Cambridge International AS & A Level

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CHEMISTRY **9701/21**

Paper 2 AS Level Structured Questions **May/June 2016**

MARK SCHEME

Maximum Mark: 60

Published

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Question	Mark Scheme	Mark	Total
1 (a)	<table><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><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></table>	[1] [1] [1] [1]	[4]
(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]
(c) (i)	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]
(ii)	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]
(iii)	electron (pair) repulsion (**Y** has a) pair of electrons in a (3)p orbital / a (3)p orbital is full ORA	[1] [1]	[2]
(iv)	$(1s^2)2s^2 2p^6 3s^2 3p^5$	[1]	[1]
(d) (i)	0.56(%)	[1]	[1]

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Question	Mark Scheme	Mark	Total
(ii)	$\frac{(A \times 0.56) + (86 \times 9.86) + (87 \times 7.00) + (88 \times 82.58)}{100} = 87.71$ A = 84	[1] [1]	[2]
			[16]
2 **(a)**	**D** = Ga **G** = Se	[1]	[1]
(b) **(i)**	$\mathbf{D}_2O_3$ + $6HCl \rightarrow 2\mathbf{D}Cl_3$ + $3H_2O$ M1 = species; M2 = balancing	 [1] [1]	[2]
(ii)	$\mathbf{D}_2O_3$ + $2NaOH$ + $7H_2O$ → $2Na\mathbf{D}(OH)_4(H_2O)_2$ OR $\mathbf{D}_2O_3$ + $2NaOH$ + $3H_2O$ → $2Na\mathbf{D}(OH)_4$ OR $\mathbf{D}_2O_3$ + $2NaOH$ → $2Na\mathbf{D}O_2$ + H_2O OR $\mathbf{D}_2O_3$ + $2OH^-$ + $7H_2O$ → $2[\mathbf{D}(OH)_4(H_2O)_2]^-$ OR $\mathbf{D}_2O_3$ + $2OH^-$ + $3H_2O$ → $2[\mathbf{D}(OH)_4]^-$ OR $\mathbf{D}_2O_3$ + $2OH^-$ → $2\mathbf{D}O_2^-$ + H2O M1 = species; M2 = balancing	 [1] [1]	[2]
(c)	giant ionic / ionic lattice	[1]	[1]
(d)	$\mathbf{G}O_2$ + H_2O → $H_2\mathbf{G}O_3$	[1]	[1]
			[7]

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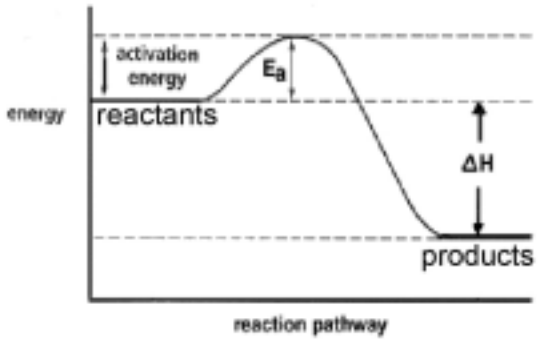
Question	Mark Scheme	Mark	Total
3 (a) (i)	bubbles / effervescence / fizzing	[1]	max [3]
	calcium gets smaller / disappears	[1]	
	water turns cloudy / milky	[1]	
	calcium sinks	[1]	
(ii)	$Ca + 2H_2O \rightarrow Ca(OH)_2 + H_2$	[1]	[1]
(iii)	faster bubbling / disappearance of Ba OR no / less precipitate forms (owtte)	[1]	[1]
(b) (i)			[2]
	M1 – general layout with products below reactants AND both labelled	[1]	
	M2 – E_a and ΔH / energy change / released labelled with vertical lines	[1]	
(ii)	activation energy is high	[1]	[2]
	so few/no particles with $E \geqslant E_a$	[1]	

