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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Question	Indicative material	Mark	Total
1 (a)	**I** Initial and final readings and titre recorded for rough titre **and** accurate titre details tabulated *(minimum 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 $\delta \leqslant 0.30\,cm^3$ Award **V** and **VI** if $0.30 < \delta \leqslant 0.50\,cm^3$ Award **V** if $0.50 < \delta \leqslant 0.80\,cm^3$. Spread penalty: if the two best titres used by the Examiner were $\geqslant 0.5\,cm^3$ apart, cancel one accuracy mark.	1 1 1	[7]

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Question	Indicative material	Mark	Total
(b)	Candidate must average two (or more) accurate titres where the **total** spread is $\leqslant 0.20\,cm^3$. 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 decimal places rounded to the nearest 0.01.* *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.* ***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 / (**(c)(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]**

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Question	Indicative material	Mark	Total
2 (a)	**I** Mass of **FA 4** used by candidate was between 1.80 g and 2.00 g	1	
	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	1	
	III All **balance readings** (minimum 3) recorded to same dp **and** mass of **FA 4** used and water lost correctly calculated	1	
	IV Heating repeated until constant mass (final readings within 0.05 g for 2 dp balance and identical for 1 dp balance)	1	
	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	[6]
(b) (i)	Correctly calculated loss in mass / mass **FA 4** to 2 – 4 sf	1	
(ii)	Correctly calculates % loss = 36 × 100 / 147.1	1	
(iii)	% purity = $\frac{\text{(i)} \times 100}{\text{(ii)}}$	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]**

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<table>
<tr><th>Question</th><th>Indicative material</th><th>Mark</th><th>Total</th></tr>
<tr><td colspan="4">FA 5 is Na_2CO_3(aq); FA 6 is H_2SO_4(aq); FA 7 is CH_3COOH(aq); FA 8 is $MnSO_4$(s) and $MgCO_3$(s)</td></tr>
<tr><td>3 (a) (i)</td><td>See table
<table>
<tr><th></th><th>FA 5</th><th>FA 6</th><th>FA 7</th></tr>
<tr><td>+ Na_2CO_3</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>+ $CuSO_4$</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>+ $BaCl_2$ / $Ba(NO_3)_2$</td><td>white ppt</td><td>white ppt</td><td>no reaction / no change / no ppt</td></tr>
</table></td><td>4</td><td></td></tr>
<tr><td>(ii)</td><td>H^+ / hydrogen ion</td><td>1</td><td></td></tr>
<tr><td>(iii)</td><td>CO_3^{2-} / carbonate</td><td>1</td><td></td></tr>
<tr><td>(iv)</td><td>$Cu^{2+}(aq) + CO_3^{2-}(aq) \rightarrow CuCO_3(s)$</td><td>1</td><td>[7]</td></tr>
</table>

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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_2O_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_2O_2 / disproportionation allow oxidation of Mn^{2+} / oxidation or reduction of H_2O_2	1	[8]
Qn 3		**Total**	**[15]**

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