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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

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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)	(3rd 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]

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Question	Mark Scheme	Marks	Total
(ii)	Ba Cl O $\frac{45.1}{137}$ $\frac{23.4}{35.5}$ $\frac{31.5}{16}$ $\frac{0.329}{0.329}$ $\frac{0.659}{0.329}$ $\frac{1.969}{0.329}$ 1.00 2.00 5.98 / 6 emp form = $BaCl_2O_6$	1 1 1	[3]
(d) (i)	**X** = $Mg(OH)_2$ **Y** = MgO **Z** = $Mg(NO_3)_2$	1 1 1	[3]
(ii)	reagent = nitric acid $MgO + 2HNO_3 \rightarrow Mg(NO_3)_2 + H_2O$	1 1	[2]
(iii)	Heat / thermal decomposition	1	[1]
(iv)	$Mg + 2H_2O \rightarrow Mg(OH)_2 + H_2$ $2Mg(NO_3)_2 \rightarrow 2MgO + 4NO_2 + O_2$	1 1	[2]
			[21]

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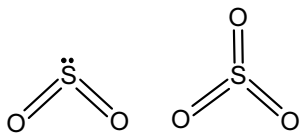
Question	Mark Scheme	Marks	Total
2 (a)	$4FeS_2 + 11O_2 \rightarrow 2Fe_2O_3 + 8SO_2$	1 1	[2]
(b) (i)	Very exothermic / gets very hot OR creates (acid / H_2SO_4) spray / mist / fog / fumes	1	1
(ii)	$SO_3 + H_2SO_4 \rightarrow H_2S_2O_7$ $H_2S_2O_7 + H_2O \rightarrow 2H_2SO_4$	1 1	[2]
(c) (i)	 M1 SO_2 correct M2 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>Ea 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)	$K_p = \frac{pSO_3^{\,2}}{pSO_2^{\,2} \times pO_2}$	1	[1]

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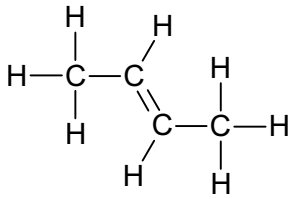
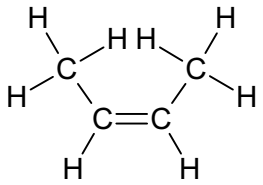
Question	Mark Scheme	Marks	Total
(iii)	$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$ 2 2 0 (–1.8) (–0.9) 0.2 1.1 1.80 $xSO_3 = 1.8/3.1 = 0.581$ $xSO_2 = 0.2/3.1 = 0.065$ $xO_2 = 1.1/3.1 = 0.355$ $K_p = \frac{0.581^2 \times \cancel{(2 \times 10^5)^2}}{0.065^2 \times \cancel{(2 \times 10^5)^2} \times 0.355 \times 2 \times 10^5} = 1.13 \times 10^{-3}\ Pa^{-1}$	1 1 1 1+1	[5]
			[19]
3 (a)	**P**; $CH_2 = C(CH_3)_2$ **Q**; $CH_3CH_2CH = CH_2$ **R**; $CH_3CH = CHCH_3$ **S**; $(CH_3)_2CO$	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)	 trans-but-2-ene  cis-but-2-ene	1 1	[2]

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Question	Mark Scheme	Marks	Total
(c)	reagent; $NaBH_4$ or LiA/H_4 or names	1	
	product; propan-2-ol	1	[2]
			[10]
4 (a)	$CH_3CH_2CO_2H + 4[H] \rightarrow CH_3CH_2CH_2OH + H_2O$	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)	$2\ CH_3CH_2CO_2H + CaCO_3 \rightarrow (CH_3CH_2CO_2)_2Ca + H_2O + CO_2$	1+1	[2]
(d) (i)	CH_3CO_2H	1	
	warm / hot / high temperature / heat / reflux **AND** concentrated sulfuric acid	1	[2]
(ii)	water (or hydrogen chloride or ethanoic acid)	1	[1]
			[10]

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