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

9701/35 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 – initial and final burette readings recorded for Rough titre **and** initial and final burette readings **and** volume of **FA 2** added recorded for each accurate titre **and** 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 has also been carried out.*	1	
	PDO Recording	**IV** All accurate burette readings (initial and final) recorded to nearest 0.05 cm^3 *Assess this mark 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 0.1 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]

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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** Correctly evaluates $\frac{10.00}{40}$ = 0.25(0) **II** Uses **answer (i)** × $\frac{\text{mean titre}}{1000}$ in step **(ii)** **and** **answer (ii)** x $\frac{1000}{10}$ in step **(iii)** *If an answer, with no working, is given in any section allow if correct.*	1 1	[2]
	Total			**[Total: 10]**

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2 (a)	PDO Recording	**I** Has correct headings (minimum three) and units in the weighing table in **(2)(a)** and correct units in the titration table in **(2)(b)** *Acceptable units are /g, (g), mass in grams, mass in g; similarly /cm^3,* **II** All three balance reading are read with constant precision (same no of decimal places) and to at least 1 decimal place	1 1	[2]
On Supervisor script scale the titre for 3.00 g of **FA 3** added to the acid. Calculate **8** × **(3.00 – mass of FA 3 used)** and **subtract** from the titre obtained. Mass of **FA 3** used = (mass tube + **FA 3**) – (mass tube + residue) *If (mass tube + residue) < mass of empty tube then use (mass tube + **FA 3**) – (mass tube).*				
(b)	MMO Quality	Award **I** and **II** if the difference between candidate and Supervisor scaled titres is within 0.40 cm^3 Award **I** only if the difference is between 0.50+ cm^3 and 0.80 cm^3	1 1	[2]
(c)	**There is no mark available for this section.**			
(d)	ACE Interpretation	**I** Uses $\frac{\text{mean titre}}{1000} \times 0.280$ in step **(i)** **and** uses **answer (i)** × $\frac{250}{25}$ in step **(ii)** **II** Correctly evaluates $\frac{0.5 \times 250}{1000} = 0.125$ in step	1 1	
	PDO Display	**III** Uses **answer (iv)** × 0.5 × 100 in step **(v)** **IV** Working shown in a minimum of **three** sections *Working should be a step in the right direction:* *step (i) 0.28 × titre volume (in cm^3/dm^3)* *step (ii) Use of 25 & 250 or 10* *step (iii) 0.5 and 250* *step (iv) the correct two numbers* *step (v) would need to include 2 (0.5) and 100* *step (vi) must be correct* **V** 3 to 5 significant figures in final answers to **all sections attempted** – minimum of **three** final answers required	1 1 1	[5]

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(e)	ACE Conclusions	Explains one of the following: If 5.5 g of $CaCO_3$ had been used the titre would be too small/not enough HC*l* remains for the titration (**not** 'all the acid has reacted') **or** Difficult/takes too long to dissolve 5.5 g of solid/it will not all dissolve in 150 cm^3 (of acid) **or** Excessive/too fast effervescence/fizzing/rate of gas evolved **or** Acid spray	1	[1]
(f)	ACE Interpretation	**(i)** **If balance displays to 1 decimal place:** error in balance reading is ±0.05 g ***or*** ±0.1(0) g error in mass of **FA 3** is ±0.1 g ***or*** ±0.2 g **If balance displays to 2 decimal places:** error in balance reading is ±0.005 g ***or*** ±0.01 g error in mass of **FA 3** is ±0.01 g ***or*** ±0.02 g **If balance displays to 3 decimal places:** error in balance reading is ±0.0005 g ***or*** 0.001g error in mass of **FA 3** is ±0.001 g ***or*** ±0.002 g **(ii)** Correctly evaluates to at least 2 significant figures: $\frac{\textbf{candidate's error in mass of FA 3}}{\textbf{mass of FA 3 used}} \times \textbf{100}$	1 1	[2]
(g)	ACE Conclusions ACE Improvements	**(i)** Gives correct equation for the thermal decomposition of calcium carbonate including state symbols **(ii)** Outlines: weigh container weigh container + solid (heating and) weighing again repeated (heating and) weighing to constant mass **or** weigh container weighing container + solid (heating and) measuring gas volume when no further increase **and** cooled to room temperature / use of pV = nRT / $\frac{PV}{T}$ = constant	1 1	[2]
	Total			**[14]**

