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

9701/33 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	
	PDO Recording	**II** Appropriate headings and units for data given in weighing and accurate titration tables. *Acceptable headings:* *mass of tube + FA1;* *mass of tube + residue/mass of empty tube (mass of FA1 used);* *initial/final or 1st/2nd (burette) (reading)/(reading at) start/finish;* *volume added/used/ titre; or wtte [**not** "difference"]* *Acceptable units are solidus: /cm^3; brackets: (cm^3); in words: volume in cubic centimeters, volume in cm^3. Similarly for mass in g, etc* If units are not included in the heading every entry in the table must have the correct unit.	1	
	PDO Recording	**III** All accurate burette readings are given to the nearest 0.05 cm^3. *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 Decision	**IV** Two uncorrected titres within 0.10 cm^3 *Do not allow 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 any other has also been carried out.*	1	
Examiner rounds any burette readings to the nearest 0.05 cm^3, checks subtractions and then selects the "best" titre using the hierarchy: *two identical; titres within 0.05 cm^3; titres within 0.1 cm^3; etc* to calculate mean (ignore any labelled rough). Examiner compares [corrected mean titre/corrected mass of **FA 1**] with Supervisor result. Calculate the ratios to 2 dp.				
	MMO Quality	Award **V**, **VI** and **VII** if $\delta \leq 0.05$ (cm^{3}g^{-1}) Award **V** and **VI** if $0.05 < \delta \leq 0.10$ Award **V** only if $0.10 < \delta \leq 0.20$ *If the "best" **titres** are ≥ 0.60 cm^3 apart cancel one of the Q marks.*	1 1 1	[7]

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(b)	MMO Decision	Selects **correctly subtracted accurate** titre values within 0.20 cm^3. Must use more than one value. If no calculation shown then titres must be indicated (*e.g.* with a tick) in the table	1	
	PDO Display	Correct mean from any values selected (may include rough) by candidate given to same decimal places as most precise burette reading recorded in the table. *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 may 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 (×)* If no working shown allow mean if value identical to that used by Examiner.	1	[2]
(c)	ACE Interpretation	**I** In part **(i)** {titre from **(b)**/1000} × 0.01(0) *If no working shown then answer must be correct.*	1	
		II ans to **(i)** × 5 **and** ans to **(ii)** × 10 *with no additional steps*	1	
		III ans to **(iii)** × 55.8 *If* **(iii)** *incorrect allow correct* **(ii)** × 10 × 55.8	1	
		IV **correct** (ans to **(iii)** × 55.8/mass of **FA** 1) × 100 to sf shown (*ecf* allowed from **(iii)**) (sf shown may come from **(i)** with no previous rounding) *If* **(iii)** *incorrect allow correct* **(ii)** × 10 × 55.8 × 100/mass **FA 1** *(If choice of answer take the one in the answer space.)*	1	
	PDO Display	**V** 3 or 4 significant figures in final answers to all parts attempted (minimum three parts)	1	[5]
(d)	ACE Interpretation	**(i)** Uncertainty either 1 or .5 in final place. **If balance displays to 1 decimal place:** error in balance reading is ±0.05 g ***or*** ±0.1(0) g **If balance displays to 2 decimal places:** error in balance reading is ±0.005 g ***or*** ±0.01 g **If balance displays to 3 decimal places:** error in balance reading is ±0.0005 g ***or*** ±0.001g	1	
		(ii) {2 × **(i)**/mass used} × 100 answer to 2, 3 or 4 sf	1	[2]
				[Total: 16]

