Cambridge International AS & A Level

Cambridge International Examinations
Cambridge International Advanced Subsidiary and Advanced Level

CHEMISTRY **9701/21**

Paper 2 AS Structured Questions **October/November 2016**

MARK SCHEME

Maximum Mark: 60

Published

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 2016 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.

© UCLES 2016

Question	Answer	Marks
1(a)	6×10^{-3} (mol)	1 **1**
1(b)	NaOH + HCl → NaCl + H_2O	1 **1**
1(c)	6×10^{-3} (mol)	1 **1**
1(d)	4×10^{-3} (mol)	1 **1**
1(e)	4×10^{-3} (mol)	1 **1**
1(f)	1×10^{-3} (mol)	1 **1**
1(g)	170	1 **1**
1(h)	28(.0) Si/silicon	1 **2** 1
	Total:	**9**

© UCLES 2016

Question	Answer	Marks
2(a)(i)	Enthalpy / energy / heat change when one mole of a substance Burns / combusts / reacts in excess oxygen OR Completely burns / combusts / reacts in oxygen under standard conditions	1 **3** 1 1
2(a)(ii)	$C_2H_5OH + 3O_2 \rightarrow 2CO_2 + 3H_2O$	1 **1**
2(b)(i)	6813.4 / 6813 / 6810 / 6800 (J)	1 **1**
2(b)(ii)	–1362.68 / −1362.7 / –1363 / –1360 / –1400 (kJ)	1 **1**
2(b)(iii)	Any 2 from: heat / energy losses (to air and/or to the container/surroundings) incomplete combustion (volatile) ethanol evaporated ethanol is impure not all energy is lost as heat	**2** 1 1
2(c)(i)	$3C(s) + 4H_2(g) + \frac{1}{2}O_2(g) \rightarrow C_3H_7OH(l)$ $3(-393.5) \quad 4 \times (-285.8) \quad -2021.0$ $3CO_2 + 4H_2O$	**3** 1+1 1

© UCLES 2016

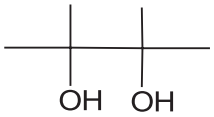
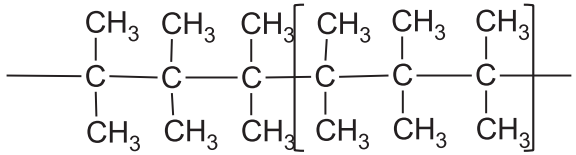
Question	Answer	Marks
2(c)(ii)	$\Delta H_f + (-2021.0) = 3(-393.5) + 4(-285.8)$ $\Delta H_f = -302.7$ ($kJ\,mol^{-1}$)	1 1 **2**
	Total:	**13**

Question	Answer	Marks
3(a)(i)	(Atoms/ ions become larger as) the number of (electron) shells increases (down the group) Increased distance of (outer) electrons (from the nucleus) OR Increased shielding results in weaker (nuclear) attraction / pull	1 **2** 1
3(a)(ii)	top line / dotted line is atomic radii / bottom line / line with crosses is ionic radii (as atoms bigger than ions) Atom has one more shell (than corresponding ion) (ora) OR Atom loses two electrons / outer (shell) electrons / valency electrons (ora) OR Atom loses electrons and so (nuclear) attraction is stronger OR Nuclear charge in ion is greater than the electron(ic) charge (ora) OR Effective nuclear charge in ion is greater (ora)	1 **2** 1
3(b)(i)	Nitrate / Nitrate(V) / NO_3^-	1 **1**
3(b)(ii)	Ba / barium OR Sr / Strontium $Ba^{2+} + SO_4^{2-} \rightarrow BaSO_4$ OR $Sr^{2+} + SO_4^{2-} \rightarrow SrSO_4$	**1** 1

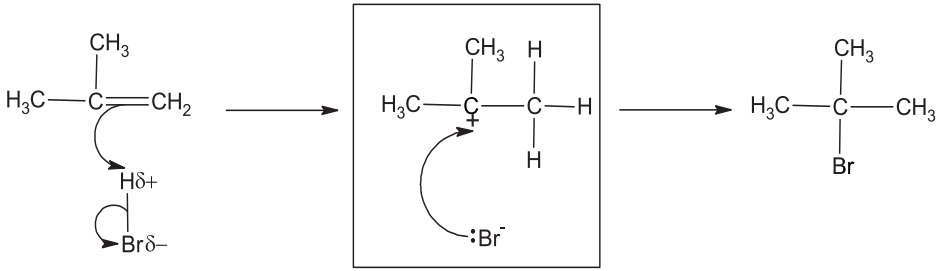
© UCLES 2016

Question	Answer	Marks	
3(b)(iii)	$Ba(NO_3)_2$ OR $Sr(NO_3)_2$	1	**2**
	$2Ba(NO_3)_2 \rightarrow 2BaO + 4NO_2 + O_2$ OR $2Sr(NO_3)_2 \rightarrow 2SrO + 4NO_2 + O_2$	1	
3(c)(i)	$H^+ + OH^- \rightarrow H_2O$ OR $Ca(OH)_2 + 2H^+ \rightarrow Ca^{2+} + 2H_2O$	1	**2**
	$2H^+ + CO_3^{2-} \rightarrow CO_2 + H_2O$ OR $CaCO_3 + 2H^+ \rightarrow Ca^{2+} + CO_2 + H_2O$ OR $H^+ + CO_3^{2-} \rightarrow HCO_3^-$ OR $CaCO_3 + H^+ \rightarrow Ca^{2+} + HCO_3^-$	1	
3(c)(ii)	Calcium carbonate is insoluble / less soluble (ora)	1	**2**
	Calcium carbonate is less likely to be / won't get washed away (ora) OR Calcium carbonate lasts longer (ora) OR Calcium carbonate is less reactive / reacts more slowly (ora)	1	
3(d)	$Mg(OH)_2$	1	**2**
	MgO	1	
	Total:		**14**

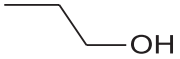
© UCLES 2016

Question	Answer	Marks
4(a)(i)	4-methylhex-2-ene	1 **1**
4(a)(ii)	(Molecules with the) same structural formula (and same molecular formula) with different arrangement of atoms/groups (in space)	1 **1**
4(a)(iii)	4 double-bond / alkene (2) different groups on each double-bonded carbon (one) chiral carbon (centre) / (one) carbon atom has 4 different groups attached / is asymmetric / is chiral	1 **4** 1 1 1
4(b)(i)	2,3-dimethylbut-2-ene	1 **1**
4(b)(ii)		1 **1**
4(b)(iii)	Propanone	1 **1**
4(b)(iv)		1 **1**
4(c)(i)	(2-)methylprop(-1-)ene	1 **1**

© UCLES 2016

Question	Answer	Marks
4(c)(ii)		4 **4**
4(c)(iii)	(tertiary carbocat)ion / (tertiary) intermediate is / C+ with least number of hydrogen atoms bonded to it is more stable (than primary)	1 **3**
	due to (positive) inductive effect of three/more methyl groups (cf one) / three / more electron releasing methyl groups three / more electron donating methyl groups	1
	reducing charge (density) on C+	1
	Total:	**18**

© UCLES 2016

Question	Answer	Marks
5(a)		1 **1**
5(b)	$H^+ / Cr_2O_7^{2-}$ (heat under) reflux	1 **2** 1
5(c)	$H^+ / Cr_2O_7^{2-}$ (heat and) distil	1 **2** 1
5(d)	(1-)propyl propanoate	1 **1**
	Total:	**6**

© UCLES 2016