

CAMBRIDGE INTERNATIONAL EXAMINATIONS

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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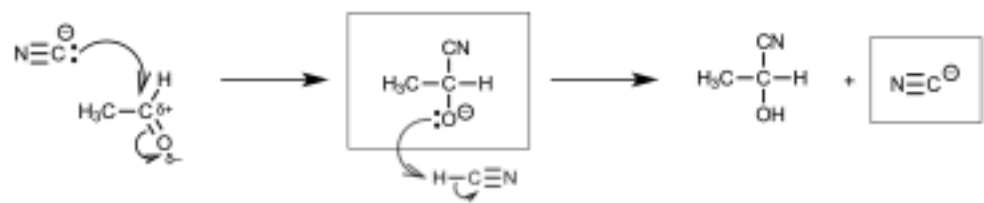
Page 2	Mark Scheme	Syllabus	Paper
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Question	Mark Scheme	Mark	Total
1 (a)	sub-atomic particle	relative mass	relative charge
	neutron	1	0
	electron	1/1836	-1
	proton	1	+1
(b) (i)	RAM = mean / average mass of the isotopes / an atom(s) relative to 1/12 the mass of an atom of ¹² C / on a scale where an atom of ¹² C is (exactly) 12 (units)	[1] [1]	[3]
	isotope = atoms with the same number of protons / atomic number / proton number with different mass numbers / numbers of neutrons / nucleon number	[1]	
(ii)	$\frac{(0.89 \times 74) + (9.37 \times 76) + (7.63 \times 77) + (23.77 \times 78) + (49.61 \times 80) + (8.73 \times 82)}{100}$	[1]	[2]
	= 79.04 (2 d.p.) AND Se	[1]	
(c) (i)	Te Cl		[1]
	$\frac{47.4}{128}$ $\frac{52.6}{35.5}$		
	$\frac{0.370}{0.370}$ $\frac{1.48}{0.370}$		
	1 4 so EF = TeCl ₄	[1]	[3]
	Empirical Formula Mass = 270 so MF = TeCl ₄	[1]	
(c) (ii)	Covalent AND simple / molecular	[1]	[2]
	low melting point / reaction with water	[1]	
(iii)	TeCl ₄ + 3H ₂ O → H ₂ TeO ₃ + 4HCl OR TeCl ₄ + 2H ₂ O → 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 → N ₂ + 2CO ₂ OR 2NO + C → N ₂ + CO ₂	[1]	[1]
(iv)	4NO ₂ + 2H ₂ O + O ₂ → 4HNO ₃	[1]	[1]
(v)	NO + ½O ₂ → NO ₂ NO ₂ + SO ₂ → NO + SO ₃ OR NO ₂ + SO ₂ + H ₂ O → NO + H ₂ SO 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 Bond forming = C–C = 350 C–O = 360 O–H = 460 = 1170 kJ Enthalpy change = 1150 – 1170 = –20 kJ mol ^{–1}	[1] [1] [1]	[3]
(b) (i)	Stereoisomerism = (molecules with the same molecular formula and same structural formula but different spatial arrangements of atoms) Chiral centre = atom with four different atoms/groups attached	[1] [1]	[2]
(ii)	(Planar) carbonyl so (equal chance of nucleophile) attacking either side	[1]	[1]
3 (c) (i)	 <p>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^{δ–} 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[–]</p>	[1] [1] [1] [1] [1]	[5]
(ii)	(CN [–] regenerated so) catalyst	[1]	[1]
			[12]

Question	Mark Scheme	Mark	Total
4 (a)	<p>Diagram illustrating isomerism between four alcohols (A, B, C, D):</p> <ul style="list-style-type: none"> A = tert-butanol B = 2-butanol C = 1-butanol D = 2-methyl-1-propanol <p>Isomerism relationships:</p> <ul style="list-style-type: none"> A and B: chain isomerism C and D: chain isomerism A and C: position isomerism A and D: chain OR position isomerism <p>OR</p> <p>Alternative diagram showing:</p> <ul style="list-style-type: none"> C = 2-methyl-1-propanol D = 1-butanol Relationships: C and D are chain isomers; C and B are chain OR position isomers. 	[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)	<p>and (either way round)</p>	[1+1]	[2]
			[13]