

CAMBRIDGE INTERNATIONAL EXAMINATIONS

Cambridge International Advanced Subsidiary and Advanced Level

MARK SCHEME for the October/November 2015 series

9701 CHEMISTRY

9701/31

Paper 3 (Advanced Practical Skills 1),
maximum raw mark 40

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	31

Question	Indicative material	Mark	Total
1 (a)	I Initial and final readings and titre value given for rough titre and initial and final readings for two (or more) accurate titrations (<i>minimum of 2 × 2 box</i>)	1	
	II Titre values recorded for accurate titrations and Appropriate headings for the accurate titration table and cm ³ units. - initial / start burette reading / volume / value - final / end burette reading / volume / value (<i>not amount</i>) - titre or volume / FA 4 and used / added - unit: /cm³ or (cm³) or in cm³ (for each heading)	1	
	III All accurate burette readings are to the nearest 0.05 cm ³ . Do not award this mark if: 50(.00) is used as an initial burette reading - more than one final burette reading is 50.(00) - any burette reading is greater than 50.(00) - there is only one accurate titration.	1	
	IV There are two uncorrected accurate titres within 0.10 cm ³ - Do not award this mark if, having performed two titres within 0.10 cm³, a further titration is performed which is more than 0.10 cm³ from the closer of the initial two titres, unless a further titration, within 0.10 cm³ of any other, has also been carried out. - Do not award the mark if any “accurate” burette readings (apart from initial 0 cm³) are given to zero dp	1	
	Examiner rounds any burette readings to the nearest 0.05 cm³, checks subtractions and then selects the “best” titres using the hierarchy: - two (or more) accurate identical titres, <i>then</i> - two (or more) accurate titres within 0.05 cm³, <i>then</i> - two (or more) accurate titres within 0.10 cm³, <i>etc</i> These best titres are used to calculate the mean titre, expressed to nearest 0.01 cm³. Examiner calculates the difference (δ) between the mean titres obtained by the candidate and the Supervisor. Accuracy marks are awarded as shown. Award V, VI and VII if δ ≤ 0.20 (cm³) Award V and VI if 0.20 < δ ≤ 0.30 Award V, only, if 0.30 < δ ≤ 0.50 Spread penalty: if the two “best” (corrected) titres used by the Examiner were ≥ 0.50 cm³ apart, cancel one accuracy mark.	3	[7]

Page 3	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – October/November 2015	9701	31

Question	Indicative material	Mark	Total
(b)	Candidate must take the average of two (or more) titres that are within a total spread of not more than 0.20 cm³. Working / explanation must be shown or ticks must be put next to the two (or more) accurate readings selected. The mean should be quoted to 2 dp, and be rounded to nearest 0.01 cm³. Two special cases, where the mean need not be to 2 dp: • Allow mean expressed to 3 dp only for 0.025 or 0.075 (e.g. 26.325 cm³) • Allow mean if expressed to 1 dp, if all accurate burette readings were given to 1 dp and the mean is exactly correct. (e.g. 26.0 and 26.2 = 26.1 is allowed) (e.g. 26.0 and 26.1 = 26.1 is wrong – should be 26.05) Note: the candidate's mean will sometimes be marked correct even if it was different from the mean calculated by the Examiner for the purpose of assessing accuracy.	1	[1]
(c)(i)(ii)	Correctly calculates • $n(\text{thio}) = 0.10 \times (\text{b}) / 1000$ • $n(\text{I}_2) = 0.5 \times (\text{i})$ Both answers must be given to 3 or 4 significant figures	1	[5]
(iii)	Correctly calculates $n(\text{KMnO}_4) = 0.025 \times 0.018 = 0.00045 \text{ or } 0.000450 \text{ or } 0.0004500$	1	
(iv)	Correct expression, with answer given to 2, 3 or 4 sig fig $n(\text{I}_2) = (\text{ii}) / (\text{iii}) \times 2$ Theoretical answer = 5.0 (for 2.0 mol KMnO₄)	1	
(v)	Correct equation ticked, corresponding to (iv)	1	
(vi)	Allow any one of the following answers: • An iodide ion loses one electron • $2\text{I}^- - 2\text{e}^- \rightarrow \text{I}_2$ (ionic equation must be correctly balanced) • Oxidation number of iodine increases from -1/ 1- (in iodide ion) to 0 (in iodine)	1	
(d) (i)	$\% \text{ error} = \frac{0.06}{25} \times 100 = 0.24 \%$	1	[2]
(ii)	The student is wrong, since KI / FA 3 is in excess .	1	
Qn 1	[Total: 15]		
2 (a)	I Table for readings, headings and correct units: Headings: • volume of FA 5 / acid • (volume of water – if included must be correct) • Time Units allow Vol or /cm³ etc.	1	

Page 4	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – October/November 2015	9701	31

