CAMBRIDGE INTERNATIONAL EXAMINATIONS

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

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 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]

(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 $25\,cm^3$) = $\frac{1}{2}$ × **(i)** **and** moles Na_2CO_3 (in $250\,cm^3$) = 10 × **(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	

(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	

(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]

(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	

(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]