CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the May/June 2014 series

9701 CHEMISTRY

9701/21   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
	GCE AS/A LEVEL – May/June 2014	9701	21

Question	Mark Scheme	Mark	Total
1 (a)	The amount of energy required / energy change / enthalpy change when one electron is removed	1	
	from each atom / (cat)ion in one mol	1	
	of gaseous atoms / (cat)ions	1	
	OR energy change when 1 mole of electrons is removed from one mole of gaseous atoms / ions		
	$X(g) \rightarrow X^+(g) + e^-$ gains 2 marks		3
(b) (i)	Group V / 5 / 15	1	
	Big difference between fifth and sixth ionisation energies	1	2
(ii)	$1s^2\ 2s^2\ 2p^3$	1	1
	ecf from **(b)(i)** if period 2		
(c) (i)	(Weighted) mean / average mass of an atom(s) (of an element)	1	
	Relative to $1/12^{th}$ of (the mass of an atom of) carbon-12 **OR**	1	2
	relative to carbon-12 which is (exactly) 12 (units)		
	allow as an expression		
(ii)	$\quad$ **Z** $\qquad$ Cl		
	$\dfrac{31.13}{A_r}\quad \dfrac{68.87}{35.5}=1:2$		
	So $\dfrac{68.87/35.5}{31.13/A_r}=2$	1	
	$A_r = \dfrac{2\times 31.13\times 35.5}{68.87}=32.0923=32.1\text{ to 3s.f.}$	1	
	Allow alternative correct methods		2

© Cambridge International Examinations 2014

Page 3	Mark Scheme	Syllabus	Paper
	GCE AS/A LEVEL – May/June 2014	9701	21

Question	Mark Scheme	Mark	Total
(d) (i)	NaCl (+ aq) → $\quad$ Na$^+$ + Cl^- NaCl + H$_2$O $\quad$ → $\quad$ Na$^+$ + Cl^- + H$_2$O SiCl_4 + 2H$_2$O → $\quad$ SiO$_2$ + 4HCl SiCl_4 + 4H$_2$O → $\quad$ Si(OH)$_4$ + 4HCl SiCl_4 + 4H$_2$O → $\quad$ SiO$_2$.2H$_2$O + 4HCl Allow correct equation with other molar amounts of water	1 1	2
(ii)	NaCl is ionic **AND** giant / lattice NaCl dissolves / does not react SiCl_4 is <u>covalent</u> **AND** molecular / simple SiCl_4 is hydrolysed / reacts	1 1 1 1	4
(e)	shape of SF$_6$ = Octahedral bond angle = 90°	1 1	2
			18
2 (a) (i)	(The MnO$_4^-$ ions cause the Fe^{2+} ions to) lose electrons owtte / ora	1	1
(ii)	MnO$_4^-$(aq) + 5Fe^{2+}(aq) + **8**H$^+$(aq) → **Mn^{2+}**(aq) + 5Fe^{3+}(aq) + **4**H$_2$O(l)	1+1+1	3
(b) (i)	$\frac{20.0 \times 0.020}{1000} = 4(.00) \times 10^{-4}$ (mol)	1	1
(ii)	MnO$_4^-$: Fe^{2+} = 1 : 5 so amount of Fe^{2+} = 5 × 4.00 × 10^{-4} = 2(.00) × 10^{-3} (mol) ecf from **(b)(i)**	1	1
(iii)	2.00 × 10^{-3} × 250 / 25 = 0.02(00) (mol) ecf from **(b)(ii)**	1	1

© Cambridge International Examinations 2014

Page 4	Mark Scheme	Syllabus	Paper
	GCE AS/A LEVEL – May/June 2014	9701	21

Question	Mark Scheme	Mark	Total
(iv)	3.40 / 0.02 = 170 ecf from **(b)(iii)**	1	1
(v)	170 – 151.8 = 18.2 18.2 / 18 = 1.01 x = 1 ecf from **(b)(iv)** if appropriate	1	1
			9
3 (a) (i)	**K** = Cl^- / chloride / F^- / fluoride $H_2SO_4 + 2NaCl \rightarrow Na_2SO_4 + 2HCl$ (or equation with F or **K** for Cl) **OR** $H_2SO_4 + NaCl \rightarrow NaHSO_4 + HCl$ (or equation with F or **K** for Cl) ecf from identity of **K** so long as halide H**K** is acidic / H**K** is a gas / an acidic gas is produced	1 1 1	3
(ii)	**L** = I^- / iodide colour = yellow ecf from identity of **L** i.e. Cl^- (white) or Br^- (cream) $Ag^+ + I^- \rightarrow AgI$ (or equation with **L**) $AgNO_3 + NaI \rightarrow AgI + NaNO_3$ (or equation with **L**) ecf from identity of **L** so long as halide	1 1 1	3
(iii)	<u>Br_2</u> / bromine has **fewer electrons** than iodine / **more electrons** than chlorine **intermolecular** / **van der Waals' forces** (in Br_2 / **M₂**) **weaker** than in iodine / **stronger** than in chlorine	1 1	2
(b) (i)	**B** = chlorine / Cl_2 **C** = hydrogen / H_2 **D** = sodium hydroxide / NaOH	1 1 1	3

© Cambridge International Examinations 2014

	Page 5	Mark Scheme	Syllabus	Paper
		GCE AS/A LEVEL – May/June 2014	9701	21

Question	Mark Scheme	Mark	Total
(ii)	anode: $2Cl^- \rightarrow Cl_2 + 2e^-$	1	
	cathode: $2H^+ + 2e^- \rightarrow H_2$ **OR** $2H_2O + 2e^- \rightarrow 2OH^- + H_2$	1	2
			13
4 (a)	decolourisation with an alkene at room conditions / quickly / easily / **OR** alkane needs higher temp / UV / is slow at room conditions	1	
	double / π / pi bond / C = C present in alkenes	1	2
(b) (i)	UV light / sunlight / high temperature	1	1
(ii)	(Free) radical Substitution	1 1	2
(iii)	$\cdot C_2H_5 + \cdot C_2H_5 \rightarrow C_4H_{10}$	1	1
(iv)	$C_2H_5Br + Br\cdot \rightarrow \cdot C_2H_4Br + HBr$ **OR** $\cdot C_2H_4Br + Br_2 \rightarrow C_2H_4Br_2 + Br\cdot$	1	1
(c) (i)	Electrophilic Addition	1 1	2

© Cambridge International Examinations 2014

Page 6	Mark Scheme	Syllabus	Paper
	GCE AS/A LEVEL – May/June 2014	9701	21

Question	Mark Scheme	Mark	Total
(ii)	M1: 2 correct curly arrows M2: correct dipole M3: correct intermediate M4: curly arrow from lone pair on Br⁻ to C⁺		4
(d)	minimum of three repeat units	2	2
(e) (i)	NaOH/KOH ethanolic / alcoholic **AND** heat / reflux	1 1	2
(ii)		1	1
(iii)	Propanenitrile / propanonitrile / propionitrile / ethyl cyanide / cyanoethane	1 1	2
			20

© Cambridge International Examinations 2014