Question	Indicative material	Mark	Total
	II Three reaction times all recorded to nearest second	1	[4]
	III and IV Examiner to calculate the time differences between Expt 1 and Expt 2 ($t_2 - t_1$). Then calculate 10% of the time for Expt 1 to 1dp (x). If ($t_2 - t_1$).> x award III . Examiner to calculate the time differences between Expt 2 and Expt 3 ($t_3 - t_2$). Then calculate 20% of the time for Expt 2 to 1dp (y). If ($t_3 - t_2$).> y award IV .	2	
(b) (i)	• Rates correctly calculated • All answers expressed to same sig fig (but not 1 sf) • Unit given.... / s⁻¹ or (s⁻¹)	1	
(ii)	Correctly calculates • Expt 1, conc = 0.08571 (or 0.0857 or 0.086) mol dm⁻³ and • Expt 3, conc = 0.02857 (or 0.0286 or 0.029) mol dm⁻³ <i>Both answers must be given to 2, 3 or 4 sig figs</i>	1	[5]
(iii)	Rate increases with (increase of) concentration	1	
(iv)	• Time is shorter for sulfuric acid • Sulfuric acid has a greater / doubled concentration of H⁺ ions.	1	
(v)	• time (for reaction) will be greater • less depth (of solution) in the 250 cm³	1	
Qn 2	[Total: 9]		
FA 6 is Na ₂ SO ₃ ; FA 7 is CaCl ₂ ; FA 8 is MgSO ₄ ; FA 9 is Al ₂ (SO ₄) ₃ ; FA 10 is MnSO ₄			
3 (a) (i)	Both observations required • white precipitate with Ba²⁺ ion • Precipitate dissolves / partially dissolves in (excess) HCl	1	
(ii)	Both observations required • white precipitate with Ba²⁺ ion • precipitate insoluble / no change with HCl	1	
(iii)	When heated, gas produced decolourises KMnO ₄ paper.	1	
(iv)	No change (when NaOH added)/no ppt/ no reaction and green (solution) formed when KMnO ₄ added	1	
	Colourless solution(with acid)	1	

Page 5	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – October/November 2015	9701	31

Question	Indicative material	Mark	Total																									
(v)	Anion is sulfite and <u>one</u> piece of evidence FA 6 with acid – SO₂/gas which decolourises KMnO₄ is formed or FA 6 with Ba²⁺ – white precipitate / BaSO₃ formed which dissolves in acid / partially soluble in acid	1																										
(vi)	Na ₂ SO ₃ + H ₂ O ₂ → Na ₂ SO ₄ + H ₂ O	1	[7]																									
(b) (i)	<table><tr><th></th><th>FA 7</th><th>FA 8</th><th>FA 9</th><th>FA 10</th></tr><tr><td>NaOH</td><td>white ppt</td><td>white ppt</td><td>white ppt</td><td>off-white / buff / beige / light brown ppt</td></tr><tr><td>excess NaOH</td><td>no change or insoluble in excess</td><td>no change or insoluble in excess</td><td>(ppt) dissolves or soluble in excess</td><td>insoluble in excess or ppt darkens (<i>owtte</i>)</td></tr><tr><td>NH₃</td><td>no ppt or no reaction</td><td>white ppt</td><td>white ppt</td><td>off-white / buff / beige / light brown ppt</td></tr><tr><td>excess NH₃</td><td>(<i>ignore</i>)</td><td>no change or insoluble in excess</td><td>no change or insoluble in excess</td><td>insoluble in excess or ppt darkens (<i>owtte</i>)</td></tr></table>		FA 7	FA 8	FA 9	FA 10	NaOH	white ppt	white ppt	white ppt	off-white / buff / beige / light brown ppt	excess NaOH	no change or insoluble in excess	no change or insoluble in excess	(ppt) dissolves or soluble in excess	insoluble in excess or ppt darkens (<i>owtte</i>)	NH ₃	no ppt or no reaction	white ppt	white ppt	off-white / buff / beige / light brown ppt	excess NH ₃	(<i>ignore</i>)	no change or insoluble in excess	no change or insoluble in excess	insoluble in excess or ppt darkens (<i>owtte</i>)	5	
	FA 7	FA 8	FA 9	FA 10																								
NaOH	white ppt	white ppt	white ppt	off-white / buff / beige / light brown ppt																								
excess NaOH	no change or insoluble in excess	no change or insoluble in excess	(ppt) dissolves or soluble in excess	insoluble in excess or ppt darkens (<i>owtte</i>)																								
NH ₃	no ppt or no reaction	white ppt	white ppt	off-white / buff / beige / light brown ppt																								
excess NH ₃	(<i>ignore</i>)	no change or insoluble in excess	no change or insoluble in excess	insoluble in excess or ppt darkens (<i>owtte</i>)																								
(ii)	Conclusions FA 7 – calcium / Ca²⁺ or barium/Ba²⁺ FA 8 – magnesium / Mg²⁺ FA 9 – aluminium / Al³⁺ FA 10 – manganese(II)/Mn²⁺ <i>Four correct = 2 marks</i> <i>Two or three correct = 1 mark</i>	2																										
(iii)	M ²⁺ + 2OH ⁻ → M(OH) ₂ (for any divalent cation) or M ³⁺ + 3OH ⁻ → M(OH) ₃ (for any trivalent cation)	1																										
(iv)	Use higher concentration	1	[9]																									
Qn 3	[Total: 16]																											

