
CHEMISTRY

9701/31

Paper 3 Advanced Practical Skills 1

October/November 2016

MARK SCHEME

Maximum Mark: 40

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.

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Page 2	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – October/November 2016	9701	31

Question	Answer	Marks
1(a)	I Correct headings and units for mass of FA 1 and volume of CO₂ • Mass of container + FA 1 • Mass of container (+ residue) • Mass of FA 1 • Volume of gas Allow vol for volume but not V Units needed for all readings II Both weighings to the same number of dp and correct mass of FA 1 calculated (If initial and final volumes recorded then subtraction for volume collected must be correct.)	1 1 2
1(b)(i)	Correctly calculates $\frac{V(a)}{24.0 \times 1000}$	1
1(b)(ii)	Correct expression (i) $\times 100.1$ or (i) $\times (40.1 + 12 + (3)16)$ Must show working	1
1(b)(iii)	Correctly uses $\frac{(ii) \times 100}{\text{mass in (a)}}$	1
	All three answers to 2 to 4 sf	1
1(c)	Any of: warm water in tub / saturate water with CO ₂ / a specific method of separation of CaCO ₃ and acid so only mixed after bung inserted / gas syringe	1
	Total	7

Page 3	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – October/November 2016	9701	31

Question	Answer	Marks
2(a)	I Initial and final burette readings and volume added recorded for rough titre and accurate titre details tabulated. [minimum 2 × 2 ‘boxes’ with relevant information]	1
	II Initial and final burette readings recorded and volume of FA 3 added recorded for each accurate titration. Headings and units correct for accurate titrations Headings: initial / final (burette) reading / volume or reading / volume at start / finish and volume / FA 3 added / used or titre [not difference / total] allow vol but not V 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(.0)	1
	IV Final uncorrected titre is within 0.10 cm ³ of any previous uncorrected accurate titre. <i>Do not include a reading if it is labelled rough.</i> <i>Do not award the mark if any accurate burette readings (apart from the initial zero) are given as integers.</i>	1

Page 4	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – October/November 2016	9701	31

Question	Answer	Marks
	V, VI and VII Examiner rounds any accurate burette readings to the nearest 0.05 cm^3, checks subtractions and then selects the 'best' accurate titres using the hierarchy: identical titres; titres within 0.05 cm^3; titres within 0.1 cm^3; etc., to calculate mean correct to 0.01 cm^3. Examiner uses the best titre to calculate the ratio of acid remaining after reaction with calcium carbonate in Question 1 to this best titre from Question 2 for Supervisor and each candidate. The ratio of this value for the candidate is compared to the ratio of this value for the Supervisor and marks awarded as follows. Award V, VI and VII for $0.95 - 1.05$ Award V and VI for $0.90 - 1.10$ Award V for $0.80 - 1.20$	3 7

Page 6	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – October/November 2016	9701	31

Question	Answer	Marks
2(c)(vii)	Correctly uses $[(vi) \times 100]/(\text{mass in (a)})$ to a minimum of 2 sf	1 5
2(d)	Question 1: % purity lower as loss of gas means fewer moles /less mass CaCO₃ Question 2: no change /% same as same amount of acid reacts / (amount) acid left is same	1 1 1 1 4 max 3
	Total	16

Question	Answer		Marks
FA 5 is NaNO ₃ (s); FA 6 is CuCO ₃ (s); FA 7 is NaBr(aq)			
3(a)(i)	FA 5	FA 6	
	(goes to) colourless or yellow liquid/ solution	(green) powder / solid (turns) black / black residue	1+1
	gas relights glowing splint	or gas turns limewater milky / cloudy white / chalky / forms white ppt	1
	gas (turns) brown / brown gas or solution turns blue	(pale) blue solution / liquid formed	1+1

Page 7	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – October/November 2016	9701	31

