UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the May/June 2011 question paper

for the guidance of teachers

9701 CHEMISTRY

9701/35 Paper 31 (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.

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Question	Sections	Indicative material	Mark	
1 (a)	PDO layout	**I** Volume given for rough titre **and** accurate titre details tabulated *Minimum of 2×2 "boxes"*	1	
	MMO collection	**II** Follows instructions – dilutes 44.50–45.50 cm^3 **FA 2** **and** records unambiguous initial and final burette readings and volume of **FA 2** diluted and volume of **FA 3** added for each titration. *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** All accurate burette readings (initial and final) recorded to nearest 0.05 cm^3 including dilution table *Assess this mark on burette readings only, ignore volume of* **FA 3** *added.*	1	
	PDO recording	**IV** has two titres within 0.10 cm^3 *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 any other has also been carried out.*	1	
	Examiner to check and correct (if necessary) subtractions in the titre table. Examiner then selects the "best" titre using the hierarchy: two identical; titres within 0.05 cm^3, titres within 0.10 cm^3, etc., (ignore rough titre) For candidates and Supervisor scale titre for 45.00 cm^3 **FA 2** diluted. Calculate titre × $^{45.00}/_{\text{volume of FA 2 diluted}}$ to 2 dp Calculate difference in Supervisor and candidate scaled values and award "quality" marks as below.			
	MMO quality	Award **V**, **VI** and **VII** for a difference from Supervisor, δ 0.30 cm^3	1	
		Award **V** and **VI** for 0.30 < δ 0.60 cm^3	1	
		Award **V** only for 0.60 < δ 1.00 cm^3 *If "best" **titres** are 0.60 cm^3 apart cancel one of the Q marks*	1	[7]

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(b)	ACE interpretation	Calculates the mean, correct to 2 decimal places from any accurate titres within 0.20 cm^3. *The third decimal place may be rounded to the nearest 0.05 cm^3.* *A mean of exactly .x25 or .x75 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 = 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)** $^{\text{volume diluted}}/_{250}$ × 1.00	1	
		II Correctly uses $^{\text{titre from (b)}}/_{1000}$ × ans to **(i)** in **(ii)** **and** ½ × ans to **(ii)** in **(iii)**	1	
		III ans to **(iii)** × $^{1000}/_{25}$ × 201.2 in **(iv)**	1	
		IV Uses $^{(38.10 - \text{ans to (iv)})}/_{38.10}$ × 100 in **(v)**	1	
	PDO display	**V** Working shown in all steps attempted and a minimum of 3 steps. (use of 2 in **(iii)**, missing × 40 or M_r in **(iv)** gains the mark) *(Working should be a step in the right direction)*	1	
		VI 3 to 4 significant figures shown in final answer to all steps attempted – minimum of 3 steps	1	[6]
(d)	ACE interpretation	Correctly evaluates: $^{0.06}/_{25}$ × 100 or 0.24 % **and** $^{0.10}/_{\text{titre in (b)}}$ × 100 *Answers must be given to at least 2 significant figures and correctly rounded for the significant figures shown.*	1	[1]
				[Total: 15]

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2 (a)	PDO layout	**I** All data presented clearly in all three sections. (6,6,7)	1	
	PDO recording	**II** Has correct headings and units on page 7.	1	
		III All thermometer readings recorded to nearest 0.5 ˚C in each of the experiments	1	
		IV Each pair of balance readings consistent and to at least 1 decimal place	1	[4]
(b)	Examiner to calculate (corrected) $\Delta T_1/m_1$ and $\Delta T_2/m_2$ for Supervisor and candidate. Compare candidate value with the same value from the Supervisor report. Award Q marks on the closer value.			
	MMO	Award **I** and **II** for δ 0.10 °Cg^{-1}	1	
	quality	Award **I** only for 0.10 < δ 0.30 °Cg^{-1}	1	[2]
(c)	MMO collection	**I** Follows instructions – weighs between 8.5 and 9.5 g of **FA 6** (mass bottle with **FA 6** – mass bottle)	1	
	PDO layout	**II** Check Δm and ΔT are correct in **(c)**	1	[2]
(d)	ACE interpretation	Examiner to check there is no obvious error in the evaluation of the expression, then award **one mark** for a mass of sodium carbonate between 2.5 and 3.5 g.	1	[1]
(e)	ACE improvements	Give **one mark** for: suggesting weighing, heating and weighing again, **or** weighing, heating and measuring gas volume **or** giving an outline for a titration method using 2 indicators.	1	[1]
				[Total: 10]