CAMBRIDGE INTERNATIONAL EXAMINATIONS

Cambridge International Advanced Subsidiary and Advanced Level

MARK SCHEME for the October/November 2015 series

9701 CHEMISTRY

9701/33

Paper 3 (Advanced Practical Skills 1), maximum raw mark 40

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	33

Question	Indicative material	Mark	Total
1 (a)	I Initial and final readings and titre recorded for rough titre and accurate titre details tabulated (<i>minimum</i> 2×2 'boxes')	1	
	II Headings and units correct for accurate titrations Headings: initial / final (burette) reading / volume or reading / volume at start / finish and titre or volume / FA 2 and added / used / titrated [not 'difference' or 'total'] and Units: (cm^3) or / cm^3 or in cm^3 [or cm^3 by every entry]	1	
	III All accurate burette readings are recorded to the nearest 0.05 cm^3 Do not award this mark if: 50(.00) is used as an initial burette reading; more than one final burette reading is 50(.00); any burette reading is greater than 50(.00) there is only one accurate titration	1	
	IV Has two uncorrected, accurate titres within 0.1 cm^3 Do not award this mark if having performed two titres within 0.1 cm^3 a further titration is performed which is more than 0.10 cm^3 from the closer of the initial two titres, unless any further titrations, within 0.1 cm^3 of any other titration have also been carried out. Do not award the mark if any 'accurate' burette readings (apart from initial 0) are given to zero dp.	1	
Examiner rounds any burette readings to the nearest 0.05 cm^3 , checks subtractions and then selects the 'best titres' using the hierarchy: - two (or more) accurate identical titres then - two (or more) accurate titres within 0.05 cm^3, then two (or more) accurate titres within 0.10 cm^3 , etc. These best titres should be used to calculate the mean corrected titre to the nearest 0.01 cm^3 . Examiner calculates the difference (δ) between the mean titres obtained by the candidate and the Supervisor. Accuracy marks awarded as shown.			
	Award V , VI and VII if $\delta \leq 0.30 \text{ cm}^3$	1	[7]
	Award V and VI if $0.30 < \delta \leq 0.50 \text{ cm}^3$	1	
	Award V if $0.50 < \delta \leq 0.80 \text{ cm}^3$. Spread penalty: if the two best titres used by the Examiner were $\geq 0.5 \text{ cm}^3$ apart, cancel one accuracy mark.	1	

Page 3	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – October/November 2015	9701	33

Question	Indicative material	Mark	Total
(b)	Candidate must average two (or more) accurate 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. <i>The mean should normally be quoted to 2 decimal places rounded to the nearest 0.01.</i> <i>Two special cases where the mean may not be to 2 dp: allow mean to 3 dp only for 0.025 or 0.075, e.g. 26.325; allow mean to 1 dp if all accurate burette readings were given to 1 dp and the mean is exactly correct. e.g. 26.0 and $26.2 = 26.1$ is correct but 26.0 and $26.1 = 26.1$ is incorrect.</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.	1	[1]
(c) (i)	Correctly calculates moles = (b) $\times 0.1 / 1000$ and answer to 3 or 4 significant figures	1	
(ii)	Same as (c)(i)	1	
(iii)	Shows correct use of either factor of 40 (1000/25) or mole ratio Answer consistent with data shown to 3 or 4 sf $M_r = 26.2 / ((\text{c})(\text{ii}) \times 40)$	1 1	
(iv)	$x = (M_r - 159.6) / 18$ Answer to nearest positive integer with use of either 159.6 or 18 and some use of experimental data.	1 1	[6]
Qn 1		Total	[14]

Page 4	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – October/November 2015	9701	33

Question	Indicative material	Mark	Total
2 (a)	I Mass of FA 4 used by candidate was between 1.80 g and 2.00 g II Suitable table, with unambiguous headings and correct units, in parallel columns or rows and a minimum of four balance readings entered • mass crucible / g (not weight) • mass crucible + FA 4 (g) • mass crucible + contents / FA 4 after heating in g • mass crucible + contents / FA 4 after 2nd / further heating / g III All balance readings (minimum 3) recorded to same dp and mass of FA 4 used and water lost correctly calculated IV Heating repeated until constant mass (final readings within 0.05 g for 2 dp balance and identical for 1 dp balance) V and VI Examiner calculates and writes % next to table Calculate $\frac{\text{total mass water lost} \times 100}{\text{mass FA 4}}$ to 1 dp Award V if % loss in range 12.8 to 16.8 Award VI if % loss in range 13.8 to 15.8	1 1 1 1 1 1	[6]
(b) (i)	Correctly calculated loss in mass / mass FA 4 to 2 – 4 sf	1	
(ii)	Correctly calculates % loss = $36 \times 100 / 147.1$	1	
(iii)	% purity = $\frac{(i) \times 100}{(ii)}$	1	[3]
(c)	(Yes) because a greater mass used and so percentage error in weighing less. or (No) because there is more water to be lost so more spitting and frothing so percentage error in mass lost will be greater	1	[1]
(d)	Greater loss of mass therefore apparent % purity is high(er) / the value / it would increase	1	[1]
Qn 2		Total	[11]

Page 5	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – October/November 2015	9701	33

