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Cambridge International Advanced Subsidiary and Advanced Level

MARK SCHEME for the May/June 2015 series

9701 CHEMISTRY

9701/21 Paper 2 (Structured Questions AS Core), maximum raw mark 60

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Question	Mark Scheme	Mark	Total
1 (a)	<table><tr><th>sub-atomic particle</th><th>relative mass</th><th>relative charge</th></tr><tr><td>neutron</td><td>1</td><td>0</td></tr><tr><td>electron</td><td>1/1836</td><td>–1</td></tr><tr><td>proton</td><td>1</td><td>+1</td></tr></table>	[1] [1] [1]	[3]
(b) (i)	RAM = mean / average mass of the isotopes / an atom(s) relative to 1/12 the mass of an atom of ^{12}C / on a scale where an atom of ^{12}C is (exactly) 12 (units) isotope = atoms with the same number of protons / atomic number / proton number with different mass numbers / numbers of neutrons / nucleon number	[1] [1] [1]	[3]
(ii)	$\frac{(0.89\times74)+(9.37\times76)+(7.63\times77)+(23.77\times78)+(49.61\times80)+(8.73\times82)}{100}$ = 79.04 (2 d.p.) **AND** Se	[1] [1]	[2]
(c) (i)	**Te** **C*l*** $\frac{47.4}{128}$ $\frac{52.6}{35.5}$ $\frac{0.370}{0.370}$ $\frac{1.48}{0.370}$ 1 4 so EF = $TeCl_4$ Empirical Formula Mass = 270 so MF = $TeCl_4$	[1] [1] [1]	[3]
(c) (ii)	Covalent **AND** simple / molecular low melting point / reaction with water	[1] [1]	[2]
(iii)	$TeCl_4 + 3H_2O \rightarrow H_2TeO_3 + 4HCl$ **OR** $TeCl_4 + 2H_2O \rightarrow TeO_2 + 4HCl$	[1]	[1]
(d) (i)	Yellow / orange flame White fumes / solid Yellow / green gas disappears	[1] [1] [1]	[max 2]

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Question	Mark Scheme	Mark	Total
(ii)	NaCl giant / lattice **AND** ionic $SiCl_4$ simple / molecular **AND** covalent For NaCl large difference in electronegativity (of sodium / Na and chlorine / Cl / Cl_2) (indicates electron transfer/ions) For $SiCl_4$ smaller difference (indicates sharing/covalency) with (weak) van der Waals' / IM forces (between molecules) ora	[1] [1] [1] [1]	[4]
			[20]
2 (a) (i)	Straight line drawn horizontally from same intercept	[1]	[1]
(ii)	T_1 because it shows greatest deviation/furthest from ideal	[1]	[1]
(iii)	reducing T (reduces KE of particles) so intermolecular forces of attraction become more significant	[1]	[1]
(iv)	greatest deviation is at high pressure increasing pressure decreases volume so volume of particles becomes more significant ora	[1] [1]	[2]
(b)	Mass of air = 100×0.00118 = 0.118 g Mass of flask = 47.930 – 0.118 = **47.812** g Mass of **Y** = 47.989 – 47.812 = **0.177** g $pV = nRT = \frac{m}{M_r} RT$ $M_r = \frac{mRT}{pV} = \frac{0.177 \times 8.31 \times 299}{1 \times 10^5 \times 100 \times 10^{-6}}$ = **44.0** (43.979 to 2 or more sf)	[1] [1] [1] [1]	[4]
(c) (i)	strong <u>triple</u> bond	[1]	[1]
(ii)	high temperature (needed for reaction between N_2 and O_2)	[1]	[1]
(iii)	$2NO + 2CO \rightarrow N_2 + 2CO_2$ **OR** $2NO + C \rightarrow N_2 + CO_2$	[1]	[1]
(iv)	$4NO_2 + 2H_2O + O_2 \rightarrow 4HNO_3$	[1]	[1]
(v)	$NO + ½O_2 \rightarrow NO_2$ $NO_2 + SO_2 \rightarrow NO + SO_3$ **OR** $NO_2 + SO_2 + H_2O \rightarrow NO + H2SO_4$	[1] [1]	[2]
			[15]

