

**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

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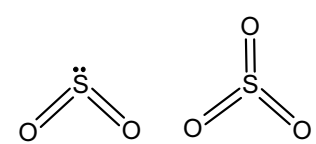
<b>Page 2</b>	<b>Mark Scheme</b>	<b>Syllabus</b>	<b>Paper</b>
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<b>Question</b>	<b>Mark Scheme</b>	<b>Marks</b>	<b>Total</b>
<b>1 (a) (i)</b>	increasing <b>distance</b> of (outer) electron(s) from nucleus OR increasing distance of outer / valence shell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

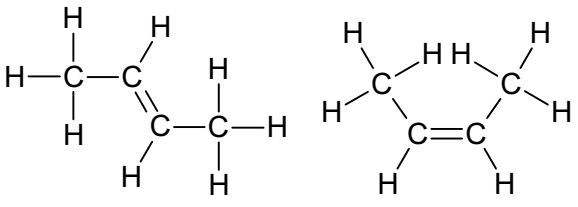
<b>Page 3</b>	<b>Mark Scheme</b>	<b>Syllabus</b>	<b>Paper</b>
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<b>Question</b>	<b>Mark Scheme</b>	<b>Marks</b>	<b>Total</b>
<b>(ii)</b>	<p>Ba      Cl      O</p> <p><math>\frac{45.1}{137}</math>    <math>\frac{23.4}{35.5}</math>    <math>\frac{31.5}{16}</math></p> <p><math>\frac{0.329}{0.329}</math>    <math>\frac{0.659}{0.329}</math>    <math>\frac{1.969}{0.329}</math></p> <p>1.00    2.00    5.98/6</p> <p>emp form = BaCl<sub>2</sub>O<sub>6</sub></p>	1       1   1	[3]
<b>(d) (i)</b>	<p><b>X</b> = Mg(OH)<sub>2</sub>  <b>Y</b> = MgO  <b>Z</b> = Mg(NO<sub>3</sub>)<sub>2</sub></p>	1 1 1	[3]
<b>(ii)</b>	<p>reagent = nitric acid</p> <p>MgO + 2HNO<sub>3</sub> → Mg(NO<sub>3</sub>)<sub>2</sub> + H<sub>2</sub>O</p>	1  1	[2]
<b>(iii)</b>	Heat/thermal decomposition	1	[1]
<b>(iv)</b>	<p>Mg + 2H<sub>2</sub>O → Mg(OH)<sub>2</sub> + H<sub>2</sub></p> <p>2Mg(NO<sub>3</sub>)<sub>2</sub> → 2MgO + 4NO<sub>2</sub> + O<sub>2</sub></p>	1  1	[2]
			<b>[21]</b>

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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/ $\text{H}_2\text{SO}_4$ ) 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 <math>\text{SO}_2</math> correct M2 <math>\text{SO}_3</math> 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) <b>exothermic AND</b> (hence in accordance with LCP) equilibrium/reaction <b>shifts left</b> (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]

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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> <math>x\text{SO}_3 = 1.8/3.1 = 0.581</math>  <math>x\text{SO}_2 = 0.2/3.1 = 0.065</math>  <math>x\text{O}_2 = 1.1/3.1 = 0.355</math> </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)	<b>P;</b> $\text{CH}_2 = \text{C}(\text{CH}_3)_2$ <b>Q;</b> $\text{CH}_3\text{CH}_2\text{CH} = \text{CH}_2$ <b>R;</b> $\text{CH}_3\text{CH} = \text{CHCH}_3$ <b>S;</b> $(\text{CH}_3)_2\text{CO}$	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]

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