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.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

Cambridge will not enter into discussions about these mark schemes.

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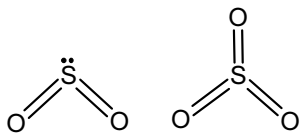
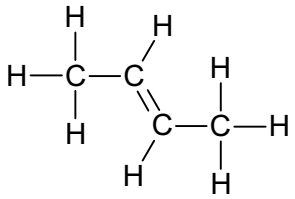
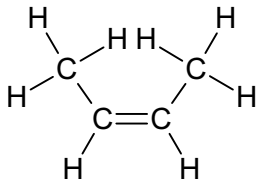
CAMBRIDGE
International Examinations

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]

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]

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]

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]

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]