Question	Indicative material	Mark	Total																
FA 5 is Na ₂ CO ₃ (aq); FA 6 is H ₂ SO ₄ (aq); FA 7 is CH ₃ COOH(aq); FA 8 is MnSO ₄ (s) and MgCO ₃ (s)																			
3 (a) (i)	See table	4																	
	<table> <tr> <th></th><th>FA 5</th><th>FA 6</th><th>FA 7</th></tr> <tr> <td>+ Na₂CO₃</td><td>no reaction</td><td>effervescence / bubbling / fizzing or gas turns limewater milky / cloudy white / white ppt</td><td>effervescence / bubbling / fizzing or gas turns limewater milky / cloudy white / white ppt</td></tr> <tr> <td>+ CuSO₄</td><td>blue ppt (not dark blue)</td><td>no reaction / no change / no ppt / pale or light blue (solution) (not '–' or 'no observation')</td><td>no reaction / no change / no ppt / pale or light blue (solution) (not '–' or 'no observation')</td></tr> <tr> <td>+ BaCl₂ / Ba(NO₃)₂</td><td>white ppt</td><td>white ppt</td><td>no reaction / no change / no ppt</td></tr> </table>		FA 5	FA 6	FA 7	+ Na ₂ CO ₃	no reaction	effervescence / bubbling / fizzing or gas turns limewater milky / cloudy white / white ppt	effervescence / bubbling / fizzing or gas turns limewater milky / cloudy white / white ppt	+ CuSO ₄	blue ppt (not dark blue)	no reaction / no change / no ppt / pale or light blue (solution) (not '–' or 'no observation')	no reaction / no change / no ppt / pale or light blue (solution) (not '–' or 'no observation')	+ BaCl ₂ / Ba(NO ₃) ₂	white ppt	white ppt	no reaction / no change / no ppt		
	FA 5	FA 6	FA 7																
+ Na ₂ CO ₃	no reaction	effervescence / bubbling / fizzing or gas turns limewater milky / cloudy white / white ppt	effervescence / bubbling / fizzing or gas turns limewater milky / cloudy white / white ppt																
+ CuSO ₄	blue ppt (not dark blue)	no reaction / no change / no ppt / pale or light blue (solution) (not '–' or 'no observation')	no reaction / no change / no ppt / pale or light blue (solution) (not '–' or 'no observation')																
+ BaCl ₂ / Ba(NO ₃) ₂	white ppt	white ppt	no reaction / no change / no ppt																
(ii)	H ⁺ / hydrogen ion	1																	
(iii)	CO ₃ ²⁻ / carbonate	1																	
(iv)	Cu ²⁺ (aq) + CO ₃ ²⁻ (aq) → CuCO ₃ (s)	1	[7]																

Page 6	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – October/November 2015	9701	33

(b)	(i)	+ NaOH: off white / buff / beige / pale or light brown (not cream) ppt and either darkens on standing or insoluble in excess	1	
		+ H ₂ O ₂ : (turns) brown / darker brown / brown-black (not black)	1	
		fizzing / effervescence / bubbling or gas relights glowing splint	1	
	(ii)	+ HNO ₃ : fizzing / effervescence / bubbling or limewater turns milky / cloudy white / white ppt	1	
		+ NaOH: White ppt and insoluble in excess	1	
	(iii)	Mn ²⁺ / manganese(II) and Mg ²⁺ / magnesium	1	
	(iv)	CO ₃ ²⁻ / carbonate	1	
	(v)	Redox / decomposition of H ₂ O ₂ / disproportionation allow oxidation of Mn ²⁺ / oxidation or reduction of H ₂ O ₂	1	[8]
Qn 3		Total	[15]	

CAMBRIDGE INTERNATIONAL EXAMINATIONS

Cambridge International Advanced Subsidiary and Advanced Level

MARK SCHEME for the October/November 2015 series

9701 CHEMISTRY

9701/34

Paper 3 (Advanced Practical Skills 2),
maximum raw mark 40

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	34

Question	Indicative material	Mark	Total
1 (a)	I The following readings are recorded • mass of Mg used • two burette readings and the titre for the rough titration • initial and final burette readings for two (or more) accurate titrations	1	
	II Titre values recorded for accurate titrations and appropriate headings for the accurate titration table and cm³ units. • initial / start (burette) reading / volume • final / end (burette) reading / volume • titre or volume / FB 2 and used / added (<i>not</i> “difference” or “total”) • unit: / cm³ or (cm³) or in cm³ (for each heading) <i>If cm³ units are not given in the headings, every entry in the table must have the correct unit.</i>	1	
	III All accurate burette readings are to the nearest 0.05 cm³. <i>Do not award this mark if:</i> • 50(.00) is used as an initial burette reading • more than one final burette reading is 50.(00) • any burette reading is greater than 50.(00) • there is only one accurate titration.	1	
	IV There are two uncorrected accurate titres within 0.10 cm³ • <i>Do not award this mark if, having performed two titres within 0.10 cm³, a further titration is performed which is more than 0.10 cm³ from the closer of the initial two titres, unless a further titration, within 0.10 cm³ of any other, has also been carried out.</i> • <i>Do not award the mark if any “accurate” burette readings (apart from initial 0 cm³) are given to zero dp</i>	1	
	Examiner checks and corrects titre subtractions where necessary. Examiner selects the best titres using the hierarchy: • two (or more) accurate identical titres <i>then</i> • two (or more) accurate titres within 0.05 cm³, <i>then</i> two (or more) accurate titres within 0.10 cm³, <i>etc.</i> These best titres are used to calculate the mean titre, expressed to nearest 0.01 cm³. Examiner calculates the difference (δ) between the mean titres obtained by the candidate and the Supervisor. Accuracy marks are awarded as shown.		

