UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the May/June 2012 question paper

for the guidance of teachers

9701 CHEMISTRY

9701/34 Paper 32 (Advanced Practical Skills 2), 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 must be read in conjunction with the question papers and the report on the examination.

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UNIVERSITY of CAMBRIDGE
International Examinations

Question	Sections	Indicative material	Mark	Total
1 (a)	MMO Collection	**I** Two rough titres recorded.	1	
	PDO Layout	**II** Single table for each titration (step 1 and 2) *Minimum of 2 × 2 "boxes"*	1	
	PDO Recording	**III** Initial and final burette readings unambiguously recorded for rough and accurate titrations carried out.	1	
		IV Correct headings and units in both titration tables. *Acceptable headings:* *initial/final or 1st/2nd (burette)* *(reading)/(volume)//(reading at)/(volume at)* *start/finish; volume added/used/titre; or wtte,* ***not** difference, total volume or volume FB 1* *Acceptable units are solidus: /cm³; brackets: (cm³); in words: volume in cubic centimetres, volume in cm³.* If units are not included in the heading every entry in the table must have the correct unit.	1	
	MMO Collection	**V** All accurate burette readings to 0.05 cm³ *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	
	Decisions	**VI** Two burette readings within 0.10 cm³ in each titration step. *Do not allow the Rough even if ticked.* *Do **not** award this mark if having performed two titres within 0.1 cm³ a further titration is performed which is more than 0.10 cm³ from the closer of the initial **two** titres, unless a fourth titration, within 0.1 cm³ of any other has also been carried out.* *Mark **not** awarded if any accurate reading is given to **zero** dp apart from initial '0'.*	1	
	Step 1: Examiner subtracts candidate's titre (corrected to 0.01 cm³) from supervisor's titre			
	MMO Quality	Award **VII**, **VIII**, **IX** if δ ≤ 0.1 cm³	1	
		Award **VII**, **VIII** if 0.10 < δ ≤ 0.20 cm³	1	
		Award **VII** if 0.20 < δ ≤ 0.40 cm³ If Supervisor's titre < 10.00 cm³ then halve the tolerances	1	
		***Spread penalty** (see below)*		
	Step 2: Examiner subtracts (corrected) candidate's titre from supervisor's titre. Check and correct titre as above.			

Question	Sections	Indicative material	Mark	Total
1 (a) cont.	MMO Quality	Award **X**, **XI**, **XII** if $\delta \leq 0.20\,cm^3$	1	
		Award **X**, **XI** if $0.20 < \delta \leq 0.40\,cm^3$	1	
		Award **X** only if $0.40 < \delta \leq 0.80\,cm^3$ If Supervisor's titre < $10.00\,cm^3$ then halve the tolerances	1	
		*Apply **spread penalty** to each of steps 1 and 2 as follows:* *titres selected (by examiner) differ by > $0.50\,cm^3$ = –1;* *Apply a spread penalty of –1 if only one accurate titration is performed.*		[12]
(b)		**(i)** Check mean titre correctly calculated from clearly selected values (ticks or working)		
	ACE Conclusion Interpret-ation	**(ii)** $C_2O_4H_2 + 2NaOH \rightarrow C_2O_4Na_2 + 2H_2O$	1	
		(iii) Correctly calculate {**(b)(i)** × 0.10}/1000 **and** **(iv) (iii)**/2 (ecf from equation)	1	[2]

Question	Sections	Indicative material	Mark	Total
(c)	ACE Interpret-ation	**I** **(i)** Calculation of mean for **(b)(i) and (c)(i)** 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. Example: 26.667 must be rounded to 26.67.* *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 or zero 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.* *Do **not** award this mark if:* *any selected titre is not within 0.20 cm^3 of any other selected titre **unless** a spread penalty has been applied **or** two pairs of accurate titres shown (e.g. 21.1, 21.2, 21.4, 21.5 should have a mean of 21.3);* *the rough titre was used to calculate the mean;* *the candidate carried out only 1 accurate titration in **both** steps 1 and 2;* *burette readings were incorrectly subtracted to obtain any of the accurate titre values.* *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	
	PDO Display	**II** Correctly calculates **(ii) (c)(i)** × 0.02/1000 **and** **(iii) (c)(ii)** × 5/2	1	
		III **(iv)** Expression **(c)(iii)** – **(b)(iv)**	1	
		IV Working in the correct direction is shown in any 4 steps of **(b)(iii)** and **(iv)**, **(c)(ii)**, **(iii)** and **(iv)**	1	[4]

