

## CAMBRIDGE INTERNATIONAL EXAMINATIONS

Cambridge International Advanced Subsidiary and Advanced Level

### MARK SCHEME for the May/June 2015 series

#### **9701 CHEMISTRY**

**9701/22**

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.

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Page 2	Mark Scheme	Syllabus	Paper
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Question	Mark Scheme	Mark	Total												
1 (a)	<table><tr><td>name of particle</td><td>relative mass</td><td>relative charge</td></tr><tr><td>proton</td><td>1</td><td>+1</td></tr><tr><td>electron</td><td>1/1836</td><td>−1</td></tr><tr><td>neutron</td><td>1</td><td>0</td></tr></table>	name of particle	relative mass	relative charge	proton	1	+1	electron	1/1836	−1	neutron	1	0	[1]	[3]
	name of particle	relative mass	relative charge												
	proton	1	+1												
	electron	1/1836	−1												
neutron	1	0													
		[1]													
		[1]													
(b) (i)	Mass of an atom(s)  relative to 1 / 12 <sup>th</sup> (the mass) of (an atom of) carbon-12 <b>OR</b> relative to carbon-12 which is (exactly) 12	[1]  [1]	[2]												
(ii)	% of third isotope = 10  $\frac{(24 \times 79) + (26 \times 11.0) + 10x}{100} = 24.3$  10x = 248  x = 24.8 (3s.f.)	[1]  [1]  [1]	[3]												
(c) (i)	anode $2\text{Cl}^- \rightarrow \text{Cl}_2 + 2\text{e}^-$ cathode $\text{Mg}^{2+} + 2\text{e}^- \rightarrow \text{Mg}$	[1] [1]	[2]												
(ii)	<table><tr><td>Mg</td><td>O</td><td>H</td><td>Cl</td></tr><tr><td>31.65</td><td>20.84</td><td>1.31</td><td>46.2</td></tr><tr><td>24.3</td><td>16</td><td>1</td><td>35.5</td></tr></table>  1.30    1.30    1.31    1.30 = 1:1:1:1  MgOHCl	Mg	O	H	Cl	31.65	20.84	1.31	46.2	24.3	16	1	35.5	[1]  [1]	[2]
Mg	O	H	Cl												
31.65	20.84	1.31	46.2												
24.3	16	1	35.5												
(d) (i)	Na <sub>2</sub> O basic / alkaline; Al <sub>2</sub> O <sub>3</sub> amphoteric / acidic and basic; SO <sub>3</sub> acidic Na <sub>2</sub> O (giant) ionic <b>AND</b> SO <sub>3</sub> (simple / molecular) covalent	[1] [1]	[2]												
(ii)	Na <sub>2</sub> O + 2HCl → 2NaCl + H <sub>2</sub> O  Al <sub>2</sub> O <sub>3</sub> + 6HCl → 2AlCl <sub>3</sub> + 3H <sub>2</sub> O  Al <sub>2</sub> O <sub>3</sub> + 2NaOH + 7H <sub>2</sub> O → 2NaAl(OH) <sub>4</sub> (H <sub>2</sub> O) <sub>2</sub> <b>OR</b> Al <sub>2</sub> O <sub>3</sub> + 2NaOH + 3H <sub>2</sub> O → 2NaAl(OH) <sub>4</sub> <b>OR</b> Al <sub>2</sub> O <sub>3</sub> + 2NaOH → 2NaAlO <sub>2</sub> + H <sub>2</sub> O <b>OR</b> Al <sub>2</sub> O <sub>3</sub> + 2OH <sup>−</sup> + 7H <sub>2</sub> O → 2[Al(OH) <sub>4</sub> (H <sub>2</sub> O) <sub>2</sub> ] <sup>−</sup> <b>OR</b> Al <sub>2</sub> O <sub>3</sub> + 2OH <sup>−</sup> + 3H <sub>2</sub> O → 2[Al(OH) <sub>4</sub> ] <sup>−</sup> <b>OR</b> Al <sub>2</sub> O <sub>3</sub> + 2OH <sup>−</sup> → 2AlO <sub>2</sub> <sup>−</sup> + H <sub>2</sub> O  SO <sub>3</sub> + NaOH → NaHSO <sub>4</sub> <b>OR</b> SO <sub>3</sub> + 2NaOH → Na <sub>2</sub> SO <sub>4</sub> + H <sub>2</sub> O	[1]  [1]  [1]  [1]  [1]	[4]												