Question	Answer	Marks								
3(a)(ii)–(iv)	<table><tr><th>FA 5</th><th>FA 6</th></tr><tr><td>(iii) solid dissolves / colourless solution allow no reaction / no change / no effervescence</td><td>effervescence / fizzing / bubbling and blue solution / liquid formed</td></tr><tr><td>(iv) no reaction / no change / no ppt / remains colourless</td><td>blue ppt and insoluble in excess</td></tr><tr><td>(v) no reaction / no change / no ppt / remains colourless</td><td>(pale) blue ppt and soluble in excess to give deep / dark blue (solution)</td></tr></table>	FA 5	FA 6	(iii) solid dissolves / colourless solution allow no reaction / no change / no effervescence	effervescence / fizzing / bubbling and blue solution / liquid formed	(iv) no reaction / no change / no ppt / remains colourless	blue ppt and insoluble in excess	(v) no reaction / no change / no ppt / remains colourless	(pale) blue ppt and soluble in excess to give deep / dark blue (solution)	1
	FA 5	FA 6								
	(iii) solid dissolves / colourless solution allow no reaction / no change / no effervescence	effervescence / fizzing / bubbling and blue solution / liquid formed								
	(iv) no reaction / no change / no ppt / remains colourless	blue ppt and insoluble in excess								
(v) no reaction / no change / no ppt / remains colourless	(pale) blue ppt and soluble in excess to give deep / dark blue (solution)									
		1								
		1								
3(a)(v)	FA 5: cation unknown; anion nitrate / NO ₃ [–] FA 6: cation Cu ²⁺ / copper(II); anion carbonate / CO ₃ ^{2–} 4 correct = 3 marks 3 correct = 2 marks 2 correct = 1 mark	1 1 1								
3(a)(vi)	CuCO ₃ (s) + H ₂ SO ₄ (aq) → CuSO ₄ (aq) + H ₂ O(l) + CO ₂ (g)	1								
3(b)(i)	Selects AgNO ₃ and NH ₃ Selects NaOH and Al and HCl / HNO ₃ / H ₂ SO ₄	1 1								
3(b)(ii)	Clearly defined test observation conclusion sections	1								
	FA 7 + AgNO ₃ cream ppt partially soluble in NH ₃	1								
	FA 7 is bromide / Br [–] from cream ppt	1								
		5								
	Total	17								

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Page 2	Mark Scheme	Syllabus	Paper
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Question	Answer	Marks
1(a)	Initial and final readings and titre value for rough and initial and final reading for two (or more) accurate titrations Appropriate headings and units and the volume of FA 2 added is recorded for each accurate titration. Headings must match readings Initial/start (burette) and reading/volume Final/end (burette) and reading/volume Titre or volume/vol/FA 2 and used/added (<i>not “difference”, “total”, “V”</i>) Units: /cm³ or (cm³) or in cm³ or cm³ for each volume. All accurate burette readings (initial and final) recorded to nearest 0.05 cm³ <i>Do not award this mark if:</i> <i>50(.00) is used as an initial burette reading;</i> <i>more than one final burette reading is 50.(00);</i> <i>any burette reading is greater than 50.(00)</i> Final uncorrected titre is within 0.10 cm³ of any previous uncorrected accurate titre.	1 1 1
Examiner rounds any accurate burette readings to the nearest 0.05 cm³, checks subtractions and then selects the ‘best’ accurate titres using the hierarchy: identical titres; titres within 0.05 cm³; titres within 0.1 cm³; etc., to calculate mean correct to 0.01 cm³. Examiner compares candidate’s titre value with that of the Supervisor.		
	V, VI and VII Award V, VI and VII for $\delta \leq 0.30 \text{ cm}^3$ Award V and VI for $0.30 < \delta \leq 0.50 \text{ cm}^3$ Award V only for $0.50 < \delta \leq 0.80 \text{ cm}^3$	1 1 1 7

Page 3	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – October/November 2016	9701	33

Question	Answer	Marks
1(b)	Calculation of the mean Check mean titre is correctly calculated from clearly selected values (ticks or working) • Candidate 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 dp rounded to the nearest 0.01. [e.g. 26.667 must be rounded to 26.67.] 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 (ignoring initial given as 0) 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.] Do not award this mark if: • the rough titre was used to calculate the mean; • the candidate carried out only 1 accurate titration; • burette readings were incorrectly subtracted to obtain any of the accurate titre values; • all burette readings (resulting in titre values used in the calculation of the mean) are integers. 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)	I Correctly calculates: $\frac{(b)}{1000} \times 0.0200$	1
1(c)(ii) and 1(c)(iii)	II Correctly uses: (i) $\times 5/2$ and (ii) $/0.025$ or (ii) $\times 1000/25$	1
1(c)(iv)	Correctly calculates: (iii) $\times 10$ or (ii) $\times 1000/25 \times 10$	1

Page 4	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – October/November 2016	9701	33

