

CAMBRIDGE INTERNATIONAL EXAMINATIONS

Cambridge International Advanced Subsidiary and Advanced Level

MARK SCHEME for the October/November 2014 series

9701 CHEMISTRY

9701/22

Paper 2 (AS Structured Questions), 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.

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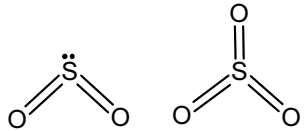
Page 2	Mark Scheme	Syllabus	Paper
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Question	Mark Scheme	Marks	Total
1 (a) (i)	increasing distance of (outer) electron(s) from nucleus OR increasing distance of outer / valence shell from nucleus	1	
	increased shielding / screening (from inner shells)	1	
	reduces attraction	1	[3]
(ii)	(3 rd electron for each in) inner / lower energy level / shell / closer to nucleus (than first two) / less shielding	1	
	(large) increase in nuclear attraction	1	[2]
(b) (i)	$(1s^2 2s^2 2p^6) 3s^2 3p^6 3d^{10} 4s^2 4p^6 5s^2$	1	[1]
(ii)	four isotopes owtte	1	[1]
(iii)	$\frac{(84 \times 0.56) + (86 \times 9.86) + (87 \times 7) + (88 \times 82.58)}{100}$	1	
	= 87.7 (must be 3 sig figs)	1	[2]
(c) (i)	(a species that) gains / takes electron(s)	1	[1]

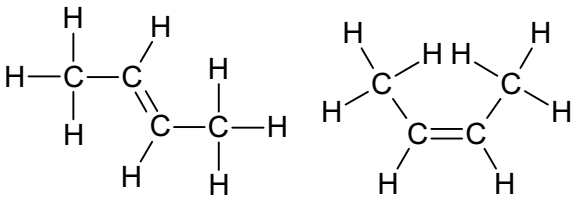
Page 3	Mark Scheme	Syllabus	Paper
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Question	Mark Scheme	Marks	Total
(ii)	<p>Ba Cl O</p> <p>$\frac{45.1}{137}$ $\frac{23.4}{35.5}$ $\frac{31.5}{16}$</p> <p>$\frac{0.329}{0.329}$ $\frac{0.659}{0.329}$ $\frac{1.969}{0.329}$</p> <p>1.00 2.00 5.98/6</p> <p>emp form = BaCl₂O₆</p>	1 1 1	[3]
(d) (i)	<p>X = Mg(OH)₂ Y = MgO Z = Mg(NO₃)₂</p>	1 1 1	[3]
(ii)	<p>reagent = nitric acid</p> <p>MgO + 2HNO₃ → Mg(NO₃)₂ + H₂O</p>	1 1	[2]
(iii)	Heat/thermal decomposition	1	[1]
(iv)	<p>Mg + 2H₂O → Mg(OH)₂ + H₂</p> <p>2Mg(NO₃)₂ → 2MgO + 4NO₂ + O₂</p>	1 1	[2]
			[21]

Page 4	Mark Scheme	Syllabus	Paper
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Question	Mark Scheme	Marks	Total
2 (a)	$4\text{FeS}_2 + 11\text{O}_2 \rightarrow 2\text{Fe}_2\text{O}_3 + 8\text{SO}_2$	1 1	[2]
(b) (i)	Very exothermic/gets very hot OR creates (acid/ H_2SO_4) spray/mist/fog/fumes	1	1
(ii)	$\text{SO}_3 + \text{H}_2\text{SO}_4 \rightarrow \text{H}_2\text{S}_2\text{O}_7$ $\text{H}_2\text{S}_2\text{O}_7 + \text{H}_2\text{O} \rightarrow 2\text{H}_2\text{SO}_4$	1 1	[2]
(c) (i)	 <p>M1 SO_2 correct M2 SO_3 correct</p>	1+1	[2]
(ii)	115–120° bent / non-linear 120° trigonal planar	1 1	[2]
(d) (i)	Advantage = higher rate Greater KE/energy/speed/collision frequency/proportion of successful collisions/more particles with $E > E_a$ Disadvantage – reduced yield/less product (Forward reaction) exothermic AND (hence in accordance with LCP) equilibrium/reaction shifts left (to counteract inc T) ora	1 1 1 1	[4]
(ii)	$K_p = \frac{p\text{SO}_3^2}{p\text{SO}_2^2 \times p\text{O}_2}$	1	[1]

Page 5	Mark Scheme	Syllabus	Paper
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Question	Mark Scheme	Marks	Total
(iii)	$ \begin{array}{ccc} 2\text{SO}_2(\text{g}) + \text{O}_2(\text{g}) \rightleftharpoons 2\text{SO}_3(\text{g}) \\ \begin{array}{ccc} 2 & 2 & 0 \\ (-1.8) & (-0.9) & \\ \underline{0.2} & \underline{1.1} & 1.80 \end{array} \end{array} $ <p> $x\text{SO}_3 = 1.8/3.1 = 0.581$ $x\text{SO}_2 = 0.2/3.1 = 0.065$ $x\text{O}_2 = 1.1/3.1 = 0.355$ </p> $ K_p = \frac{0.581^2 \times (2 \times 10^5)^2}{0.065^2 \times (2 \times 10^5)^2 \times 0.355 \times 2 \times 10^5} = 1.13 \times 10^{-3} \text{ Pa}^{-1} $	1 1 1 1+1	[5]
			[19]
3 (a)	P; $\text{CH}_2 = \text{C}(\text{CH}_3)_2$ Q; $\text{CH}_3\text{CH}_2\text{CH} = \text{CH}_2$ R; $\text{CH}_3\text{CH} = \text{CHCH}_3$ S; $(\text{CH}_3)_2\text{CO}$	1 1 1 1	[4]
(b) (i)	(Different molecules with) the same (molecular and) structural formula different arrangements of atoms (in space)/ different displayed formula	1 1	[2]
(ii)	 <p>trans-but-2-ene cis-but-2-ene</p>	1 1	[2]

Page 6	Mark Scheme	Syllabus	Paper
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Question	Mark Scheme	Marks	Total
(c)	reagent; NaBH ₄ or LiAlH ₄ or names	1	
	product; propan-2-ol	1	[2]
			[10]
4 (a)	CH ₃ CH ₂ CO ₂ H + 4[H] → CH ₃ CH ₂ CH ₂ OH + H ₂ O	1+1	[2]
(b) (i)	Oxidation	1	[1]
(ii)	Sodium/potassium dichromate or correct formula	1	
	H ⁺ /acidified and (heat under) reflux	1	[2]
(c)	2 CH ₃ CH ₂ CO ₂ H + CaCO ₃ → (CH ₃ CH ₂ CO ₂) ₂ Ca + H ₂ O + CO ₂	1+1	[2]
(d) (i)	CH ₃ CO ₂ H	1	
	warm/hot/high temperature/heat/reflux AND concentrated sulfuric acid	1	[2]
(ii)	water (or hydrogen chloride or ethanoic acid)	1	[1]
			[10]