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Cambridge International Advanced Subsidiary and Advanced Level

MARK SCHEME for the May/June 2015 series

9701 CHEMISTRY

9701/33 Paper 3 (Advanced Practical Skills 1), maximum raw mark 40

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Question	Indicative material	Mark	Total
1 (a)	**I** The following data must be shown • burette readings ***and*** titre for rough titration • 2 × 2 "box" showing both accurate burette readings	1	
	II Headings and units correct for accurate titration table and headings match readings. • initial / start (burette) reading / volume + unit • final / end (burette) reading / volume + unit • titre ***or*** volume / **FA 1** used / added *(not "difference" or "total")* + unit *Units: (cm^3) or / cm^3 or in cm^3 or cm^3 by every entry*	1	
	III All accurate burette readings to 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 Two accurate titres within 0.10 cm^3. *Do **not** award if 3rd titre > 0.10 cm^3 away from either previous titre unless a further titration is also carried out which is within 0.1 cm^3 of any other.* *Do **not** award the mark if any 'accurate' burette readings (apart from initial 0) are given to **zero** dp.*	1	
Examiner checks and corrects titre subtractions where necessary. Examiner selects the best mean titre using a hierarchy: *two identical titres within 0.05 cm^3, two or more titres within 0.10 cm^3 etc.* *Examiner subtracts (corrected) candidate's titre from Supervisor's titre.*			
	Award **V**, **VI** and **VII** if $\delta < 0.20$ cm^3 Award **V** and **VI** if $0.20 < \delta < 0.30$ cm^3 Award **V** if $0.30 < \delta < 0.50$ cm^3 *Spread penalty: if the two 'best' titres are ⩾ 0.50 cm^3 apart, cancel one of the Q marks*	1 1 1	[7]

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(b)	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 titres selected. The mean should normally be quoted to 2 dp 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)(ii)	Correctly calculates $\frac{0.1\times 25}{1000} = 2.5(0)\times 10^{-3}$ **and** **(ii)** = **(i)**	1	
(iii)	Correctly calculates $\frac{(\mathbf{c})(\mathbf{ii})\times 1000}{(\mathbf{b})}$	1	
(iv)	Correct expression $\frac{13.1}{(\mathbf{iii})}$ or correct answer if no working	1	
	All answers to **(iii)** and **(iv)** are given to 3 or 4 sf *(minimum of 3 parts attempted)*	1	[4]
(d)	If candidate titre < 28.30 cm^3, student's M_r larger as smaller **concentration** / molarity / moles in 1 dm^3 of **HA** / **FA 1** than candidate (for same mass) If candidate titre > 28.30cm^3, reverse argument to above If candidate titre = 28.30cm^3 no change / no difference in M_r as concentration same as HA / **FA 1** (owtte)	1	[1]
Qn 1			**[13]**

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Question	Indicative material	Mark	Total
2 (a)	**I** Table for 10 sets of results with unambiguous headings and correctly displayed units **or** table for 9 sets of results with separate line for initial *T* **or** table for 9 sets of results with column for initial *T*.	1	
	II All volumes (apart from 0) recorded to 1 or 2 dp and all temperatures to 0.0 or 0.5 ºC. *At least one thermometer reading should be recorded to 0.5 ºC.* *(Minimum 8 readings)*	1	
	Examiner to calculate Supervisor's and candidate's maximum ΔT. *Calculate the difference between the two values.*		
	III and **IV** awarded dependant on comparability between Supervisor's and candidate's ΔT value.	1 1	[4]
(b)	**I** Linear scales chosen so that graph occupies more than half the available length for both axes (including extra 2 ºC for *y*-axis). **and** axes correctly labelled	1	
	II All points recorded accurately plotted (within ½ small square and in the correct square, those on lines must be correctly centred). (*If blobs shown then they must be correctly centred.*)	1	
	III Two lines of best fit drawn – one for increasing temperature and one for decreasing temperature. (*Allow a best fit (balanced points) straight line even if a smooth curve is more suitable for either or both.*)	1	
	IV Correct ΔT using correct readings from graph (T_{max} to within 0.2 ºC of examiner value) **and** correct V recorded from the **intersection** on graph (to within 0.5 cm^3) ($T_{initial}$ *may come from table or from graph plot or intercept on y-axis.*)	1	[4]
(c) (i)	Correctly calculates $\frac{1.80 \times V(\mathbf{b})}{1000}$ to minimum 2 sf	1	
(ii)	Correctly calculates (25 + V**(b)**) x 4.2 $\times \Delta T$ to min 2sf	1	
(iii)	Correct expression $\frac{(\mathbf{c})(\mathbf{ii})}{(\mathbf{c})(\mathbf{i}) \times 1000}$	1	

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	Answer given to 2 to 4 sf with negative sign	1	[4]
(d)	Correctly calculates $\frac{1.0\times100}{\Delta T(\mathbf{b})}$ to minimum 2 sf	1	[1]
(e)	Safety – to prevent plastic cup tipping over / greater stability **or** (Reduce) heat loss – **air** jacket / **air** trapped (owtte)	1	[1]
(f)	Use burette / pipette for **FA 4** / instead of measuring cylinder. **or** Use smaller volumes **close to max T**	1	[1]
Qn 2			**[15]**

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Question	Indicative material	Mark	Total
	FA 5 = $(CO_2)_2Na_2$(s); **FA 6** = $(NH_4)_2Fe(SO_4)_2.6H_2O$(s)		
3 (a)	**(i)** purple / pink (solution) turns colourless / (potassium) manganate(VII) turns colourless / decolourises / purple (colour) disappears	1	
	(ii) (gas) turns (damp) (red) litmus blue / litmus goes blue **Either** condensation / liquid / water (further up tube) / water vapour / steamy fumes (***not*** *white fumes*) **or** (green solid / contents of tube / **FA 6**) turn(s) white / (light) brown *Allow yellow but not bright yellow.* *Do not allow dark brown.*	1 1	
	(iv) green ppt insoluble in excess (*Green may be qualified by intensity but not by hue – allow light / dark / dirty green but not grey–green / blue–green.*) turning brown (in air)	1 1	
	(v) white ppt insoluble in acid *Allow white ppt insoluble if "insoluble" clearly a separate line near bottom of box / next to adding acid.*	1	
	(vi) **solution** turns yellow	1	
	(vii) ammonium / NH_4^+ from correct observation in **(ii)** (*red litmus turns blue / ammonia produced / ...*) iron(II) / Fe^{2+} **and** sulfate / SO_4^{2-}	1 1	[9]
(b)	**(i)** Selects NH_3 / NaOH **or** (acidified) $KMnO_4$	1	
	(ii) green ppt **or** purple / $KMnO_4$ decolourised / solution turns yellow (*Allow solution turns orange / orange–brown / yellow–brown*)	1	
	Student incorrect / cation not oxidised as still iron(II) (owtte) **or** Student incorrect / cation not oxidised as oxidation occurs with $KMnO_4$ (if used) If brown ppt in **(ii)** with alkali allow student correct as now Fe^{3+} **or** if purple not decolourised allow student correct as already oxidised. (*Allow (acidified) potassium dichromate / $K_2Cr_2O_7$ as reagent and orange to green in obs and conclusion analogous to that for $KMnO_4$.*)	1	[3]
Qn 3			**[12]**

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