₂	175	
(a)	vvna	at is the molecul	ar formula of nex	(ane /		[1]
(b)	(i)	State the trend	in the boiling po	ints of the alk	anes.	
		••••••				
						[1]
	(ii)	Explain the tree	nd in the boiling (points of the	alkanes.	
						[1]
	(iii)	Predict the boil	ing point of octai	ne.		°C [1]
(c)	Lon	ng chain alkanes	s, such as nonar	ne, can be c	racked into shorter	chain alkanes and
	alke	enes.				
	(i)	Write a balance	ed equation for t	he cracking o	f nonane into hepta	ane and ethene.
			•••••••	•••••		[1]
	(ii)	Much of the et	hene is then con	verted into et	hanol.	
		Write a baland essential cond	ced equation for itions.	the convers	sion of ethene into	ethanol. State the
		equation				[1]
		conditions				
				•••••		[2]

1 The table below lists the boiling points of some alkanes.

3 (d) Heptane can be isomerised to produce branched chain alkanes such as 2-methylhexane or 2,3-dimethylpentane. The equation below shows the isomerisation of heptane into 2-methylhexane. (i) Using skeletal formulae, complete the balanced equation for the isomerisation of heptane into 2,3-dimethylpentane. [1] (ii) The boiling point of 2,3-dimethylpentane is 84 °C. Predict the boiling point of 2-methylhexane.°C [1] (e) Heptane can be reformed to produce methylcyclohexane which is a cycloalkane. Write a balanced equation to show the reforming of heptane to obtain methylcyclohexane. [2] State why branched chain alkanes and cycloalkanes are more useful than straight chain (f) alkanes.[1] [Total: 13]

2	Propane	, C_3H_8 , is used in the reaction sequence shown below.	Use
H ₃ C	С — СН ₂ -	$-CH_{3} \xrightarrow{\text{reaction 1}} H_{3}C - CH_{2} - CH_{2} - Cl \xrightarrow{\text{reaction 2}} H_{3}C - CH_{2} - Cl$ $aqueous OH^{-}/heat$	 2 ^{——} OH
		reaction 3 ethanolic OH ⁻ /heat OH	
		$E \stackrel{\text{polymerisation}}{\longleftarrow} H_3C \stackrel{\text{reaction 4}}{\longrightarrow} H_3C \stackrel{\text{reaction 4}}{\longrightarrow} H_3C \stackrel{\text{reaction 4}}{\longrightarrow} D$	I
	(a) The read	e reaction sequence shows several important reaction mechanisms. Select fr ctions 1 to 4 , the reaction that shows	om
	(i)	free radical substitution, reaction	[1]
	(ii)	electrophilic addition, reaction	[1]
	(iii)	elimination. reaction	[1]
	(b) In r	eaction 2 , the aqueous OH^- acts as a nucleophile.	
	(i)	State what is meant by the term nucleophile.	
			[1]
	(ii)	Complete, with the aid of curly arrows, the mechanism involved in reaction 2 . St any relevant dipoles.	woi
	Н ₃ С—	$CH_2 - CH_2 - Cl \longrightarrow H_3C - CH_2 - CH_2 - OH + \dots$	
		OH-	
			[4]

4

For Examiner's

		5	For Examiner's
(c) Co	mpounds B and D are structural isom	ners of each other.	Use
(i)	State what is meant by the term str	uctural isomers.	
			[2]
(ii)	Draw the skeletal formulae of comp	ounds B and D .	
	Compound B	Compound D	
	Compound B	Compound D	
			[2]
(d) Co	mound C can be polymerised to form	m compound E	
(u) 00	State the time of polymerised to for		[4]
(1)	State the type of polymerisation		[1]
(11)	Name compound E		[1]
(iii)	Draw a section of compound E. Sho	ow two repeat units.	
			[1]
			[Total: 15]

- 3 Acrolein, CH₂=CHCHO, and acrylic acid, CH₂=CHCOOH, are both used in industry for the manufacture of plastic resins and polymers. Both acrolein and acrylic acid can be made from prop-2-en-1-ol, CH₂=CHCH₂OH.
 - (a) (i) Draw the structures of prop-2-en-1-ol and acrolein. Clearly display the functional groups in each compound.

prop-2-en-1-ol	acrolein	

(ii) Name the functional group common to **both** prop-2-en-1-ol and acrolein.

.....[1]

- (b) Prop-2-en-1-ol can be oxidised to form either acrolein or acrylic acid.
 - (i) Identify a suitable oxidising mixture.

.....[2]

- (ii) Write a balanced equation for the oxidation of prop-2-en-1-ol into acrolein. Use [O] to represent the oxidising agent.
 -[1]
- (c) A sample of prop-2-en-1-ol was oxidised and an infra-red spectrum of the organic product was obtained.



	By acid	referring to your <i>Data Sheet</i> , decide whether acrolein, CH_2 =CHCHO, or acrylic d, CH_2 =CHCOOH, was formed.
	Th€	e infra-red spectrum above is of
	bec	ause
	•••••	
	•••••	
		[3]
(d)	Acr	ylic acid reacts with prop-2-en-1-ol to produce an ester.
	(i)	Complete the balanced equation for this reaction.
		$CH_2 = CHCOOH + CH_2 = CHCH_2OH \rightarrow \dots $ [2]
	(ii)	Draw the structure of the ester. Clearly display all of the functional groups.
[
		[2]
		[Total: 13]

For 8 Examiner's Use Propene, $CH_3CH == CH_2$, is an alkene and undergoes an addition reaction with bromine. 4 State what you would see when propene reacts with bromine. (a) (i)[1] (ii) Complete, with the aid of curly arrows, the mechanism involved in the reaction between propene and bromine. Show any relevant dipoles and charges. $H_3C - CH = CH_2$ ----Br Br [4] (b) Propene, $CH_3CH == CH_2$, also reacts with HBr to produce two bromoalkanes that are structural isomers. CH₃CHBrCH₃ $CH_3CH = CH_2 + HBr$ CH₂CH₂CH₂Br Propyne, CH₃C = CH, reacts like propene. It reacts with HBr to give three isomers with molecular formula C₃H₆Br₂. Draw the three isomers with molecular formula C₃H₆Br₂. [3] [Total: 8]

- 5 In this question, one mark is available for the quality of spelling, punctuation and grammar.
 - (a) The rates of hydrolysis of chloroethane, bromoethane and iodoethane are different.
 - Describe how you would monitor the reaction rates.
 - Explain why chloroethane, bromoethane and iodoethane react at different rates.

Use suitable equations in your answer.

.....[6]

- For Examiner's Use
- (b) In 1930, an American engineer, Thomas Midgley, demonstrated a new refrigerant. As part of his demonstration, he inhaled a lung full of dichlorodifluoromethane, CCl_2F_2 , and used it to blow out a candle.

Use Midgley's demonstration to suggest **two** properties of CCl_2F_2 . Explain, with a reason, **two** other uses of chemicals such as CCl_2F_2 , other than as a refrigerant.

Quality of Written Communication [1]

[Total: 11]

END OF QUESTION PAPER