

MARK SCHEME for the May/June 2014 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.

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Page 2	Mark Scheme	Syllabus	Paper
	GCE AS/A LEVEL – May/June 2014	9701	31

Question	Sections	Indicative material	Mark	Total
1 (a)	PDO Layout	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	
	PDO Recording	II Appropriate headings and units for all accurate data. and volume FA 1 added recorded for each accurate titre. <i>Headings should match readings.</i> - initial/start (burette) reading/volume - final/end (burette) reading/volume - titre or volume/FA 1 used/added (not “difference”) unit: /cm³ or (cm³) or in cm³ or cm³ for each entry	1	
		III All accurate burette readings recorded to 0.05 cm ³ . <i>The need to record to 0.05 applies only to the burette readings and not to the recorded titres.</i> <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).	1	
	MMO Decisions	IV Has two uncorrected, accurate titres within 0.1 cm ³ <i>Do not include a reading labelled ‘rough’.</i> <i>Do not award this mark if, having performed two titres within 0.1 cm³, a further titration is performed that is more than 0.1 cm³ from the closer of the two initial titres unless further titrations within 0.1 cm³ of any other have also been carried out.</i> <i>Do not award the mark if any ‘accurate’ burette readings (apart from initial 0) are given to zero dp.</i>	1	
Examiner rounds burette readings to the nearest 0.05 cm³, checks subtractions and then selects the ‘best’ titres using the hierarchy: two (or more) identical, then two (or more) within 0.05 cm³, then two (or more) within 0.1 cm³, etc. Examiner compares candidate mean titre with Supervisor mean titre.				
(a)	MMO Quality	Award V and VI for difference from Supervisor, $\delta \leq 0.20 \text{ cm}^3$ Award V only for $0.20 < \delta \leq 0.40 \text{ cm}^3$ <i>Spread penalty: if the two ‘best’ titres are $\geq 0.50 \text{ cm}^3$ apart cancel one of the Q marks.</i>	2	[6]

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Question	Sections	Indicative material	Mark	Total
2 (a)	PDO Recording	I Table to include • volume of hydrogen peroxide/FA 2, • volume of potassium iodide/FA 4, • volume of distilled water, • reaction time. volume/V in cm³/cm³/ (cm³), time/t in seconds//s/(s). (Minimum 2 expts recorded)	1	[6]
		II All times recorded to the nearest second. (Minimum 2 expts)	1	
	ACE Interpretation	III Correctly calculates all three rates (allow to 2 or 3 sf) Compare times for Expts 1 and 3 with those of the Supervisor.	1	
	MMO Quality	Award IV , V and VI for both times within 3 s Award IV and V for one within 3 s and one within 6 s Award IV only for either within 6 s (If only 2 expts carried out IV is available – from either expt performed)	3	
(b)	ACE Conclusion	Rate increases with increasing concentration of hydrogen peroxide and potassium iodide (ora). Allow ecf from candidate's results.	1	[1]
(c)	MMO Decisions	Selects different volumes of FA 4 (less than 20 cm ³ , not 10 cm ³ and not closer than 2 cm ³ to suggested volumes or to 20 cm ³ or to 10 cm ³)	1	[2]
		Volumes of distilled water selected so that vol of water + vol of FA 4 = 20 cm ³ and FA 2 = 20 cm ³ If FA 3 and FA 5 are shown then the volumes must be constant.	1	
(d)	ACE Improvements	Reason: change of temperature Use water bath to maintain constant temperature	1	[2]
		Reason: decomposition of hydrogen peroxide Store H ₂ O ₂ (aq) in the fridge, make up fresh H ₂ O ₂ (aq), check conc. of H ₂ O ₂ (aq), keep H ₂ O ₂ (aq) in dark/dim light.	1	
(e) (i)	ACE Interpretation	Expression $\frac{1}{\text{time from Expt 1}} \times 100$ or correct value.	1	[2]
		(Higher conc. of thiosulfate means) greater reaction time (allow reaction will be slower) and so a smaller percentage error.	1	
Qn 2	Total			[13]

