(b) Under certain conditions nitrogen reacts with oxygen to make N₂O.

$$2N_2(g) + O_2(g) \rightleftharpoons 2N_2O(g)$$
 equation 5.2

The enthalpy profile diagram for this reaction is shown in Fig. 5.3.

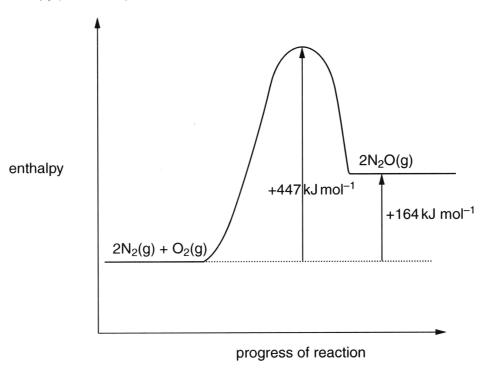


Fig. 5.3

(i) Calculate the enthalpy change when 240 dm³ of N₂O(g), measured at room temperature and pressure, is formed from N₂ and O₂.

enthalpy change = kJ [2]

(ii) What is the enthalpy change of formation, $\Delta H_{\rm f}$, of N₂O(g)?

 $\Delta H_{\rm f} =$ kJ mol⁻¹ [1]

Turn over

© OCR 2013



TE IN THIS MARGIN) D

OOR OCR OCR OCR OCR OCR OCR OCR OCR

OCR OCR

OCR

OCR OCR OCR

OCR OCR OCR OCR OCR OCR OCR

OCR OCR

OCR OCR OCR

OCR

OCR OCR OCR OCR OCR OCR OCR OCR OCR OCR

OCR OCR OCR OCR

OCR OCR OCR OCR OCR OCR OCR

OCR OCR OCR OCR

OCR OCR OCR

OCR OCR OCR

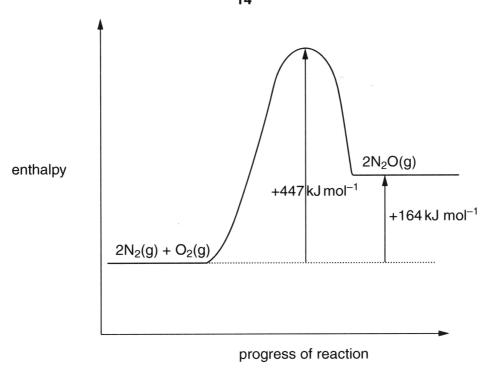


Fig. 5.3 (repeated)

The reaction in equation 5.2 is reversible. (iii)

$$2N_2(g) + O_2(g) \rightleftharpoons 2N_2O(g)$$
 equation 5.2

[Total: 11]

Calculate the activation energy, $\boldsymbol{E}_{\mathrm{a}}$, for the reverse reaction.

	E_{a} (reverse reaction) = KJ mol ⁻¹ [1]
(c)	Describe and explain, using equations, how the concentration of ozone in the stratosphere is maintained.
	[2]
(d)	In the stratosphere, NO catalyses the breakdown of ozone.
	Write two equations to show how NO catalyses this breakdown.
	[2]

© OCR 2013

- 6 Mass spectrometry and infrared spectroscopy are used in analysis.
 - (a) The element sulfur exists as molecules, S_n .

COCR

OCR OCR

OOCR

OOCR

OOCR OOCR OOCR

O OCR

OOCR OOCR

O OCR O OCR O OCR

O OCR O OCR O OCR

O OCR O OCR O OCR

0 OCR 0 OCR 0 OCR 0 OCR 0 OCR 0 OCR 0 OCR 0 OCR 0 OCR 0 OCR

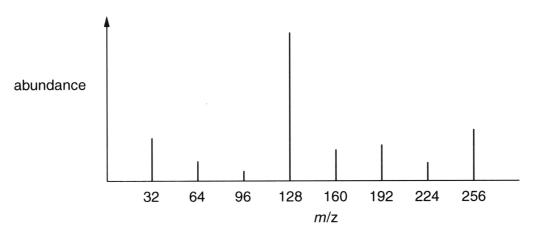
0 OCR 0 OCR 0 OCR 0 OCR 0 OCR 0 OCR 0 OCR 0 OCR 0 OCR 0 OCR

O OCR O OCR O OCR

O OCR O OCR O OCR

Olocr Olocr Olocr

OLOCR OLOCR OLOCR The mass spectrum that would be given by a sample of sulfur is shown below. All the sulfur atoms are the same isotope.



(i) State the m/z value of the molecular ion.

