

**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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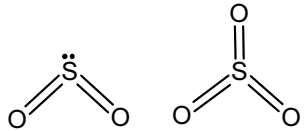
<b>Page 2</b>	<b>Mark Scheme</b>	<b>Syllabus</b>	<b>Paper</b>
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<b>Question</b>	<b>Mark Scheme</b>	<b>Marks</b>	<b>Total</b>
<b>1 (a) (i)</b>	increasing <b>distance</b> of (outer) electron(s) from nucleus OR increasing distance of outer / valence shell 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]

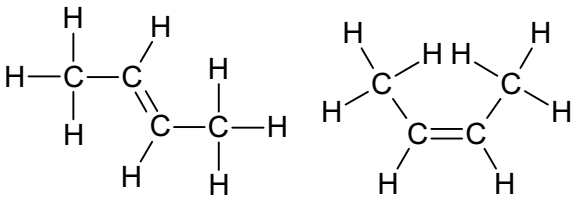
<b>Page 3</b>	<b>Mark Scheme</b>	<b>Syllabus</b>	<b>Paper</b>
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<b>Question</b>	<b>Mark Scheme</b>	<b>Marks</b>	<b>Total</b>
<b>(ii)</b>	<p>Ba      Cl      O</p> <p><math>\frac{45.1}{137}</math>    <math>\frac{23.4}{35.5}</math>    <math>\frac{31.5}{16}</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)	 M1 $\text{SO}_2$ correct M2 $\text{SO}_3$ correct	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]