
CHEMISTRY

9701/21

Paper 2 AS Level Structured Questions

May/June 2017

MARK SCHEME

Maximum Mark: 60

Published


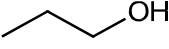
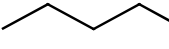
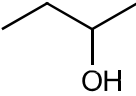
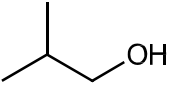
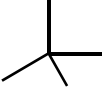
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Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

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Cambridge is publishing the mark schemes for the May/June 2017 series for most Cambridge IGCSE[®], Cambridge International A and AS Level and Cambridge Pre-U components, and some Cambridge O Level components.

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Question	Answer	Marks
1(a)	The mass of a molecule OR the (weighted) average / (weighted) mean mass of the molecules	1
	Relative / compared to $\frac{1}{12}$ (the mass) of <u>an atom</u> of carbon-12 OR on a scale in which a carbon-12 atom / isotope has a mass of (exactly) 12 (units)	1
1(b)(i)	3	1
1(b)(ii)	8	1
1(b)(iii)	$\text{C}_3\text{H}_8\text{O} + 4\frac{1}{2}\text{O}_2 \rightarrow 3\text{CO}_2 + 4\text{H}_2\text{O}$	1
1(b)(iv)	 OH AND propan-2-ol / 2-propanol	1
	 AND propan-1-ol / 1-propanol	1
	Alternative answers (any two):	
	 OH AND butan-1-ol / 1-butanol  OH AND butan-2-ol / 2-butanol  AND (2-)methylpropan-1-ol / (2-)methyl-1-propanol  OH AND (2-)methylpropan-2-ol / (2-)methyl-2-propanol	

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Question	Answer	Marks
1(b)(v)	correct conversions of data to SI/consistent units $p = 100\,000$; $V = 20 \times 10^{-6}$; $T = 393$	1
	calculation of $n (= pVRT)$ from M1 values $n = \frac{100 \times 10^3 \times 20 \times 10^{-6}}{8.31 \times 393}$	1
	calculation of mass $m (= n \times Mr)$ AND answer correct to 3sf $m = 6.12 \times 10^{-4} \times 60 = 0.0367$ (g) Alternative answer for using $C_4H_{10}O$: $m = 6.12 \times 10^{-4} \times 74 = 0.0453$ (g)	1
	Total:	10

Question	Answer			Marks
2(a)	substance	type of bonding	type of lattice structure	1
	copper	metallic	giant/metallic	
	ice	covalent OR hydrogen(-bonding) / H(-bonding)	hydrogen-bonded / simple / molecular	1
	silicon(IV) oxide	covalent	giant (molecular) / macromolecular	1
	iodine	covalent	simple / molecular	1
	sodium chloride	ionic	giant / ionic	1
2(b)(i)	hydrogen bonding			1

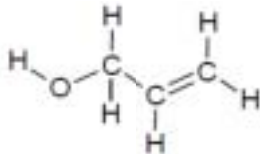
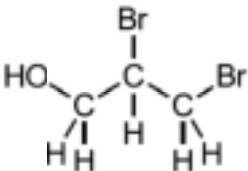
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Question	Answer	Marks
2(b)(ii)	H-bond between O and H of different molecules	1
	minimum three partial charges (in a row) over two H ₂ O molecules, i.e.: <div style="text-align: center;"> either $\delta^- \text{O} - \text{H}^{\delta+} \text{ --- } \delta^- \text{O}$ or $\text{H}^{\delta+} \text{ --- } \delta^- \text{O} - \text{H}^{\delta+}$ </div>	1
	lone pair of electrons on O of H-bond, in line with H-bond	1
2(c)(i)	X = liquid AND Z = solid	1
	Y = liquid and solid OR 'liquid / solid' OR 'liquid OR solid'	1
2(c)(ii)	(kinetic) energy reducing	1
	motion slowing <i>owtte</i>	1
2(c)(iii)	energy given out / released forming bonds / forming bonds exothermic	1
	compensates for / counteracts heat loss / cooling <i>owtte</i>	1
	Total:	15

