Cambridge International AS & A Level

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Cambridge International Advanced Subsidiary and Advanced Level

CHEMISTRY **9701/21**

Paper 2 AS Level Structured Questions **May/June 2017**

MARK SCHEME

Maximum Mark: 60

Published

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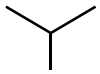
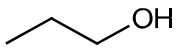
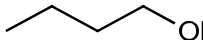
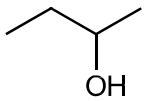
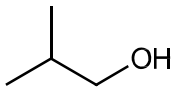
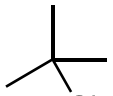
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Question	Answer	Marks
1(a)	The mass of a molecule OR the (weighted) average / (weighted) mean mass of the molecules	**1**
	Relative / compared to $\frac{1}{12}$ (the mass) of <u>an atom</u> of carbon–12 OR on a scale in which a carbon–12 atom / isotope has a mass of (exactly) 12 (units)	**1**
1(b)(i)	**3**	**1**
1(b)(ii)	**8**	**1**
1(b)(iii)	$C_3H_8O + 4½O_2 \rightarrow 3CO_2 + 4H_2O$	**1**
1(b)(iv)	 **AND** propan–2–ol / 2–propanol	**1**
	 **AND** propan–1–ol / 1–propanol	**1**
	Alternative answers (any two):  **AND** butan–1–ol / 1–butanol  **AND** butan–2–ol / 2–butanol  **AND** (2–)methylpropan–1–ol / (2–)methyl–1–propanol  **AND** (2–)methylpropan–2–ol / (2–)methyl–2–propanol	

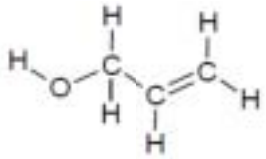
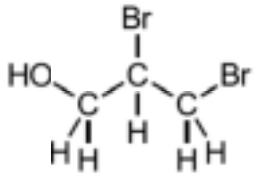
Question	Answer	Marks
1(b)(v)	correct conversions of data to SI/consistent units p = 100 000 ; V = 20×10^{-6} ; T = 393	**1**
	calculation of *n (= pVIRT)* from M1 values $n = \frac{100 \times 10^3 \times 20 \times 10^{-6}}{8.31 \times 393}$	**1**
	calculation of mass *m (= n × Mr)* **AND** answer correct 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**

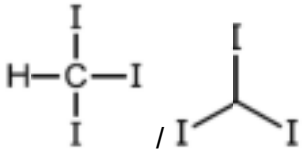
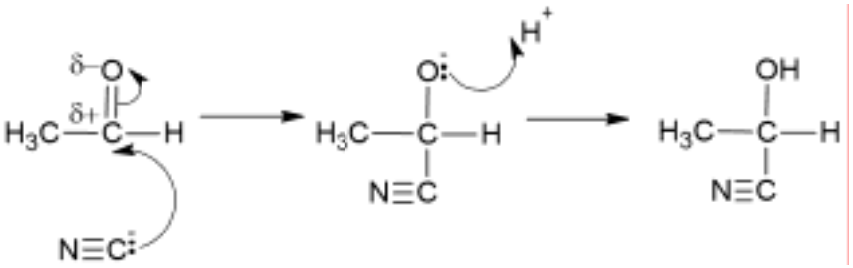
Question	Answer			Marks
2(a)	substance	type of bonding	type of lattice structure	
	copper	metallic	giant/metallic	**1**
	ice	covalent OR hydrogen(-bonding) / H(–bonding)	hydrogen-bonded / simple / molecular	**1**
	silicon(IV) oxide	covalent	giant (molecular) / macromolecular	**1**
	iodine	covalent	simple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

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_2O molecules, i.e.: either $^{\delta-}O—H^{\delta+}$ - - - - $^{\delta-}O$ or $H^{\delta+}$ - - - - $^{\delta-}O—H^{\delta+}$	**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 *owtte*	**1**
2(c)(iii)	energy given out / released forming bonds / forming bonds exothermic	**1**
	compensates for / counteracts heat loss / cooling *owtte*	**1**
	Total:	**15**

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) high activation energy	**1**
3(b)(ii)	white flame / white light / white smoke / white solid	**1**
3(b)(iii)	$Mg(s) + 2H_2O(l) \rightarrow Mg(OH)_2(s) + H_2(g)$	**2**
3(c)(i)	$2Mg(NO_3)_2 \rightarrow 2MgO + 4NO_2 + O_2$	**1**
3(c)(ii)	$CaCO_3 \rightarrow CaO + CO_2$	**1**
	$CaO + H_2O \rightarrow Ca(OH)_2$	**1**
3(d)(i)	reduce acidity in soil / increase pH of soil	**1**
	(both) basic / base(s)	**1**
3(d)(ii)	$CaCO_3 + 2H^+ \rightarrow Ca^{2+} + CO_2 + H_2O$ OR $CaCO_3 + 2H^+ \rightarrow Ca^{2+} + H_2CO_3$	**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)	$HOCH_2CHBrCH_2Br$ OR 	**1**
4(b)(iv)	CO_2 / carbon dioxide	**1**
4(c)(i)	**P** = propanal	**1**
	Q = propanone	**1**

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 :C≡N to $C^{(\delta+)}$	**1**
	correct dipole on carbonyl $^{\delta+}C=O^{\delta-}$ AND curly arrow from bond to $O^{(\delta-)}$	**1**
	correct intermediate, including $C–O^-$ AND curly arrow from lone pair to H^+	**1**
	Total:	**19**