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CAMBRIDGE INTERNATIONAL EXAMINATIONS

Cambridge International Advanced Subsidiary and Advanced Level

MARK SCHEME for the May/June 2015 series

9701 CHEMISTRY

9701/31 Paper 3 (Advanced Practical Skills 1), maximum raw mark 40

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Question	Indicative material	Mark	Total
1 (a)	**I** Initial and final burette readings and titre unambiguously recorded in rough and accurate titrations. *Minimum of 2 × 2 boxes for accurate.*	1	
	II Headings and units correct for accurate titration and headings match readings. *Headings: initial / final (burette) reading / volume or Reading / volume / vol / value at start / finish* ***and*** *Volume / vol /* ***FA*** *1 added / used or titre [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 (initial and final) recorded to 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)*	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 that is more than 0.1 cm^3 from the closer of the two initial titres unless further titrations within 0.1 cm^3 of any other has 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 all all burette readings to the nearest 0.05 cm^3 and checks subtractions. Examiner selects the 'best' titres using the hierarchy: two (or more) identical, then two (or more) within 0.05 cm^3 , then two (or more) within 0.1 cm^3, etc.			

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Question	Indicative material	Mark	Total
	Award **V**, **VI** and **VII** if $\delta \leqslant 0.20\,cm^3$ Award **V** and **VI** if $0.20 \leqslant \delta \leqslant 0.40\,cm^3$ Award **V** if $0.40 \leqslant \delta \leqslant 0.60\,cm^3$ *Spread penalty: if the two 'best' titres used by the examiner are more than 0.50 cm^3 apart cancel one of the Q marks.*	1 1 1	[7]
(b)	Calculation of mean Candidate must average two (or more) titres that are **all** within $0.20\,cm^3$. 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 dp rounded to the nearest 0.01. Example: 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 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.*	1	[1]
(c)(i)(ii)	**I** Correctly calculates $\frac{0.0200 \times (b)}{1000}$ in step **(i)** **and** $\times$ 5 in **(ii)**	1	
(iii)	**II** Expression **(ii)** / 0.025	1	
(iv)	**III** Expression **(iii)** $\times$ 392.0 (or addition of A_rs shown)	1	
	IV Answers to **(i)** to **(iv)** given to 3 or 4 sf (min 3 answers needed)	1	[4]
Qn 1	**Total**	**[12]**	

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Question	Indicative material	Mark	Total
2 (a)	**I** Table with unambiguous headings and correct units All readings must be included.	1	
	II All temperatures recorded to .0 or .5 °C. Must include at least one ending in .0 and one ending in .5.	1	
Examiner calculates candidate's ΔT max from table.			
	III Award if the difference between candidate and Supervisor is within 4.0 °C	1	
	IV Award if the difference between candidate and Supervisor is within 2.0 °C	1	[4]
(b) (i)	Axes labelled temperature or *T* or °C or temperature and time or minutes or min or t. Linear scales chosen to use more than half of each axis and to include 5 °C more than the maximum temp.	1	
	All points recorded (minimum of 10). Correct plotting – each point accurately plotted (within ½ small square and in the correct square).	1	
(ii)	All three straight lines drawn	1	
	Lines of best fit and extrapolated	1	
(iii)	Correct ΔT from graph to within .2 °C of examiner value using the candidate's lines.	1	[5]

Question	Indicative material	Mark	Total
(c) (i)	Correct answer to 4.2 × 40 × ans**(b)(iii).** Allow answers to 2 –4 sf	1	
(ii)	Correct answer to **(i)** / 219000 Allow answers to 2–4 sf	1	
(iii)	Expression **(ii)** / 0.040 Allow answers to 2–4 sf	1	[3]
(d) (i)	Correct answer correct to number of sf shown (min 2 sf): 0.5 / highest temp × 100	1	
(ii)	Do not agree as the zinc is in excess	1	
(iii)	Incorrect as temperature rise is the same **or** Incorrect as (a smaller volume) has a greater % error ORA	1	[3]
Qn 2	**Total**	**[15]**	

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Question	Indicative material	Mark	Total
	FA 5 is $(NH_4)_2Fe(SO_4)_2(aq)$; **FA 6** is $CuCO_3 + MgSO_4.7H_2O$		
3 (a)	Fizzing	1	
	Acid or any named acid	1	[2]
(b)(i)–(vi)	In **(i)** (solid goes from green) to black / grey	1	
	In **(i)** condensation / water / water vapour / steam / steamy fumes	1	
	In **(ii)** fizzing **and** forms a (light) blue solution .	1	
	Cloudy with limewater in **(i)** or **(ii)** or **(a)**	1	
	In **(ii)** blue ppt with sodium hydroxide and insoluble in excess.	1	
	Any **2** from: In **(iv)** white ppt insoluble in excess	1	
	In **(v)** white ppt insoluble in excess In **(vi)** white ppt	1	
(vii)	Cation: Cu^{2+}	1	
	Cation: Mg^{2+}	1	
	Anions: CO_3^{2-} **and** SO_4^{2-} **and** SO_3^{2-}	1	
(viii)	Selects acid/ named acid to add to test **(vi)** (**not** H_2SO_4) **or** Selects named acid to add to **FA 6 and** tests with $H^+/Cr_2O_7^{2-}$ or H^+/MnO_4^- **and** SO_4^{2-} insoluble and SO_3^{2-} soluble **or** SO_4^{2-} no change and SO_3^{2-} (orange) turns green or (purple) turns colourless	1	[11]
Qn 3	**Total**	**[13]**	

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