Cambridge International AS & A Level

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CHEMISTRY **9701/22**

Paper 2 AS Level Structured Questions **October/November 2016**

MARK SCHEME

Maximum Mark: 60

Published

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Question	Answer	Mark
1(a)	0.04 **OR** 4×10^{-2}	**1**
1(b)(i)	$Na_2CO_3 + 2HCl \rightarrow 2NaCl + CO_2 + H_2O$	**1**
1(b)(ii)	0.00075 **OR** 7.5×10^{-4}	**1**
1(b)(iii)	0.0015 **OR** 1.5×10^{-3}	**1**
1(b)(iv)	0.015 **OR** 1.5×10^{-2}	**1**
1(b)(v)	0.025 **OR** 2.5×10^{-2}	**1**
1(b)(vi)	0.0125 **OR** 1.25×10^{-2} **OR** 0.013 **OR** 1.3×10^{-2}	**1**
1(b)(vii)	40 Ca / calcium	**1** **1**
	Total:	**9**

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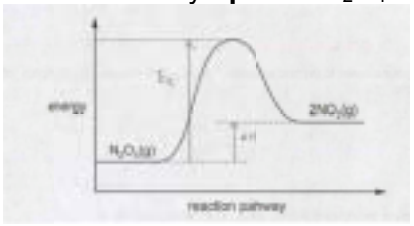
Question	Answer	Mark
2(a)	Arrow vertically **up** from N_2O_4 line to $2NO_2$ line labelled enthalpy change / ΔH Arrow vertically **up** from N_2O_4 line to dashed line from peak labelled activation energy / E_a 	**1** **1**
2(b)(i)	$M_r = \frac{m \times R \times T}{p \times V} \quad \left(= \frac{4.606 \times 8.31 \times 323}{1.68 \times 10^5 \times 1 \times 10^{-3}}\right)$ = 73.6	**1** **1**
2(b)(ii)	2n	**1**
2(b)(iii)	0.05 – n + 2n **OR** 0.05 + n	**1**
2(b)(iv)	$\frac{2n}{(0.05 + n)}$	**1**
2(b)(v)	N_2O_4 = 0.0375 NO_2 = 0.0250	**1** **1**
2(b)(vi)	$K_p = \frac{pNO_2^2}{pN_2O_4}$	**1**

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Question	Answer	Mark
2(b)(vii)	$(0.4 \times 1.68 \times 10^5)^2/(0.6 \times 1.68 \times 10^5)$ **OR** $0.4^2 \times 1.68 \times 10^5/0.6$	1
	44800 **OR** 44.8	1
	Pa **OR** kPa	1
	Total:	13

Question	Answer	Mark
3(a)(i)	Increasing nuclear attraction	1
	Increasing nuclear charge / number of protons **AND** constant / similar shielding / same shell	1
3(a)(ii)	From 12 / Mg to 13 / A*l*: (Outer) electron in '13' / A*l* in (3)p (whereas outer electron in '12' / Mg in (3)s) (3p =) higher energy level / more shielded	 1 1
	From 15 / P to 16 / S electron repulsion ('16' / S has a) pair of electrons in a (3)p orbital / a (3)p orbital is full ORA	 1 1
3(a)(iii)	(decreasing IE down Group 0) due to decreasing nuclear attraction	1
	increasing shielding / increasing number of shells / energy levels / increasing distance of (outer) electrons (from nucleus)	1

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Question	Answer	Mark
3(b)(i)	Increasing strength of / more energy needed to break (metallic) bonding / increasing strength of attraction between (cat)ion / nucleus and delocalised / free / sea of / cloud of electrons	1
	Increasing number of delocalised electrons / decreasing (cat)ion size / increasing charge / charge density of (cat)ion	1
3(b)(ii)	Attraction for electrons too strong to fully delocalise all 3 in A*l* **OR** difference in size between 12/Mg^{2+} and 13/Al^{3+} is less than difference in size between 11/Na^{+} and 12/Mg^{2+} **OR** magnitude of increase in charge is less from 2+ to 3+ than from 1+ to 2+	1
3(b)(iii)	Increase (15 / P to 16 / S) then decrease (to 17 / C*l* and 18 / Ar) **OR** general decrease (from 15 / P to 18 / Ar) with an increase from 15 / P to 16 / S **OR** $S_{(8)}$>$P_{(4)}$>C$l_{(2)}$>Ar	1
	(melting point depends on strength of) VdW / IMFs	1
	The greater the number of electrons in the molecule (atom for Ar) the greater the strength of VdW / IMFs **OR** the greater the melting point ora	1
3(b)(iv)	Giant covalent (structure) / many (strong) covalent bonds (need breaking)	1
	Total:	**15**

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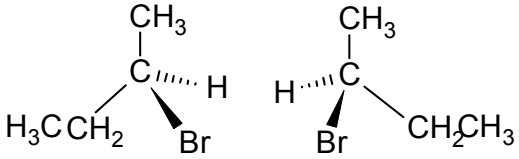
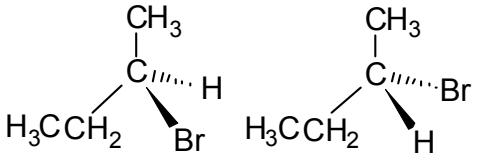
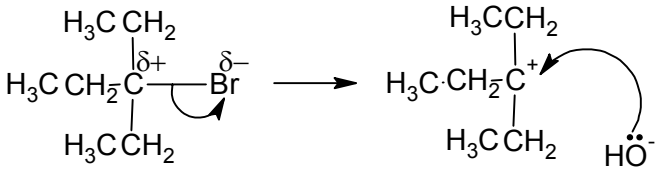
Question	Answer	Mark
4(a)(i)	2–bromobutane	**1**
4(a)(ii)	e.g. of mirror images  e.g. of swapped groups 	**1+1**
4(a)(iii)	$CH_3CH_2CH_2CH_2Br$ $(CH_3)_2CHCH_2Br$ $(CH_3)_3CBr$	**1** **1** **1**
4(b)(i)	3-bromo-3-ethylpentane	**1**
4(b)(ii)	 M1 = dipole and curly arrow from bond to (or just beyond) Br M2 = correct carbocation M3 = OH^- with curly arrow from lone pair <u>on O</u> to C(+)	**1** **1** **1**
4(b)(iii)	S_N1 / nucleophilic substitution	**1**

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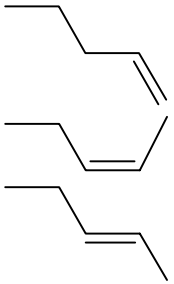
Question	Answer	Mark
4(c)(i)	Sodium / potassium hydroxide	**1**
	Ethanol / alcohol **AND** heat	**1**
4(c)(ii)	elimination	**1**
4(c)(iii)		**1** **1** **1**
	Total:	**17**

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Question	Answer	Mark
5(a)(i)	C*l*● and ●CH_3	**1**
5(a)(ii)	Cl^- and $^+CH_3$ / CH_3^+	**1**
5(b)(i)	Oxidation **OR** reduction	**1**
5(b)(ii)	Condensation	**1**
5(b)(iii)	Reduction **OR** oxidation **OR** addition	**1**
5(b)(iv)	Addition	**1**
	Total:	**6**

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