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Cambridge International Advanced Subsidiary and Advanced Level

MARK SCHEME for the October/November 2014 series

9701 CHEMISTRY

9701/35 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 readings and titre value given for rough titre **and** initial and final readings for two (or more) accurate titrations (*minimum of 2 × 2 box*)	1	
	II Appropriate headings and units for accurate titration **and** volume **FA 2** added recorded for each accurate titre. Headings should match readings. • initial / start (burette) reading / volume (not V or vol) • final / end (burette) reading / volume • titre **or** volume / **FA 2 and** used / added (*but not "difference"*) unit: / cm^3 or (cm^3) or in cm^3 or cm^3 for each entry	1	
	III **All** accurate burette readings recorded to 0.05 cm^3. *The need to record to 0.05 applies only to the burette readings and **not** to the recorded titres.* *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 consider the 'rough' even if ticked.* *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 titration 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	
	Round any burette readings to the nearest 0.05 cm^3. Check and correct subtractions for Supervisor and candidate. Examiner then selects the "best" titre 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. Examiner compares candidate mean titre with Supervisor mean titre.		
	V, **VI** and **VII** Award **V**, **VI** and **VII** for a difference from Supervisor, $\delta \leqslant 0.20\ cm^3$ Award **V** and **VI** for $0.20\ cm^3 < \delta \leqslant 0.40\ cm^3$ Award **V only** for a difference of $0.40 < \delta \leqslant 0.60\ cm^3$ ***Spread penalty**: if the 'best' titres are > 0.50 cm^3 apart cancel one of the Q marks.*	3	[7]

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(b)	**Calculation of mean** • Candidate must average two (or more) titres where the total spread is $<0.20\,cm^3$. • 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**, and be correctly rounded to the 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 as correct even if it is different from the mean calculated by the examiner for the purpose of assessing accuracy.*	1	[1]
(c) (i)	Correct **working** shown $\frac{0.110 \times \text{mean titre}}{1000}$ in step **(i)**	1	
(ii)	Balanced equation with added state symbols $Na_2CO_3(aq) + \mathbf{2}HNO_3\mathbf{(aq)} \rightarrow \mathbf{2}NaNO_3\mathbf{(aq)} + CO_2\mathbf{(g)} + H_2O\mathbf{(l)}$	1	
(iii) and (iv)	Correctly calculates moles Na_2CO_3 (in $25\,cm^3$) = $\frac{1}{2} \times$ **(i)** **and** moles Na_2CO_3 (in $250\,cm^3$) = $10 \times$ **(iii)**	1	
(v)	Correctly calculates $M_r = \frac{150.0}{4 \times \textbf{(iv)} \times 10}$ or $(3.75 / \textbf{(iv)})$ *Theoretical answer = 286*	1	

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(vi)	Correctly calculates **x** to the nearest integer. $\mathbf{x} = \frac{\mathbf{(v)} - 106}{18}$ *Allow ecf* Answers to **(i)**, **(iii)**, **(iv)** and **(v)** shown to 3 or 4 sf. *Minimum of 3 answers needed to qualify for the mark.* ***All** answers given must have correct sf.*	1 1	[6]
(d) (i) and (ii)	$0.05\,\text{cm}^3$ $\% = \frac{0.1 \times 100}{\text{accurate titre}}$ *Allow **any** accurate titre to be used (but not the mean).*	1	[1]
			[Total: 15]
2 (a)	Correct headings **and** units • mass of container and **FA 4** / solid • mass of container (empty / plus residue) • mass of **FA 4** (used) • initial temperature / thermometer reading • maximum / highest temperature / final / thermometer reading / temp. / T • temperature rise	1	
(a) and (c)	All four weighings shown to <u>same</u> number of dp	1	
(a)	Check and correct subtractions of Supervisor and candidate. Calculate difference between (corrected) candidate's and Supervisor's temperature rise, δ. Award if $\delta \leqslant 1.0\,°C$ If ΔT is $< 6.5\,°C$ only award if $\delta < 0.5\,°C$.	 1	[3]
(b) (i)	Correctly calculates: energy produced = $25 \times 4.2 \times$ temp rise (to 2–4 sf)	1	
(ii)	Correctly calculates moles of **FA 4** = $\frac{\text{mass used}}{106}$ *Answer must be expressed to 2–4 sf*	1	

