CAMBRIDGE INTERNATIONAL EXAMINATIONS

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

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.

Cambridge will not enter into discussions about these mark schemes.

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CAMBRIDGE
International Examinations

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]

(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	[4]
(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	
(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]**

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 °C. *At least one thermometer reading should be recorded to 0.5 °C.* *(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 °C 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 °C 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	

	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]**

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]**