

CAMBRIDGE INTERNATIONAL EXAMINATIONS

Cambridge International Advanced Level

MARK SCHEME for the May/June 2015 series

9701 CHEMISTRY

9701/51

Paper 5 (Planning, Analysis and Evaluation),
maximum raw mark 30

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.

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Page 2	Mark Scheme	Syllabus	Paper
	Cambridge International A Level – May/June 2015	9701	51

Question	Statement	Expected Answer	Mark
1 (a) (i)	M10	$\text{HCOO}^-(\text{aq}) \longrightarrow \text{CO}_2(\text{g}) + \text{H}^+(\text{aq}) + 2\text{e}^-$ $\text{MnO}_4^-(\text{aq}) + 8\text{H}^+(\text{aq}) + 5\text{e}^- \longrightarrow \text{Mn}^{2+}(\text{aq}) + 4\text{H}_2\text{O}(\text{l})$	[1] [1]
(ii)	M6	Magnesium methanoate is $1.312 \text{ mol dm}^{-3}$ $[\text{HCOO}^-(\text{aq})] = 2.624 \text{ mol dm}^{-3}$	[1] [1]
(iii)	M6	Use <u>volumetric apparatus</u> (to measure 5.0 cm^3 / saturated (magnesium) methanoate solution). Make (the above) up to the mark (with water) in a 250 cm^3 volumetric / graduated flask	[1] [1]
(iv)	M3/P4	H^+ is needed for the reaction with manganite Provided the acid is in excess / sufficient / enough, the volume does not matter	[1] [1]
(v)	M5	A <u>pale</u> pink colour	[1]
(vi)	M10	$0.051 \text{ mol dm}^{-3}$	[1]
(vii)	M10	1.28 mol dm^{-3}	[1]

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Question	Statement	Expected Answer	Mark
(b)	P1/P2	(Independent) Temperature (Dependent) Concentration of magnesium methanoate	[1]
(c)	P3	ΔH is positive (An increase in temperature) will favour / promote / increase / a movement in the direction of the endothermic change / reaction	[1] [1]
(d)	P3	Precipitate is formed / barium sulfate is insoluble / insoluble product	[1]
			[15]
2 (a) (i)	D1	$K_c = \frac{[\text{HI}]^2}{[\text{H}_2][\text{I}_2]}$	[1]
(ii)	D1	$K_c = \frac{4y^2}{(a - y)^2}$	[1]

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Question	Statement	Expected Answer			Mark	
(b) (i)	D3		a mol dm ⁻³	a – y mol dm ⁻³	y mol dm ⁻³	
			0.200	0.022	0.178	
			0.500	0.050	0.450	
			0.800	0.252	0.548	
			1.000	0.200	0.800	
			1.500	0.365	1.135	
			2.100	0.570	1.530	
			2.800	0.652	2.148	
			3.400	0.700	2.700	
			3.800	0.867	2.933	
			4.200	0.868	3.332	
			4.900	1.150	3.750	
		All results for y are to 3 decimal places All values for y are correct				
(ii)	D1	All points plotted correctly			[1]	
(iii)	E5	Appropriate straight line drawn through the origin			[1]	

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Question	Statement	Expected Answer	Mark
(c) (i)	D3/C1	Co-ordinates read correctly from the line	[1]
		Slope of the graph calculated correctly and given to three significant figures with no units.	[1]
(ii)	D3/C1	Uses $\frac{\sqrt{K_c}}{2 + \sqrt{K_c}}$ = gradient (value or y/a) and provides working	[1]
		Gives value of K_c	[1]
(d)	P4	The hydrogen with air / oxygen is explosive at 760K / raised temperature	[1]
(e)	E4	Faster reaction / increased rate	[1]
		The value of K_c would be unaffected	[1]
(f) (i)	E4/C2	The line drawn on the graph has a less steep gradient	[1]
(ii)		The equilibrium constant will be smaller	[1]
			[15]

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Question	Expected Answer	Mark
1 (a) (i)	$2\text{H}^+(\text{aq}) + 2\text{e}^- \longrightarrow \text{H}_2(\text{g})$ ✓	[1]
	$4\text{OH}^-(\text{aq}) \longrightarrow \text{O}_2(\text{g}) + 2\text{H}_2\text{O}(\text{l}) + 4\text{e}^-$ OR $2\text{H}_2\text{O}(\text{l}) \longrightarrow \text{O}_2(\text{g}) + 4\text{H}^+(\text{aq}) + 4\text{e}^-$ ✓	[1]
(ii)	Any straight line from the origin which has double the oxygen volume at a given time ✓	[1]
(iii)	Any straight line from the origin which has 0.45/0.75 x oxygen volume at a given time ✓	[1]
(b) (i)	Circuit has an ammeter in series and is complete ✓	[1]
	Gases are released at the correct electrode ✓	[1]
	Diagram shows collection of hydrogen using a means of measuring the volume of the gas ✓	[1]
	Diagram shows carbon dioxide from the anode being absorbed into a named alkali ✓	[1]
	Diagram then shows ethene being collected using a means of measuring the volume of the gas ✓	[1]
(ii)	The current / ammeter reading The time taken The volume of hydrogen The volume of ethene Mass of alkali before Mass of alkali after	[1]
	3 of the above ✓ 4 or more of the measurements made ✓	[1]

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(iii)	(N =) 24 000 x C / V ✓	[1]
(iv)	N/96 500 ✓	[1]
(v)	Any correctly balanced equation for the reaction of carbon dioxide and an alkali ✓	[1]
(vi)	But-2-ene ✓	[1]
		[15]

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2 (a) (i)	$\text{Na}_2\text{CO}_3 + 2\text{HX} \longrightarrow 2\text{NaX} + \text{CO}_2 + \text{H}_2\text{O}$ ✓	[1]
(ii)	1 mol of Na_2CO_3 reacts with 2 mol of HX ✓	[1]
(b) (i)	$K_a = [\text{H}^+]^2 / [\text{HX}]$ ✓	[1]
(ii)	$[\text{H}^+] = 0.00372$ ✓ $[\text{H}^+]^2 / [\text{HX}] = 0.000138$ OR (answer above) ² / 0.1 ✓ OR $\text{p}K_a = 2\text{pH} + \log[\text{HX}]$ ✓ $= 4.86 - 1$ ✓	[1] [1]
(c) (i)	All points plotted correctly ✓	[1]
	Appropriate curve of best-fit is drawn ✓	[1]
(ii)	Circles the point at mass of NaX = 0.3g ✓ If anomaly is below the line: NaX might not have fully dissolved/mixture not stirred/too little NaX added ✓ If anomaly is above the line; Too much NaX added	[1] [1]
(d) (i)	At pH 3.86, $[\text{HX}] = [\text{NaX}]$ OR $[\text{X}^-]$ ✓	[1]
	Calculates M_r of NaX = 112 or $[\text{X}^-] = 89$ ✓	[1]
	Calculates M_r of HX as 90 ✓	[1]
(ii)	Structure given has both an –OH and a –COOH group and has rmm = ans(d)(i) ✓	1

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(e)	Any two from: spitting HX vaporises / evaporates HX decomposes OR is thermally unstable ✓✓	[2]
		[15]

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