

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 from each atom / (cat)ion in one mol of gaseous atoms / (cat)ions 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	1 1 1	3
(b) (i)	Group V / 5 / 15 Big difference between fifth and sixth ionisation energies	1 1	2
(ii)	$1s^2 2s^2 2p^3$ ecf from (b)(i) if period 2	1	1
(c) (i)	(Weighted) mean / average mass of an atom(s) (of an element) Relative to $1/12^{\text{th}}$ of (the mass of an atom of) carbon-12 OR relative to carbon-12 which is (exactly) 12 (units) allow as an expression	1 1	2
(ii)	$\frac{Z}{A_r} \quad \frac{Cl}{35.5} = 1:2$ $\text{So } \frac{68.87/35.5}{31.13/A_r} = 2$ $A_r = \frac{2 \times 31.13 \times 35.5}{68.87} = 32.0923 = 32.1 \text{ to 3s.f.}$ Allow alternative correct methods	1 1	2

Page 3	Mark Scheme	Syllabus	Paper
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Question	Mark Scheme	Mark	Total
(d) (i)	$\text{NaCl} (+ \text{aq}) \rightarrow \text{Na}^+ + \text{Cl}^-$ $\text{NaCl} + \text{H}_2\text{O} \rightarrow \text{Na}^+ + \text{Cl}^- + \text{H}_2\text{O}$ $\text{SiCl}_4 + 2\text{H}_2\text{O} \rightarrow \text{SiO}_2 + 4\text{HCl}$ $\text{SiCl}_4 + 4\text{H}_2\text{O} \rightarrow \text{Si(OH)}_4 + 4\text{HCl}$ $\text{SiCl}_4 + 4\text{H}_2\text{O} \rightarrow \text{SiO}_2 \cdot 2\text{H}_2\text{O} + 4\text{HCl}$ 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)	$\text{MnO}_4^-(\text{aq}) + 5\text{Fe}^{2+}(\text{aq}) + 8\text{H}^+(\text{aq}) \rightarrow \text{Mn}^{2+}(\text{aq}) + 5\text{Fe}^{3+}(\text{aq}) + 4\text{H}_2\text{O}(\text{l})$	1+1+1	3
(b) (i)	$\frac{20.0 \times 0.020}{1000} = 4(.00) \times 10^{-4} \text{ (mol)}$	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

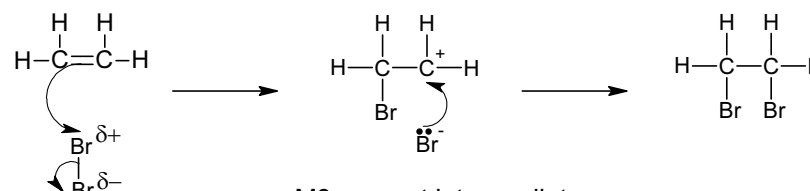
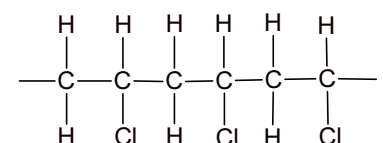
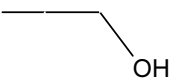
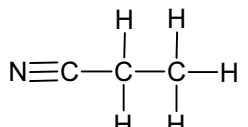
Page 4	Mark Scheme	Syllabus	Paper
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Question	Mark Scheme	Mark	Total
(iv)	$3.40/0.02 = 170$ ecf from (b)(iii)	1	1
(v)	$170 - 151.8 = 18.2$ $18.2/18 = 1.01$ $x = 1$ ecf from (b)(iv) if appropriate	1	1
			9
3 (a) (i)	K = Cl^- / chloride / F^- / fluoride $H_2SO_4 + 2NaCl \rightarrow Na_2SO_4 + 2HCl$ (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 HK is acidic / HK 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>Br₂/bromine</u> has fewer electrons than iodine / more electrons than chlorine intermolecular/van der Waals' forces (in Br ₂ / M ₂) 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

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Question	Mark Scheme	Mark	Total
(ii)	anode: $2\text{Cl}^- \rightarrow \text{Cl}_2 + 2\text{e}^-$ cathode: $2\text{H}^+ + 2\text{e}^- \rightarrow \text{H}_2$ OR $2\text{H}_2\text{O} + 2\text{e}^- \rightarrow 2\text{OH}^- + \text{H}_2$	1 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 double / π / pi bond / $\text{C}=\text{C}$ present in alkenes	1 1	 2
(b) (i)	UV light / sunlight / high temperature	1	1
(ii)	(Free) radical Substitution	1 1	2
(iii)	$\cdot\text{C}_2\text{H}_5 + \cdot\text{C}_2\text{H}_5 \rightarrow \text{C}_4\text{H}_{10}$	1	1
(iv)	$\text{C}_2\text{H}_5\text{Br} + \text{Br}\cdot \rightarrow \cdot\text{C}_2\text{H}_4\text{Br} + \text{HBr}$ OR $\cdot\text{C}_2\text{H}_4\text{Br} + \text{Br}_2 \rightarrow \text{C}_2\text{H}_4\text{Br}_2 + \text{Br}\cdot$	1	1
(c) (i)	Electrophilic Addition	1 1	2

Page 6	Mark Scheme	Syllabus	Paper
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Question	Mark Scheme	Mark	Total
(ii)	 <p>M1: 2 correct curly arrows</p> <p>M2: correct dipole</p> <p>M3: correct intermediate</p> <p>M4: curly arrow from lone pair on Br⁻ to C⁺</p>		4
(d)	 <p>minimum of three repeat units</p>	2	2
(e) (i)	NaOH/KOH ethanolic/ alcoholic AND heat/ reflux	1 1	2
(ii)		1	1
(iii)	 <p>Propanenitrile/ propanonitrile/ propionitrile/ ethyl cyanide/ cyanoethane</p>	1 1	2
			20