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2 (a)	PDO Display	**I** Tabulates mass of (empty) crucible, mass of crucible + **FA 4**, mass of crucible + residue/**FA 4** after heating, mass of **FA 4**/**hydrated** magnesium sulfate, mass of water lost. *Do **not** award if mass of **FA 4** or mass of water incorrect*	1	
	PDO Recording	**II** Records **all** weighings consistently to at least 1 decimal place [minimum three weighings].	1	
	MMO Decision	**III** Final weighings after reheating are within 0.05 g or identical if masses recorded to 1 dp	1	
Examiner to calculate [lowest mass of residue/mass of **FA 4**] of Supervisor and candidate to 2 dp. If two experiments carried out then use sum of masses of residues and sum of masses of **FA 4** to calculate the ratio. *If the Supervisor's value is doubtful (higher than the majority of candidates) then check whether candidates are close to the expected value of 0.55 or use candidate average if majority in close agreement. (Contact team leader)*				
	MMO Quality	Award **IV** and **V** if $\delta \leq 0.05$ Award **IV** only if $0.05 < \delta \leq 0.10$	1 1	[5]
(b)	ACE Interpretation	Part **(i)** [mass of water lost/(7 × 18)] **or** [mass of water lost × 246.4/18] (allow m(H_2O) × 246.4/7) *M_r H_2O must be 18* *Allow ecf for mass of water lost* *If two experiments carried out then mass of water may be taken from either or the mean.* *Allow mark if answer calculated correctly but working not shown.*	1	
		Part **(i)** [mass of water lost × 246.4/7 × 18] correctly evaluated to 3 sf [= mass of water lost × 1.956] *(Ignore part **(ii)**)* There are other chemically correct methods – mark accordingly.	1	[2]
(c)	ACE Improvements	Use a lid (for the early gentle heating) **or** larger mass (for smaller percentage error) **or** use (cool in) desiccator	1	[1]
				[Total: 8]

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FA 5 is $NaHCO_3(s)$; **FA 6** is $NH_4Br(s)$; **FA 7** is $H_2SO_4(aq)$					
3	**(a)**	MMO Collection	On heating, steam or condensation or water vapour, misty vapour is noted **or** solid becomes powdery	1	
		MMO Decisions	Tests for gas using limewater **or in 3(d)**	1	[2]
	(b)	PDO Layout	Presents results of tests in an unambiguous way *Minimum 4 × 2 boxes*	1	
		MMO Collection	(No reaction with cold NaOH and) gas/ammonia/fumes produced (on heating) that turn(s) red litmus blue *Do not award if ppt reported with NaOH (CON)*	1	
			No reaction with ammonia **and** no reaction with barium chloride/nitrate	1	
			Cream ppt with silver nitrate that partially dissolves/is insoluble in aqueous ammonia	1	
		ACE Conclusion	**FA 6** cation: ammonium/NH_4^+ *from some evidence and no CON obs*	1	
			FA 6 anion: bromide/Br^- *No ecf but can award Br^- from any mention of cream but ppt must be present **or** off-white ppt insoluble or partially soluble in NH_3.*	1	[6]
	(c)	MMO Collection	**Ignore any observations after water added.** Steamy/misty white/orange/red/red-brown (not brown) gas/vapour/ fumes/smoke produced **or** gas/vapour/fumes/smoke bleaches litmus (paper) **or** gas/vapour/fumes/smoke turns (potassium) dichromate (solution) from orange to green	1	
			(White) solid turns red/orange (not yellow, not brown, not solution, not ppt) Ignore "hot"	1	
		ACE Conclusion	**FA 6** is oxidised/redox reaction/oxidation because Br^- becomes Br_2/Br_2 is produced **or** redox/reduction because H_2SO_4 forms/becomes SO_2 (with positive dichromate observation) **or** exothermic because tube becomes hot/heat given out.	1	[3]
	(d)	MMO Collection	Fizzing/effervescence/bubbling (occurs) (*not gas is produced)* If limewater test used here give second mark in **(a)**.	1	
			White ppt with lead nitrate **and** no reaction with silver nitrate	1	[2]

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(e)	MMO Decision	barium chloride/nitrate followed by hydrochloric/nitric acid (not $Ba^{2+}(aq)$, $BaNO_3$, …) (If H^+ already identified then "followed by hydrochloric/nitric acid" is not essential.)	1	
	ACE Conclusion	**FA 7** cation: protons/H^+ if there is a positive observation with blue litmus paper/K_2CrO_4/Mg/Na_2CO_3	1	
		FA 7 anion: sulfate/SO_4^{2-} Allow from minimum evidence of white ppt with $Ba^{2+}(aq)$	1	[3]
				[Total: 16]

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