Page 3	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – October/November 2015	9701	34

Question	Indicative material	Mark	Total
	Award V, VI and VII if $\delta \leq 0.50 \text{ cm}^3$ Award V and VI if $0.50 < \delta \leq 1.00 \text{ cm}^3$ Award V, only, if $1.00 < \delta \leq 1.50 \text{ cm}^3$ Spread penalty: if the two “best” (corrected) titres used by the Examiner were $\geq 0.50 \text{ cm}^3$ apart, cancel one accuracy mark.	3	[7]
(b)	Candidate must take the average of two (or more) titres that are within a total spread of not more than 0.20 cm^3. Working / explanation 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 decimal places rounded to nearest 0.01 cm^3. <i>Two special cases where the mean may not be to 2 dp: allow mean to 3 dp only for 0.025 or 0.075, e.g. 26.325; allow mean to 1 dp if all accurate burette readings were given to 1 dp and the mean is exactly correct. e.g. 26.0 and $26.2 = 26.1$ is correct but 26.0 and $26.1 = 26.1$ is incorrect.</i> Note: the candidate's mean will sometimes be marked correct even if it was different from the mean calculated by the Examiner for the purpose of assessing accuracy.	1	[1]
(c) (i)	mol NaOH = $0.120 \times \frac{25.0}{1000} = 0.003(00)$	1	
(ii)	- NaOH + HCl $\rightarrow$ NaCl + H₂O - Answer to (ii) must be the same as in (i)	1	
(iii) + (iv)	Correct expressions required in both (iii) and (iv) <i>(Correct expression = correct figures shown)</i> (iii) : no moles of HCl (in 250 cm^3) = (ii) $\times \frac{250}{(b)}$ (iv) : no moles of HCl (in 25.0 cm^3) = $2.00 \times \frac{25.0}{1000}$ (= 0.05)	1	
(v)	Correct expression: Mol HCl used = (iv) – (iii)	1	
(vi)	Equation and correctly calculates answer for number of moles Mg: $\text{Mg(s)} + 2\text{HCl(aq)} \rightarrow \text{MgCl}_2\text{(aq)} + \text{H}_2\text{(g)}$ - No of moles Mg = $0.5 \times \text{(v)}$	1	
(vii)	$A_r = \frac{\text{mass of Mg used}}{\text{(vi)}}$	1	[6]
(d) (i)	<u>All</u> solid / magnesium dissolved / disappeared / reacted (owtte) or indicator turned from blue to yellow when FB 2 added (to alkali)	1	
(ii)	(If 1.0 g Mg is used) Mg would be in excess / acid would be the limiting reagent / all the acid would be used up	1	

Page 4	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – October/November 2015	9701	34

Question	Indicative material	Mark	Total
	Reference to moles of both acid and Mg (or other correct calculation) Calculation to show that Mg would be in excess $n(\text{Mg}) = \frac{1}{24.3} = 0.041 \text{ mol}$ (allow $\frac{1}{24}$ or $\frac{1}{(c)(vii)}$) $n(\text{HCl})$ needed = 0.082 mol or only 0.05 mol present	1	
Qn 1		Total	[17]

Page 5	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – October/November 2015	9701	34

Question	Indicative material	Mark	Total
2 (a)	I Table/list of data, showing the following: - five unambiguous/clear headings <i>accept 'mass of ...' or '.../g' (not 'weight')</i> <i>accept "mass of crucible + FB 4 after heating"</i> <i>ignore omission of the crucible lid</i> - three balance readings, with unit shown at least once - mass of water (or mass lost) - mass of residue (<i>owtte</i>) - all calculations must be correct <i>All data must be written in the space provided</i>	1	
	Examiner should check calculations of masses of water and anhydrous MgSO_4. Examiner calculates the ratio $\frac{\text{mass of water lost}}{\text{mass of residue}}$ to 2 dp The theoretical value is 1.0465...Marks awarded for accuracy as shown.		
	Award II if the ratio is between 0.80 and 1.15 (inclusive) Award III if the ratio is between 0.95 and 1.10	2	[3]
(b) (i)	Correctly calculates to 2 – 4 sf Number of moles = $\frac{\text{mass loss}}{18}$	1	
(ii)	Correctly calculates to 2 – 4 sf Number of moles of anhydrous $\text{MgSO}_4 = \frac{(\text{i})}{7}$	1	
(iii)	Working/ expression for M_r and answer of the correct magnitude given to 2 – 4 sf $M_r = \frac{\text{mass of residue}}{(\text{ii})}$	1	
(iv)	Correctly calculates relative atomic mass: $A_r = (\text{iii}) - 96.1$	1	[4]
(c) (i)	Reheat solid /residue to constant mass .	1	
(ii)	To prevent absorption of water (vapour)	1	[2]
Qn 2		Total	[9]

Page 6	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – October/November 2015	9701	34

Question	Indicative material	Mark	Total
FB 5 is $\text{MgCl}_2(\text{aq})$; FB 6 is $\text{Zn}(\text{NO}_3)_2(\text{s})$			
3 (a)	Two reagents needed - sodium hydroxide - barium chloride / barium nitrate	1	[4]
	Observations: NaOH – white precipitate, insoluble in excess	1	
	Barium ions – no precipitate / no change / no reaction	1	
	Conclusions: Mg^{2+} / magnesium (ion) is present and SO_4^{2-} / sulfate (ion) is not present	1	
(b) (i)	Heating FB 6 : look for the following nine observations (on gentle heating) solid melts / dissolves / turns to liquid / solution - liquid is colourless - bubbling / fizzing / effervescence / boiling - steam / (water) vapour given off / misty fumes / condensation formed (when strongly heated), brown gas / fumes - yellow solid / residue formed (gas) relights a glowing splint - gas turns (blue) litmus red (ignore bleaching) - white / cream / paler (yellow) solid / residue Award marks as shown. 5 observations correct = 4 marks 4 observations correct = 3 marks 3 observations correct = 2 marks 2 observations correct = 1 mark	4	

