CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the May/June 2013 series

9701 CHEMISTRY

9701/33 Paper 33 (Advanced Practical Skills), 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.

Cambridge is publishing the mark schemes for the May/June 2013 series for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level components and some Ordinary Level components.

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Question	Sections	Indicative material	Mark	Total
1 (a)	PDO Recording	Table completed and all temperatures recorded to 0.5 °C; must include initial T and at least one of the nine readings must be .5 (others .0) or vice versa.	1	
	MMO Decision	Suitable choice of volumes (**FA 2** + water = 35 cm^3): one either side of maximum or two between maximum and one of the values differing by 5 cm^3. If 'max' at 35 then allow 2 between 30 & 35 or allow two volumes > 35. (ignore water volume)	1	[2]
(b) (i)	PDO Layout	Scales chosen so that graph occupies more than half the available length for *x*- and *y*-axis and axes labelled volume/cm^3 or **FA 2**/cm^3 and temperature/°C (or brackets).	1	
	PDO Layout	**All** points plotted to within half a small square. (6 min)	1	
(ii)	PDO Layout	Two appropriate/sensible best fit lines drawn – must intersect at or above max temperature.	1	
(iii)	ACE Interpret-ation	ΔT calculated from graph.	1	
	MMO Quality	Award if ΔT within 1.0 °C of Supervisor.	1	[5]
(c) (i)	PDO Display	Shows $Q = 60 \times 4.3 \times \Delta T$	1	
(ii)	ACE Interpret-ation	Moles = $\frac{25 \times 0.950}{1000}$ = 0.024 (0.0238 or 0.02375)	1	
(iii)	ACE Interpret-ation	Correctly calculates enthalpy change, including sign, to 2–4 sf $= - \frac{\textbf{(c)(i)}}{1000 \times \textbf{(c)(ii)}}$	1	[3]
				[Total: 10]

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2 (a)	PDO Layout	**I** Volume given for rough titre **and** accurate titre details tabulated. (Minimum 2 × 2 boxes)	1	
	MMO Collection	**II** Initial and final burette readings recorded for rough titre **and** volume of **FA 4** added recorded for each accurate titre. Headings and units correct for accurate titration.	1	
	PDO Recording	**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(.0).*	1	
	MMO Decisions	**IV** Has two uncorrected accurate titres within 0.1 cm^3. Do not award if, having performed two titres within 0.1 cm^3, a further titration is performed that is more than 0.1 cm^3 from the closer of the original 2 titres unless a further titration has been carried out which is within 0.1 cm^3 of any others. Do not award if titres from burette readings to no dp are used (apart from use of 0 for initial reading).	1	
Examiner rounds any accurate burette readings to the nearest 0.05 cm^3, checks subtractions and then selects the 'best' titres for Supervisor and candidate using the hierarchy: *two identical; titres within 0.05 cm^3; titres within 0.1 cm^3; etc.* to calculate mean correct to 0.01 cm^3. Examiner compares candidate mean titre with Supervisor mean titre.				
	MMO Quality	**V, VI** and **VII** Award **V**, **VI** and **VII** for $\delta \leq 0.20\ cm^3$ Award **V** and **VI** for $0.20\ cm^3 < \delta \leq 0.40\ cm^3$ Award **V** for $0.40\ cm^3 < \delta \leq 0.60\ cm^3$ *Apply **spread penalty** as follows:* *If best titres are ≥ 0.50 cm^3 cancel one of the Q marks.*	3	[7]

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(b)	ACE Interpret-ation	Mean titre is correctly calculated from clearly selected values (ticks or working). Candidate must average two (or more) titres that are within 0.20 cm^3 of each other. 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 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 eg 26.325;* *allow mean to 1 dp if **all** accurate burette readings were given to 1 dp and the mean is exactly correct. eg 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)	ACE Interpret-ation	Correctly calculates $\frac{0.095 \times \textbf{(b)}}{1000}$ to 3 or 4 sf.	1	
(ii)	ACE Interpret-ation	Correctly calculates $\frac{\textbf{(c)(i)}}{2}$ to 3 or 4 sf		
(iii)		**and** $\frac{\textbf{(c)(ii)} \times 1000}{25.0}$ to 3 or 4 sf (*do not penalise sf twice*).	1	
(iv)	ACE Interpret-ation	$A_r = \frac{[6.90/\textbf{(c)(ii)}] - 60}{2}$ calculated to 0–2 dp	1	
(v)	ACE Conclusion	Corresponding identity of **M** (must be Group 1) *(can be from negative number – ignore sign).*	1	
	PDO Display	Working in the correct direction shown in at least 3 stages in **(i)**, **(ii)**, **(iii)** and **(iv)**.	1	[5]