[1]

(ii) Suggest the formula for a molecule of sulfur.

[1]

(iii) What is the formula for the fragment ion with m/z = 128?

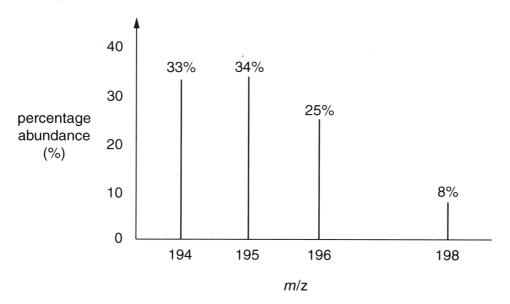
r	47
	IJ

© OCR 2013



Turn over

(b) A sample of an element, ${\bf L}$ is analysed using mass spectrometry. The mass spectrum is shown below.



Calculate the relative atomic mass of **L**. Give your answer to **one** decimal place.

	relative atomic mass of L =	[2]
(c)	Give an everyday use for infrared spectroscopy.	
		[1]

© OCR 2013

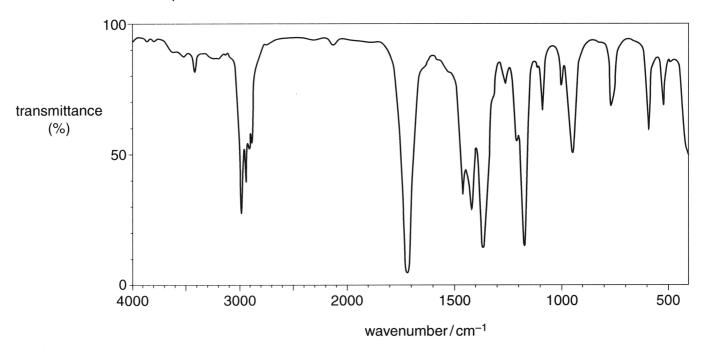
* 3132848716 *

(d) The solvent, M, is an organic compound used in paints. The solvent M was analysed.

M has a relative molecular mass of 72.0.

The percentage composition by mass of **M** is C, 66.7%; H, 11.1%; O, 22.2%.

The infrared spectrum of **M** is shown below.



The analysis produces several possible organic structures.

Suggest, with reasons, two possible structures for w .
[5]

[Total: 11]
Turn over

© OCR 2013



OCR OCR

(oZ ₹

(O∑ ₹

OOR

OCR OCR OCR OCR OCR

OCR OCR

OCR OCR

OCR OCR OCR OCR OCR OCR

OCR OCR

COCR COCR COCR

OOCR OOCR OOCR OOCR OOCR

OCR OCR

OOCR OOCR OOCR OOCR OOCR

OCR OCR OCR OCR

GOCR GOCR GOCR GOCR GOCR GOCR GOCR

OOCR

OOCR OOCR

OOCR OOCR

The	list sl	nows the s	tructural formulae of some	e halogenoalk	kanes.
		N O P Q	$\mathrm{CF_3CFC}l_2$ $\mathrm{CH_3CH_2Br}$ $\mathrm{CH_3CH_2CH_2CH_2Br}$ $\mathrm{CH_3CH_2CH_2CH_2I}$	R S T	CH ₃ CH ₂ CHC <i>l</i> CH ₃ CH ₃ CHBrCH ₂ CHICH ₃ (CH ₃) ₃ CBr
(a)	Cho	ose from th	ne list above, the letter of	the halogeno	palkane that is extremely unreactive.
()					[1]
(b)			nes react with hot KOH(ac	զ) to make alc	cohols.
, ,	(i)	Choose f		letter of the	halogenoalkane which reacts with hot
					[1]
	(ii)	Lloina th		describe the q) to make ar	mechanism of the reaction between alcohol.
			elevant dipoles and the na		
					[4]
	(iii)	Why is t	ne reaction of P with hot K	OH(aq) slowe	er than the reaction of Q with hot KOH(aq)?
		•••••			
					[1]



© OCR 2013

7

* 3132848718

(C)	one of the listed halogenoalkanes, N, O, P, Q, R, S or T.	ilo
		[2]
(d)	CFCs were once used as propellants but have now been replaced by biodegradal alternatives.	ole
	State one type of a biodegradable alternative.	
		[1]

Turn over

[Total: 10]

© OCR 2013

X

OCR

(OCR (OCR OCR **∮**OCR **OCR** (OCR MOCR **∮**OCR OCR OCR

(OCR COCR COCR OCR OCR COCR (OCR OCR OCR OCR (OCR (OCR (OCR OCR OCR COCR OCR COCR OCR OCR COCR COCR (OCR COCR OCR OCR (OCR OCR OCR (OCR COCR COCR

COCR COCR COCR COCR

COCR COCR COCR COCR COCR

COCR

QOCR QOCR QOCR



8 Poly(propenenitrile) is used to make acrylic fibres for clothing.

Poly(propenenitrile) is a polymer manufactured from propenenitrile.

propenenitrile

(a) Draw a section showing two repeat units of poly(propenenitrile).

