UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the May/June 2007 question paper

9701 CHEMISTRY

9701/32 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.

All Examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes must be read in conjunction with the question papers and the report on the examination.

- CIE will not enter into discussions or correspondence in connection with these mark schemes.

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UNIVERSITY of CAMBRIDGE
International Examinations

Skill		**Breakdown of marks**	
Manipulation, measurement and observation	16 marks	Successful collection of data and observations	8 marks
		Decisions relating to measurements or observations	8 marks
Presentation of data and observations	12 marks	Recording data and observations	5 marks
		Display of calculation and reasoning	3 marks
		Data layout	4 marks
Analysis, conclusions and evaluation	12 marks	Interpretation of data or observations and identifying sources of error	6 marks
		Drawing conclusions	5 marks
		Suggesting improvements	1 mark

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Question	Sections	Indicative material	Mark	
1 (a) (i)	PDO Layout	Tabulates initial and final burette readings and volume added in each of the tables *Tabulation may be vertical or horizontal.* *Ignore absence of units* *Do NOT award this mark if any final and initial burette readings are inverted or 50 is used as the initial burette reading*	[1]	
(ii)	PDO Recording	Both burette readings in the dilution table and final and initial burette readings for all accurate titres in the titration table recorded to the nearest 0.05 cm^3. *Treat all titres as "accurate" unless labelled rough or trial*	[1]	
(iii)	MMO Collection	Follows instructions – Rough plus sufficient accurate titrations *Award this mark if there are three or more titres OR where two titres only have been recorded they are within 0.20 cm^3 (neither labelled as rough).* *The first titre does not have to be labelled rough*	[1]	
(iv)	MMO Decisions	Has at least two uncorrected titres within 0.1 cm^3 **Accuracy (v) and (vi)** Give 2 marks if difference to Supervisor is **0.3** or less Give 1 of these two marks for a difference of **0.3+ to 0.5** Give 0 marks for a difference greater than **0.5**	[1] [2]	**[6]**
(b)	ACE Interpretation	Candidate selects/calculates appropriate "average" from any uncorrected titre values within 0.20 cm^3.	[1]	**[1]**
(c) (i)(ii)	ACE Interpretation	Examiner checks each of the first four steps of the calculation. Award two marks if all steps are chemically correct. Withhold 1 mark for each chemical error – no negative marks. Count non-completed steps as chemical errors. step 1 $\frac{\text{titre}}{1000}$ x 0.0120 step 2 x 5 step 3 $\times\frac{1000}{25}$ step 4 $\times\frac{250}{\text{volume diluted}}$	[2]	
(iii)	PDO Display	Working shown in each step attempted	[1]	
(iv)		3 or 4 significant figures in final answer given for each of the first four steps	[1]	
(v)		Answer to last section is correctly evaluated to 4 sf for (candidate's value to 4th step x 392). *(Answer may be from final answer to step 4 or using number carried on calculator).*	[1]	**[5]**

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Question	Sections	Indicative material	Mark	
(d)	ACE Improvement	Candidate suggests heating solution to eliminate air OR suggests practical way of storing water without air re-dissolving • Storing in a full bottle (no air space) • Ignore and reference to vacuum (pump)	[1]	**[1]**
(e)	ACE Interpretation	Smallest division correctly read from burette and error estimated at ½ smallest division *Burettes are graduated at 0.1 cm^3*	[1]	**[1]**
(f)	ACE Interpretation	Doubles error in reading to get maximum possible error	[1]	**[1]**
(g)	ACE Conclusions	Explains that errors are identical (in the same direction) (and cancel).	[1]	**[1]**
			[Total: 16]	

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Question	Sections	Indicative material	Mark	
2 (a)	MMO Decisions	Calculates the minimum mass of $NaHCO_3$ needed to give an excess. (10.08 g) *Do not penalise rounding to 10.1 g if 10.08 has been shown in calculation*	[1]	**[1]**
(b)	PDO Layout	Tabulates all experimental readings: (mass of empty weighing bottle, mass of bottle + solid, mass of bottle + residual solid, initial temperature, final temperature) and ΔT.	[1]	
	PDO Recording	Single table covering both experiments	[1]	
		Table has correct labels and units (<u>only g and ^{o}C</u>)	[1]	
	MMO Collection	All weighings recorded with consistent precision to at least 1 dp and all temperature readings recorded to 1 dp only	[1]	
		Give one mark if difference between (all) candidate's ΔT values, **as calculated by the Examiner**, is within 0.5 ^{o}C	[1]	
		Give one mark if the difference between mean ΔT value for Supervisor and closer/closest ΔT value of candidate, **as calculated by the Examiner**, is within 0.5 ^{o}C	[1]	**[6]**
(c)	ACE Interpretation	Examiner calculates to 1 decimal place the mean ΔT value from the candidate's ΔT values for each experiment.	[1]	
		Give 1 mark if the candidate's answer to (d) is within 1% of (examiner calculated mean ΔT x 4.3) and the correct sign (+) is given.		**[1]**
			[Total: 8]	