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(d) (i)	ACE Interpret-ation	(Titration more accurate) because temperature rises are small **or** titration apparatus/burette/pipette is more accurately calibrated or more precise or lower % error or is more accurate than measuring cylinder (*ora* for measuring cylinder) **or** the indicator gives an exact/precise end point but measuring temperature rise does not.	1	
(ii)	ACE Improve-ment	use more volumes near the maximum ΔT **or** use burette/pipette **or** better insulation/use of lid **or** use more accurately calibrated thermometer **or** increase concentration(s) **or** measuring initial T of solutions for each expt carried out	1	[2]
				[Total: 15]

FA 5 is $ZnCO_3$ + NaBr; **FA 6** is $NaNO_2$; **FA 7** is Na_2SO_4				
3 (b) (i)	MMO Collection	Effervescence / fizzing / bubbling or gas (evolved) **which turns limewater milky**.	1	
(ii)	MMO Collection	White precipitate, dissolves in excess sodium hydroxide.	1	
	ACE Conclusion	Zn^{2+}, $A\ell^{3+}$ and Pb^{2+} *Allow zinc, aluminium, lead* no ecf.	1	
(iii)	MMO Decisions	Suitable pair of reagents chosen to distinguish between the 3 expected ions (NH_3 + one other).	1	
	PDO Display	Six correct theoretical results for the three ions. *Allow* '--' *for no reaction* Award one mark if one set of theoretical results match the given reagent (ie mark horizontally or vertically) **ecf possible** from observations in **(ii)** (for 1 mark) as pairs require a single reagent Mg^{2+} and Ca^{2+} **if** white ppt insoluble in excess in **(ii)**; Ba^{2+} and NH_4^+ **if** no ppt obtained in **(ii)**; two out of the correct three ions are chosen	1	

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reagent	Zn^{2+}	Al^{3+}	Pb^{2+}
aqueous NH_3	white ppt soluble in excess	white ppt insol in excess	white ppt insol in excess
aqueous KI	no reaction/sol	no reaction/sol	yellow ppt/insol
aq named sulfate	no reaction/sol	no reaction/sol	white ppt/insol
aq named chromate	no reaction/sol	no reaction/sol	yellow ppt/insol
aq named chloride	no reaction/sol	no reaction/sol	white ppt/insol

reagent	Mg^{2+}	Ca^{2+}
aqueous NH_3	white ppt insoluble in excess	no ppt
allow aq named SO_4^{2-}	no reaction	white ppt
reagent	Ba^{2+}	NH_4^+
aq NaOH + heat	no reaction	NH_3 given off/gas turns red litmus blue
or aq named SO_4^{2-}	white ppt	no reaction

(iii) cont.	MMO Collection	Practical results: *(independent of earlier work)* White ppt soluble in excess NH_3 (ignore 2nd reagent)	1	
	ACE Conclusion	cation is Zn^{2+}/zinc *(allow from ppt soluble in excess – no mention of white)*	1	[7]
(c)	MMO Collection	Cream ppt with silver nitrate **and** ppt partially dissolves with ammonia/ insoluble in ammonia/ soluble in conc. NH_3.	1	
	ACE Conclusion	**bromide/Br^-** ecf from off-white or qualified cream ppt with $AgNO_3$	1	[2]
(d)	ACE Conclusion	carbonate/CO_3^{2-} (candidate must have 'gas' in **(b)(i)**)	1	[1]
(e) (i)	MMO Collection	1 for each correct horizontal row or vertical column	3	

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test	**FA 6**	**FA 7**
A*l* + NaOH	ammonia/gas turns (damp) red litmus blue	no reaction / dash (ignore gases evolved unless turns red litmus blue or other con)
Ba^{2+}	no reaction	white ppt
acid	allow (brown) gas/ effervescence	ppt insol/no change / no reaction (not dash)
HC*l*	brown gas / blue solution	no reaction / no change / dash

(ii)	ACE Conclusion	**FA 6** contains NO_2^- minimum evidence needed is (brown) gas produced with acid (may be in 2nd or 3rd test) **FA 7** contains SO_4^{2-} (*from correct obs with Ba^{2+} + HC*l*)*	1	
(iii)	ACE Conclusion	Redox / oxidation of A*l* / reduction of N / NO_2^- / H / OH^-	1	[5]
				[Total: 15]

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