Page 5	Mark Scheme	Syllabus	Paper
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Question	Sections	Indicative material	Mark	Total
FA 6 is ZnSO ₄ (aq) and NaBr(aq); FA 7 is FeSO ₄ (aq)				
3 (a)	(i)	MMO Decisions	I Selects NaOH(aq) and NH ₃ (aq), and uses each in excess	1
		PDO Layout	II Unambiguous layout of all 4 observations (excess must be stated).	1
		MMO Collection	III White ppt with NaOH and soluble in excess.	1
			IV White ppt with NH ₃ soluble in excess.	1
		ACE Conclusion	V Zn ²⁺	1
	(ii)	MMO Collection	VI Cream ppt with AgNO ₃ and partially sol / insol in NH ₃	1
			VII White ppt with BaCl ₂ /Ba(NO ₃) ₂ and insol in nitric acid.	1
		ACE Conclusion	VIII Br ⁻	1
			IX SO ₄ ²⁻	1
				[9]
(b)	(i)	MMO Collection	I Green ppt turning brown (in contact with air)	1
	(ii)		II No reaction/no change or yellow or green solution	1
	(iii)		III Red-brown/brown/green-brown ppt and effervescence	1
			IV Gas relights a glowing splint	1
	(iv)	ACE Conclusion	V Redox	1
	(v)		VI Decomposition of hydrogen peroxide to give oxygen or ppt is Fe(OH) ₃ / oxidation of Fe ²⁺ to Fe ³⁺	1
				[6]
Qn 3	Total		[15]	

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Question	Sections	Indicative material	Mark	Total
1 (a)	PDO Layout	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	
	PDO Recording	II Appropriate headings and units for all accurate data. and volume FB 1 added recorded for each accurate titre. <i>Headings should match readings.</i> - initial/start (burette) reading/volume - final/end (burette) reading/volume - titre or volume/FB 1 used/added (not “difference”) unit: /cm³ or (cm³) or in cm³ or cm³ for each entry	1	
		III All accurate burette readings recorded to 0.05 cm ³ . <i>The need to record to 0.05 applies only to the burette readings and not to the recorded titres.</i> <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).	1	
	MMO Decisions	IV Has two uncorrected, accurate titres within 0.1 cm ³ . <i>Do not include a reading labelled ‘rough’.</i> <i>Do not award this mark if, having performed two titres within 0.1 cm³, a further titration is performed that is more than 0.1 cm³ from the closer of the two initial titres unless further titrations within 0.1 cm³ of any other have also been carried out.</i> <i>Do not award the mark if any ‘accurate’ burette readings (apart from initial 0) are given to zero dp.</i>	1	
All burette readings should be rounded to the nearest 0.05 cm³. Subtractions should be checked. The ‘best’ titres should be selected using the hierarchy: two (or more) identical, then two (or more) within 0.05 cm³, then two (or more) within 0.1 cm³, etc. Examiner compares candidate mean titre with Supervisor mean titre.				
(a)	MMO Quality	V, VI and VII Award V, VI and VII for a difference from Supervisor, $\delta \leq 0.20 \text{ cm}^3$ Award V and VI for $0.20 < \delta \leq 0.30 \text{ cm}^3$ Award V only for $0.30 < \delta \leq 0.50 \text{ cm}^3$ <i>Spread penalty: if the two ‘best’ titres are $\geq 0.50 \text{ cm}^3$ apart cancel one of the Q marks.</i>	3	[7]

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Question	Sections	Indicative material	Mark	Total
(b)	MMO Decisions	Candidate must average two (or more) titres that are within 0.20 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 dp 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> <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)	ACE Interpretation	I Correctly calculates $\frac{(b) \times 0.100}{1000}$ in (i) and gives ans (i) $\times 40$ in (iii) (both answers to 3 or 4 sf)	1	
	PDO Display	II Gives correct equation in (ii) $\text{H}^+ + \text{HCO}_3^- \rightarrow \text{H}_2\text{O} + \text{CO}_2$ (allow H_2CO_3)	1	[2]
Qn 1	Total		10	

