

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.

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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 2 × 2 'boxes'</i>)	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 <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 any further titrations, within 0.1 cm³ of any other titration 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	
<p>Examiner rounds any burette readings to the nearest 0.05 cm³, checks subtractions and then selects the 'best titres' using the hierarchy:</p> <ul style="list-style-type: none">• two (or more) accurate identical titres then• two (or more) accurate titres within 0.05 cm³, then <p>two (or more) accurate titres within 0.10 cm³, etc. These best titres should be used to calculate the mean corrected titre to the nearest 0.01 cm³. Examiner calculates the difference (δ) between the mean titres obtained by the candidate and the Supervisor. Accuracy marks awarded as shown.</p>			
	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	

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	Cambridge International AS/A Level – October/November 2015	9701	33

Question	Indicative material	Mark	Total
(b)	<p>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></p> <p><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></p> <p>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.</p>	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 $M_r = 26.2 / ((c)(ii) \times 40)$	1 1	
(iv)	<p>$x = (M_r - 159.6) / 18$</p> <p>Answer to nearest positive integer with use of either 159.6 or 18 and some use of experimental data.</p>	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)	<p>I Mass of FA 4 used by candidate was between 1.80 g and 2.00 g</p> <p>II Suitable table, with unambiguous headings and correct units, in parallel columns or rows and a minimum of four balance readings entered</p> <ul style="list-style-type: none"> • 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 <p>III All balance readings (minimum 3) recorded to same dp and mass of FA 4 used and water lost correctly calculated</p> <p>IV Heating repeated until constant mass (final readings within 0.05 g for 2 dp balance and identical for 1 dp balance)</p> <p>V and VI Examiner calculates and writes % next to table</p> <p>Calculate $\frac{\text{total mass water lost} \times 100}{\text{mass FA 4}}$ to 1 dp</p> <p>Award V if % loss in range 12.8 to 16.8 Award VI if % loss in range 13.8 to 15.8</p>	<p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p>	[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)	<p>(Yes) because a greater mass used and so percentage error in weighing less.</p> <p>or</p> <p>(No) because there is more water to be lost so more spitting and frothing so percentage error in mass lost will be greater</p>	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
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(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]	