

CAMBRIDGE INTERNATIONAL EXAMINATIONS

Cambridge International Advanced Subsidiary and Advanced Level

MARK SCHEME for the October/November 2014 series

9701 CHEMISTRY

9701/21

Paper 2 (AS Structured Questions), maximum raw mark 60

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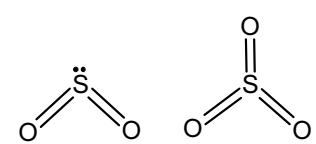
Page 2	Mark Scheme	Syllabus	Paper
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Question	Mark Scheme	Marks	Total
1 (a) (i)	increasing distance of (outer) electron(s) from nucleus OR increasing distance of outer / valence shell from nucleus	1	
	increased shielding / screening (from inner shells)	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]

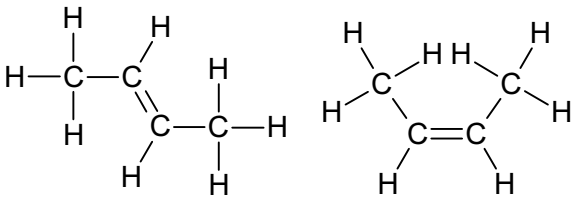
Page 3	Mark Scheme	Syllabus	Paper
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Question	Mark Scheme	Marks	Total
(ii)	<p>Ba Cl O</p> <p>$\frac{45.1}{137}$ $\frac{23.4}{35.5}$ $\frac{31.5}{16}$</p> <p>$\frac{0.329}{0.329}$ $\frac{0.659}{0.329}$ $\frac{1.969}{0.329}$</p> <p>1.00 2.00 5.98/6</p> <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]