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FA 8 is NaC*l*(aq); **FA 9** is $NaNO_2$(aq); **FA 10** is NaBr(aq); **FA 11** is $CuSO_4$(aq); **FA 12** is $MgSO_4$(aq)				
3 (a)	MMO decisions	Selects any named acid	1	
	MMO collection	Records brown gas with **FA 9** and no reaction with **FA 8** and **FA 10**	1	[2]
(b)	MMO decisions	**I** Selects: *(correct full name or formula)* silver nitrate as first reagent, aqueous ammonia as second reagent, aqueous ammonia added to tube with Ag^+, 1st box ticked (*do not allow if Pb^{2+} used as 2nd reagent)* **or** lead nitrate as first reagent, silver nitrate as second reagent, Ag^+(aq) added to fresh sample, 2nd box ticked	1	
	MMO collection	**II** <u>If Ag^+ used as 1st reagent</u> Give one mark for white ppt with **FA 8 and** cream ppt with **FA 10** <u>If Pb^{2+} used as 1st reagent</u> Give one mark for white ppt with **FA 8 and FA 10** *If* **FA 9** *not previously identified then no change/no reaction/no ppt* *(ignore any yellow colouration of solution with Pb^{2+})*	1	
		III <u>If Ag^+ used as 1st reagent (with NH_3 as 2nd)</u> Give one mark if white ppt with **FA 8** is soluble in aqueous ammonia **and** cream ppt with **FA 10** is insoluble or partially soluble in aqueous ammonia <u>If Ag^+ used as 1st reagent (with Pb^{2+} as 2nd)</u> Allow observations marks <u>If Pb^{2+} used as 1st reagent (with Ag^+ as 2nd)</u> Give one mark for white ppt with **FA 8** and Ag^+ **and** cream ppt with **FA 10** and Ag^+. *Ignore observations for* **FA 9**.	1	[3]
(c)	ACE conclusion	Mark consequentially on observations; Give **one mark** for appropriate anions identified for **FA 8**, **FA 9** and **FA 10**. (Allow from off-white or cream ppt for Br^- + Ag^+)	1	[1]

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(d)	PDO recording	**I** Observations in a single table. All additions of NaOH(aq) and NH_3(aq) shown to excess where there is an initial ppt	1	
	MMO collection	**II** All observations correct for **FA 11** (Blue ppt in each, blue ppt insoluble in excess NaOH, soluble in excess NH_3 or forming/turning to a deep/dark blue solution)	1	
		III All observations correct for **FA 12** (White ppt insoluble in each)	1	[3]
(e)	ACE conclusion	**I** Mark consequentially to observations. Expected conclusion is Cu^{2+} in **FA 11** and Mg^{2+} in **FA 12** Allow Ca^{2+} from white ppt insoluble in excess NaOH and no ppt with NH_3.	1	
		II Gives appropriate evidence for each ion in the conclusion. Minimum evidence required for the expected ions: **Cu^{2+}** Records a blue ppt with either of the reagents **or** deep blue solution with excess NH_3. **Mg^{2+}** White ppt insoluble in excess NH_3 (or in each of the reagents)	1	[2]
(f)	MMO collection	**I** Blue, black, purple colour observed on adding starch in **(ii)**	1	
		II The brown (solution) or (brown) solution formed in **(i)** is decolourised/colour fades/paler **or** brown (solution) in **(i)** **and** white, off-white or light brown ppt recorded.	1	
	ACE conclusion	Award **III** and **IV** for **two** correct pairs	1	
		Award **III only** for **one** correct pair Expected results **(i)** I^- is oxidised, Cu^{2+} is reduced **(ii)** $S_2O_3^{2-}$ is oxidised, I_2 is reduced Mark horizontally or vertically.	1	[4]
				[Total: 15]

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