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.

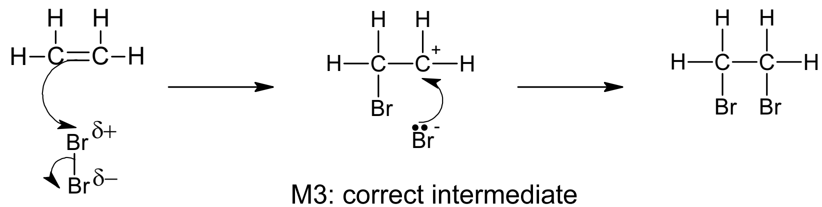
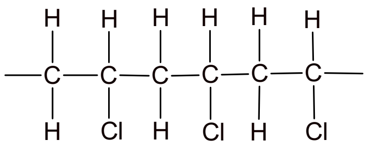
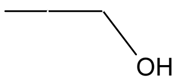
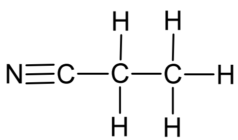
Cambridge is publishing the mark schemes for the May/June 2014 series for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level components and some Ordinary Level components.

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 / 12th 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)	**Z** Cl $\frac{31.13}{A_r} \quad \frac{68.87}{35.5} = 1:2$ So $\frac{68.87/35.5}{31.13/A_r} = 2$ $A_r = \frac{2 \times 31.13 \times 35.5}{68.87} = 32.0923 = 32.1 \text{ to } 3\text{s.f.}$ Allow alternative correct methods	 1 1	2

Question	Mark Scheme	Mark	Total
(d) (i)	$NaCl$ (+ aq) → Na^+ + Cl^- $NaCl + H_2O$ → $Na^+ + Cl^- + H_2O$	1	
	$SiCl_4 + 2H_2O$ → $SiO_2 + 4HCl$ $SiCl_4 + 4H_2O$ → $Si(OH)_4 + 4HCl$ $SiCl_4 + 4H_2O$ → $SiO_2.2H_2O + 4HCl$	1	
	Allow correct equation with other molar amounts of water		2
(ii)	$NaCl$ is ionic **AND** giant / lattice $NaCl$ dissolves / does not react $SiCl_4$ is covalent **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**$H_2O(l)$	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 $Fe^{2+} = 5 \times 4.00 \times 10^{-4} = 2(.00) \times 10^{-3}$ (mol) ecf from **(b)(i)**	1	1
(iii)	$2.00 \times 10^{-3} \times 250 / 25 = 0.02(00)$ (mol) ecf from **(b)(ii)**	1	1

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 C*l*) **OR** $H_2SO_4 + NaCl \rightarrow NaHSO_4 + HCl$ (or equation with F or **K** for C*l*) 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 / bromine</u> has **fewer electrons** than iodine / **more electron**s than chlorine **intermolecular / van der Waals' forces** (in Br_2 / $\mathbf{M_2}$) **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

Question	Mark Scheme	Mark	Total
(ii)	anode: $2Cl^{-} \rightarrow Cl_2 + 2e^{-}$ cathode: $2H^{+} + 2e^{-} \rightarrow H_2$ **OR** $2H_2O + 2e^{-} \rightarrow 2OH^{-} + H_2$	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 / C = C present in alkenes	1 1	 2
(b) (i)	UV light / sunlight / high temperature	1	1
(ii)	(Free) radical Substitution	1 1	 2
(iii)	$\bullet C_2H_5 + \bullet C_2H_5 \rightarrow C_4H_{10}$	1	1
(iv)	$C_2H_5Br + Br\bullet \rightarrow \bullet C_2H_4Br + HBr$ **OR** $\bullet C_2H_4Br + Br_2 \rightarrow C_2H_4Br_2 + Br\bullet$	1	1
(c) (i)	Electrophilic Addition	1 1	 2

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