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Cambridge International Advanced Subsidiary and Advanced Level

MARK SCHEME for the October/November 2015 series

9701 CHEMISTRY

9701/34 Paper 3 (Advanced Practical Skills 2), maximum raw mark 40

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Question	Indicative material	Mark	Total
1 (a)	**I** The following readings are recorded • mass of Mg used • two burette readings and the titre for the rough titration • initial **and** final burette readings for **two** (or more) accurate titrations	1	
	II Titre values recorded for accurate titrations and appropriate headings for the accurate titration table **and** cm^3 units. • initial / start (burette) reading / volume • final / end (burette) reading / volume • titre **or** volume / **FB 2 and** used / added *(not "difference"or "total")* • unit: / cm^3 ***or*** (cm^3) ***or*** in cm^3 (for each heading) *If cm^3 units are not given in the headings, every entry in the table must have the correct unit.*	1	
	III All accurate burette readings are 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 There are two uncorrected **accurate** titres within 0.10 cm^3 • *Do **not** award this mark if, having performed two titres within 0.10 cm^3, a further titration is performed which is more than 0.10 cm^3 from the closer of the initial two titres, **unless** a further titration, within 0.10 cm^3 of any other, has also been carried out.* • *Do **not** award the mark if any "accurate" burette readings (apart from initial 0 cm^3) are given to **zero** dp*	1	
	Examiner checks and corrects titre subtractions where necessary. Examiner 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 are used to calculate the mean titre, expressed to nearest 0.01 cm^3. Examiner calculates the difference (δ) between the mean titres obtained by the candidate and the Supervisor. Accuracy marks are awarded as shown.		

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Question	Indicative material	Mark	Total
	Award **V**, **VI** and **VII** if $\delta \leqslant$ **0.50** cm^3 Award **V** and **VI** if **0.50 <** $\delta \leqslant$ **1.00** cm^3 Award **V**, only, if **1.00 <** $\delta \leqslant$ **1.50** cm^3 **Spread penalty**: if the two "best" (corrected) titres used by the Examiner were $\geqslant 0.50\,cm^3$ apart, cancel **one** accuracy mark.	3	[7]
(b)	Candidate must take the average of two (or more) titres that are within a total spread of not more than $0.20\,cm^3$. Working / explanation 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 nearest $0.01\,cm^3$. *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 correct even if it was different from the mean calculated by the Examiner for the purpose of assessing accuracy.*	1	[1]
(c) (i)	mol NaOH = $0.120 \times {}^{25.0}/_{1000} = 0.003(00)$	1	
(ii)	• $NaOH + HCl \rightarrow NaCl + H_2O$ • Answer to **(ii)** must be the same as in **(i)**	1	
(iii) + (iv)	Correct **expressions** required in both **(iii)** and **(iv)** (*Correct expression = correct figures shown*) **(iii) :** no moles of HCl (in $250\,cm^3$) = **(ii)** $\times {}^{250}/_{\textbf{(b)}}$ **(iv) :** no moles of HCl (in $25.0\,cm^3$) = $2.00 \times {}^{25.0}/_{1000}$ (= 0.05)	1	
(v)	Correct expression: Mol HCl used = **(iv) – (iii)**	1	
(vi)	Equation **and** correctly calculates answer for number of moles Mg: • $Mg(s) + 2HCl(aq) \rightarrow MgCl_2(aq) + H_2(g)$ • No of moles Mg = $0.5 \times$ **(v)**	1	
(vii)	$A_r = {}^{\text{mass of Mg used}}/_{\textbf{(vi)}}$	1	[6]
(d) (i)	All solid / magnesium dissolved / disappeared / reacted (owtte) **or** indicator turned from blue to yellow when **FB 2** added (to alkali)	1	
(ii)	(If 1.0 g Mg is used) Mg would be in excess / acid would be the limiting reagent / all the acid would be used up	1	

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Question	Indicative material	Mark	Total
	Reference to moles of both acid and Mg (or other correct calculation) Calculation to show that Mg would be in excess n(Mg) = $^{1}/_{24.3}$ = 0.041 mol (allow $^{1}/_{24}$ or $^{1}/_{\text{(c)(vii)}}$) n(HC*l*) needed = 0.082 mol or only 0.05 mol present	1	
Qn 1		**Total**	**[17]**

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Question	Indicative material	Mark	Total
2 (a)	**I** Table / list of data, showing the following: • five unambiguous / clear headings *accept 'mass of ...' or '... / g' (**not** 'weight')* *accept "mass of crucible + **FB 4** after heating"* *ignore omission of the crucible lid* • three balance readings, with unit shown at least once • mass of water (***or*** mass lost) • mass of residue *(owtte)* • all calculations must be correct *All data must be written in the space provided*	1	
	Examiner should check calculations of masses of water and anhydrous $MgSO_4$. Examiner calculates the ratio $^{\text{mass of water lost}}/_{\text{mass of residue}}$ to 2 dp The theoretical value is 1.0465...Marks awarded for accuracy as shown.		
	Award **II** if the ratio is between 0.80 and 1.15 (inclusive) Award **III** if the ratio is between 0.95 and 1.10	2	[3]
(b) (i)	Correctly calculates to 2 – 4 sf Number of moles = $^{\text{mass loss}}/_{18}$	1	
(ii)	Correctly calculates to 2 – 4 sf Number of moles of anhydrous $MgSO_4$ = $^{\textbf{(i)}}/_{7}$	1	
(iii)	Working / expression for M_r and answer of the correct magnitude given to 2 – 4 sf M_r = $^{\text{mass of residue}}/_{\textbf{(ii)}}$	1	
(iv)	Correctly calculates relative atomic mass: A_r = **(iii)** – 96.1	1	[4]
(c) (i)	Reheat solid / residue to **constant mass**.	1	
(ii)	To prevent absorption of water (vapour)	1	[2]
Qn 2		**Total**	**[9]**

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Question	Indicative material	Mark	Total
	FB 5 is $MgCl_2(aq)$; **FB 6** is $Zn(NO_3)_2(s)$		
3 (a)	Two reagents needed • sodium hydroxide • barium chloride / barium nitrate Observations: • NaOH – white precipitate, insoluble in excess • Barium ions – no precipitate / no change / no reaction Conclusions: • Mg^{2+} / magnesium (ion) is present **and** • SO_4^{2-} / sulfate (ion) is **not** present	1 1 1 1	[4]
(b) (i)	Heating **FB 6**: look for the following **nine** observations • (on gentle heating) solid melts / dissolves / turns to liquid / solution • liquid is colourless • bubbling / fizzing / effervescence / boiling • steam / (water) vapour given off / misty fumes / condensation formed • (when strongly heated), brown gas / fumes • yellow solid / residue formed • (gas) relights a glowing splint • gas turns (blue) litmus red (ignore bleaching) • white / cream / paler (yellow) solid / residue *Award marks as shown.* • *5 observations correct = 4 marks* • *4 observations correct = 3 marks* • *3 observations correct = 2 marks* • *2 observations correct = 1 mark*	4	

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Question	Indicative material	Mark	Total
(ii)	Observations with $AgNO_3$ and H_2SO_4 No reaction / no change in **both**	1	
	With NH_3 – white precipitate soluble in excess	1	
	With **cold** NaOH – white precipitate soluble in excess	1	
	With **hot** NaOH – no reaction / no gas produced / (gas) did **not** turn red litmus blue	1	
	With NaOH + A*l* (gas) turns (damp red) litmus blue	1	
(iii)	Identification – **FB 6** is $Zn(NO_3)_2$	1	[10]
Qn 3		**Total**	**[14]**

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