Question	Answer	Marks
	3 or 4 significant figures in final answers to all parts (<i>minimum 3 parts attempted</i>)	1 4
	Total:	12

Question	Answer	Marks
2(a)	Examiner to calculate 10% and 20% of Supervisor's time and round this to nearest second. Candidate's time compared with supervisor's time. Award 2 marks if time within 10% of supervisor Award 1 mark if time within 20% of supervisor	2
2(b)(i)	Correctly calculates: $2.61 \times 10^{-5} \times$ reaction time from (a)	1

Page 5	Mark Scheme	Syllabus	Paper
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Question	Answer	Marks
2(b)(ii)	Correctly uses: (i) $\times 0.080$ or (i) $\times 80/1000$ and no additional working	1
2(b)(iii) and 2(b)(iv)	Correctly uses: $2 \times \text{ans (ii)}$ and (iii) / 0.020 or (iii) $\times 1000/20$ Time recorded to nearest second in (a) and (c) and 2 – 4 sf in all answers in (b) (minimum 3 parts attempted)	1 1 4
2(c)	Examiner calculates ratio of reaction time (a) /reaction time (b) Award if $1.80 \leq \text{ratio} \leq 2.80$	1 1
2(d)(i)	Time is less/shorter because the amount/volume/concentration of thiosulfate/FA 6 is less (ora) Time is approximately half because (the amount/no. of moles/concentration of) the thiosulfate/FA 6 is half .	1 1

Page 6	Mark Scheme	Syllabus	Paper
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Question	Answer	Marks
2(d)(ii)	(No because) the error is greater in (c) with some explanation e.g. because more readings taken/water added	1
	The measuring cylinder is used more times in (c) or smaller volumes /10 cm ³ instead of 20 cm ³ are measured in (c) or 6 rather than 5 readings taken/more reagents used/water also added/added in addition or smaller volumes therefore greater percentage error	1
		4
	Total:	11

Page 7	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – October/November 2016	9701	33

Question	Answer	Marks																									
FA 7 is ZnSO ₄ ; FA 8 is (NH ₄) ₂ Fe(SO ₄) ₂ ; FA 9 is CrK(SO ₄) ₂ ; FA 10 is MnSO ₄ ; FA 11 is NaNO ₂																											
3(a)	Selects NaOH and NH ₃	1																									
	Single table to show results with both NaOH and NH ₃ . No repeat headings. At least two of the FAs tested	1																									
	<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>green ppt</td><td>grey-green ppt</td><td>off-white/ pale brown/ buff ppt</td></tr><tr><td>excess</td><td>soluble</td><td>insoluble</td><td>soluble</td><td>insoluble</td></tr><tr><td>NH₃</td><td>white ppt</td><td>green ppt</td><td>grey-green ppt</td><td>off-white/ pale brown/ buff ppt</td></tr><tr><td>excess</td><td>soluble</td><td>insoluble</td><td>insoluble</td><td>insoluble</td></tr></table>		FA 7	FA 8	FA 9	FA 10	NaOH	white ppt	green ppt	grey-green ppt	off-white/ pale brown/ buff ppt	excess	soluble	insoluble	soluble	insoluble	NH ₃	white ppt	green ppt	grey-green ppt	off-white/ pale brown/ buff ppt	excess	soluble	insoluble	insoluble	insoluble	1
		FA 7	FA 8	FA 9	FA 10																						
	NaOH	white ppt	green ppt	grey-green ppt	off-white/ pale brown/ buff ppt																						
	excess	soluble	insoluble	soluble	insoluble																						
	NH ₃	white ppt	green ppt	grey-green ppt	off-white/ pale brown/ buff ppt																						
	excess	soluble	insoluble	insoluble	insoluble																						
			1																								
			1																								
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Page 8	Mark Scheme	Syllabus	Paper
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Question	Answer	Marks								
	<table><tr><td>FA 7</td><td>FA 8</td><td>FA 9</td><td>FA 10</td></tr><tr><td>Zn²⁺</td><td>Fe²⁺</td><td>Cr³⁺</td><td>Mn²⁺</td></tr></table> Award 1 mark for 2 correct ions. Award 2 marks for all 4 correct.	FA 7	FA 8	FA 9	FA 10	Zn ²⁺	Fe ²⁺	Cr ³⁺	Mn ²⁺	1 1 11
FA 7	FA 8	FA 9	FA 10							
Zn ²⁺	Fe ²⁺	Cr ³⁺	Mn ²⁺							
3(b)	(dark) brown ppt/solid/suspension/deposit and effervescence/bubbling/fizzing positive test for oxygen – (gas/ O₂) relights glowing splint	1 1 2								
3(c)(i)	blue solution and effervescence/bubbling/fizzing or brown fumes/gas	1								
3(c)(ii)	NO₂⁻ or nitrite from either blue solution or brown gas	1								