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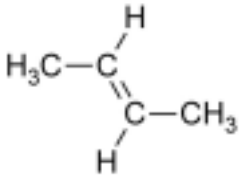
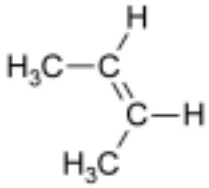
Question	Mark Scheme	Mark	Total
(iii)	high melting / boiling point strong forces (of attraction / between oppositely charged ions) / strong (ionic) bonding	[1] [1]	[2]
(iv)	MgO is basic / reacts with acid	[1]	[1]
(c) (i)	increases (down the group)	[1]	[1]
(ii)	$MgCO_3 \rightarrow MgO + CO_2$	[1]	[1]
(iii)	$2Ca(NO_3)_2 \rightarrow 2CaO + 4NO_2 + O_2$	[1]	[1]
			[15]
4 (a)	$CH_2{=}CHCH_2CH_3$ / $CH_2CHCH_2CH_3$ AND $CH_3CH{=}CHCH_3$ / $CH_3CHCHCH_3$	[1]	[1]
(b)	$CH_2{=}CHCH_2CH_3$ / $CH_2CHCH_2CH_3$ AND $(CH_3)_2C{=}CH_2$ / $(CH3)_2CCH_2$	[1]	[1]
(c)	 *trans*-but-2-ene (or *E*)	[1]	[2]
	 *cis*-but-2-ene (or *Z*)	[1]	

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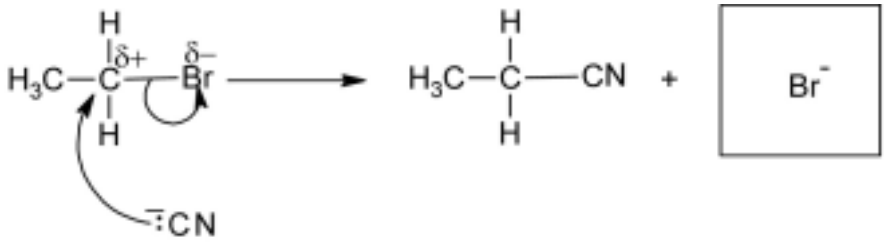
Question	Mark Scheme	Mark	Total
(d)	**B** is $CH_2=CHCH_2CH_3$ OR $CH_3CH=CHCH_3$ OR $(CH_3)_2C=CH_2$	[1]	
	distinguished by addition of bromine	[1]	[3]
	brown/red/orange/yellow to colourless/decolourises with **B** (but not **A**)	[1]	
			[7]
5 (a)			[2]
	M1 = lone pair on C of CN− AND curly arrow from lone pair to C of C—Br	[1]	
	M2 = correct dipole on C—Br, curly arrow from C—Br bond to Br AND Br^-	[1]	
(b) (i)	reduction	[1]	[1]
(ii)	disappearance of peak / dip / trough / absorption at 1680–1730	[1]	
	due to (loss of) C=O	[1]	
	OR		[2]
	peak at 3200–3650	[1]	
	due to (alcohol) O—H (formation)	[1]	
(c) (i)	sodium/potassium hydroxide aqueous	[1] [1]	[2]

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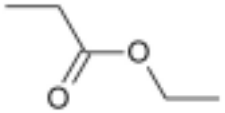
Question	Mark Scheme	Mark	Total
(ii)	ethanol	[1]	[1]
(d) (i)	(conc) H^+ / (conc) acid / (conc)H_2SO_4 / (conc)H_3PO_4	[1]	[1]
(ii)		[1]	[1]
(iii)	ethyl propanoate	[1]	[1]
(e) (i)	**V** = $CH_3CH_2CHCHCH_2CH_3$ / $CH_3CH_2CH{=}CHCH_2CH_3$ **T** = $CH_3CH_2CH(OH)CH(OH)CH_2CH_3$	[1] [1]	[2]
(ii)	**V** = geometric(al) / *cis-trans* / *E–Z* **T** = optical	[1] [1]	[2]
			[15]

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