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(iii)	Correct **expression**: $\Delta H = -\frac{\textbf{(i)}}{\textbf{(ii)} \times 1000}$ *Negative sign must be shown in answer.* *Answer must be expressed to 2–4 sf*	1	[3]
(c) and (a)	All four thermometer readings shown to .0 °C or .5 °C Examiner calculates difference between (corrected) candidate's and Supervisor's temperature fall, δ. If δ <2.0 °C award one mark. If ΔT is <9.5 °C only award if δ < 1.5 °C. If ΔT is<6.5 °C only award if δ <1.0 °C. If ΔT is<3.5 °C only award if δ <0.5 °C.	1 1	[2]
(d) (i) and (iii)	Correct **expressions** Energy absorbed = 25 × 4.2 × temp fall **and** $\Delta H = +\frac{\textbf{(i)}}{\textbf{(ii)} \times 1000}$ (*sign needed in final answer*)	1	
(ii)	Correct expression for number of moles No. of moles = $\frac{\text{mass of } \textbf{FA 5}}{Mr}$ where M_r = 106 + 18**x** (**x** is candidate's own value, or 8)	1	[2]
(e)	Attempt at use of Hess's law, either by cycle or reverse reaction 2 Correctly calculates $\Delta H_{(\text{dehydration})}$ ΔH = **(d)(iii)** – **(b)(iii)**	1 1	[2]

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(f)	Accept **one** of the following answers • Agree – acid spray is reduced (since reaction will be slower) / smaller T rise so less heat loss / larger volume so volume measurement more accurate • Disagree – smaller temperature change, so higher (percentage) error of reading / reaction slower so **more** heat loss.	1	[1]
			[Total: 13]
	FA 7 is $Al_2(SO_4)_3$ + NaCl; **FA 8** is $MgCO_3$ + KI; **FA 9** is $(NH_4)_2Fe(SO_4)_2$		
3 (a) (i)	**Both** observations with HNO_3 recorded correctly **FA 7** no reaction / no change / dissolves **FA 8** fizzing **or** (gas) turns limewater milky	1	
(ii) or (iii)	**FA 7** + NaOH: white ppt, soluble in excess **or** **FA 7** + NH_3: (faint) white ppt, insoluble in excess	1	
(iv)	**FA 7** + $Ba(NO_3)_2$: white ppt (insoluble in acid) **and** **FA 8** + $Ba(NO_3)_2$: no ppt / no change / no reaction	1	
(v)	**FA 7** + $AgNO_3$: white ppt, soluble in ammonia **and** **FA 8** + $AgNO_3$: yellow ppt, insoluble in NH_3 *All four correct observations required.*	1	

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(vi)	<u>cation</u> cation is aluminium / Al^{3+} **and** white ppt with NH_3 insoluble in excess <u>anions</u> **FA 7** anions: sulfate and chloride / SO_4^{2-} and Cl^- **FA 8** anions: carbonate and iodide / CO_3^{2-} and I^- All four identities correct = 2 marks Any 2 or 3 identities correct = 1 mark	1 1 1	[7]
(b) (i)	Any **two** observations correct = 1 mark Any **three** (or more) correct = 2 marks • **FA 9** is (pale) green • steam / vapour / condensation / water / liquid • litmus turns blue • yellow / white / brown residue / formed • white smoke (produced on strong heating) • litmus turns red on strong heating	2	
(ii)	Uses NaOH as reagent With NaOH **or** NH_3 (dark / dirty) green ppt formed **and** Fe^{2+} identified. With NaOH and heat gas / ammonia turns litmus blue **and** NH_4^+ identified	1 1 1	[5]
			[Total: 12]

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