Page 7	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – October/November 2015	9701	34

Question	Indicative material	Mark	Total
(ii)	Observations with AgNO_3 and H_2SO_4 No reaction/no change in both	1	
	With NH_3 – white precipitate soluble in excess	1	
	With cold NaOH – white precipitate soluble in excess	1	
	With hot NaOH – no reaction/no gas produced/(gas) did not turn red litmus blue	1	
	With $\text{NaOH} + \text{Al}$ (gas) turns (damp red) litmus blue	1	
(iii)	Identification – FB 6 is $\text{Zn}(\text{NO}_3)_2$	1	[10]
Qn 3	Total		[14]

CAMBRIDGE INTERNATIONAL EXAMINATIONS

Cambridge International Advanced Subsidiary and Advanced Level

MARK SCHEME for the October/November 2015 series

9701 CHEMISTRY

9701/35

Paper 3 (Advanced Practical Skills 1),
maximum raw mark 40

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	35

Question	Indicative material	Mark	Total
1 (a)	I Initial and final readings and titre value given for rough titre and initial and final readings for two (or more) accurate titrations (<i>minimum of 2 × 2 box</i>)	1	
	II Titre values recorded for accurate titrations and Appropriate headings for the accurate titration table and cm ³ units. - initial / start burette reading / volume / value - final / end burette reading / volume / value (<i>not amount</i>) - titre or volume / FA 4 and used / added - unit: /cm³ or (cm³) or in cm³ (for each heading)	1	
	III All accurate burette readings are to the nearest 0.05 cm ³ . Do not award this mark if: 50(.00) is used as an initial burette reading - more than one final burette reading is 50.(00) - any burette reading is greater than 50.(00) - there is only one accurate titration.	1	
	IV There are two uncorrected accurate titres within 0.10 cm ³ - Do not award this mark if, having performed two titres within 0.10 cm³, a further titration is performed which is more than 0.10 cm³ from the closer of the initial two titres, unless a further titration, within 0.10 cm³ of any other, has also been carried out. - Do not award the mark if any “accurate” burette readings (apart from initial 0 cm³) are given to zero dp	1	
	Examiner rounds any burette readings to the nearest 0.05 cm³, checks subtractions and then selects the “best” titres using the hierarchy: - two (or more) accurate identical titres, <i>then</i> - two (or more) accurate titres within 0.05 cm³, <i>then</i> - two (or more) accurate titres within 0.10 cm³, <i>etc</i> These best titres are used to calculate the mean titre, expressed to nearest 0.01 cm³. Examiner calculates the difference (δ) between the mean titres obtained by the candidate and the Supervisor. Accuracy marks are awarded as shown. Award V, VI and VII if δ ≤ 0.20 (cm³) Award V and VI if 0.20 < δ ≤ 0.30 Award V, only, if 0.30 < δ ≤ 0.50 Spread penalty: if the two “best” (corrected) titres used by the Examiner were ≥ 0.50 cm³ apart, cancel one accuracy mark.	3	[7]

Page 3	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – October/November 2015	9701	35

Question	Indicative material	Mark	Total
(b)	Candidate must take the average of two (or more) titres that are within a total spread of not more than 0.20 cm³. Working / explanation must be shown or ticks must be put next to the two (or more) accurate readings selected. The mean should be quoted to 2 dp, and be rounded to nearest 0.01 cm³. Two special cases, where the mean need not be to 2 dp: - Allow mean expressed to 3 dp only for 0.025 or 0.075 (e.g. 26.325 cm³) - Allow mean if expressed to 1 dp, if all accurate burette readings were given to 1 dp and the mean is exactly correct. (e.g. 26.0 and 26.2 = 26.1 is allowed) (e.g. 26.0 and 26.1 = 26.1 is wrong – should be 26.05) Note: the candidate's mean will sometimes be marked correct even if it was different from the mean calculated by the Examiner for the purpose of assessing accuracy.	1	[1]
(c)(i)(ii)	Correctly calculates $n(\text{thio}) = 0.10 \times (\text{b}) / 1000$ $n(\text{I}_2) = 0.5 \times (\text{i})$ Both answers must be given to 3 or 4 significant figures	1	[5]
(iii)	Correctly calculates $n(\text{KMnO}_4) = 0.025 \times 0.018 = 0.00045 \text{ or } 0.000450 \text{ or } 0.0004500$	1	
(iv)	Correct expression, with answer given to 2, 3 or 4 sig fig $n(\text{I}_2) = (\text{ii}) / (\text{iii}) \times 2$ Theoretical answer = 5.0 (for 2.0 mol KMnO₄)	1	
(v)	Correct equation ticked, corresponding to (iv)	1	
(vi)	Allow any one of the following answers: An iodide ion loses one electron $2\text{I}^- - 2\text{e}^- \rightarrow \text{I}_2$ (ionic equation must be correctly balanced) - Oxidation number of iodine increases from –1/ 1– (in iodide ion) to 0 (in iodine)	1	
(d) (i)	$\% \text{ error} = \frac{0.06}{25} \times 100 = 0.24 \%$	1	[2]
(ii)	The student is wrong, since KI / FA 3 is in excess .	1	
Qn 1	[Total: 15]		
2 (a)	I Table for readings, headings and correct units: Headings: - volume of FA 5 / acid (volume of water – if included must be correct) - Time Units allow Vol or /cm³ etc.	1	

