
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.

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	31

Question	Answer	Marks	
1(a)	<p>I Correct headings and units for mass of FA 1 and volume of CO₂</p> <ul style="list-style-type: none"> • Mass of container + FA 1 • Mass of container (+ residue) • Mass of FA 1 • Volume of gas <p>Allow vol for volume but not V Units needed for all readings</p> <p>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.)</p>	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	4
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	
			1
		Total	7

Page 3	Mark Scheme	Syllabus	Paper
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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
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Question	Answer	Marks
	<p>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.</p> <p>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.</p> <p>The ratio of this value for the candidate is compared to the ratio of this value for the Supervisor and marks awarded as follows.</p> <p>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</p>	<p>3</p> <p>7</p>

Page 5	Mark Scheme	Syllabus	Paper
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Question	Answer	Marks
2(b)	<p>Check mean titre is correctly calculated from clearly selected values (ticks or working).</p> <ul style="list-style-type: none"> • 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. <p>[e.g. <i>26.667 must be rounded to 26.67</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. <i>26.0 and 26.2 = 26.1 is correct</i> <i>but 26.0 and 26.1 = 26.1 is incorrect.</i>] Do not award this mark if:</p> <ul style="list-style-type: none"> • the rough titre was used to calculate the mean; • 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 calculation of mean) are integers. <p><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></p>	1 1
2(c)(i) and (ii)	<p>Correctly calculates $\frac{0.140 \times (\mathbf{b})}{1000}$</p> <p>and same answer in (ii) and both answers to 3 or 4 sf</p>	1
2(c)(iii) and 2(c)(iv)	<p>Correctly uses (ii) $\times 10$</p> <p>and Answer = $5.(00) \times 10^{-2}$</p>	1
2(c)(v)	<p>Correctly calculates (iv) $-$ (iii)</p>	1
2(c)(vi)	<p>Correctly uses $[(\mathbf{v}) \times 100.1]/2$</p>	1

Page 6	Mark Scheme	Syllabus	Paper
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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)	<table border="1" style="width: 100%;"> <thead> <tr> <th style="width: 50%; text-align: center;">FA 5</th> <th style="width: 50%; text-align: center;">FA 6</th> </tr> </thead> <tbody> <tr> <td>(goes to) colourless or yellow liquid/ solution</td> <td>(green) powder / solid (turns) black / black residue</td> </tr> <tr> <td>gas relights glowing splint</td> <td>or gas turns limewater milky / cloudy white / chalky / forms white ppt</td> </tr> <tr> <td>gas (turns) brown / brown gas or solution turns blue</td> <td>(pale) blue solution / liquid formed</td> </tr> </tbody> </table>	FA 5	FA 6	(goes to) colourless or yellow liquid/ solution	(green) powder / solid (turns) black / black residue	gas relights glowing splint	or gas turns limewater milky / cloudy white / chalky / forms white ppt	gas (turns) brown / brown gas or solution turns blue	(pale) blue solution / liquid formed	1+1
	FA 5	FA 6								
	(goes to) colourless or yellow liquid/ solution	(green) powder / solid (turns) black / black residue								
gas relights glowing splint	or gas turns limewater milky / cloudy white / chalky / forms white ppt									
gas (turns) brown / brown gas or solution turns blue	(pale) blue solution / liquid formed									
		1								
		1+1								

Page 7	Mark Scheme	Syllabus	Paper
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Question	Answer	Marks								
3(a)(ii)–(iv)	<table border="1"> <thead> <tr> <th>FA 5</th> <th>FA 6</th> </tr> </thead> <tbody> <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> </tbody> </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 1 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)									
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								