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**CHEMISTRY**

**9701/21**

Paper 2 AS Level Structured Questions

**May/June 2016**

MARK SCHEME

Maximum Mark: 60

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**Published**

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.

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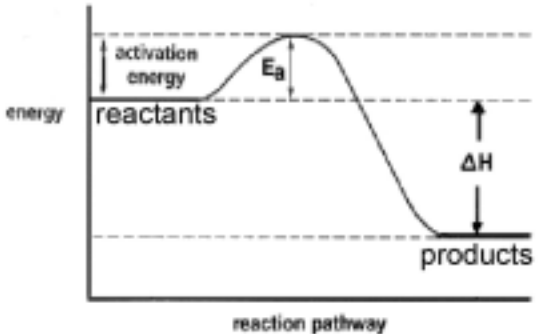
<b>Page 2</b>	<b>Mark Scheme</b>	<b>Syllabus</b>	<b>Paper</b>
	<b>Cambridge International AS/A Level – May/June 2016</b>	<b>9701</b>	<b>21</b>

<b>Question</b>	<b>Mark Scheme</b>	<b>Mark</b>	<b>Total</b>																																			
<b>1 (a)</b>	<table border="1"> <thead> <tr> <th>name of element</th> <th>nucleon no.</th> <th>atomic no.</th> <th>no. of protons</th> <th>no. of neutrons</th> <th>no. of electrons</th> <th>overall charge</th> </tr> </thead> <tbody> <tr> <td>lithium</td> <td>6</td> <td>3</td> <td>3</td> <td>3</td> <td>2</td> <td>+1</td> </tr> <tr> <td>oxygen</td> <td>17</td> <td>8</td> <td>8</td> <td>9</td> <td>10</td> <td>-2</td> </tr> <tr> <td>iron</td> <td>54</td> <td>26</td> <td>26</td> <td>28</td> <td>24</td> <td>+2</td> </tr> <tr> <td>chlorine</td> <td>35</td> <td>17</td> <td>17</td> <td>18</td> <td>17</td> <td>0</td> </tr> </tbody> </table>	name of element	nucleon no.	atomic no.	no. of protons	no. of neutrons	no. of electrons	overall charge	lithium	6	3	3	3	2	+1	oxygen	17	8	8	9	10	-2	iron	54	26	26	28	24	+2	chlorine	35	17	17	18	17	0	[1] [1] [1] [1]	[4]
name of element	nucleon no.	atomic no.	no. of protons	no. of neutrons	no. of electrons	overall charge																																
lithium	6	3	3	3	2	+1																																
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iron	54	26	26	28	24	+2																																
chlorine	35	17	17	18	17	0																																
<b>(b)</b>	line straight on labelled 'neutrons' line (curving) up labelled 'protons' proton line clearly shows less (overall) deflection than electron curve	[1] [1] [1]	[3]																																			
<b>(c) (i)</b>	Group 16/6/VI AND Big (owtte) increase/big difference/big gap/big jump/jump in increase/jump in difference after 6th IE	[1]	[1]																																			
<b>(ii)</b>	increases (across period) due to increasing attraction (of nucleus for electrons)  due to increasing nuclear charge/atomic/proton number AND constant/similar shielding/same (outer/number of) shell/energy level	[1] [1]	[2]																																			
<b>(iii)</b>	electron (pair) repulsion (Y has a) pair of electrons in a (3)p orbital/a (3)p orbital is full ORA	[1] [1]	[2]																																			
<b>(iv)</b>	$(1s^2)2s^22p^63s^23p^5$	[1]	[1]																																			
<b>(d) (i)</b>	0.56(%)	[1]	[1]																																			

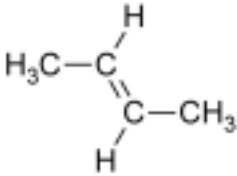
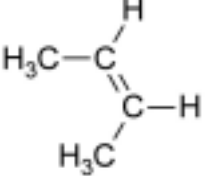
Page 3	Mark Scheme	Syllabus	Paper
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Question	Mark Scheme	Mark	Total
(ii)	$\frac{(A \times 0.56) + (86 \times 9.86) + (87 \times 7.00) + (88 \times 82.58)}{100} = 87.71$ <p>A = 84</p>	[1] [1]	[2]
			[16]
2 (a)	D = Ga G = Se	[1]	[1]
(b) (i)	$\text{D}_2\text{O}_3 + 6\text{HCl} \rightarrow 2\text{DCl}_3 + 3\text{H}_2\text{O}$ <p>M1 = species; M2 = balancing</p>	[1] [1]	[2]
(ii)	$\text{D}_2\text{O}_3 + 2\text{NaOH} + 7\text{H}_2\text{O} \rightarrow 2\text{NaD}(\text{OH})_4(\text{H}_2\text{O})_2 \text{ OR}$ $\text{D}_2\text{O}_3 + 2\text{NaOH} + 3\text{H}_2\text{O} \rightarrow 2\text{NaD}(\text{OH})_4 \text{ OR}$ $\text{D}_2\text{O}_3 + 2\text{NaOH} \rightarrow 2\text{NaDO}_2 + \text{H}_2\text{O} \text{ OR}$ $\text{D}_2\text{O}_3 + 2\text{OH}^- + 7\text{H}_2\text{O} \rightarrow 2[\text{D}(\text{OH})_4(\text{H}_2\text{O})_2]^- \text{ OR}$ $\text{D}_2\text{O}_3 + 2\text{OH}^- + 3\text{H}_2\text{O} \rightarrow 2[\text{D}(\text{OH})_4]^- \text{ OR}$ $\text{D}_2\text{O}_3 + 2\text{OH}^- \rightarrow 2\text{DO}_2^- + \text{H}_2\text{O}$ <p>M1 = species; M2 = balancing</p>	[1] [1]	[2]
(c)	giant ionic/ionic lattice	[1]	[1]
(d)	$\text{GO}_2 + \text{H}_2\text{O} \rightarrow \text{H}_2\text{GO}_3$	[1]	[1]
			[7]

