CAMBRIDGE INTERNATIONAL EXAMINATIONS

Cambridge International Advanced Subsidiary and Advanced Level

MARK SCHEME for the October/November 2015 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.

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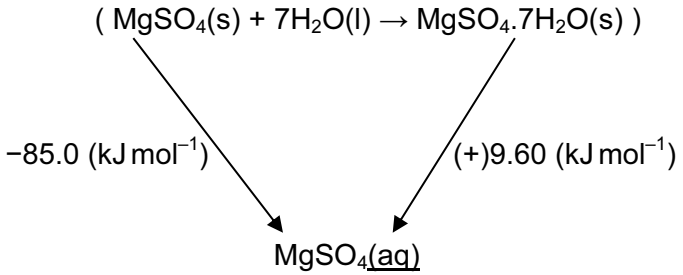
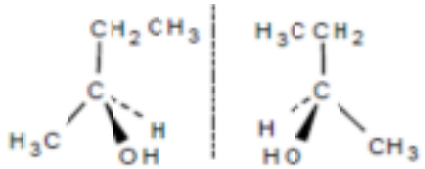
Cambridge is publishing the mark schemes for the October/November 2015 series for most Cambridge IGCSE®, Cambridge International A and AS Level components and some Cambridge O Level components.

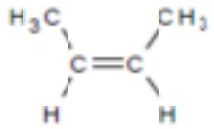
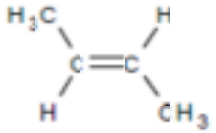
CAMBRIDGE
International Examinations

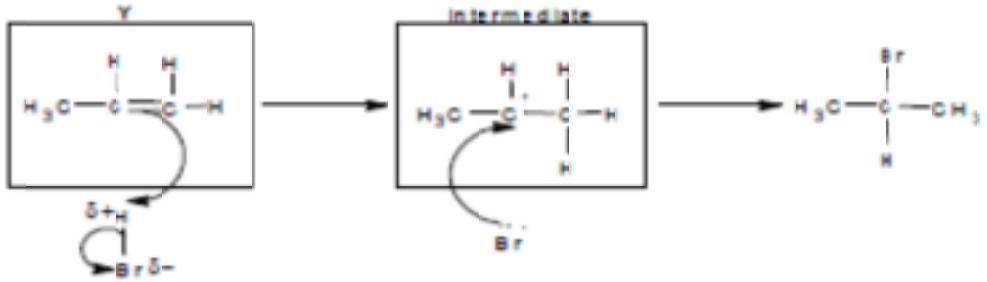
Question	Mark Scheme	Mark	Total
1 (a)	<table><tr><th>name of isotope</th><th>type of particle</th><th>charge</th><th>symbol</th><th>electron configuration</th></tr><tr><td>carbon-13</td><td>atom</td><td>0</td><td>$^{13}_{6}C$</td><td>$1s^2 2s^2 2p^2$</td></tr><tr><td>chloride(-37)</td><td>anion</td><td>1−</td><td>Cl</td><td>$1s^2 2s^2 2p^6 3s^2 3p^6$</td></tr><tr><td>sulfur-34</td><td>atom</td><td>0</td><td>$^{34}_{16}S$</td><td>$1s^2 2s^2 2p^6 3s^2 3p^4$</td></tr><tr><td>iron-54</td><td>cation</td><td>2+</td><td>$^{54}_{26}Fe^{(2+)}$</td><td>$1s^2 2s^2 2p^6 3s^2 3p^6 3d^6$</td></tr></table>	[5]	[5]
(b) (i)	ability / tendency / power of an atom / nucleus to attract / pull electron(s) in a covalent bond / shared pair of electrons / bonding pair of electrons	[1] [1]	[2]
(ii)	Covalent overlap of orbitals OR shared <u>pair</u>(s) (of electrons) OR metallic positive ions / cations surrounded by delocalised electrons	[1] [1] [1] [1]	[2]
(iii)	Ionic/electrovalent (electrostatic) Attraction between oppositely charged / +ve and –ve <u>ions</u>	[1] [1]	[2]
(c) (i)	similar strength / amount / number of intermolecular forces / induced dipole / van der Waals' / VdW / London forces / LDF / dispersion forces therefore similar energy needed	[1] [1]	[2]