Page 4	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – October/November 2015	9701	35

Question	Indicative material	Mark	Total
	II Three reaction times all recorded to nearest second	1	[4]
	III and IV Examiner to calculate the time differences between Expt 1 and Expt 2 ($t_2 - t_1$). Then calculate 10% of the time for Expt 1 to 1dp (x). If ($t_2 - t_1$).> x award III . Examiner to calculate the time differences between Expt 2 and Expt 3 ($t_3 - t_2$). Then calculate 20% of the time for Expt 2 to 1dp (y). If ($t_3 - t_2$).> y award IV .	2	
(b) (i)	• Rates correctly calculated • All answers expressed to same sig fig (but not 1 sf) • Unit given.... / s⁻¹ or (s⁻¹)	1	[5]
(ii)	Correctly calculates • Expt 1, conc = 0.08571 (or 0.0857 or 0.086) mol dm⁻³ and • Expt 3, conc = 0.02857 (or 0.0286 or 0.029) mol dm⁻³ <i>Both answers must be given to 2, 3 or 4 sig figs</i>	1	
(iii)	Rate increases with (increase of) concentration	1	
(iv)	• Time is shorter for sulfuric acid • Sulfuric acid has a greater / doubled concentration of H⁺ ions.	1	
(v)	• time (for reaction) will be greater • less depth (of solution) in the 250 cm³	1	
Qn 2	[Total: 9]		
FA 6 is Na ₂ SO ₃ ; FA 7 is CaCl ₂ ; FA 8 is MgSO ₄ ; FA 9 is Al ₂ (SO ₄) ₃ ; FA 10 is MnSO ₄			
3 (a) (i)	Both observations required • white precipitate with Ba²⁺ ion • Precipitate dissolves / partially dissolves in (excess) HCl	1	
(ii)	Both observations required • white precipitate with Ba²⁺ ion • precipitate insoluble / no change with HCl	1	
(iii)	When heated, gas produced decolourises KMnO ₄ paper.	1	
(iv)	No change (when NaOH added)/no ppt/ no reaction and green (solution) formed when KMnO ₄ added	1	
	Colourless solution(with acid)	1	

Page 5	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – October/November 2015	9701	35

Question	Indicative material	Mark	Total																									
(v)	Anion is sulfite and <u>one</u> piece of evidence FA 6 with acid – SO₂/gas which decolourises KMnO₄ is formed or FA 6 with Ba²⁺ – white precipitate / BaSO₃ formed which dissolves in acid / partially soluble in acid	1																										
(vi)	Na ₂ SO ₃ + H ₂ O ₂ → Na ₂ SO ₄ + H ₂ O	1	[7]																									
(b) (i)	<table><tr><td></td><td>FA 7</td><td>FA 8</td><td>FA 9</td><td>FA 10</td></tr><tr><td>NaOH</td><td>white ppt</td><td>white ppt</td><td>white ppt</td><td>off-white / buff / beige / light brown ppt</td></tr><tr><td>excess NaOH</td><td>no change or insoluble in excess</td><td>no change or insoluble in excess</td><td>(ppt) dissolves or soluble in excess</td><td>insoluble in excess or ppt darkens (<i>owtte</i>)</td></tr><tr><td>NH₃</td><td>no ppt or no reaction</td><td>white ppt</td><td>white ppt</td><td>off-white / buff / beige / light brown ppt</td></tr><tr><td>excess NH₃</td><td>(<i>ignore</i>)</td><td>no change or insoluble in excess</td><td>no change or insoluble in excess</td><td>insoluble in excess or ppt darkens (<i>owtte</i>)</td></tr></table>		FA 7	FA 8	FA 9	FA 10	NaOH	white ppt	white ppt	white ppt	off-white / buff / beige / light brown ppt	excess NaOH	no change or insoluble in excess	no change or insoluble in excess	(ppt) dissolves or soluble in excess	insoluble in excess or ppt darkens (<i>owtte</i>)	NH ₃	no ppt or no reaction	white ppt	white ppt	off-white / buff / beige / light brown ppt	excess NH ₃	(<i>ignore</i>)	no change or insoluble in excess	no change or insoluble in excess	insoluble in excess or ppt darkens (<i>owtte</i>)	5	
	FA 7	FA 8	FA 9	FA 10																								
NaOH	white ppt	white ppt	white ppt	off-white / buff / beige / light brown ppt																								
excess NaOH	no change or insoluble in excess	no change or insoluble in excess	(ppt) dissolves or soluble in excess	insoluble in excess or ppt darkens (<i>owtte</i>)																								
NH ₃	no ppt or no reaction	white ppt	white ppt	off-white / buff / beige / light brown ppt																								
excess NH ₃	(<i>ignore</i>)	no change or insoluble in excess	no change or insoluble in excess	insoluble in excess or ppt darkens (<i>owtte</i>)																								
(ii)	Conclusions FA 7 – calcium / Ca²⁺ or barium/Ba²⁺ FA 8 – magnesium / Mg²⁺ FA 9 – aluminium / Al³⁺ FA 10 – manganese(II)/Mn²⁺ <i>Four correct = 2 marks</i> <i>Two or three correct = 1 mark</i>	2																										
(iii)	M ²⁺ + 2OH [–] → M(OH) ₂ (for any divalent cation) or M ³⁺ + 3OH [–] → M(OH) ₃ (for any trivalent cation)	1																										
(iv)	Use higher concentration	1	[9]																									
Qn 3	[Total: 16]																											