Page 4	Mark Scheme	Syllabus	Paper
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Question	Sections	Indicative material	Mark	Total
2 (a)	PDO Display	I Shows clearly mass of empty crucible, mass of crucible + FB 3 , mass of crucible and residue with correct units. (mass/g or (g) or in g)	1	[4]
	Recording	II Records all weighings consistently to at least 1 dp and records the correctly calculated mass of FB 3 used and water lost. <i>Units must be correct and headings must be unambiguous.</i>	1	
	MMO Quality	Calculate mass of water lost/mass of FB 3 to 2 dp and compare with Supervisor value. Award III and IV if $\delta \leq 0.05$ Award IV only if $0.05 < \delta \leq 0.08$	2	
(b) (i)	ACE Interpretation	I $\frac{\text{mass water lost}}{18}$ (expression) or correct moles of water Final answer must be to 2 to 4 sf	1	[5]
		II moles of water divided by 10 or correct answer	1	
		III M_r in (ii) from mass/ans (i)	1	
		IV Calculates A_r of M $A_r = \frac{M_r - 240}{2}$	1	
(ii)				
(iii)	Conclusion	V Choice of identity of M corresponds to nearest A_r	1	
(c)	ACE Interpretation	0.1 or 0.2 for 1 dp balance, 0.01 or 0.02 for 2 dp balance, 0.001 or 0.002 for 3 dp balance in (i) and $\frac{(i) \times 100}{\text{mass of water}}$ in (ii) (expression or correct answer)	1	[1]
(d)	ACE Improvement	Problem and appropriate improvement required. Not all the water was lost (1) so heat to constant mass (1) Water was regained on cooling (1) so cool in a desiccator/ with a lid (1) Use a balance with more dp (1) this gives a lower percentage error (1) The solid frothed/spat on heating (1) so use a deeper crucible/heat even more gently (1) Small amount of solid used gives high percentage error (1) use more solid.	2	[2]
Qn 2	Total			[12]

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Question	Sections	Indicative material	Mark	Total
FB 4 is MgSO_4 ; FB 5 is $\text{C}_6\text{H}_{12}\text{O}_6(\text{aq})$ reacts as ethanal; FB 6 is H_2O reacts as propanone; FB 7 is $\text{C}_2\text{H}_5\text{OH}$; FB 8 is $\text{HCOOH}(\text{aq})$				
3	(a) (i)	MMO Decisions	I Selects NaOH and NH_3 , and uses each in excess.	1
		PDO Layout	II Unambiguous layout of all 4 observations.	1
		MMO Collection	III White ppt with NaOH and insoluble in excess.	1
			IV White ppt with NH_3 and insoluble in excess.	1
		ACE Conclusion	V Mg^{2+}	1
	(ii)	MMO Decisions Collection	VI Selects barium chloride/barium nitrate and hydrochloric/nitric acid. VII White ppt.	1 1
			OR VI selects acidified potassium manganate(VII) VII no reaction/stays purple/purple solution formed	
		ACE Conclusion	OR VI add a named acid and test for sulfur dioxide VII negative test VIII SO_4^{2-}	1 [8]
(b)	(i)	MMO Collection	I FB 5 and Tollens': silver mirror/black or brown or grey ppt	1
			II FB 7 and manganate(VII): colour change purple to colourless/decolourised	1
			III No reaction for FB 6 with both reagents and FB 7 with Tollens'	1
	(ii)	ACE Conclusion	IV FB 6 is propanone (with no reactions observed) V FB 5 and FB 7 identified	1 1
	(iii)	MMO Decisions	VI Selects 2,4-DNPH	1
		ACE Conclusion	VII Red/orange/yellow ppt for FB 5 and FB 6 and no change for FB 7 ecf from identities in (ii)	1 [7]

Page 6	Mark Scheme	Syllabus	Paper
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Question	Sections	Indicative material	Mark	Total
(c)	MMO Collection	Decolourises KMnO_4 Effervescence/fizzing/bubbles Turns limewater milky	1 1 1	[3]
Qn 3	Total		[18]	

