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

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UNIVERSITY of CAMBRIDGE
International Examinations

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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