CAMBRIDGE INTERNATIONAL EXAMINATIONS

Cambridge International Advanced Subsidiary and Advanced Level

MARK SCHEME for the October/November 2015 series

9701 CHEMISTRY

9701/36

Paper 3 (Advanced Practical Skills 2),
maximum raw mark 40

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	36

Question	Indicative material	Mark	Total
1 (a)	I Constructs a single table for 6 results. II Correct headings and units. Volumes/V/vol in cm³ or /cm³ or (cm³), time/t in seconds or /s or (s). III All times recorded to the nearest second and all volumes to 0.05 cm³. IV Four further experiments chosen with intervals not less than 2 cm³ and no volume less than 6 cm³. At least one volume must be less than 10 cm³ and at least one must be more than 10 cm³. V Water added to make total volume of FB 1 and water 20 cm³ in each experiment and no other changes in volume. VI Times increase with decrease in volume FB 1. VII and VIII Examiner rounds times to nearest second and calculates (time for expt 2)/(time for expt 1) to 2 dp. Ratio is compared with that of Supervisor. Award marks as follows: VI if ratio within 0.2 of Supervisor. VII if ratio within 0.1 of Supervisor.	1 1 1 1 1 1 1 1	[8]
(b)	(i) number of moles S₂O₃²⁻ = 1.2 × 10⁻⁴ (ii) Correctly calculates answer to (i) / 2 = 0.6 × 10⁻⁴ and (iii) answer to (ii) × 2 = 1.2 × 10⁻⁴. (iv) Correct expression $\frac{1.2 \times 10^{-4}}{0.06} = 2.(0) \times 10^{-3}$ (v) Rates correctly calculated using $\frac{(\text{c})(\text{iv}) \times 10^6}{t}$ Units for rate given as mol dm⁻³ s⁻¹ and 3 correct columns used.	1 1 1 1 1	[5]
(c)	I Axes labelled – rate on y-axis and volume or FB 1 / cm³ on x-axis II Uniform scales to use at least half of each axis including 0,0 if point plotted. III Correct plotting – all points recorded plotted and within half a small square and within correct small square.	1 1 1	

Page 3	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – October/November 2015	9701	36

	IV Draws a line of best fit. (can be straight line or curve). <i>Straight lines must be straight (single line with no kinks, drawn using a ruler) or a smooth curve (gradual change in gradient). Points not on the line must be balanced on either side of the best fit line but any points ringed or labelled as anomalous should be ignored.</i>	1	[4]
(d)	Rate increases as concentration of Fe^{3+} increases Comment on graph as drawn. <i>Possible comments include:</i> <i>The results are consistent since all points are on/near the line.</i> <i>An anomalous point is present/or not present.</i> <i>Would have expected graph to go through 0,0.</i> <i>Straight line shows rate proportional to conc/vol</i>	1 1	[2]
(e)	Alter volume of FB 2 /KI whilst keeping other volume of FB 1 / FeCl_3 constant Add water to keep total volume constant	1 1	[2]
(f)	Modification 1 Reaction time less. (Less accurate since) larger % error (in time). Modification 2 Reaction time stays the same (Less accurate since) greater % error in volume.	1 1 1 1	[4]
(g)	(i) Experiment with shortest reaction time (ii) Correct expression $\frac{0.5 \times 100\%}{\text{smallest reaction time}}$	1 1	[2]
[Total: 27]			

Page 4	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – October/November 2015	9701	36

FB 4 $\text{Cu}(\text{NH}_4)_2(\text{SO}_4)_2 \cdot 6\text{H}_2\text{O}$, **FB 5** $\text{Fe}(\text{NH}_4)(\text{SO}_4)_2 \cdot 6\text{H}_2\text{O}$, **FB 6** $\text{C}_6\text{H}_{12}\text{O}_6$

2 (a) (i)	FB 4	FB 5	1	
	colour to dark(er)/deep blue	no change/no reaction.	1	
	brown (solution) (+ off-white/beige ppt)	no reaction/no change/no ppt		
	blue ppt. insol. in excess	green ppt. insol in excess/ goes brown		
	blue ppt. soluble in excess to give dark blue solution	green ppt. insol in excess/ goes brown	1	
	white ppt. and insol in HCl/no change	white ppt and insol in HCl/no change	1	
			1	[5]
(ii)	Anion present in both is SO_4^{2-} / sulfate and FB 4 Cu^{2+} / copper(II) and FB 5 Fe^{2+} /iron(II)		1	[1]
(iii)	Heat with (aqueous) sodium hydroxide. Ammonia/gas given off that turns litmus blue		1	
	Cation is NH_4^+ / ammonium		1	[2]
(b) (i)	Manganate (VII) changes from purple to colourless.		1	
	Silver colour/grey ppt/black ppt/silver mirror		1	[2]
(ii)	Aldehyde and/or ketone (both needed)/ carbonyl compound/functional group is C=O .		1	[1]
(iii)	Aldehyde		1	[1]
(iv)	+1 to 0		1	[1]
[Total: 13]				