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	MMO Collection	II Appropriate headings and units for all accurate data. and volume FA 1 added recorded for each accurate titre. <i>Headings should match readings.</i> - initial/start (burette) reading/volume - final/end (burette) reading/volume - titre or volume/FA 1 used/added (not “difference”) unit: /cm³ or (cm³) or in cm³ or cm³ for each entry	1	
	PDO Recording	III All accurate burette readings recorded to 0.05 cm ³ . <i>The need to record to 0.05 applies only to the burette readings and not to the recorded titres.</i> <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).	1	
	MMO Decisions	IV Has two uncorrected, accurate titres within 0.1 cm ³ . <i>Do not include a reading labelled ‘rough’.</i> <i>Do not award this mark if, having performed two titres within 0.1 cm³, a further titration is performed that is more than 0.1 cm³ from the closer of the two initial titres unless further titrations within 0.1 cm³ of any other have also been carried out.</i> <i>Do not award the mark if any ‘accurate’ burette readings (apart from initial 0) are given to zero dp.</i>	1	
All burette readings should be rounded to the nearest 0.05 cm³. Subtractions should be checked. The ‘best’ titres should be selected using the hierarchy: two (or more) identical, then two (or more) within 0.05 cm³, then two (or more) within 0.1 cm³, etc. Examiner compares candidate mean titre with Supervisor mean titre.				
(a)	MMO Quality	V, VI and VII Award V, VI and VII for a difference from Supervisor, $\delta \leq 0.20 \text{ cm}^3$ Award V and VI for $0.20 < \delta \leq 0.30 \text{ cm}^3$ Award V only for $0.30 < \delta \leq 0.50 \text{ cm}^3$ <i>Spread penalty: if the two ‘best’ titres used by the Examiner are $\geq 0.50 \text{ cm}^3$ apart cancel one of the Q marks.</i>	3	[7]

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(b)	ACE Interpretation	Candidate must average two (or more) titres that are all within 0.20 cm³. 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 dp 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> <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)	PDO Display ACE Interpretation ACE Conclusion	I Uses the expression $\frac{0.0200 \times (\mathbf{b})}{1000}$ in (i) (or answer correct to 3 or 4 sf) II Correctly evaluates $\frac{0.0530 \times 25}{1000}$ in (ii) (to 3 or 4 sf) III $\frac{\text{answer to (ii)}}{\text{answer to (i)}}$ in (iii) and correct answer to 2, 3 or 4 sf IV Equation 2 as ratio is 5:2 or 2½ and reference to their answer in (iii) <i>Allow ecf</i> V Oxidation state = (+)4 in (v) from equation 2 <i>Allow ecf ((+)3)</i>	1 1 1 1 1	[5]
Qn 1	Total		[13]	

Page 4	Mark Scheme	Syllabus	Paper
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Question	Sections	Indicative material	Mark	Total
2 (a)	PDO Recording	Four thermometer readings and two masses tabulated with correct headings and units. (mass/g or (g) or in g; temperature/temp/T/°C, etc.) <i>If units are omitted from the headings then they must appear next to each entry in the table.</i>	1	
	Display	Consistent dp for balance readings and (<i>minimum</i> 3) thermometer readings to ×.0/×.5.	1	
Correct temperatures to nearest 0.5 °C. Examiner calculates ΔT for longer piece of magnesium for Supervisor and candidate.				
(a)	MMO Quality	Award one mark if the difference between candidate and Supervisor is ≤ 2.0 °C. Award second mark if the difference between candidate and Supervisor is ≤ 1.0 °C.	1 1	[4]
(b)	ACE Interpretation	I $\frac{\text{mass longer Mg}}{24.3} < \frac{50 \times 1.00}{1000}$ in (i)	1	
	MMO Collection	II No solid/metal left/ all Mg disappeared/dissolved in (ii)	1	
	ACE Interpretation	III Expression $50 \times 4.3 \times \Delta T$ or correct answers in (iii) and (v)	1	
	PDO Display	IV Uses $\frac{\text{answer to (iii)}}{\text{mass shorter Mg}/24.3}$ in (iv) and $\frac{\text{answer to (v)}}{\text{mass longer Mg}/24.3}$ in (vi) <i>Allow ecf from (i)</i>	1	
	ACE Interpretation	V Correct answers given to 2–4 sf in kJ and minus signs in (iv) and (vi)	1	
(c)	ACE Interpretation	(2 × 0.5/smaller ΔT) × 100 for shorter piece of Mg in (iii)	1	[1]
(d)	ACE Interpretation	Mass of/weighing Mg (ribbon) or volume of H ₂ SO ₄ used or corrosion on Mg	1	
	Improvements	Use greater mass/balance to more dp or use burette/pipette (to measure volume) or use sand paper or emery paper or use lid or taller beaker or taller cup to prevent acid spray	1	
Qn 2	Total		[12]	

