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

9701/34 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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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** In the correct spaces, records initial and final burette readings 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** 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 of either of the pair has also been carried out.*	1	
	PDO Recording	**IV** All accurate burette readings (initial and final) recorded to nearest 0.05 cm^3. *Assessed on burette readings only.*	1	
	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 0.10 cm^3 etc. Award **V**, **VI** and **VII** for a difference to Supervisor within 0.15 cm^3 Award **V** and **VI** only for a difference of 0.15+ cm^3 – 0.25 cm^3 Award **V** only for a difference of 0.25+ cm^3 – 0.40 cm^3 *If the selected "best" titres are > 0.40 cm^3 apart, cancel one of the Q marks awarded.*	3	[7]

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(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 .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)		**No additional factor/expression is allowed in any step** *If an answer, with no working, is given in any section allow if correct.*		
	ACE Interpretation	**I** Uses $^{2.00}/_{\mathbf{158.0}}$ in step **(i)** **and** **answer (i)** × $^{\text{cand titre}}/_{1000}$ in step **(ii)**	1	
	PDO Display	**II** Uses **answer (ii)** × 5 in step **(iii)** **and** **answer (iii)** × $^{1000}/_{25}$ in step **(iv)**	1	
		III Uses **answer (iv)** × **151.9** in step **(v)**, **and** **answer (v)** × $^{100}/_{21.50}$ in step **(vi)**	1	
		IV Appropriate working shown in a minimum of **four** sections.	1	
		V 3 to 5 significant figures in final answers to all sections attempted – *minimum of **four** final answers required*	1	[5]
				[Total: 13]

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2 (a)	PDO Layout	**I** Records at least **four** different balance readings and at least one mass of solid/gas *Accept 0.0(0X) g as the mass of the empty tube or a statement that the tube is tared.*	1	
	PDO Recording	**II** Gives all appropriate headings and units when recording results. *Do **not** accept mass of empty tube as 0.0(00)g here unless tube is described as tared.* *(minimum of three pieces of information)*	1	
		III All recorded balance readings consistent to at least 1 decimal place. *(minimum of **three** balance readings)*	1	
	MMO Decisions	**IV** Evidence of reheating to "constant" mass. For balances reading to 1 d.p. two masses must be identical For 2 or 3 d.p. balances, two masses must be within 0.05 g	1	
	MMO Quality	**V and VI** checks and corrects if necessary all subtractions in the results table. Calculate $\frac{\text{mass heated}}{\text{mass of residue}}$ to 3 significant figures. Compare to supervisor standard or standard value of 1.40. Award **V and VI** for a difference up to 0.10 Award **V only** for a difference of 0.10+ to 0.20 *Where a candidate repeats the experiment use cumulative masses of* **FB 3** *and residue.* *Where masses of* **FB 3** *and residue cannot be checked, accept candidate values to calculate the ratio.*	2	[6]
(b)	ACE Interpretation	**(i)** Calculates **2.71, (2.710, 2.7097)** **and** **(ii)** Has: cand value in **(i)** x mass loss from table in **(a)** If no mass loss is recorded in the table, check the value used.	1	
	ACE Conclusions	**(iii)** Ticks the appropriate box for the experiment **and** makes some comparison between mass of $NaHCO_3$ and the mass of **FB 3** used If mass of $NaHCO_3$ calculated in **(ii)** ≥ mass of **FB 3**, ignore any ticked box but award the mark for any statement that the mass is not possible.	1	[2]

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(c)	ACE Improvements	**(i)** No mass change with Na_2CO_3 (on heating). **(ii)** **Evidence** for no gas produced, e.g.: limewater unaffected, no gas collected in a gas syringe *If there is reference to measuring mass and to measuring volume but the absence of change is not mentioned, award **one** of the two marks available.*	1 1	[2]
(d)	ACE Interpretation	Max errors of 0.05, 0.005 and 0.0005 respectively for balances A, B and C. Calculates: 1.11% error for balance A 0.25% error for balance B 0.20% error for balance C Allow ecf on % errors only if: *(i) Max errors given are 0.1, 0.01 and 0.001 respectively for balances A, B and C and % errors are 2.22%, 0.50% and 0.40%* *(ii) All max errors are incorrect by a factor 10 e.g. 0. 5, 0. 05 and 0. 005. % errors are 11.1%, 2.5% and 2.0%*	1 1	[2]
				[Total: 12]

