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.

CAMBRIDGE
International Examinations

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)	$\frac{Al}{20.3}$ $\frac{Cl}{79.7}$ 27 35.5 $\frac{0.752}{0.752}$ $\frac{2.25}{0.752}$ 1 3 $AlCl_3$	[1] [1]	[2]

Question	Mark Scheme	Mark	Total
(iii)	$pV = \frac{m}{M_r}RT$ $\quad M_r = \frac{mRT}{pV}$ $\quad = \frac{1.36 \times 8.31 \times 473}{100 \times 10^3 \times 200 \times 10^{-6}}$ = 267 **OR** $pV = nRT$ $\quad n = \frac{pV}{RT}$ $\quad = \frac{100 \times 10^3 \times 200 \times 10^{-6}}{8.31 \times 473}$ $= 5.09 \times 10^{-3}$ $M_r = \frac{1.36}{5.09 \times 10^{-3}} = 267$	[1] [1] [1] [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)	$S(s) + 1½O_2(g) \rightarrow SO_3(l)$	[1]	[1]
(b) (i)	$944 + (3 \times 436) = 2252$ $6 \times 390 = 2340$ $2252 - 2340 = -88\,(kJ\,mol^{-1})$	[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]

Question	Mark Scheme	Mark	Total
(c) (i)	$2NH_3 + H_3PO_4 \rightarrow (NH_4)_2HPO_4$	[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 $2NO_2 + H_2O \rightarrow HNO_2 + HNO_3$ OR $4NO_2 + 2H_2O + O_2 \rightarrow 4HNO_3$ OR $SO_2 + NO_2 \rightarrow SO_3 + NO$ AND $SO_3 + H_2O \rightarrow H_2SO_4$	[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)	$CH_3CH_2CH(CH_3)CH_2CH_2CH_3$ 3-methylhexane $CH_3CH(CH_3)CH(CH_3)CH_2CH_3$ / $(CH_3)_2CHCH(CH_3)CH_2CH_3$ 2,3-dimethylpentane	[1] [1] [1] [1]	[4]
(b) (i)	$C_7H_{16} + 11O_2 \rightarrow 7CO_2 + 8H_2O$	[1]	[1]
(ii)	$C_7H_{16} + 4O_2 \rightarrow 7C + 8H_2O$	[1]	[1]

Question	Mark Scheme	Mark	Total
(iii)	global dimming / PAN / smog / global warming	[1]	[1]
(c) (i)	(Free) Radical Substitution	[1]	[1]
(ii)	$Cl_2 \rightarrow 2Cl\bullet$ OR $Cl_2 \rightarrow Cl\bullet + Cl\bullet$ $C_7H_{16} + Cl\bullet \rightarrow \bullet C_7H_{15} + HCl$ $\bullet C_7H_{15} + Cl_2 \rightarrow C_7H_{15}Cl + Cl\bullet$ $\bullet C_7H_{15} + Cl\bullet \rightarrow C_7H_{15}Cl$ OR $\bullet C_7H_{15} + \bullet C_7H_{15} \rightarrow C_{14}H_{30}$ Initiation; Propagation; Termination (used correctly)	[1] [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)	White ppt / solid / suspension	[1]	[1]
(iii)	$Ag^+(aq) + Cl^-(aq) \rightarrow AgCl(s)$	[1]	[1]
(c) (i)	CH_3CHO / ethanal	[1]	[1]

Question	Mark Scheme	Mark	Total
(ii)	CH_3CH_2OH higher bpt than CH_3CHO ora	[1]	
	due to hydrogen bonding in ethanol / stronger IMFs	[1]	[3]
	prevents further oxidation owtte	[1]	
			[11]