

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

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

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

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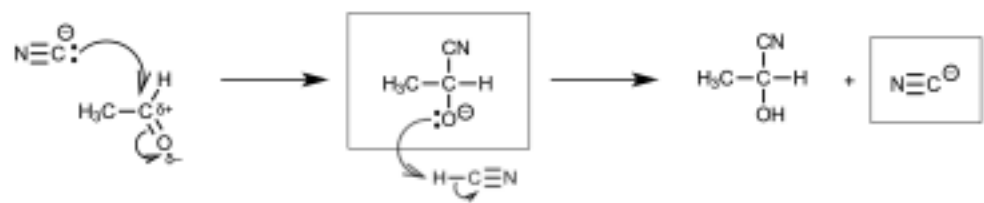
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Question	Mark Scheme	Mark	Total
1 (a)	sub-atomic particle	relative mass	relative charge
	neutron	1	0
	electron	1/1836	-1
	proton	1	+1
(b) (i)	RAM = mean/average mass of the isotopes/an atom(s) relative to 1/12 the mass of an atom of ¹² C/on a scale 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]

Page 4	Mark Scheme	Syllabus	Paper
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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 = <chem>CC(C)(C)O</chem> (tert-butanol) B = <chem>CCC(O)C</chem> (2-butanol) C = <chem>CCCCO</chem> (1-butanol) D = <chem>CC(C)CO</chem> (2-methylpropan-1-ol) <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 B and D: chain OR position isomerism <p>OR</p> <ul style="list-style-type: none"> C = <chem>CC(C)CO</chem> (2-methylpropan-1-ol) D = <chem>CCCCO</chem> (1-butanol) Relationship between C and D: chain isomerism Relationship between C and B: chain OR position isomerism 	<p>[1] [1] [1]</p> <p>[1]</p> <p>[1] [1] [1]</p>	[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]