

CAMBRIDGE INTERNATIONAL EXAMINATIONS**Cambridge International Advanced Subsidiary and Advanced Level****MARK SCHEME for the March 2016 series****9701 CHEMISTRY****9701/33**

Paper 3 (Advanced Practical Skills), maximum raw mark 40

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Page 2	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – March 2016	9701	33

question	indicative material	mark	total																					
1 (a)	I All thermometer readings and mass of FA 2 recorded. Do not award if mass of FA 2 > 0.50 g.	1	[4]																					
	II All temperatures recorded to 0.5 °C.	1																						
	Award III and IV if within ranges given of supervisor's value.	2																						
	<table><tr><td>supervisor's ΔT/°C</td><td>III</td><td>IV</td></tr><tr><td>≥ 46.0</td><td>± 5.0</td><td>± 2.5</td></tr><tr><td>36.0–45.5</td><td>± 4.0</td><td>± 2.0</td></tr><tr><td>26.0–35.5</td><td>± 3.0</td><td>± 1.5</td></tr><tr><td>16.0–25.5</td><td>± 2.0</td><td>± 1.0</td></tr><tr><td>6.0–15.5</td><td>± 1.0</td><td>± 0.5</td></tr><tr><td>< 6.0</td><td>± 0.5</td><td>–</td></tr></table>	supervisor's ΔT/°C		III	IV	≥ 46.0	± 5.0	± 2.5	36.0–45.5	± 4.0	± 2.0	26.0–35.5	± 3.0	± 1.5	16.0–25.5	± 2.0	± 1.0	6.0–15.5	± 1.0	± 0.5	< 6.0	± 0.5	–	
	supervisor's ΔT/°C	III		IV																				
	≥ 46.0	± 5.0		± 2.5																				
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16.0–25.5	± 2.0	± 1.0																						
6.0–15.5	± 1.0	± 0.5																						
< 6.0	± 0.5	–																						
(b)	I Axes labelled with units and uniform scale chosen to use more than half of each axis including 10 °C above the highest recorded temperature.	1	[4]																					
	II All recorded points plotted (minimum 9).	1																						
	III Appropriate lines of best fit drawn: - best fit lines must be or a smooth curve; - Points not on the line must be balanced on either side of the best-fit line and any points ringed or labelled as anomalous ignored.	1																						
	IV Lines extrapolated and correct value (within 0.5 °C) of ΔT read from graph.	1																						
(c) (i)	Correctly calculates $Q = 25 \times 4.2 \times \Delta T$ from (b).	1	[3]																					
	(ii) Correct expression for value of enthalpy change $= \frac{-(c)(i) \times 24.3}{\text{mass in (a)} \times 1000}$ (ignore sign)	1																						
	Negative sign and both answers recorded to 2–4 sig. fig. and no rounding to 1 sig. fig. during calculation (unless exact value).	1																						
(d)	Incorrect, as the acid was in excess already.	1	[1]																					
(e)	Any one from: - use lid or use specified extra insulation to reduce heat losses (by convection or conduction); - use a pipette or burette for FA 1 to reduce % error/as more accurately calibrated (owtte); - use magnesium turnings/powder so reaction complete sooner as there is heat loss while magnesium ribbon is still reacting; - use lid or plastic cup with higher walls to reduce acid spray;	1	[1]																					