Page 3	Mark Scheme	Syllabus	Paper
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Question	Mark Scheme	Mark	Total
			[18]
2 (a) (i)	$2\text{PbS} + 3\text{O}_2 \rightarrow 2\text{PbO} + 2\text{SO}_2$ reagents and formulae balancing	[1] [1]	[2]
(ii)	S (is oxidised) $-2$ to $(+)$ $4$ O (is reduced) $0$ to $-2$	[1] [1]	[2]
(b) (i)	$T = 400 - 600^\circ\text{C}$ (chosen as a compromise because) High $T$ increases rate ora High $T$ decreases yield/moves eqm left/makes less $\text{SO}_3$ as forward reaction exothermic ora	[1] [1] [1]	[3]
(ii)	High pressure increases rate as collision frequency increases ora  High pressure moves eqm right/favours forward reaction as more moles on left ora Uneconomic to use high pressures/high yield at low pressure	[1]  [1] [1]	[3]
(c) (i)	Reaction (too) exothermic/acid spray produced	[1]	[1]
(ii)	$\text{SO}_3 + \text{H}_2\text{SO}_4 \rightarrow \text{H}_2\text{S}_2\text{O}_7$ $\text{H}_2\text{S}_2\text{O}_7 + \text{H}_2\text{O} \rightarrow 2\text{H}_2\text{SO}_4$	[1] [1]	[2]
(d)	Preservative owtte antimicrobial/antioxidant/reducing agent	[1] [1]	[2]
(e) (i)	$12.35 \times 0.01 / 1000 = 1.235 \times 10^{-4}$	[1]	[1]
(ii)	$1.235 \times 10^{-4} \times 1000 / 50 = 2.47 \times 10^{-3}$	[1]	[1]
(iii)	$2.47 \times 10^{-3} \times 64.1 = 0.158327 \text{ g} = 158$ (3 sf only)	[1]	[1]
			[18]
3 (a) (i)	Bond breaking = $\text{Cl-Cl} = 242$ $\text{C-H} = 410 = 652 \text{ kJ}$  Bond forming = $\text{C-Cl} = 340$ $\text{H-Cl} = 431 = 771 \text{ kJ}$  Enthalpy change = $652 - 771 = -119$	[1]  [1] [1]	[3]
(ii)	UV/High $T$ /sunlight	[1]	[1]

Page 4	Mark Scheme	Syllabus	Paper
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Question	Mark Scheme	Mark	Total
(iii)	Initiation $\text{Cl}_2 \rightarrow 2\text{Cl}\cdot$  Propagation $\text{C}_2\text{H}_6 + \text{Cl}\cdot \rightarrow \cdot\text{C}_2\text{H}_5 + \text{HCl}$ $\cdot\text{C}_2\text{H}_5 + \text{Cl}_2 \rightarrow \text{C}_2\text{H}_5\text{Cl} + \text{Cl}\cdot$  Termination $\cdot\text{C}_2\text{H}_5 + \cdot\text{C}_2\text{H}_5 \rightarrow \text{C}_4\text{H}_{10}$  All three names correctly assigned	[1]  [1] [1]  [1]  [1]	[5]
(b) (i)	ethene	[1]	[1]
(ii)	KOH/NaOH  ethanolic <b>AND</b> heat/reflux	[1]  [1]	[2]
(iii)	$\text{H}_2$ <b>AND</b> Pt or Ni (catalyst)	[1]	[1]
			[13]
4 (a) (i)	<b>A</b> = $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CHO}$ <b>B</b> = $\text{CH}_3\text{CH}_2\text{CH}(\text{CH}_3)\text{CHO}$ <b>C</b> = $(\text{CH}_3)_2\text{CHCH}_2\text{CHO}$ <b>D</b> = $(\text{CH}_3)_3\text{CCHO}$	[1] [1] [1] [1]	[4]
(ii)		[1+1]	[2]
(b) (i)	Fehling's/Benedict's <b>OR</b> Tollens' <b>OR</b> dichromate <b>OR</b> manganate Warm/heat Fehling's/Benedict's =(Brick)-red ppt Tollens' = silver/mirror <b>OR</b> grey/black precipitate Dichromate = orange to green Manganate = purple to colourless	[1] [1]  [1]	[3]
(ii)	(2,4-)DNP(H)/Brady's reagent  Orange/yellow/red-orange/yellow-orange ppt	[1]  [1]	[2]
			[11]