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UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the October/November 2010 question paper for the guidance of teachers

9701 CHEMISTRY

9701/36 Paper 3 (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.

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Question	Sections	Indicative material	Mark	
1 (a)	PDO layout	**I** Volume given for Rough titre **and** accurate titre details tabulated.	1	
	MMO Collection	**II** Follows instructions - dilutes 45.50 – 46.50 cm^3 **FB 1** **and** initial and final burette readings recorded for Rough titre **and** initial and final burette readings **and** volume of **FB 2** added recorded for each accurate titre *Headings should match readings.* *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	
	MMO Decisions	**III** 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 0.1 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 fourth titration, within 0.1 cm^3 of the third titration (or first two) has also been carried out.*	1	
	PDO Recording	**IV** All accurate burette readings (initial and final) recorded to nearest 0.05 cm^3 (Accurate titration & dilution tables) *Assess this mark on burette readings only* For candidates and Supervisor scale titre for 46.00 cm^3 **FB 1** diluted. Calculate titre $\times \frac{46.00}{\textbf{volume of FB1 added}}$ Calculate difference in Supervisor and candidate scaled values and award "quality" marks as below. [If candidate has not recorded a volume diluted, use 46.00 cm^3]	1	

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	MMO Quality	**V**, **VI** and **VII** Round any burette readings to the nearest 0.05 cm^3. Check and correct subtractions in the titre table. **Select the "best" titre using the hierarchy:** two identical; titres within 0.05 cm^3; titres within 0.1 cm^3; etc. Award **V**, **VI** and **VII** for a difference from Supervisor within 0.20 cm^3 Award **V** and **VI** only for a difference of 0.20+ cm^3 – 0.30 cm^3 Award **V** only for a difference of 0.30+ – 0.50 cm^3 *If the "best" titres are ≥ 0.50 cm^3 apart cancel one of the Q marks.*	3	[7]
(b)	ACE Interpretation	Calculates the mean, correct to 2 decimal places (third decimal place rounded to the nearest 0.05 cm^3) from any accurate titres within 0.20 cm^3. *A mean of exactly .×25 or .×75 is allowed but the candidate may round up or down to the nearest 0.05 cm^3.* *If **ALL** burette readings are given to 1 decimal place then the mean can be given to 1 decimal place if numerically correct without rounding.* *Mean of 24.3 and 24.4 = 24.35 (✓)* *Mean of 24.3 and 24.4 (×)* ***Titres to be used in calculating the mean must be clearly shown – in an expression or ticked in the titration table.***	1	[1]
(c)	ACE Interpretation	**I** Expression correct in step **(i)** $\frac{\textbf{volume diluted}}{\textbf{1000}} \times 0.125$	1	
		II Uses **answer to (i)** $\times \frac{25}{250}$ in step **(ii)**	1	
		III Uses **answer to (ii)** × 2 in step **(iii)** **and** **answer to (iii)** $\times \frac{1000}{\text{titre}}$ in step **(iv)** *If an answer, with no working, is given in any section allow if correct.*	1	
	PDO Display	**IV** Appropriate working shown in a minimum of 3 sections.	1	
		V 3 to 5 significant figures in final answers to all sections attempted – minimum of 3 final answers required to qualify for the award of this mark.	1	[5]

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(d)	ACE Interpretation	**(i)** For Student A explains that final burette reading was also 0.05 cm^3 greater than the true value ("error" in same direction) *Ignore parallax error* *Not errors cancel – reason needed*	1	
		(ii) For Student B explains that final burette reading was 0.05 cm^3 greater than the true value ("error" in opposite direction) *Not errors compound each other/add up*	1	[2]
(e)	ACE Conclusions	**(i)** Explains that carbon dioxide is acidic (and its absorption reverses the colour change of the indicator)	1	
	ACE Improvements	**(ii)** Puts acid/**FB 3** in burette and pipettes NaOH/ **FB 2** into flask **or** Heat the solution/Use hot solution	1	[2]
				[Total: 17]