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question	indicative material	mark	total
2 (a)	I Initial and final burette readings and volume added recorded for rough titre and accurate titre details tabulated.	1	[7]
	II Initial and final burette readings recorded and volume of FA 4 added recorded for each accurate titration. All headings and units correct for accurate titrations: - initial / final (burette) reading / volume or reading / volume at start / finish - volume / FA 4 added / used or titre (cm³) or /cm³ or in cm³ or cm³ by every entry.	1	
	III All accurate burette readings are recorded to the nearest 0.05 cm ³ .	1	
	IV Has two uncorrected, accurate titres within 0.1 cm ³ .	1	
	V, VI and VII Award V , VI and VII for $\delta \leq 0.20 \text{ cm}^3$ Award V and VI for $0.20 \text{ cm}^3 < \delta \leq 0.30 \text{ cm}^3$ Award V for $0.30 \text{ cm}^3 < \delta \leq 0.50 \text{ cm}^3$		
(b)	Mean titre correctly calculated from clearly selected values. - Candidates must average two (or more) titres where the total spread is $\leq 0.20 \text{ cm}^3$. - Working must be shown or ticks must be put next to the two (or more) accurate readings selected. - The mean should normally be quoted to 2 d.p. rounded to the nearest 0.01. <i>Note: the candidate's mean will sometimes be marked as correct even if it is different from the mean calculated by the examiner for the purpose of assessing accuracy.</i>	1	[1]
(c)(i)(ii)	Correctly calculates $\frac{0.100 \times (\mathbf{b})}{1000}$ and (ii) = (i)	1	[5]
(iii)	Correct expression $\frac{(\mathbf{c})(\mathbf{ii}) \times 1000 \times 10}{25}$	1	
(iv)	mol Mg = mass in 1(a) / 24.3 and mol HCl = (c)(iii) $\times 25 / 1000$	1	
	mol HCl > 2 $\times$ mol Mg (owtte) so the statement is correct. Allow ecf from incorrect (iii) .	1	
	Final answers (i) , (ii) and (iii) to 3 or 4 sig. fig. and no rounding errors.	1	

Page 4	Mark Scheme	Syllabus	Paper
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question	indicative material	mark	total
(d)	Correct expression $\frac{0.1 \times 100}{(b)}$ and answer to minimum 2 sig. fig. / correct answer to minimum 2 sig. fig. and FA 3 (is measured more accurately). Allow ecf from (b) > 41.67 cm ³ then FA 4 (is measured more accurately).	1	[1]

test	observations	
	FA 5	FA 6
NaOH	no reaction / no change / no ppt	white ppt, soluble in excess
NH ₃	no reaction / no change / no ppt	white ppt, insoluble in excess
HCl (warm)	blue solution brown gas / gas turning brown / gas turns blue litmus red / bleaches	no reaction / no change
H ⁺ / MnO ₄ ⁻	decolourises / purple to colourless or (solution) stays colourless	stays purple / pink or changes to purple / pink
Ba ²⁺ / HCl	no reaction / no change / no ppt	white ppt, insoluble in HCl

question	indicative material	mark	total
FA 5 is NaNO ₂ ; FA 6 is Al ₂ (SO ₄) ₃ ; FA 7 is Na ₂ SO ₃ (Na ₂ S ₂ O ₅)			
3 (a)	Observations fully correct for both FA 5 and FA6 for NaOH.	1	[8]
	Observations fully correct for both FA 5 and FA6 for NH ₃ .	1	
	Observation of blue solution or brown gas with FA 5 and no reaction with FA 6 for HCl.	1	
	Observations fully correct for both FA 5 and FA6 for H ⁺ / MnO ₄ ⁻ .	1	
	Observations fully correct for both FA 5 and FA6 for Ba ²⁺ / HCl.	1	
	Cations: FA 5 unknown and FA 6 Al ³⁺ / aluminium	1	
	Anions: FA 5 NO ₂ ⁻ / nitrite FA 6 SO ₄ ²⁻ / sulfate	1 1	

Page 5	Mark Scheme	Syllabus	Paper
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question	indicative material	mark	total
(b) (i)	(Warm with) Al and NaOH and test gas with (damp) red litmus paper.	1	[5]
	No reaction and not nitrate / N / same element as FA 5 .	1	
	BaCl ₂ / Ba(NO ₃) ₂ and HCl / HNO ₃	1	
	or H ⁺ / KMnO ₄ / acidified potassium manganate(VII) or any named acid, (warm) and test gas with H ⁺ / KMnO ₄ .		
	Ba ²⁺ and acid: white ppt, soluble in acid or H ⁺ / MnO ₄ ⁻ : solution decolourises / purple to colourless or acid and test gas with H ⁺ / KMnO ₄ : gas (evolved with acid) which decolourises H ⁺ / MnO ₄ ⁻ (paper).	1	
(ii)	FA 7 contains sulfite / SO ₃ ²⁻	1	