

CAMBRIDGE INTERNATIONAL EXAMINATIONS

Cambridge International Advanced Subsidiary and Advanced Level

MARK SCHEME for the October/November 2015 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.

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.

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.

® IGCSE is the registered trademark of Cambridge International Examinations.

Page 2	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – October/November 2015	9701	21

Question	Mark Scheme	Mark	Total
1 (a)	regular arrangement / lattice of cations / positive ions surrounded by delocalised electrons	[1] [1]	[2]
(b) (i)	electrical conductor corrosion resistant low density ductile owtte	[1] [1]	[max2]
(ii)	Giant / lattice	[1]	[1]
(iii)	(electrical) insulator	[1]	[1]
(c) (i)	Simple covalent / covalent molecule Weak intermolecular forces / VdW forces OR little energy needed to break down / overcome intermolecular / VdW forces	[1] [1]	[2]
(ii)	$\begin{array}{r} Al \quad Cl \\ \hline 20.3 \quad 79.7 \\ \hline 27 \quad 35.5 \\ \\ 0.752 \quad 2.25 \\ \hline 0.752 \quad 0.752 \\ \\ 1 \quad 3 \quad AlCl_3 \end{array}$	[1] [1]	[2]

Page 3	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – October/November 2015	9701	21

Question	Mark Scheme	Mark	Total
(iii)	$pV = \frac{m}{M_r}RT$ $M_r = \frac{mRT}{pV} = \frac{1.36 \times 8.31 \times 473}{100 \times 10^3 \times 200 \times 10^{-6}}$ $= 267$ <p>OR</p> $pV = nRT$ $n = \frac{pV}{RT} = \frac{100 \times 10^3 \times 200 \times 10^{-6}}{8.31 \times 473}$ $= 5.09 \times 10^{-3}$ $M_r = \frac{1.36}{5.09 \times 10^{-3}} = 267$	[1] [1] [1]	[2]
(iv)	Al_2Cl_6	[1]	[1]
			[13]
2 (a) (i)	The enthalpy change when one mole of a compound is formed from its element(s)	[1] [1]	[2]
(ii)	$S(s) + 1\frac{1}{2}O_2(g) \rightarrow SO_3(l)$	[1]	[1]
(b) (i)	$944 + (3 \times 436) = 2252$ $6 \times 390 = 2340$ $2252 - 2340 = -88 \text{ (kJ mol}^{-1}\text{)}$	[1] [1] [1]	[3]
(ii)	Fe catalyst 200 atm 400–500 (°)C	[1] [1] [1]	[3]
(iii)	High T increases rate AND Low T improves yield owtte Chosen temp is a compromise High P favours/increases (both rate and) yield owtte pressure chosen limited by cost (of compression and ‘thick walls’)	[1] [1] [1] [1]	[4]

Page 4	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – October/November 2015	9701	21

Question	Mark Scheme	Mark	Total
(c) (i)	$2\text{NH}_3 + \text{H}_3\text{PO}_4 \rightarrow (\text{NH}_4)_2\text{HPO}_4$	[1]	[1]
(ii)	NH_3 identified as base AND H_3PO_4 identified as acid base accepts protons AND acid donates protons	[1] [1]	[2]
(d) (i)	nitrates / fertilisers wash into rivers eutrophication / algal bloom / promote algal growth bacteria use up oxygen in decay process	[1] [1] [1]	[3]
(ii)	(oxides of nitrogen / NO_x / NOs) cause acid rain $2\text{NO}_2 + \text{H}_2\text{O} \rightarrow \text{HNO}_2 + \text{HNO}_3$ OR $4\text{NO}_2 + 2\text{H}_2\text{O} + \text{O}_2 \rightarrow 4\text{HNO}_3$ OR $\text{SO}_2 + \text{NO}_2 \rightarrow \text{SO}_3 + \text{NO}$ AND $\text{SO}_3 + \text{H}_2\text{O} \rightarrow \text{H}_2\text{SO}_4$	[1] [1]	[2]
			[21]
3 (a) (i)	structural isomers: (different molecules with) same molecular formula but different structural formulae chiral: has a carbon / C attached to 4 different groups / atoms / chains OR has no plane / line of symmetry / has non-superimposable mirror images	[1] [1]	[2]
(ii)	$\text{CH}_3\text{CH}_2\text{CH}(\text{CH}_3)\text{CH}_2\text{CH}_2\text{CH}_3$ 3-methylhexane $\text{CH}_3\text{CH}(\text{CH}_3)\text{CH}(\text{CH}_3)\text{CH}_2\text{CH}_3 / (\text{CH}_3)_2\text{CHCH}(\text{CH}_3)\text{CH}_2\text{CH}_3$ 2,3-dimethylpentane	[1] [1] [1] [1]	[4]
(b) (i)	$\text{C}_7\text{H}_{16} + 11\text{O}_2 \rightarrow 7\text{CO}_2 + 8\text{H}_2\text{O}$	[1]	[1]
(ii)	$\text{C}_7\text{H}_{16} + 4\text{O}_2 \rightarrow 7\text{C} + 8\text{H}_2\text{O}$	[1]	[1]

Page 5	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – October/November 2015	9701	21

Question	Mark Scheme	Mark	Total
(iii)	global dimming / PAN / smog / global warming	[1]	[1]
(c) (i)	(Free) Radical Substitution	[1]	[1]
(ii)	$Cl_2 \rightarrow 2Cl\cdot$ OR $Cl_2 \rightarrow Cl\cdot + Cl\cdot$ $C_7H_{16} + Cl\cdot \rightarrow \cdot C_7H_{15} + HCl$ $\cdot C_7H_{15} + Cl_2 \rightarrow C_7H_{15}Cl + Cl\cdot$ $\cdot C_7H_{15} + Cl\cdot \rightarrow C_7H_{15}Cl$ OR $\cdot C_7H_{15} + \cdot C_7H_{15} \rightarrow C_{14}H_{30}$ Initiation; Propagation; Termination (used correctly)	[1] [1] [1] [1]	[5]
			[15]
4 (a) (i)	$CH_3CH_2OH + HCl \rightarrow CH_3CH_2Cl + H_2O$ or $CH_3CH_2OH + PCl_5 \rightarrow CH_3CH_2Cl + HCl + POCl_3$ or $CH_3CH_2OH + SOCl_2 \rightarrow CH_3CH_2Cl + HCl + SO_2$	[1+1]	[2]
(ii)	NaOH / KOH warm / heat / reflux AND aqueous	[1] [1]	[2]
(b) (i)	$CH_2=CH_2$ / ethane / C_2H_4 / CH_2CH_2	[1]	[1]
(ii)	<u>White</u> ppt / solid / suspension	[1]	[1]
(iii)	$Ag^+(aq) + Cl^-(aq) \rightarrow AgCl(s)$	[1]	[1]
(c) (i)	CH_3CHO / ethanal	[1]	[1]

Page 6	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – October/November 2015	9701	21

Question	Mark Scheme	Mark	Total
(ii)	CH ₃ CH ₂ OH higher bpt than CH ₃ CHO ora due to hydrogen bonding in ethanol/stronger IMFs prevents further oxidation owtte	[1] [1] [1]	[3]
			[11]