Page 4	Mark Scheme	Syllabus	Paper
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Question	Mark Scheme	Mark	Total
3 (a) (i)	bubbles / effervescence / fizzing calcium gets smaller / disappears water turns cloudy / milky calcium sinks	[1] [1] [1] [1]	max [3]
(ii)	$\text{Ca} + 2\text{H}_2\text{O} \rightarrow \text{Ca}(\text{OH})_2 + \text{H}_2$	[1]	[1]
(iii)	faster bubbling / disappearance of Ba OR no / less precipitate forms (owtte)	[1]	[1]
(b) (i)	 <p>M1 – general layout with products below reactants AND both labelled</p> <p>M2 – <math>E_a</math> and <math>\Delta H</math> / energy change / released labelled with vertical lines</p>	 [1] [1]	[2]
(ii)	activation energy is high so few / no particles with $E \geq E_a$	[1] [1]	[2]

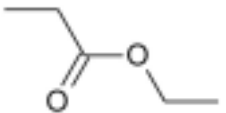
Page 5	Mark Scheme	Syllabus	Paper
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Question	Mark Scheme	Mark	Total
(iii)	high melting/boiling point strong forces (of attraction / between oppositely charged ions) / strong (ionic) bonding	[1] [1]	[2]
(iv)	MgO is basic / reacts with acid	[1]	[1]
(c) (i)	increases (down the group)	[1]	[1]
(ii)	$\text{MgCO}_3 \rightarrow \text{MgO} + \text{CO}_2$	[1]	[1]
(iii)	$2\text{Ca}(\text{NO}_3)_2 \rightarrow 2\text{CaO} + 4\text{NO}_2 + \text{O}_2$	[1]	[1]
			[15]
4 (a)	$\text{CH}_2=\text{CHCH}_2\text{CH}_3 / \text{CH}_2\text{CHCH}_2\text{CH}_3$ AND $\text{CH}_3\text{CH}=\text{CHCH}_3 / \text{CH}_3\text{CHCHCH}_3$	[1]	[1]
(b)	$\text{CH}_2=\text{CHCH}_2\text{CH}_3 / \text{CH}_2\text{CHCH}_2\text{CH}_3$ AND $(\text{CH}_3)_2\text{C}=\text{CH}_2 / (\text{CH}_3)_2\text{CCH}_2$	[1]	[1]
(c)	  <i>trans</i> -but-2-ene (or <i>E</i> ) <i>cis</i> -but-2-ene (or <i>Z</i> )	[1] [1]	[2]

Page 6	Mark Scheme	Syllabus	Paper
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Question	Mark Scheme	Mark	Total
(d)	<b>B</b> is CH <sub>2</sub> =CHCH <sub>2</sub> CH <sub>3</sub> OR CH <sub>3</sub> CH=CHCH <sub>3</sub> OR (CH <sub>3</sub> ) <sub>2</sub> C=CH <sub>2</sub> distinguished by addition of bromine brown/red/orange/yellow to colourless/decolourises with <b>B</b> (but not <b>A</b> )	[1] [1] [1]	[3]
			[7]
5 (a)	<p>M1 = lone pair on C of CN<sup>-</sup> AND curly arrow from lone pair to C of C—Br M2 = correct dipole on C—Br, curly arrow from C—Br bond to Br AND Br<sup>-</sup></p>	[1] [1]	[2]
(b) (i)	reduction	[1]	[1]
(ii)	disappearance of peak / dip / trough / absorption at 1680–1730 due to (loss of) C=O OR peak at 3200–3650 due to (alcohol) O—H (formation)	[1] [1] [1] [1]	[2]
(c) (i)	sodium/potassium hydroxide aqueous	[1] [1]	[2]

Page 7	Mark Scheme	Syllabus	Paper
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Question	Mark Scheme	Mark	Total
(ii)	ethanol	[1]	[1]
(d) (i)	(conc) H <sup>+</sup> / (conc) acid / (conc)H <sub>2</sub> SO <sub>4</sub> / (conc)H <sub>3</sub> PO <sub>4</sub>	[1]	[1]
(ii)		[1]	[1]
(iii)	ethyl propanoate	[1]	[1]
(e) (i)	V = CH <sub>3</sub> CH <sub>2</sub> CHCHCH <sub>2</sub> CH <sub>3</sub> / CH <sub>3</sub> CH <sub>2</sub> CH=CHCH <sub>2</sub> CH <sub>3</sub> T = CH <sub>3</sub> CH <sub>2</sub> CH(OH)CH(OH)CH <sub>2</sub> CH <sub>3</sub>	[1] [1]	[2]
(ii)	V = geometric(al) / <i>cis-trans</i> / <i>E-Z</i> T = optical	[1] [1]	[2]
			[15]