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2 (a)	PDO Recording	**I** Records results in a single table for both experiments. No repetition of headings	1	
	MMO Quality	**II** Titre for either Flask A or B within 0.50 cm^3 of Supervisor	1	
		III Titre for either Flask A or B within 0.30 cm^3 of Supervisor	1	
		IV Titre for both Flask A and B within 0.30 cm^3 of Supervisor	1	[4]
(b)	ACE Interpretation	(i) Calculates a volume of 200 cm^3 in step (i)	1	
		(ii) Correctly calculates titre x 5 for each flask	1	[2]
(c)	ACE Conclusions	Mark consequentially to practical results Chooses expt with lower titre – less remains (or converse argument) **or** higher value in **(b)(iii)** *Allow ecf*	1	[1]
(d)	ACE Conclusions	Comparison of candidate's $\mathbf{K_c}$ values Judgement on constancy or otherwise Supports/does not support equilibrium	1	[1]
				[Total: 8]

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FB 7 is $Fe(NH_4)_2(SO_4)_2(aq)$; **FB 8** is $Na_2SO_4(aq)$; **FB 9** is $CaCl_2(aq)$					
3	**(a)**	MMO Decisions	**I** Selects sodium hydroxide as reagent (Not if + Al) **and** describes (warming the solution and) testing any gas evolved with red litmus/pH paper	1	
		MMO Collection	**II** Records positive test for ammonia gas with **FB 7** only *Must link gas/NH_3 with positive test (Allow even if Al mentioned in* **I***)*	1	
		MMO Decisions	**III** Selects barium chloride or nitrate together with HCl or HNO_3 *Do not accept Ba^{2+} as a reagent Accept $Ba^{2+}(aq)$ or a solution containing Ba^{2+} ions*	1	
		MMO Collection	**IV** White ppt, persisting in acid with **FB 7** and with **FB 8** *Allow from unspecified strong acid provided there is no ppt with **FB 9**.*	1	
		MMO Conclusions	**V** Mark consequentially to observations for solutions containing NH_4^+ and SO_4^{2-} ***ecf allowed here but not with other identities*** *Allow from strong acid or from H_2SO_4 if clearly added after $Ba^{2+}(aq)$*	1	[5]
	(b)	PDO Layout	**I** (Tabulates) observations clearly, showing: observation when each reagent is first added **and** observation when reagent added to excess if there is a ppt	1	
		MMO Collection	**II, III** and **IV** 1 mark for correct observations in **each** of the columns or rows representing **FB 7, FB 8** and **FB 9** **or** 1 mark for correct observations in the row or column representing a reagent added (initial and excess count as one row/column)	3	[4]

Minimum observations

Solution	FB 7	FB 8	FB 9
NaOH	Green ppt insoluble (in excess)	no reaction/no change/no ppt *Not "–" words needed (Only penalise once)*	White ppt insoluble (in excess)
NH_3	Green ppt insoluble (in excess)	colourless soln/no reaction/no change/no ppt	No reaction/no change/no ppt

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(c)	ACE Conclusions	**One mark** for **FB 7 and FB 9** containing Fe^{2+} and Ca^{2+} respectively provided no CON obs in **(a)** or **(b)** *No ecf* *Ignore **FB 8**, ignore supporting evidence*	1	[1]
		FB 10 is $CuCO_3(s)$		
(d) (i)	MMO Collection	**I** observes the <u>solid</u> <u>turning</u> <u>black</u> in step **(i)**	1	
		II observes fluidity in solid layer in step **(i)** *Allow description of fluidised solid as "liquid"*	1	
	MMO Decisions	**III** describes an appropriate test for any of the following <u>gas</u>es: O_2, CO_2, NH_3 or SO_2 (gas or O_2/etc needed)	1	
	MMO Collection	**IV** lime water turns milky/cloudy/chalky *Gas or CO_2 turns limewater milky. scores* **III** and **IV**	1	
(ii)		**V** on adding acid to residue from **FB 10**, observes green solution (on warming) *Ignore any residual solid* *Allow blue-green or bluish green* *Allow if (qualified) green solution turns blue on cooling* May award **either III or IV** here but only for gas tests for CO_2 or SO_2 **or** limewater observations	1	[5]
				[Total: 15]

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