Page 9	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – October/November 2016	9701	33

Question	Answer	Marks
3(c)(iii)	selects NaOH and Al (for nitrite or nitrate) or selects (acidified) potassium manganate(VII)/ potassium permanganate/ KMnO_4 If carbonate in (ii) (from bubbling without brown gas in (i)) then allow use of limewater to test gas If halide from no reaction then allow use of AgNO_3 and NH_3 If sulfate/sulfite from no reaction then allow use of $\text{BaCl}_2/\text{Ba}(\text{NO}_3)_2$ and HCl/HNO_3 Warming (with NaOH and Al) and gas/ammonia turns (damp red) litmus (paper) blue or Decolourises MnO_4^-	1 1 4
	Total:	17

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October/November 2016

MARK SCHEME

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	Cambridge International AS/A Level – October/November 2016	9701	34

Question	Answer	Marks
1(a)	I Mass of magnesium recorded with /g or (g) and initial and final burette readings and volume of hydrogen with unambiguous headings and correct unit. Examiner to calculate 10% and 20% of Supervisor's volume and round this to 1 dp. Candidate's volume compared with Supervisor's volume. Award II if within 20% Award II and III if within 10%	1 1 3
1(b)(i)	Correct calculation moles $H_2 = \frac{\text{volume collected}}{24000}$ to 2 – 4 sf Volume of gas must be correctly calculated.	1
1(b)(ii)	Correctly uses $A_r = \frac{\text{mass used}}{\text{(i)}}$ to 2 – 4 sf	1 2

Page 3	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – October/November 2016	9701	34

Question	Answer	Marks
1(c)(i)	Correct expression Error in mass = $\frac{0.1 \text{ or } 0.01 \text{ or } 0.001}{\text{mass of Mg}} \times 100^*$ (depending on dp of balance)	1
	Correct expression Error in volume = $\frac{0.1 \times 100^*}{\text{volume of gas in (a)}}$	1
1(c)(ii)	Use a larger mass of magnesium (<i>for either</i>)/use a balance that reads to more dp (<i>mass error was larger</i>)/use a burette more precisely calibrated/smaller graduations (<i>volume error was larger</i>)	1 3

Page 5	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – October/November 2016	9701	34

Question	Answer	Marks
	III All accurate burette readings recorded to the nearest 0.05 cm^3 <i>Do not award this mark if:</i> <i>50(.00) is used as an initial burette reading;</i> <i>more than one final burette reading is 50(.00)</i> <i>any burette reading is $> 50(.00)$</i> IV Final uncorrected titre is within 0.10 cm^3 of any previous uncorrected accurate titre. Examiner rounds any accurate burette readings to the nearest 0.05 cm^3, checks subtractions and then selects the 'best' accurate titres using the hierarchy: identical titres; titres within 0.05 cm^3; titres within 0.1 cm^3; etc., to calculate mean correct to 0.01 cm^3. Examiner compares candidate's titre value with that of the Supervisor. 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 $0.30 \text{ cm}^3 < \delta \leq 0.50 \text{ cm}^3$	1 1 1 1 1 7
2(b)	Calculation of mean Check mean titre is correctly calculated from clearly selected values (ticks or working) • Candidate 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 dp rounded to the nearest 0.01. [e.g. 26.667 must be rounded to 26.67] 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 (ignoring initial given	1

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Question	Answer	Marks
	as 0) 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.] Do not award this mark if: - the rough titre was used to calculate the mean; - the candidate carried out only 1 accurate titration; - burette readings were incorrectly subtracted to obtain any of the accurate titre values; all burette readings (resulting in titre values used in the calculation of the mean) are integers. <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
2(c)(i)	Correctly calculates $\frac{2.64}{106 \times 40} = 6.23 / 6.225 / 6.226 \times 10^{-4}$	1
2(c)(ii) and 2(c)(iii)	Correctly uses (i) $\times 2$ and $\frac{\textbf{(ii)} \times 250}{\textbf{(b)}}$	1
2(c)(iv)	Correctly calculates $\text{Moles HCl} = \frac{30 \times 1.00}{1000} = 0.03(00)$	1

