UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the May/June 2007 question paper

9701 CHEMISTRY

9701/31 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.

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.

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UNIVERSITY of CAMBRIDGE
International Examinations

Generic Mark Scheme for Papers 31 and 32

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 1st titre is to lower precision than subsequent titres*	[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	[1]	
		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**	[2]	**[6]**
(b)	ACE Interpretation	Candidate selects/calculates appropriate "average" from any uncorrected titre values within 0.20 cm^3.	[1]	**[1]**
(c) (i) and (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. $\frac{\text{vol diluted}}{1000} \times 0.50$ $\times \frac{\text{titre}}{250}$ $\times \frac{1}{2} \times \frac{1000}{25}$ *(Potential 2 errors)* $\times 106$	[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 3 sf using candidate's value to 4th step. *(Answer may be from final answer to step 4 or use number carried on calculator)*	[1]	**[5]**

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Question	Sections	Indicative material	Mark	
(d)	ACE Interpretation	Smallest division correctly read from measuring cylinder and error estimated at ½ smallest division Both % errors correctly calculated *[Award second mark ecf from smallest division and estimated error]*	[1] [1]	**[2]**
(e)	ACE Conclusions	Draws appropriate conclusion from **(d)** – supported by (experimental) evidence • compares consistency of two titres performed • comments on lower titre than in 1st experiment • compares % error for measuring cylinder and pipette • refers to liquid remaining in the measuring cylinder (allowed for in pipette) • measuring cylinder has large error – volumes added will vary (each time) leading to variable titres	[1]	**[1]**
(f)	ACE Improvement	Candidate suggests heating solution to drive off CO_2 *(accept use of hot water only if linked to decreased solubility of carbon dioxide)*	[1]	**[1]**
			[Total: 16]	

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Question	Sections	Indicative material	Mark	
2 (a)	PDO Layout	Tabulates all experimental readings for at least one experiment. (mass of empty weighing bottle, mass of bottle + solid, mass of bottle + residual solid, initial temperature, final temperature) and ΔT and **m**	[1]	
	PDO Recording	Tabulated values are in a 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]	**[4]**
(b)	MMO Collection	Give one mark if difference between candidate's ΔT/m values, is within 0.1 ^{o}C g^{-1}	[1]	
		Give one mark if the difference between mean ΔT/m value for Supervisor and closer ΔT/m value of candidate, is within 0.1 ^{o}C g^{-1}	[1]	**[2]**
(c)	MMO Decisions	Candidate <u>refers to</u> his/her experimental values to arrive at an appropriate comment as to whether the experiment should be further repeated *[The answer must be based on the reliability (consistency) of the two experiments performed]*	[1]	**[1]**
(d)	ACE Interpretation	Examiner calculates to 3sf the mean ΔT/m value from the candidate's ΔT/m values for each experiment. Give 1 mark if the candidate's answer to **(d)** is within 1% of examiner calculated mean ΔT/m x 61.59.	[1]	**[1]**
			[Total: 8]	

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Question	Sections	Indicative material	Mark	
FA 6 is solid basic zinc carbonate, FA 7 is solid copper(II) chloride				
3 (a)	PDO Layout	Tabulates observations for **FA 6** and **FA 7**	[1]	
	MMO Collection	Observes and records blue or green solution with **FA 7 and** colourless solution with **FA 6**	[1]	
	MMO Decisions	Selects lime water in test for gas with **FA 6**	[1]	
	ACE Conclusion	Identifies carbon dioxide as gas evolved from test with limewater *Evidence for CO_2 may also be found in the conclusion for the anion and can be awarded retrospectively*	[1]	**[4]**
(b)	PDO Layout	Tabulates observations *This table should show clearly rows/columns for NaOH and NH_3 as reagents and **FA 6/FA 7**.* *The table does not need lines to be drawn – clearly laid out and headed blocks of text are acceptable*	[1]	
	PDO Recording	All observations in a single table *The key feature to look for is reagent information – it should only appear once for each reagent and cover **FA 6** and **FA7***	[1]	
		Full observations for reagents to excess	[1]	
	MMO Collection	Records white ppt soluble in excess NaOH and excess NH_3 for **FA 6**	[1]	
		For **FA 7** records a blue ppt with NaOH and a <u>lighter/paler</u> blue ppt with ammonia	[1]	
		For **FA 7** records (blue/white only) ppt soluble in excess ammonia to form a deep/dark blue <u>solution</u>.	[1]	**[6]**

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Question	Sections	Indicative material	Mark	
(c)	ACE Conclusions	Cation in **FA 6** **Summarises evidence for Zn^{2+} from solubility of white ppt in NH_3(aq)** *Mark the conclusions for **FA 6** consequentially for incorrect observations.* Cation in **FA 7** Summarises evidence for Cu^{2+} from blue ppt with NaOH(aq) and NH_3(aq) or deep/dark blue colour of solution with excess NH_3(aq) Anion in **FA 6** Summarises evidence for CO_3^{2-} from **(a)**.	[1] [1] [1]	**[3]**
(d)	MMO Decisions	*Expected observations are required* Test 1 Selects $AgNO_3$ or other soluble silver salt to test for chloride Addition of Ag^+(aq) or a solution containing Ag^+ or silver(I) ions is acceptable Selects aqueous ammonia – added to ppt with NH_3 Test 2 Selects soluble lead salt e.g. $Pb(NO_3)_2$ as reagent Addition of Pb^{2+}(aq) or a solution containing Pb^{2+} or lead(II) ions is acceptable Give one of the last two marks if Ag^+ and Pb^{2+} only are given.	[1] [1] [1]	**[3]**
			[Total: 16]	

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