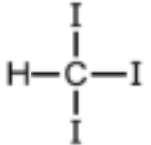
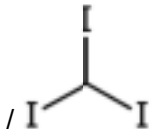
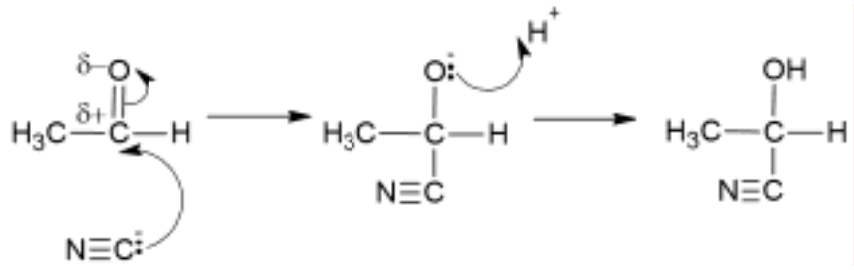
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Question	Answer	Marks
3(a)(i)	A	1
3(a)(ii)	H	1
3(a)(iii)	G	1
3(a)(iv)	B	1
3(a)(v)	F	1
3(b)(i)	(strong) heating	1
	(to provide / overcome) <u>high</u> activation energy	1
3(b)(ii)	<u>white</u> flame / <u>white</u> light / <u>white</u> smoke / <u>white</u> solid	1
3(b)(iii)	$\text{Mg(s)} + 2\text{H}_2\text{O(l)} \rightarrow \text{Mg(OH)}_2\text{(s)} + \text{H}_2\text{(g)}$	2
3(c)(i)	$2\text{Mg(NO}_3)_2 \rightarrow 2\text{MgO} + 4\text{NO}_2 + \text{O}_2$	1
3(c)(ii)	$\text{CaCO}_3 \rightarrow \text{CaO} + \text{CO}_2$	1
	$\text{CaO} + \text{H}_2\text{O} \rightarrow \text{Ca(OH)}_2$	1
3(d)(i)	reduce acidity in soil / increase pH of soil	1
	(both) basic / base(s)	1
3(d)(ii)	$\text{CaCO}_3 + 2\text{H}^+ \rightarrow \text{Ca}^{2+} + \text{CO}_2 + \text{H}_2\text{O}$ OR $\text{CaCO}_3 + 2\text{H}^+ \rightarrow \text{Ca}^{2+} + \text{H}_2\text{CO}_3$	1
	Total:	16

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Question	Answer	Marks
4(a)(i)	(molecules / isomers with) the same molecular formula / same number of atoms of each element	1
	different structural / displayed formulae / arrangement of bonds	1
4(a)(ii)	sp ² overlap of (2)s with two (2)p (atomic) orbitals	1
	sp ³ overlap of (2)s with all three (2)p (atomic) orbitals	1
4(a)(iii)	sp ² = 116° – 124°	1
	sp ³ = 106° – 112°	1
4(b)(i)		1
4(b)(ii)	(electrophilic) addition	1
	bromine decolourises / turns colourless / fades (from orange / brown)	1
4(b)(iii)	HOCH ₂ CHBrCH ₂ Br OR 	1
4(b)(iv)	CO ₂ / carbon dioxide	1
4(c)(i)	P = propanal	1
	Q = propanone	1

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Question	Answer	Marks
4(c)(ii)	  tr(i)iodomethane / CHI_3 /	1
4(d)(i)	(molecules / isomers with) the same (molecular and) structural formula	1
	Any two of: chiral centre / C attached to four different groups / atoms non-super(im)posable mirror images different spatial / 3D arrangement of atoms (owtte) different rotation of plane-polarised light	1
4(d)(ii)	 curly arrow from lone pair on $\text{:C}\equiv\text{N}$ to $\text{C}^{(\delta+)}$	1
	correct dipole on carbonyl $\delta^+\text{C}=\text{O}^{\delta-}$ AND curly arrow from bond to $\text{O}^{(\delta-)}$	1
	correct intermediate, including $\text{C}-\text{O}^-$ AND curly arrow from lone pair to H^+	1
	Total:	19