Page 7	Mark Scheme	Syllabus	Paper
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Question	Answer	Marks
2(c)(v) and 2(c)(vi)	Correctly uses (iv) – (iii) and $\frac{0.21}{\text{(v)}} \times 2$ Answers to 3 or 4 sf <i>(minimum 4 answers attempted, allow 2 sf in (vi))</i>	1 5
2(d)(i)	Half the volume needed since 1:1 ratio/1 mole NaOH in equation	1
2(d)(ii)	(Impure) since absorbed/reacted with CO ₂ or water vapour/water from the air	1 2
	Total	15

Page 8	Mark Scheme	Syllabus	Paper
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Question	Answer				Marks
FB 5 is CH ₃ COCH ₃ FB 6 is C ₂ H ₅ OH FB 7 is C ₂ H ₅ CHO FB 8 is Cu(NO ₃) ₂					
3(a)(i)		FB 5	FB 6	FB 7	
	Acidified MnO ₄ ⁻	no reaction	Purple to colourless (solution)/(solution) turns colourless		1
	KI + ClO ⁻	(Pale) yellow/cream solid/ppt		no reaction	
	Tollens'	no reaction		Silver/black/ (dark) grey solid/ ppt/silver mirror	1
					1
3(a)(ii)	FB 5 is propanone, FB 6 is ethanol, FB 7 is propanal				1

Page 9	Mark Scheme	Syllabus	Paper
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Question	Answer	Marks
3(a)(iii)	Reagent: 2,4–dinitrophenylhydrazine/2,4–DNP(H)/Brady’s reagent Result: propanone and propanal: orange/yellow and solid/ppt (not red) ethanol: no reaction/stays yellow (allow remains colourless) or Reagent: $\text{SOCl}_2/\text{PCl}_3/\text{PCl}_5$ Result: propanone and propanal: no visible reaction/no misty fumes ethanol: steamy/misty fumes (allow white fumes) or Reagent: ethanoic acid + conc H_2SO_4 (and warm) Result: propanone and propanal: no reaction/ no sweet smell ethanol: sweet/ fruity smell or Reagent: Na Result: propanone and propanal: no reaction/ no bubbles ethanol: effervescence/ bubbling/ fizzing	1 1 or 1 1 or 1 1 or 1 1
3(a)(iv)	Reagent: Fehling’s/Benedict’s/Sandell’s Result: ethanol and propanone: no reaction/stays/turns blue propanal: orange/red/brick-red solid/ ppt	1 1 8
3(b)(i)	(Pale) blue ppt (not dark blue)	1
3(b)(ii)	Black solid	1
3(b)(iii)	Blue/green solution	1

Page 10	Mark Scheme	Syllabus	Paper
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Question	Answer	Marks
3(b)(iv)	Any two of • effervescence/bubbling/fizzing • solid goes pink/brown (allow red-brown) • blue/colour of solution fades (owtte)	1
3(b)(v)	Oxygen relights glowing splint or nitrogen dioxide is brown	1
3(b)(vi)	$\text{Cu}(\text{NO}_3)_2$	1
3(b)(vii)	$\text{Cu}^{2+}(\text{aq}) + 2\text{OH}^{-}(\text{aq}) \rightarrow \text{Cu}(\text{OH})_2(\text{s})$	1
	Total:	7 15

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1(a)	I Correct headings and units for mass of FA 1 and volume of CO₂ • Mass of container + FA 1 • Mass of container (+ residue) • Mass of FA 1 • Volume of gas Allow vol for volume but not V Units needed for all readings II Both weighings to the same number of dp and correct mass of FA 1 calculated (If initial and final volumes recorded then subtraction for volume collected must be correct.)	1 1 2
1(b)(i)	Correctly calculates $\frac{V(a)}{24.0 \times 1000}$	1
1(b)(ii)	Correct expression (i) × 100.1 or (i) × (40.1 + 12 + (3)16) Must show working	1
1(b)(iii)	Correctly uses $\frac{(ii) \times 100}{\text{mass in (a)}}$	1
	All three answers to 2 to 4 sf	1
1(c)	Any of: warm water in tub / saturate water with CO ₂ / a specific method of separation of CaCO ₃ and acid so only mixed after bung inserted / gas syringe	1
	Total	7