Question	Mark Scheme	Mark	Total
(ii)	M1 HC*l* polar / has a dipole AND F_2 non-polar / has no dipole OR (permanent) dipole (-dipole) attractions / forces between HC*l* (molecules) AND induced dipole (-induced dipole) attractions / forces / LDFs between F_2 (molecules) M2 more energy needed for HC*l* than F_2 OR pd-pd forces stronger than id-id forces OR IMFs / VdWs in HC*l* stronger than in F_2	[1] [1]	[2]
(iii)	Hydrogen bonding (between methanol molecules) Stronger than IMFs / van der Waals' in other three / is the strongest intermolecular force	[1] [1]	[2]
			[17]
2 (a)	M1 Heat (energy) change (**or** $H_{prod} - H_{react}$) measured at constant pressure OR enthalpy change when the amount/moles of reactants as shown in a (reaction) equation react together to give products M2 measured at standard conditions	[1] [1]	[2]
(b) (i)	q = 2125.53	[1]	[1]
(ii)	amount = 0.025(0)	[1]	[1]
(iii)	−85.(0)	[1]	[1]

Question	Mark Scheme	Mark	Total
(iv)		[1]	[1]
(v)	ΔH + 9.6 = −85.0 ΔH = −85.0 − 9.6 = −94.6 (kJ mol^{-1})	[1]	[1]
			[7]
3 (a) (i)	Na_2O or Na_2O_2; MgO; P_4O_{10} or P_4O_6 ; SO_2	[1] [1]	[2]
(ii)	Na: Yellow / orange / gold flame / white solid / powder / smoke $4Na + O_2 \rightarrow 2Na_2O$ or $2Na + O_2 \rightarrow Na_2O_2$ S: Blue flame / (yellow) solid melts / turns red / amber / white fumes $S + O_2 \rightarrow SO_2$	[1] [1] [1] [1]	[4]
(b) (i)	acidic P and S amphoteric A*l* and basic Na and Mg	[1] [1]	[2]
(ii)	acidic: covalent (bonding) basic: ionic (bonding)	[1] [1]	[2]

Question	Mark Scheme	Mark	Total
(iii)	$Al_2O_3 + 6HCl \rightarrow 2AlCl_3 + 3H_2O$ **OR** $Al_2O_3 + 6H^+ \rightarrow 2Al^{3+} + 3H_2O$ $Al_2O_3 + 2NaOH + 7H_2O \rightarrow 2NaAl(OH)_4(H_2O)_2$ **OR** $Al_2O_3 + 2NaOH + 3H_2O \rightarrow 2NaAl(OH)_4$ **OR** $Al_2O_3 + 2NaOH \rightarrow 2NaAlO_2 + H_2O$ **OR** $Al_2O_3 + 2OH^- + 7H_2O \rightarrow 2[Al(OH)_4(H_2O)_2]^-$ **OR** $Al_2O_3 + 2OH^- + 3H_2O \rightarrow 2[Al(OH)_4]^-$ **OR** $Al_2O_3 + 2OH^- \rightarrow 2AlO_2^- + H_2O$	[1] [1]	[2]
(c)	sulfur forms SO_2 / SO_2 + / mixes $H_2O \rightarrow H_2SO_3$ or in words OR SO_2 + / mixes H_2O ($\rightarrow$acid) / or in words OR SO_2 + / mixes $H_2O + (1/2O_2) \rightarrow H_2SO_4$ / or in words	[1] [1]	[2]
			[14]
4 (a) (i)	Nucleophilic Substitution	[1]	[1]
(ii)	Has a chiral centre / carbon OR has a <u>carbon / C</u> attached to 4 different groups / atoms / chains OR has no plane / line of symmetry	[1]	[1]
(iii)		[1+1]	[2]
(iv)	Elimination	[1]	[1]

Question	Mark Scheme	Mark	Total
(v)	 *cis*-but-2-ene  *trans*-but-2-ene	[1] [1]	[2]
(vi)	But-1-ene 2 Hs on one of the double-bonded Cs OR does not have 2 different groups on both atoms / each atom in C=C	[1] [1]	[2]
(b) (i)	ammonia / NH_3	[1]	[1]
(ii)	propanoyl chloride / C_2H_5COCl	[1]	[1]
(iii)	$CH_3CH(NHCOC_2H_5)CH_3$	[1]	[1]
(iv)	Reduction (1) $LiAlH_4$ / lithium aluminium hydride / lithium tetrahydridoaluminate	[1] [1]	[2]
(v)	aluminium oxide	[1]	[1]

Question	Mark Scheme	Mark	Total
(vi)	 M1 = correct structure of **Y** and curly arrow from double bond to H M2 = dipole and curly arrow from H-Br bond to Br M3 = correct intermediate M4 = Br^- with lone pair and curly arrow from lone pair to C(+)	 [1] [1] [1] [1]	[4]
(vii)	electrophilic addition	[1]	[1]
(viii)	secondary carbocation more stable than primary due to electron releasing character / (positive) inductive effect of alkyl groups	[1] [1]	[2]
			[22]