Question	Sections	Indicative material	Mark	Total
(d)	ACE Interpret-ation	**I** Correct M_r in both **(i)** 90(.0) and **(ii)** 134(.0) Allow ecf from misprint in **(ii)** of 102(.0)	1	
		II Correct calculation of **(i)** $C_2O_4H_2$ = **(b)(iv)** × 90.0 (allow ecf) **and** **(ii)** $C_2O_4Na_2$ = **(c)(iv)** × 134.0 (allow ecf) [Default values: **(i)** 0.05859/0.0586; **(ii)** 0.05534/0.0553 or 0.04213/0.0421] If one of **(d)(i)** or **(d)(ii)** is fully correct then one mark may be awarded. i.e. mark horizontally or vertically	1	
	Conclusion	**III** **(iii)** Expression {mass $C_2O_4Na_2$ in **(ii)**/total mass} × 100 [total mass = **(d)(i)** + **(d)(ii)**] If × 100 missing from expression then correct % needed	1	
	PDO Display	**IV** Final answer to each step attempted of **(b)(ii)**, **(iv)**, **(c)(ii)**, **(iii)**,**(iv)** and **(d)(i)**, **(ii)**, **(iii)** to 3 or 4 sf (minimum 5 steps)	1	[4]
(e)	ACE Interpret-ation	**(i)** (±)0.05 cm^3	1	
		(ii) **(i)** × 2 (ecf) so burette less accurate/ student incorrect use of {0.10/25} × 100 or (±)0.06 compared with (±)0.10	1	[2]
(f)	ACE Improve-ment	No improvement as acid in excess	1	[1]
				[Total: 25]

Question	Sections	Indicative material	Mark	Total
FB 5 = $NaNO_2$; FB 6 = NH_4Cl; FB 7 = $NaNO_3$; FB 8 = $NiSO_4$(aq); FB 9 = $FeSO_4$(aq)				
2 (a)	MMO Collection	**I** **(i)** effervescence/bubbling/fizzing **and** either brown gas or blue solution	1	
		II **(ii)** (colourless) solution (turns) yellow/orange/red-brown/brown **or** forms black/dark grey ppt/solid	1	
		III **(iii)** (purple) solution/$KMnO_4$ turns colourless/blue **or** solution remains colourless/turns blue	1	
		IV **(iv)** solid sublimes//solid/ppt reforms (on cooler part of tube)//white solid/ppt further up tube	1	
		V **(v)** **gas**/NH_3 turns (damp) red litmus blue **and** no reaction in **(vii)** (ignore bubbling/ etc. on heating) (If gas not tested in **(v)** but is in **(iv)** then mark may be awarded provided NH_3 appears in **(v)**)	1	
		VI **(vi)** gas relights glowing splint **or** solid melts/dissolves/forms solution **and** pale yellow/white/cream/off-white solid/ppt forms on cooling	1	[6]
(b)	ACE Conclusion	**(i)** N from single correct obs [brown gas **(i)(ii)(iii)**/blue solution **(i)(iii)**/ NH_3 **(iv)(v)**/O_2 **(vi)**] (allow N_2)	1	
		(ii) **FB 5** +3 **FB 6** –3	1	
		(iii) redox/oxidation and reduction// oxidation of N/NO_2^-//reduction of Mn/MnO_4^-	1	[3]

Question	Sections	Indicative material	Mark	Total
(c)	MMO Decisions	**I** **(i)** NaOH and NH_3 Allow $KMnO_4$ and/or $K_2Cr_2O_7$	1	
	PDO Layout	**II** **(ii)** Tabulated with no repeated headings *Allow from incorrect reagents but do not award if extra reagent introduced.*	1	
	MMO Collection	**III** Both give green ppt with NaOH. **FB 8** blue solution with NH_3 (not dark blue) **FB 9** green ppt with NH_3 **FB 8** no change/no reaction with $KMnO_4$ and $K_2Cr_2O_7$ **FB 9** ($KMnO_4$) turns yellow/decolourised/yellow-brown/orange; ($K_2Cr_2O_7$) turns green/yellow-green *Allow $Fe(OH)_2$ ppt as dirty or dark green*	1	
	ACE Conclusion	**IV** **(iii)** Fe^{2+} = **FB 9** from green/etc. ppt insol in excess NH_3 (ora) (= 2 obs) **or** green/etc. ppt turning brown in NH_3 (= 2 obs) green/etc. ppt with NH_3 (= 1 obs) (positive MnO_4^- = 1 obs) (positive $Cr_2O_7^{2-}$ = 1 obs) Evidence must match observations in **(ii)**	1	
		V **(iv)** (green) solution/turns blue (Ni^{2+}) *allow towards blue e.g. cyan* If Fe^{2+} = **FB 8** in **(iii)** then ecf obs: solution/turns (pale) yellow/no reaction/no change	1	
	MMO Collection	**VI** **(v)** (purple)/$KMnO_4$ turns yellow/decolourised/yellow-brown/orange	1	[6]
				[Total: 15]