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Question	Answer	Marks
2(a)	I Initial and final burette readings and volume added recorded for rough titre and accurate titre details tabulated. [minimum 2 × 2 ‘boxes’ with relevant information]	1
	II Initial and final burette readings recorded and volume of FA 3 added recorded for each accurate titration. Headings and units correct for accurate titrations Headings: initial / final (burette) reading / volume or reading / volume at start / finish and volume / FA 3 added / used or titre [not difference / total] allow vol but not V 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(.0)	1
	IV Final uncorrected titre is within 0.10 cm ³ of any previous uncorrected accurate titre. <i>Do not include a reading if it is labelled rough.</i> <i>Do not award the mark if any accurate burette readings (apart from the initial zero) are given as integers.</i>	1

Page 4	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – October/November 2016	9701	35

Question	Answer	Marks
	V, VI and VII Examiner rounds any accurate burette readings to the nearest 0.05 cm^3, checks subtractions and then selects the 'best' accurate titres using the hierarchy: identical titres; titres within 0.05 cm^3; titres within 0.1 cm^3; etc., to calculate mean correct to 0.01 cm^3. Examiner uses the best titre to calculate the ratio of acid remaining after reaction with calcium carbonate in Question 1 to this best titre from Question 2 for Supervisor and each candidate. The ratio of this value for the candidate is compared to the ratio of this value for the Supervisor and marks awarded as follows. Award V, VI and VII for $0.95 - 1.05$ Award V and VI for $0.90 - 1.10$ Award V for $0.80 - 1.20$	3 7

Page 6	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – October/November 2016	9701	35

Question	Answer	Marks
2(c)(vii)	Correctly uses $[(vi) \times 100]/(\text{mass in (a)})$ to a minimum of 2 sf	1 5
2(d)	Question 1: % purity lower as loss of gas means fewer moles /less mass CaCO₃ Question 2: no change /% same as same amount of acid reacts / (amount) acid left is same	1 1 1 1 4 max 3
	Total	16

Question	Answer		Marks
FA 5 is NaNO ₃ (s); FA 6 is CuCO ₃ (s); FA 7 is NaBr(aq)			
3(a)(i)	FA 5	FA 6	
	(goes to) colourless or yellow liquid/ solution	(green) powder / solid (turns) black / black residue	1+1
	gas relights glowing splint	or gas turns limewater milky / cloudy white / chalky / forms white ppt	1
	gas (turns) brown / brown gas or solution turns blue	(pale) blue solution / liquid formed	1+1

Page 7	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – October/November 2016	9701	35

Question	Answer		Marks
3(a)(ii)–(iv)	FA 5	FA 6	
	(iii) solid dissolves / colourless solution allow no reaction / no change / no effervescence	effervescence / fizzing / bubbling and blue solution / liquid formed	1
	(iv) no reaction / no change / no ppt / remains colourless	blue ppt and insoluble in excess	1
	(v) no reaction / no change / no ppt / remains colourless	(pale) blue ppt and soluble in excess to give deep / dark blue (solution)	1
3(a)(v)	FA 5: cation unknown; anion nitrate / NO_3^- FA 6: cation Cu^{2+} / copper(II); anion carbonate / CO_3^{2-} 4 correct = 3 marks 3 correct = 2 marks 2 correct = 1 mark		1 1 1
3(a)(vi)	$\text{CuCO}_3(\text{s}) + \text{H}_2\text{SO}_4(\text{aq}) \rightarrow \text{CuSO}_4(\text{aq}) + \text{H}_2\text{O}(\text{l}) + \text{CO}_2(\text{g})$		1
3(b)(i)	Selects AgNO_3 and NH_3 Selects NaOH and Al and HCl / HNO_3 / H_2SO_4		1 1
3(b)(ii)	Clearly defined test observation conclusion sections FA 7 + AgNO_3 cream ppt partially soluble in NH_3 FA 7 is bromide / Br^- from cream ppt		1 1 1
	Total		17

CHEMISTRY

9701/36

Paper 3 Advanced Practical Skills 2

October/November 2016

MARK SCHEME

Maximum Mark: 40

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.