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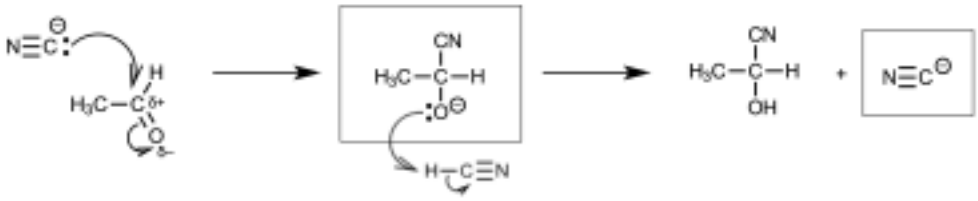
Question	Mark Scheme	Mark	Total
3 (a)	Bond breaking = C=O = 740 C–H = 410 = 1150 kJ	[1]	
	Bond forming = C–C = 350 C–O = 360 O–H = 460 = 1170 kJ	[1]	
	Enthalpy change = 1150 – 1170 = **–20** kJ mol^{-1}	[1]	[3]
(b) (i)	Stereoisomerism = (molecules with the same molecular formula and) same structural formula but different spatial arrangements of atoms	[1]	
	Chiral centre = atom with four different atoms/groups attached	[1]	[2]
(ii)	(Planar) carbonyl so (equal chance of nucleophile) attacking either side	[1]	[1]
3 (c) (i)	 M1 = lone pair **AND** curly arrow from lone pair to carbonyl C M2 = partial charges on C=O **AND** curly arrow from bond (=) to $O^{\delta-}$ M3 = structure of intermediate including charge M4 = lone pair **AND** two correct curly arrows (from lone pair to H **AND** from H—C to C) M5 = CN^-	[1] [1] [1] [1] [1]	[5]
(ii)	(CN^- regenerated so) catalyst	[1]	[1]
			[12]

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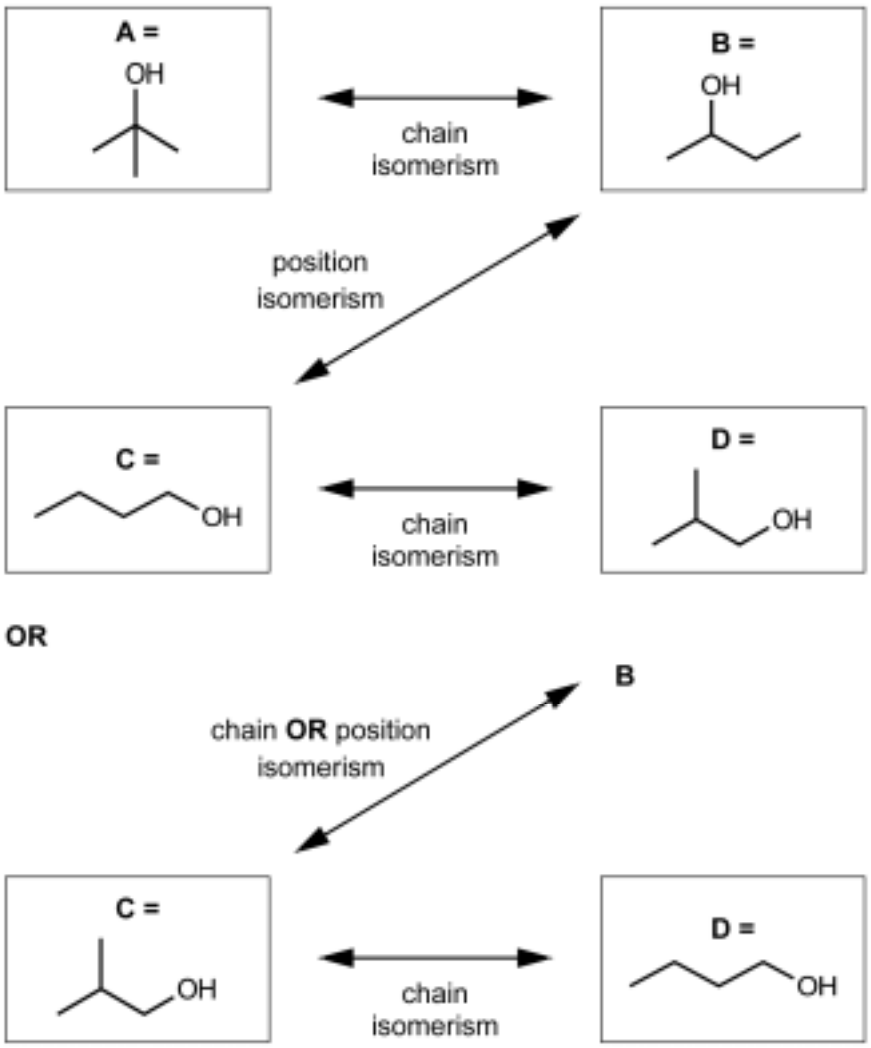
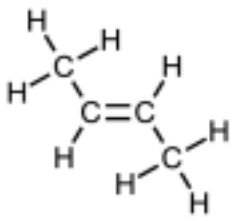
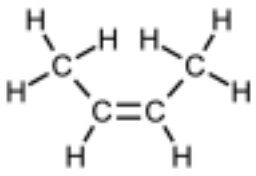
Question	Mark Scheme	Mark	Total
4 (a)		[1] [1] [1] [1] [1] [1] [1]	[7]
(b) (i)	but-1-ene / 1-butene but-2-ene / 2-butene	[1] [1]	[2]
(ii)	but-2-ene **AND** two different groups on each carbon (of C=C) double bond means no free rotation	[1] [1]	[2]
(iii)	 and  (either way round)	[1+1]	[2]
			[13]

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