

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 border="1"> <thead> <tr> <th>name of particle</th> <th>relative mass</th> <th>relative charge</th> </tr> </thead> <tbody> <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> </tbody> </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]																		
[1]																		
(b) (i)	Mass of an atom(s) relative to $1/12^{\text{th}}$ (the mass) of (an atom of) carbon-12 OR relative to carbon-12 which is (exactly) 12	[1] [1]	[2]															
(ii)	% of third isotope = 10 $\frac{(24 \times 79) + (26 \times 11.0) + 10x}{100} = 24.3$ $10x = 248$ $x = 24.8 \text{ (3s.f.)}$	[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 style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: center;">Mg</td> <td style="text-align: center;">O</td> <td style="text-align: center;">H</td> <td style="text-align: center;">Cl</td> <td></td> </tr> <tr> <td style="text-align: center;">$\frac{31.65}{24.3}$</td> <td style="text-align: center;">$\frac{20.84}{16}$</td> <td style="text-align: center;">$\frac{1.31}{1}$</td> <td style="text-align: center;">$\frac{46.2}{35.5}$</td> <td></td> </tr> <tr> <td style="text-align: center;">1.30</td> <td style="text-align: center;">1.30</td> <td style="text-align: center;">1.31</td> <td style="text-align: center;">1.30</td> <td style="text-align: center;">= 1:1:1:1</td> </tr> </table> MgOHCl	Mg	O	H	Cl		$\frac{31.65}{24.3}$	$\frac{20.84}{16}$	$\frac{1.31}{1}$	$\frac{46.2}{35.5}$		1.30	1.30	1.31	1.30	= 1:1:1:1	[1] [1]	[2]
Mg	O	H	Cl															
$\frac{31.65}{24.3}$	$\frac{20.84}{16}$	$\frac{1.31}{1}$	$\frac{46.2}{35.5}$															
1.30	1.30	1.31	1.30	= 1:1:1:1														
(d) (i)	Na ₂ O basic/alkaline; Al ₂ O ₃ amphoteric/acidic and basic; SO ₃ acidic Na ₂ O (giant) ionic AND SO ₃ (simple/molecular) covalent	[1] [1]	[2]															
(ii)	$\text{Na}_2\text{O} + 2\text{HCl} \rightarrow 2\text{NaCl} + \text{H}_2\text{O}$ $\text{Al}_2\text{O}_3 + 6\text{HCl} \rightarrow 2\text{AlCl}_3 + 3\text{H}_2\text{O}$ $\text{Al}_2\text{O}_3 + 2\text{NaOH} + 7\text{H}_2\text{O} \rightarrow 2\text{NaAl}(\text{OH})_4(\text{H}_2\text{O})_2$ OR $\text{Al}_2\text{O}_3 + 2\text{NaOH} + 3\text{H}_2\text{O} \rightarrow 2\text{NaAl}(\text{OH})_4$ OR $\text{Al}_2\text{O}_3 + 2\text{NaOH} \rightarrow 2\text{NaAlO}_2 + \text{H}_2\text{O}$ OR $\text{Al}_2\text{O}_3 + 2\text{OH}^- + 7\text{H}_2\text{O} \rightarrow 2[\text{Al}(\text{OH})_4(\text{H}_2\text{O})_2]^-$ OR $\text{Al}_2\text{O}_3 + 2\text{OH}^- + 3\text{H}_2\text{O} \rightarrow 2[\text{Al}(\text{OH})_4]^-$ OR $\text{Al}_2\text{O}_3 + 2\text{OH}^- \rightarrow 2\text{AlO}_2^- + \text{H}_2\text{O}$ $\text{SO}_3 + \text{NaOH} \rightarrow \text{NaHSO}_4$ OR $\text{SO}_3 + 2\text{NaOH} \rightarrow \text{Na}_2\text{SO}_4 + \text{H}_2\text{O}$	[1] [1] [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 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 $Cl_2 \rightarrow 2Cl\cdot$ Propagation $C_2H_6 + Cl\cdot \rightarrow \cdot C_2H_5 + HCl$ $\cdot C_2H_5 + Cl_2 \rightarrow C_2H_5Cl + Cl\cdot$ Termination $\cdot C_2H_5 + \cdot C_2H_5 \rightarrow C_4H_{10}$ All three names correctly assigned	[1] [1] [1] [1] [1]	[5]
(b) (i)	ethene	[1]	[1]
(ii)	KOH/NaOH ethanolic AND heat/reflux	[1] [1]	[2]
(iii)	H ₂ AND Pt or Ni (catalyst)	[1]	[1]
			[13]
4 (a) (i)	A = CH ₃ CH ₂ CH ₂ CH ₂ CHO B = CH ₃ CH ₂ CH(CH ₃)CHO C = (CH ₃) ₂ CHCH ₂ CHO D = (CH ₃) ₃ CCHO	[1] [1] [1] [1]	[4]
(ii)		[1+1]	[2]
(b) (i)	Fehling's/Benedict's OR Tollens' OR dichromate OR manganate Warm/heat Fehling's/Benedict's =(Brick)-red ppt Tollens' = silver/mirror OR grey/black precipitate Dichromate = orange to green Manganate = purple to colourless } with the aldehyde/A-D	[1] [1] [1]	[3]
(ii)	(2,4-)DNP(H)/Brady's reagent Orange/yellow/red-orange/yellow-orange ppt	[1] [1]	[2]
			[11]