Page 2	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – October/November 2016	9701	36

Question	Answer	Marks
1(a)	Three masses and all temperatures recorded in a table with unambiguous headings (<i>no need to include the word mass but do not allow weight, allow t for time</i>) and correctly displayed units: / g, (g), in g (allow time in mins or minutes). Temperatures recorded to 0.5 °C. Examiner checks Supervisor's and candidate's subtraction for mass of FB2. Examiner calculates Supervisor value of $\Delta T/m$ to 1 dp and records it at the top of the accuracy grid. ($\Delta T = T_{\text{max}} - T$ at 2 minutes) Examiner calculates candidate value of $\Delta T/m$ to 1 dp and difference from Supervisor.	1 1

Supervisor ratio	<10	10–20	20>
Award III if difference is	± 2.0	± 3.0	± 4.0
Award IV if difference is	± 1.0	± 2.0	± 3.0

	Award III and IV according to above table	1 1 4
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Page 3	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – October/November 2016	9701	36

Question	Answer	Marks
1(b)	I Axes clearly labelled (headings or units) and T on y-axis. Uniform scale to use more than half of each axis including 3°C above the highest recorded temperature. II All points plotted to within half a small square and within the correct small square. <i>(Any point that is supposed to be on a line must be on the line and any point that is supposed to be within a small square must not be on a boundary line. Do not allow large dots unless the centre of the dot is correctly positioned).</i> III Appropriate lines of best fit drawn. AND either a straight line / smooth curve after the max T OR a smooth curve from 3 minutes. IV Lines extrapolated and correct value (within 0.2°C) of ΔT from graph	1 1 1 1 4
1(c)(i)	Correctly calculates energy change = $25 \times 4.2 \times \Delta T$ from (b) or correctly calculated ΔT from table	1
1(c)(ii)	Correctly uses value of energy change $\Delta H = \frac{(\text{c})(\text{i}) \times 65.4}{\text{correct mass from (a)} \times 1000}$ Negative sign and both answers recorded to 2–4 sf	1 1 3
1(d)	Correctly uses = $\frac{(\text{c})(\text{ii}) \times 100}{217}$	1 1

Page 4	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – October/November 2016	9701	36

1(e) effect	1(e) reason
maximum T would be to RHS/ gradient (to max T) less steep/longer time to the maximum T	surface area less (so reaction slower)
max T remains same	as number of amount/ moles (of zinc) is the same
max T is smaller as reaction takes longer/is slower/surface area is less	greater heat loss

Question	Answer	Marks
1(e)	stated effect reason (<i>reason must follow effect</i>)	1 1 2
	Total	14

Page 5	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – October/November 2016	9701	36

Question	Answer	Marks
2(a)	Mass of solid used between 2.20 and 2.40 g Table with correct headings / units • mass of crucible • mass of crucible + FB 3 • mass of crucible + residue / FB 3 after heating Units: /g, (g), in g, in gram(me)s Award III if % mass loss is ≥ 30 but ≤ 42 Award III and IV if % mass loss is ≥ 33 but ≤ 39	1 1 1 1 4
2(b)(i) and (ii)	Correctly calculates mass of anhydrous salt AND mass of water lost.	1
2(b)(iii)	Shows expression: $\frac{\text{mass water}}{18} \div \frac{\text{mass anhydrous}}{159.6}$ Correctly calculates, including showing working, value of x from (iii) and gives as integer	1 1
2(b)(iv)	Equation completed with x from (iii) and state symbols	1 4
2(c)(i)	(Solid) turns blue and steam / water vapour given off / temperature rises / heat released / hissing / sizzling (owtte)	1
2(c)(ii)	Anhydrous salt returns to hydrated or original formula quoted Reaction is exothermic	1 1 3

Page 6	Mark Scheme	Syllabus	Paper
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Question	Answer	Marks
2(d)	Value less than accepted value: not all water removed and heat to constant mass Value more than accepted value: (anhydrous) salt decomposes and practical method of limiting temperature / heat very gently / thermostatically controlled oven	1 1 2
	Total:	13

Page 8	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – October/November 2016	9701	36

Question	Answer	Marks
3(b)	Use of NaOH(aq) AND NH₃(aq) (as test for metal ions) AND using solution of FB 6 / using FB 6 (aq) Use of NaOH(aq) and with excess and result: white ppt soluble in excess Use of NH₃(aq) and with excess and result: white ppt soluble in excess With NaOH(aq) and heat and gas / NH₃ that turns litmus blue Cations are zinc / Zn²⁺ and ammonium / NH₄⁺	1 1 1 1 5
	Total:	13