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FA 7 is $Fe_2(SO_4)_3$(aq); **FA 8** is $CrCl_3$(aq); **FA 9** is ZnI_2(aq) [$ZnCl_2$ + KI]				
3 (a)	PDO Layout	**I** (Tabulates) observations clearly, showing: observation when each reagent is first added **and** observation when reagent added to <u>excess</u> (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 **FA 7**, **FA 8** and **FA 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	
	ACE Conclusions	**Award <u>V</u>** only if **one ion only** is correctly identified	1	
		Award <u>V</u> and **<u>VI</u>** if **all three ions** are correctly identified from candidate's observations. Allow ecf*	1	[6]

<u>Minimum for observations marks:</u>

Solution	FA 7	FA 8	FA 9
NaOH	red-brown/brown/rust ppt insoluble (in excess)	grey-green ppt <u>soluble</u>/dissolves (in excess) giving a dark green solution	White/milky white ppt soluble/dissolves (in excess)
NH_3	red-brown ppt insoluble (in excess) *(suitable qualified brown)*	grey-green ppt insoluble (in excess)	White/milky white ppt soluble/dissolves (in excess)

<u>Minimum for conclusions marks: (</u>*with incomplete but not CON observations)*

FA 7 red-brown ppt with either;
FA 8 grey-green ppt with either/(dark) green solution with excess NaOH;
FA 9 white ppt soluble in excess NH_3.

<u>* ecfs allowed</u>

FA 8 allow Fe^{2+} if green ppt insoluble in excess NaOH (no grey-green ppts)
FA 9 allow Al^{3+} **and** Pb^{2+} if white ppt insoluble in excess NH_3
FA 9 allow Ba^{2+} **and** NH_4^+ if no ppt with either
FA 9 allow Mg^{2+} if white ppt insoluble in excess of both

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(b)	MMO Decisions	**I** Selects barium chloride or barium nitrate for the test in step **(i)** *Do not allow Ba^{2+} alone* *$Ba^{2+}(aq)$ or soln containing Ba^{2+} (ions) is acceptable*	1	
	MMO Collection	**II** Records white/off-white precipitate with <u>only</u> **FA 7**	1	
	MMO Decisions	**III** Selects silver nitrate or lead nitrate in **(ii)** to add to the solutions (that do not contain sulfate) *Do not allow Ag^+ or Pb^{2+} alone* *Aqueous ions or solutions containing the ion are acceptable as above*	1	
	MMO Collection	**IV** Appropriate observations **FA 8** white ppt with Ag^+/white ppt or no ppt with Pb^{2+} **FA 9** yellow ppt with either *Ignore observations with any solution candidate has identified as sulfate*	1	
	ACE Conclusions	**V** **FA 8** is chloride, **FA 9** is iodide Credit if the supporting evidence fits the ion identified and the practical performed for **FA 8** and **FA 9** provided there is no CON observation in **(i)** *Do not credit if Ag^+ gives a ppt with **FA 7*** Marks **IV** and **V** may be awarded from **FA 8** white ppt chloride (**IV**) **FA 9** yellow ppt iodide (**V**)	1	[5]

<u>Other possibilities:</u>

Two white ppts with aqueous Ba^{2+} then remaining solution tested with aqueous Ag^+/Pb^{2+}
This would score marks **I**, **III** and may score one of **IV** or **V**

Aqueous Ba^{2+} gives positive result with solution other than **FA 7** and tests with aqueous Ag^+/Pb^{2+} performed
(This would score marks **I** and **III**)
Ignore observation and conclusion with **FA 7**
Award correct observation and valid conclusion for third ion thus scoring one of **IV** or **V**

Aqueous Ba^{2+} gives positive result with all three solutions
Award mark **I**, and mark **III** may be awarded for selection of aqueous Ag^+/Pb^{2+} **or** statement that no further testing is required **but no other marks can be awarded** in this section.

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FA 10 is $NaNO_3(s)$; FA **11** is $NaNO_2(s)$				
(c) (i)	MMO Collection	**I** Solid/**FA 10** melts/to a liquid/solution (on heating)	1	
		II Observes <u>bubbles</u> of gas in liquid/solution **or** Liquid/solution turns yellow/pale yellow	1	
	MMO Decisions	**III** Describes an appropriate test <u>in either **(i)** or **(ii)**</u> for any of the following <u>gas</u>es: O_2, CO_2, NH_3 or SO_2 *There must be a reference to gas being evolved before this mark can be awarded.*	1	
	MMO Collection	**IV** Positive identification of oxygen gas in **(i)**: glowing splint rekindles/relights/glows brighter *(gas evolved rekindles a glowing splint would gain marks* **III** ***and*** **IV***)* *('glowing splint rekindles' would gain mark* **III** *not* **IV***)*	1	
(ii)		**V** On adding acid to residue to **FA 11**, observes brown/yellow-brown gas *(not yellow, orange or red-brown)* **or** blue solution *(allow greenish blue)*	1	[5]
	Total			**[16]**

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