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Question	Sections	Indicative material	Mark	Total
FA 4 is $\text{FeCl}_3(\text{aq})$ FA 5 is $\text{MnSO}_4(\text{aq})$ FA 6 is $(\text{NH}_4)_2\text{Fe}(\text{SO}_4)_2(\text{aq})$				
3 (a) (i)	MMO Collection	I (Solution) turns pink/pink-brown/brown/purple or no reaction/no change	1	
		II (Purple decolourised and) (dark) brown ppt	1	
		III (Purple) decolourised	1	
	(ii) ACE Conclusion	IV (FA 5 and) FA 6	1	
(b) (i)	PDO Layout	I NaOH on answer line and unambiguous table of results including observations for excess NaOH with all three	1	
	MMO Collection	II Brown/orange/red-brown/rust ppt (insoluble in excess NaOH with FA 4)	1	
		III Off-white/buff/light brown ppt (insoluble in excess NaOH with FA 5)	1	
		IV Green/dirty green ppt (insoluble in excess NaOH with FA 6)	1	
		V ppt with FA 5 darkens/turns dark(er) brown and ppt with FA 6 darkens/turns green-brown/brown/orange-brown/red-brown on standing	1	
		VI On warming/heating with NaOH gas evolved turns (damp) red litmus (paper) blue with FA 6 only	1	
	(ii) ACE Conclusion	VII FA 4 contains Fe^{3+} and FA 5 contains Mn^{2+} and FA 6 contains Fe^{2+}	1	
		VIII FA 6 contains NH_4^+	1	
(c) (i)	MMO Decisions	Selects AgNO_3 or $\text{BaCl}_2/\text{Ba}(\text{NO}_3)_2$	1	
	MMO Collection	AgNO_3 : FA 4 white ppt and no ppt/reaction with FA 5 and FA 6 or $\text{BaCl}_2/\text{Ba}(\text{NO}_3)_2$: white ppt with FA 5 and FA 6 and no ppt/reaction with FA 4	1	
(ii)	ACE Conclusion	FA 4 (contains the chloride ion)	1	[3]
Qn 3	Total			[15]

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1 (a)	PDO Layout	I Unambiguous headings for 2 balance readings and volume of FB 2 added between 47.5 and 48.5 cm ³	1	
	MMO Collection	II 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	
	PDO Recording	III Appropriate headings and units for all accurate data. and volume FB 3 added recorded for each accurate titre. <i>Headings should match readings.</i> - initial/start (burette) reading/volume - final/end (burette) reading/volume - titre or volume/FB 3 used/added (not “difference”) unit: /cm³ or (cm³) or in cm³ or cm³ for each entry	1	
	MMO Decisions	IV All accurate burette readings recorded to 0.05 cm ³ . <i>The need to record to 0.05 applies only to the burette readings and not to the recorded titres. 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).	1	
		V Has two uncorrected, accurate titres within 0.1 cm ³ <i>Do not include a reading labelled ‘rough’.</i> <i>Do not award this mark if, having performed two titres within 0.1 cm³, a further titration is performed that is more than 0.1 cm³ from the closer of the two initial titres unless further titrations within 0.1 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) are given to zero dp.</i>	1	
Round any burette readings to the nearest 0.05 cm³. Check and correct subtractions in the titre table. Examiner then selects the “best” titre using the hierarchy: two identical; titres within 0.05 cm³; titres within 0.1 cm³; etc. Candidate scaled titre calculated as: Scaled titre = $\frac{\text{Cand titre} \times \text{Cand} \{ (V_{\text{added}}/500) - 1.6 \times \text{mass}/100.1 \}}{\text{Supervisor} \{ (V_{\text{added}}/500) - 1.6 \times \text{mass}/100.1 \}}$ Examiner compares candidate scaled titre with Supervisor’s titre.				
(a)	MMO Quality	Award VI, VII, VIII and IX for $\delta \leq 0.40 \text{ cm}^3$ Award VI, VII and VIII for $0.40 \text{ cm}^3 < \delta \leq 0.80 \text{ cm}^3$ Award VI and VII for $0.80 \text{ cm}^3 < \delta \leq 1.20 \text{ cm}^3$ Award VI only for $1.20 \text{ cm}^3 < \delta \leq 2.00 \text{ cm}^3$ <i>If the “best” titres are $\geq 0.50 \text{ cm}^3$ apart cancel one of the Q marks.</i>	4	[9]