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Question	Sections	Indicative material	Mark	
FB 6 is iron(III) chloride; FB 7 is chromium(III) iodide ($CrCl_3$ / KI); FB 8 is cobalt(II) sulphate				
3 (a) (i)	PDO Layout	Presents tests, techniques and observations clearly *To gain this mark there should be some reference in the table to washing at least one precipitate*	[1]	
(ii)	PDO Recording	All observations in a single table	[1]	
(iii)	MMO Decisions	Selects silver nitrate or other soluble silver salt as reagent Addition of $Ag^+(aq)$ or a solution containing Ag^+ or silver(I) ions is acceptable	[1]	
(iv)		Uses (aqueous) ammonia with the silver halide precipitates	[1]	
(v)		Filters or decants to obtain ppt (as soln is coloured not easy to see ppt) *Reference to separating precipitate and solution for at least one of **FB 6** or **FB 7***	[1]	
(vi)	MMO Collection	Records yellow ppt insoluble in ammonia with **FB 7** and white ppt soluble in ammonia with **FB 6**	[1]	
(vii)	ACE Conclusions	Uses observations to make consequential deductions as to halide ions present. *Candidates should identify Cl^- in **FB 6** and I^- in **FB 7** (no halide in **FB 8**) but mark other halides correct providing observations are completely correct for these ions* *If $AgNO_3$ and $Pb(NO_3)_2$ selected as reagents only points **(i)**, **(ii)**, **(iii)** and **(v)** can awarded*	[1]	**[7]**
(b)	MMO Decisions	Selects barium chloride or barium nitrate (Addition of $Ba^{2+}aq$) or a solution containing Ba^{2+} or barium ions is acceptable] and hydrochloric (or nitric) acid as reagents *not sulphuric acid*	[1]	
	MMO Collection	Records white ppt with $BaCl_2$, insoluble in acid for only **FB 8 or** White ppt with $BaCl_2$ and no SO_2 (gas turning dichromate(VII) green) when **FB 8** tested with HCl.	[1]	
	ACE Conclusion	Uses observations to make consequential conclusion for sulphate or sulphite if the white precipitate with $BaCl_2$ is observed to dissolve when acid is added Marks in this section may be awarded for testing a single solution providing $Ag^+(aq)$ has been added to all three solutions and the halides identified If sulphuric acid or an unspecified acid is added after $BaCl_2$, **one mark maximum** can be awarded in the section for a white ppt insoluble in acid. No marks if the acid is added before $BaCl_2$	[1]	**[3]**

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Question	Sections	Indicative material	Mark	
(c)	PDO Layout	Tabulates observations *[This table should show clearly rows/columns for NaOH and NH_3 as reagents and **FB6/FB7/FB8**.* *The table does not need lines to be drawn – clearly laid out and headed blocks of text are acceptable]*	[1]	
	PDO Recording	All observations reported to reagent added in excess	[1] [1]	
	MMO Collection	Give **one mark each** for correct observations for <u>TWO</u> of the following **FB 6** – (Fe^{3+}), **FB 7** (Cr^{3+}), **and FB 8** (Co^{2+}). **FB 6** – <u>red-brown</u>/(brown/rusty) ppt, insoluble in excess with both NaOH and NH_3. **FB 7** – **<u>grey-green</u>** ppt with NaOH and NH_3. ppt soluble in excess NaOH (to give a dark green solution) ppt insoluble in excess NH_3. **FB 8** – blue ppt with NaOH, (possibly turning pink) or brown with excess of the reagent. The ppt is insoluble. Blue ppt with NH_3, expected to be insoluble in excess reagent of concentration used but (possibly dissolving to form a yellow/brown solution).	[1]	**[4]**
(d)	ACE Conclusions	Correctly identifies and gives evidence for Fe^{3+} in **FB 6** Minimum evidence – red-brown ppt with NaOH and with NH_3 Cr^{3+} in **FB 7** Minimum evidence – grey-green ppt with NaOH and with NH_3 OR grey-green ppt with NaOH, soluble in excess to form a green solution	[1]	
		Recognises transition metal cation from various colour changes of precipitates	[1]	
		Where **FB 8** is included as one of the identified ions (probably incorrectly as Cu^{2+}) <u>the transition metal cation may be awarded for Cr^{3+}</u> from the colour of the precipitate with NaOH and NH_3		**[2]**
			[Total: 16]	

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