

CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level

MARK SCHEME for the May/June 2014 series

9701 CHEMISTRY

9701/23

Paper 2 (Structured Questions AS Core),
maximum raw mark 60

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

Cambridge will not enter into discussions about these mark schemes.

Cambridge is publishing the mark schemes for the May/June 2014 series for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level components and some Ordinary Level components.

Page 2	Mark Scheme	Syllabus	Paper
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Question	Mark Scheme – 9701/23	Mark	Total mark
1 (a)	the amount of substance containing $6(.02) \times 10^{23}$ (fundamental) particles of that substance (or; the amount of substance containing as many particles as there are atoms in 12 g of carbon-12)	(1)	[1]
(b) (i)	$2\text{NaOH} + \text{CO}_2 \rightarrow \text{Na}_2\text{CO}_3 + \text{H}_2\text{O}$ allow ionic equations or formation of NaHCO_3	(1)	[1]
(ii)	$95 - 75 = 20 \text{ cm}^3$	(1)	[1]
(iii)	excess oxygen = 75 cm^3 so used = 25 cm^3	(1)	[1]
(iv)	$2\text{C}_x\text{H}_y + 5\text{O}_2 \rightarrow 4\text{CO}_2 + z\text{H}_2\text{O}$	(2)	[2]
(v)	$x = 2; y = 2; z = 2$ (or $z = 1$ if $\text{C}_x\text{H}_y + 2.5\text{O}_2 \rightarrow 2\text{CO}_2 + z\text{H}_2\text{O}$)	(1+1+1)	[3]
(c) (i)	W = $(\text{CH}_3)_2\text{C}=\text{CH}_2$ = 2-methylpropene X = $(\text{CH}_3)_2\text{CBrCH}_3$ = 2-bromo-2-methylpropane Y = $(\text{CH}_3)_2\text{CHCH}_2\text{Br}$ = 1-bromo-2-methylpropane Z = $(\text{CH}_3)_3\text{COH}$ = 2-methylpropan-2-ol	(1) (1) (1) (1)	[4]
(ii)	Markovnikov addition / H adds to C with most Hs tertiary carbocation more stable than primary inductive effect of three alkyl groups owtte	(1) (1) (1)	[Max 2]
		Total	15

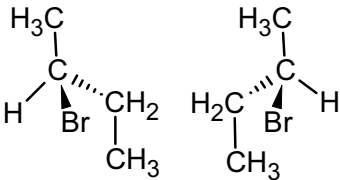
Page 3	Mark Scheme	Syllabus	Paper
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2 (a)	$\text{NH}_4^+ + \text{OH}^- \rightarrow \text{NH}_3 + \text{H}_2\text{O}$	(1)	[1]
(b) (i)	Initial acid = $40 \times 0.4 / 1000 = 0.016$ (mol)	(1)	[1]
(ii)	$\frac{25 \times 0.12}{1000} = 3.0 \times 10^{-3}$ (mol) (of OH^- used)	(1)	[1]
(iii)	excess acid = $\text{OH}^- = 0.003$ acid reacted = $0.016 - 0.003 = 0.013$ (mol)	(1)	[1]
(iv)	$\text{NH}_4^+:\text{H}^+ = 1:1$ so = 0.013 (mol NH_4^+)	(1)	[1]
(v)	amount of Cu = mass / $M_r = 0.413 / 63.5 = 6.5 \times 10^{-3}$ (mol) so Cu: $\text{NH}_4 = 0.0065:0.013 = 1:2$ so x = 2	(1) (1)	[2]
(vi)	$M_r = 399.7$	(1)	[1]
		Total	8

Page 4	Mark Scheme	Syllabus	Paper
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3	(a) (i)	(reaction between atmospheric N ₂ and O ₂) due to lightning / biological processes or bacteria <u>in soil</u> AND in car engines / power stations / metal refining / furnaces	(1)	[1]
	(ii)	2NO ₂ + H ₂ O → HNO ₂ + HNO ₃ OR 2NO ₂ + H ₂ O + 1/2O ₂ → 2HNO ₃ OR 3NO ₂ + H ₂ O → 2HNO ₃ + NO	(1)	[1]
	(iii)	SO ₂ + NO ₂ → SO ₃ + NO	(1)	
		NO + 1/2O ₂ → NO ₂	(1)	
		SO ₃ + H ₂ O → H ₂ SO ₄	(1)	[3]
	(b) (i)	$K_p = p\text{N}_2\text{O}_4 / (p\text{NO}_2)^2$	(1)	[1]
	(ii)	moles of NO ₂ = 0.32	(1)	[1]
	(iii)	x(N ₂ O ₄) = 1.84 / 2.16 = 0.85	(1)	
		x(NO ₂) = 0.32 / 2.16 = 0.15 ecf from (b)(ii)	(1)	[2]
	(iv)	pN ₂ O ₄ = 0.85 × 140 = 119 (kPa)	(1)	
		pNO ₂ = 0.15 × 140 = 21 (kPa) ecf from (b)(iii)	(1)	[2]
	(v)	$K_p = 119 / 21^2 = 0.270 \text{ kPa}^{-1}$ ecf from (b)(i) and (b)(iv)	(2)	[2]
			Total	13

Page 5	Mark Scheme	Syllabus	Paper
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4	(a) (i)	decreases down the group ora	(1)	[1]
	(ii)	X–X bond strength decreases from Cl–Cl to I–I	(1)	
		But decreasing strength of H–X down group more significant	(1)	[2]
(b)	(i)	$\text{CaCl}_2 + \text{H}_2\text{SO}_4 \rightarrow \text{CaSO}_4 + 2\text{HCl}$ OR $\text{CaCl}_2 + 2\text{H}_2\text{SO}_4 \rightarrow \text{Ca}(\text{HSO}_4)_2 + 2\text{HCl}$	(1)	[1]
	(ii)	HI/I [–] reduces/is oxidised by conc H ₂ SO ₄ /because iodine is produced instead	(1)	[1]
	(iii)	brown gas/fumes produced $2\text{H}_2\text{SO}_4 + 2\text{KBr} \rightarrow \text{SO}_2 + \text{Br}_2 + 2\text{H}_2\text{O} + \text{K}_2\text{SO}_4$ (or ionic)	(1) (1+1)	[3]
(c)	(i)	CH ₃ CH ₂ CH ₂ CH ₂ Br primary	(1)	
		CH ₃ CH ₂ CHBrCH ₃ secondary	(1)	
		(CH ₃) ₂ CHCH ₂ Br primary	(1)	
(ii)		(CH ₃) ₃ CBr tertiary	(1)	[4]
		2-bromobutane	(1)	
			(1+1)	[3]
(d)		halide ions liberated (by hydrolysis of halogenoalkanes) form precipitate with Ag ⁺	(1)	
		OR $\text{Ag}^+ + \text{X}^- \rightarrow \text{AgX}$ order due to decreasing bond strength (C–I < C–Br < C–Cl)	(1)	[2]

Page 6	Mark Scheme	Syllabus	Paper
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(e) (i)	nucleophilic substitution	(2)	[2]
(ii)	<p>M1 = curly arrow from lone pair on OH⁻; M2 for curly arrow from C-Br bond to Br AND dipole</p>	(2)	[2]
(f) (i)	inert or volatile owtte	(1)	[1]
(ii)	destroy ozone	(1)	
	(in stratosphere) C-Cl bond broken by UV/free radicals produced	(1)	[2]
		Total	24