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Question	Sections	Indicative material	Mark	Total
(b)	ACE Interpretation	Candidate must average two (or more) titres that are all within 0.20 cm³. 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 dp 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> <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)	ACE Interpretation	I Correctly calculates $\frac{0.200 \times 25}{1000} = 5 \times 10^{-3}$ in (i) and gives 5×10^{-3} in (ii)	1	[7]
(iii)		II Uses (ii) $\times \frac{250}{(b)}$ in (iii)	1	
(iv)		III Correct expression $\frac{2.00 \times V \text{ diluted}}{1000}$ in (iv)	1	
		IV Correct expressions (iv) – (iii) in (v) and (v) $\div 2$ in (vi)	1	
(v)&(vi)		V (vi) $\times 100.1$ (allow $\times 100$) in (vii)	1	
		VI (answer $\div$ correct mass FB 1) $\times 100$ in (vii)	1	
(vii) (2 marks)	PDO Display	VII Answers to steps (iii) to (vii) given to 3 or 4 sf <i>minimum number of steps attempted = 4 to access this mark</i>	1	
(d) (i)	ACE Interpretation	smallest = 48.40, largest = 48.60	1	[3]
(ii)	Conclusion	Correct link between volume of FB 2 used/in excess/ concentration of remaining FB 2 and titre or between concentration/volume FB 3 /HCl remaining/in excess and titre. (higher volume/concentration gives smaller titre ora)	1	
		Correct reference to student(s) X and/or Y	1	
Qn 1	Total		[20]	

Page 5	Mark Scheme	Syllabus	Paper
	GCE AS/A LEVEL – May/June 2014	9701	34

Question	Sections	Indicative material	Mark	Total
FB 6 is $\text{MgSO}_4 + \text{HNO}_3(\text{aq})$; FB 7 is $\text{ZnCO}_3(\text{s}) + \text{KI}(\text{s})$				
3 (a)	MMO Collection	I White ppt with NH_3 insoluble in excess	1	[6]
		II No visible reaction/no change and White ppt	1	
	ACE Conclusion	III Mg^{2+} and Al^{3+} and SO_4^{2-} and/or SO_3^{2-} in (iv)	1	
	MMO Decisions	IV Selects NaOH in (v) . (Allow $\text{KI}/\text{HCl}/\text{H}_2\text{SO}_4/\text{K}_2\text{CrO}_4$ if Pb^{2+} in (iv))	1	
	Collection	V White ppt insoluble in excess (NaOH) (Allow no reaction with KI if Pb^{2+} in (iv))	1	
	ACE Conclusion	VI (not) Al^{3+} / Mg^{2+} is present Allow ecf from incorrect <u>cations</u> in (iv) and correct observation with NaOH	1	
(b) (i) (ii) (iii) (iv) (v)	MMO Collection	I Solid turns yellow on heating and paler yellow/white on cooling	1	[7]
		II Effervescence and gas turns limewater milky (or in (i))	1	
		III (Solution turns) (darker) yellow/orange/red/brown and blue/black with starch	1	
		IV (Pale) yellow ppt	1	
	ACE Conclusion	V White ppt soluble in excess	1	
		VI and VII Identifies all three ions (Zn^{2+} , CO_3^{2-} and I^-)	1	
		VI only Identifies two ions. Minimum evidence: Zn^{2+} white ppt soluble in excess NH_3 CO_3^{2-} effervescence or positive limewater I^- either (iii) or (iv) correct	1	
Qn 3	Total		[13]	

MARK SCHEME for the May/June 2014 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 May/June 2014 series for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level components and some Ordinary Level components.