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FB 4 is $MnSO_4(aq)$; **FB 5** is $MgSO_4(aq)$; **FB 6** is $Al_2(SO_4)_3(aq)$; **FB 7** is $(NH_4)_2SO_4(aq)$				
3 (a)	MMO Collection	Give **one** mark for each of the following: **I** for **FB 4** – tests **(i)** and **(iv)** **II** for **FB 5** – tests **(i)** and **(iv)** **III** for **FB 6** – tests **(i)** and **(iv)** **IV** for **FB 7** – tests **(i)**, **(iii)** and **(iv)** **V** Give one mark for any change/darkening of the initial **precipitate** in test **(ii)** for **FB 4** to a qualified brown. *The darkening may be described in test* **(i)** *or in test* **(iv)** **VI** Describes the **test <u>on gas</u>** for ammonia in test **(iii)** for any solution that has **no precipitate** in either part test of **(i)** and is warmed. *The test for ammonia is expected with* **FB 7** *Do* ***not*** *award* ***(VI)*** *if the test is carried out with a solution in which a precipitate had formed at any stage* ***or*** *If a solution in which no precipitate is formed is* ***not*** *warmed with sodium hydroxide*	1 1 1 1 1 1	[6]

Results required with NaOH(aq) and NH_3(aq) for the award of marks I to IV in 3(a)

test		*observations*			
		FB 4	**FB 5**	**FB 6**	**FB 7**
(i)	addition of NaOH	off-white, pale brown, buff or beige precipitate *Do* ***not*** *accept cream or equivalent colour precipitates*	white precipitate	white precipitate	No precipitate or no change *Do* ***not*** *accept clear on its own as an observation; clear solution is acceptable*
	further addition of NaOH	precipitate insoluble	precipitate insoluble	precipitate soluble	no precipitate or no change *(may be left blank)*
(iii)	warming solution with NaOH				any reference to a gas being evolved **or** reference to red litmus turning blue
(iv)	addition of NH_3	as NaOH	as NaOH	as NaOH	as NaOH
	further addition of NH_3	as NaOH	as NaOH	precipitate insoluble	as NaOH

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(b)	ACE Conclusions	**Do not accept any ion other than Mn^{2+}, Mg^{2+}, Al^{3+} or NH_4^+ in any section.** **Marks I to III** **Ions must be correct, including charge, if a symbol has been given. – <u>no ecf in this section</u>.** Award **<u>I only</u>** if **one ion only** is identified from correct observations. Award **<u>I and II</u>** if **two ions only** are identified from correct observations. Award **<u>I, II and III</u>** if **all four cations** are identified from correct observations. *The 4th cation may be identified by elimination from incomplete supporting evidence.* A deduction of Mn^{2+} is allowed from a cream ppt with NaOH(aq) and NH_3(aq) **IV** Award this mark if the supporting evidence fits the ion identified and the practical performed for at least three of the four ions ***<u>Allow ecf</u> on ion order for mark* IV**. (Mg^{2+} and Al^{3+} are most likely to be interchanged depending on "solubility in excess" observations.	 1 1 1 1	[4]

Minimum evidence required in observations for the ion identity marks I, II and III.
In some cases, identification may be allowed from incomplete observations. There must, however, be no observations that are contrary to those expected with any "correctly" identified ion.

The same criteria will be applied to "candidate's supporting evidence in awarding mark IV. Candidates are not permitted to introduce (from the Qualitative Analysis Notes) supporting evidence that is not given in the observations.

Mn^{2+}	off-white precipitate with each reagent, or off-white precipitate turning brown with either of the reagents identification of the ion is allowed from an incorrect observation of a cream or yellow-white precipitate – one ion is known to be Mn^{2+}
Mg^{2+}	white precipitate, insoluble in (excess) NaOH
Al^{3+}	white precipitate, soluble in (excess) NaOH
NH_4^+	no precipitate/no change with either reagent **or** ammonia, alkaline gas or gas turning red litmus blue evolved

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(c)	MMO Collection	Records no precipitate/no reaction with each of the reagents.	1	[1]
(d)	ACE Conclusions	States that Pb^{2+}/lead(II) would give similar results. *Award this mark providing there are no contrary observations for the solution identified as containing Al^{3+}*	1	[1]
(e)	MMO Collection	Records a white ppt in **(i)** Records a yellow precipitate or precipitate turning yellow in **(ii)**.	1 1	[2]
(f)	ACE Conclusions	Award one mark for any attempt to describe replacement of C*l* by I in the ppt.	1	[1]
				[Total: 15]

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