(b)	Explain why this manufacture of poly(propenenitrile) has a 100% atom economy.					

[1]

© OCR 2013

* 3132848720 *

(c) Propenenitrile is manufactured from propene as shown in the equation.

$$C_3H_6(g) + NH_3(g) + 1\frac{1}{2}O_2(g) \rightleftharpoons CH_2CHCN(g) + 3H_2O(g) \Delta H = -540 \text{ kJ mol}^{-1}$$

The conditions used are 450 °C and 2.5 atmospheres in the presence of a catalyst.

Describe and explain, using le Chatelier's principle, the effect on the position of equilibrium of the following changes:

- a temperature above 450°C
- a pressure above 2.5 atmospheres
- the absence of a catalyst.

in your answer you should link the effects you describe with your explanations.
[5]

Question 8 continues on page 22

© OCR 2013

Turn over



OCR OCR

OCR OCR OCR

OCR OCR OCR

COCR COCR

S MARGIN)

O O S

10[≥] ₹

109.3

OCR OCR OCR

OCR

OCR

OCR **∮**OCR **NOCR** OCR COCR OCR OCR



(d) A factory is able to make 11.13 kg of propenenitrile from 220 mol of propene.

	Calculate the percentage yield of the reaction to form propenenitrile from propene.					
	paraentage viold -					
	percentage yield =% [2]					
(e)	The chemical industry uses temperature and catalysts to control the rate of reactions.					
(-)	The chemical industry uses temperature and catalysts to control the rate of reactions.					
	Using Boltzmann distribution diagrams, explain the effect on the rate of a reaction of:					
	increasing the temperature					
	increasing the temperatureadding a catalyst.					
	increasing the temperature					
	increasing the temperatureadding a catalyst.					
	 increasing the temperature adding a catalyst. 					
	 increasing the temperature adding a catalyst. 					
	 increasing the temperature adding a catalyst. 					
	 increasing the temperature adding a catalyst. 					
	 increasing the temperature adding a catalyst. 					
	 increasing the temperature adding a catalyst. 					
	 increasing the temperature adding a catalyst. 					
	 increasing the temperature adding a catalyst. 					
	 increasing the temperature adding a catalyst. 					
	 increasing the temperature adding a catalyst. 					
	 increasing the temperature adding a catalyst. 					
	 increasing the temperature adding a catalyst. 					
	 increasing the temperature adding a catalyst. 					
	 increasing the temperature adding a catalyst. 					
	 increasing the temperature adding a catalyst. 					



© OCR 2013



* 3132848722 *

 ••••
••••
[7]

END OF QUESTION PAPER

[Total: 16]

© OCR 2013



COCR

OCR OCR OCR OCR OCR

OCR OCR OCR

OCR OCR OCR OCR OCR OCR OCR

OCR OCR

OCR OCR OCR

OCR OCR OCR OCR OCR OCR OCR OCR OCR OCR OCR OCR OCR OCR OCR OCR OCR OCR OCR OCR

OCR OCR

OCR OCR OCR



* 3132848723

ADDITIONAL ANSWER SPACE

If additional space is required, you should use the following lined page. The question number(s) must be clearly shown in the margin.	
•••••	
•••••	
•••••	
	<u> </u>
•••••	



Copyright Information

OCR is committed to seeking permission to reproduce all third-party content that it uses in its assessment materials. OCR has attempted to identify and contact all copyright holders whose work is used in this paper. To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced in the OCR Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download from our public website (www.ocr.org.uk) after the live examination series.

If OCR has unwittingly failed to correctly acknowledge or clear any third-party content in this assessment material, OCR will be happy to correct its mistake at the earliest possible opportunity.

For queries or further information please contact the Copyright Team, First Floor, 9 Hills Road, Cambridge CB2 1GE.

OCR is part of the Cambridge Assessment Group; Cambridge Assessment is the brand name of University of Cambridge Local Examinations Syndicate (UCLES), which is itself a department of the University of Cambridge.

© OCR 2013



* 3132848724 *