Page 2	Mark Scheme	Syllabus	Paper
	GCE AS/A LEVEL – May/June 2014	9701	35

Question	Sections	Indicative material	Mark	Total
1 (a)	MMO Collection	I Burette readings and correct volume given for dilution and volume between 24.00 and 26.00 cm ³	1	
	PDO Layout	II 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	
	PDO Recording	III Appropriate headings and units for accurate titration. and volume FA 3 added recorded for each accurate titre. <i>Headings should match readings.</i> - initial/start (burette) reading/volume - final/end (burette) reading/volume - titre or volume/FA 1 used/added (<i>but not “difference”</i>) unit: /cm³ or (cm³) or in cm³ or cm³ for each entry	1	
	MMO Decisions	IV All accurate burette readings recorded to 0.05 cm ³ . <i>The need to record to 0.05 applies only to the burette readings and not to the recorded titres.</i> <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) V Has two uncorrected, accurate titres within 0.1 cm ³ <i>Do not consider the rough even if ticked.</i> <i>Do not award this mark if having performed two titres within 0.1 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 0.1 cm³ of any other titration has also been carried out.</i> <i>Do not award the mark if any ‘accurate’ burette readings (apart from initial 0) are given to zero dp.</i>	1	
Round any burette readings to the nearest 0.05 cm³. Check and correct subtractions in the dilution and titre tables. Examiner then selects the “best” titre using the hierarchy: two identical; titres within 0.05 cm³; titres within 0.1 cm³; etc. Candidate scaled titre = Cand vol diluted × Cand mean titre/Sup vol diluted Examiner compares candidate scaled titre with Supervisor’s titre.				
(a)	MMO Quality	VI, VII and VIII Award VI, VII and VIII for $\delta \leq 0.20 \text{ cm}^3$ Award VI and VII for $0.20 \text{ cm}^3 < \delta \leq 0.40 \text{ cm}^3$ Award VI only for a difference of $0.40 < \delta \leq 0.60 \text{ cm}^3$ <i>If the “best” titres are $\geq 0.50 \text{ cm}^3$ apart cancel one of the Q marks.</i>	3	[8]

Page 3	Mark Scheme	Syllabus	Paper
	GCE AS/A LEVEL – May/June 2014	9701	35

Question	Sections	Indicative material	Mark	Total
(b)	ACE Interpretation	Candidate must average two (or more) titres that are all within 0.20 cm³. 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 dp 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> <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)	ACE Interpretation PDO Display	I Correctly evaluates $\frac{0.500 \times \text{vol diluted}}{250}$ in (i) II Correctly calculates (i) $\times \frac{(b)}{1000}$ in (ii) III Correctly calculates (ii) $\div 2$ in (iii) IV Correctly calculates (iii) $\times \frac{1000}{25}$ in (iv) V All answers given to 3 or 4 sf <i>minimum 3 steps attempted to access this mark</i>	1 1	[5]
(d)	ACE Interpretation Conclusion	(i) smallest = 24.70, largest = 24.90 (ii) lower conc FA 3 leads to greater titre therefore greater conc. of Ca(OH)₂	1 1	[2]
(e)	ACE Conclusion	limewater reacts with carbon dioxide in air	1	[1]
Qn 1	Total		[17]	

Page 4	Mark Scheme	Syllabus	Paper
	GCE AS/A LEVEL – May/June 2014	9701	35

Question	Sections	Indicative material	Mark	Total
2 (a)	PDO Layout	I Headings with units and three balance readings and two correctly calculated masses of solid are tabulated clearly. Mass /g, (g), in g, in grams <i>If units are omitted from the headings then they must appear next to each entry in the table.</i>	1	
	MMO Collection	II White solid turns yellow/green-yellow on heating and white/becomes paler on cooling	1	
On Supervisor script calculate mass FA 4 ÷ mass loss to 1 dp. Calculate FA 4 ÷ mass loss for the candidate to 1 dp and calculate difference from Supervisor.				
(a)	MMO Quality	III and IV Award III and IV if $\delta \leq 0.5$. Award IV only if $0.5 < \delta \leq 1.0$.	1 1	 [4]
(b)	ACE Interpretation	I Correctly calculates mass loss from results in (a) in (i)	1	[4]
	PDO Display	II Correctly calculates M_r : $\text{ZnCO}_3 = 125.4$ and $\text{CO}_2 = 44(.0)$ in (ii)	1	
		III Uses $\frac{(i) \times 125.4}{44}$ in (ii) (allow ecf)	1	
		IV Uses $\frac{(ii) \times 100}{\text{correct mass FA 4}}$ in (iii)	1	
(c)	ACE Improvement	Heat to constant mass/ use larger mass	1	[2]
	Interpretation	All decomposes/all CO_2 given off smaller % error	1	
Qn 2	Total		[10]	

Page 5	Mark Scheme	Syllabus	Paper
	GCE AS/A LEVEL – May/June 2014	9701	35

Question	Sections	Indicative material	Mark	Total								
FA 5 is $\text{ZnCO}_3(\text{s}) + \text{Al}_2(\text{SO}_4)_3(\text{s})$ FA 7 is $\text{NH}_4\text{Cl}(\text{s}) + \text{NaHCO}_3(\text{s})$												
3 (a) (i)	MMO Collection	I Effervescence (and colourless solution)	1	[7]								
		II White ppt with NaOH soluble in excess	1									
		III White ppt with NH_3 insoluble/partially soluble in excess	1									
		IV No reaction/no change/no ppt	1									
		V White ppt (if additional HCl/HNO ₃ added then ppt must remain)	1									
	(vi) ACE Conclusion	VI Al^{3+} VII SO_4^{2-} as white ppt with Ba^{2+}	1									
(b) (i)	MMO Collection	I Condensation or sublimation (<i>allow misty/white fumes</i>) (on gentle heating) and (gas/ NH_3) turns (damp) red litmus blue	1	[6]								
		(ii)	II White/off-white/cream ppt soluble in NH_3		1							
		(iii)	III No reaction or white ppt in 1 st box (allow no ppt) and effervescence in 2 nd box		1							
	MMO Decisions	IV Uses limewater in either 3 rd test or in (a)(i)	1									
		(iv) ACE Conclusion	V and VI Identifies NH_4^+ , Cl^- and CO_3^{2-} or SO_3^{2-} with appropriate evidence.		1							
	V only Identifies all three ions without evidence or identifies two ions with evidence.		1									
	<table><tr><th>ion</th><th>minimum evidence</th></tr><tr><td>NH_4^+</td><td>gas turning litmus blue/NH_3 (provided correct litmus result in obs)</td></tr><tr><td>Cl^-</td><td>white ppt with AgNO_3</td></tr><tr><td>CO_3^{2-} SO_3^{2-}</td><td>(rapid) effervescence with acid white ppt with Ba^{2+} and effervescence/ppt dissolves in acid</td></tr></table>		ion		minimum evidence	NH_4^+	gas turning litmus blue/ NH_3 (provided correct litmus result in obs)	Cl^-	white ppt with AgNO_3	CO_3^{2-} SO_3^{2-}	(rapid) effervescence with acid white ppt with Ba^{2+} and effervescence/ppt dissolves in acid	
	ion	minimum evidence										
NH_4^+	gas turning litmus blue/ NH_3 (provided correct litmus result in obs)											
Cl^-	white ppt with AgNO_3											
CO_3^{2-} SO_3^{2-}	(rapid) effervescence with acid white ppt with Ba^{2+} and effervescence/ppt dissolves in acid											
Qn 3	Total	[13]										