UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

Pre-U Certificate

MARK SCHEME for the May/June 2012 question paper

for the guidance of teachers

9791 CHEMISTRY

9791/04 Paper 1 (Practical), 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

Skill	Total marks	Breakdown of marks		Qu. 1	Qu. 2	Qu. 3
Manipulation, measurement and observation	16 marks	Successful collection of data and observations	9 marks	0	0	9
		Quality of measurements or observations	4 marks	2	2	0
		Decisions relating to measurements or observations	3 marks	0	2	1
Presentation of data and observations	7 marks	Recording data and observations	2 marks	0	2	0
		Display of calculations and reasoning	2 marks	0	2	0
		Data layout	3 marks	1	2	0
Analysis, conclusions and evaluation	17 marks	Interpretation of data or observations and identifying sources of error	9 marks	3	6	0
		Drawing conclusions	7 marks	1	0	6
		Suggesting improvements	1 mark	1	0	0

MMO = manipulation, measurement and observation
collection = successful collection of data and observations
quality = quality of measurements or observations
decisions = decisions relating to measurements or observations

PDO = presentation of data and observations
recording = recording data and observations
display = display of calculations and reasoning
layout = data layout

ACE = analysis, conclusions and evaluation
interpretation = interpretation of data or observations and identifying sources of error
conclusions = drawing conclusions
improvements = suggesting improvements

	Sections	Learning outcomes	Indicative material	Mark
1 (a)	PDO layout	Use the appropriate presentation medium to produce a clear presentation of the data	I All balance readings clearly shown in a single table including mass of residue and mass of water. All readings given to the same number of decimal places.	[1]
	ACE interpretation	Calculate other quantities from data	II Calculates correctly the mass of water and mass of residue	[1]
	MMO quality	Make accurate and consistent measurements and observations	III + IV Ratio of corrected mass of residue: corrected mass of water compared to supervisor value. Award III and IV if $\delta \leqslant 0.20$. Award only III if $0.20 \leqslant \delta \leqslant 0.40$	[2]
(b)	ACE interpretation	Calculates other quantites from data	Calculates moles of water lost (minimum 2 sig fig)	[1]
	ACE interpretation	Calculates other quantities from data	Calculates relative formula mass of salt (either hydrated or anhydrous)	[1]
	ACE conclusion	Draw conclusions from interpretations of observations, data and calculated values.	Identifies *M* as Ba (only allow ecf for Group 2 metal) (working leading to identification of the metal must be seen to award this mark)	[1]
(c)	ACE improvement	Suggest modifications to an experimental arrangement that will improve the accuracy of the experiment	Any sensible suggestion. e.g. repeat heating/cooling to constant mass, cooling in a desiccator, use of a lid (to avoid slight spitting) *etc*.	[1]
				[Total:8]

	Sections	Learning outcomes	Indicative material	Mark
2 (a)	PDO layout	Use the appropriate presentation medium to produce a clear presentation of the data	I Records clearly the mass of weighing bottle + **FA 2**, mass of weighing bottle + residue, and mass of **FA 2**.	[1]
	PDO layout	Use the appropriate presentation medium to produce a clear presentation of the data	II Tabulates initial burette reading, final burette readings and volume of silver chloride added. Do not award if 50. (00) is used as the initial burette reading.	[1]
	PDO recording	Use column headings that include both the quantity and the unit and that conform to accepted scientific conventions	III Appropriate headings and units for data given. If the units are not included in the heading then every entry in the table must have a correct unit.	[1]
	PDO recording	Record raw readings of a quantity to the same degree of precision	IV All accurate burette readings and volumes of silver nitrate added are given to nearest 0.05 cm^3. (Treat all titres as accurate unless labelled otherwise)	[1]
	MMO decision	Identify where repeated readings are appropriate	V Two or more uncorrected titres within 0.20 cm^3	[1]
	MMO quality	Make accurate and consistent measurements and observations	VI + VII Examiner checks subtractions and selects best titres to calculate mean (ignoring any labelled rough). Examiner compares [corrected mean titre/ corrected mass of **FA 2**] with supervisor value. Award 2 marks if difference from supervisor is 0.30 $cm^3\ g^{-1}$ or less; award 1 mark if difference from supervisor is between 0.30 and 0.60 $cm^3\ g^{-1}$	[2]

	Sections	Learning outcomes	Indicative material	Mark
(b)	MMO decision	Identify where repeated readings are appropriate	Selects correct titre values within 0.2 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	Use correct number of significant figures for calculated quantites	Correct mean given to same decimal places as most precise burette reading recorded in the table. Do not award if any burette readings were incorrectly subtracted. Do not award for mean given to 1 dp if not an exact mean, e.g. mean of 23.5, 23.5, 23.6 must be 23.53 and not 23.5, but award mark for mean of 25.3 and 25.5 as 25.4.	[1]
(c)	ACE interpretation	Calculate other quantities from data	I $\frac{\text{titre}}{1000} \times 0.05$	[1]
	ACE interpretation	Calculate other quantities from data	II ans to I × 10	[1]
	ACE interpretation	Calculate other quantities from data	III ans to II × 35.5	[1]
	ACE interpretation	Calculate other quantities from data	IV $\frac{\text{ans II} \times 35.5}{\text{mass of } \mathbf{FA\ 2}}$	[1]
	PDO display	Show working in calculations	V Correct working shown in I, II and III. Allow error in titre value and ratio but do not allow ratio of 1:1.	[1]

(d) (i)	ACE interpretation	Estimate, quantitatively, the uncertainty in quantitative measurements	± 0.10 cm^3 as twice an individual reading of ± 0.05 cm^3 (allow ± 0.18 cm^3 as calibration error for 25.00 cm^3 from a class B burette is ± 0.08 cm^3 . Calibration + reading error then is ± 0.18 cm^3) (allow any reasonable value if explained)	[1]
(ii)	ACE interpretation	Estimate, quantitatively, the uncertainty in quantitative measurements	Correctly calculated using value from **(b)** and ans **(d)(i)**.	[1]
				[Total: 16]

FA 5 is a solution of $(NH_4)_2SO_4.FeSO_4.6H_2O$ in sulfuric acid.				
3 (a)	MMO collection	Use their apparatus to collect an appropriate quantity of data or observations, including differences in colour, solubility or quantity of materials	I **FA 5** gives a green ppt with sodium hydroxide or aqueous ammonia II which turns brown in contact with air III Warming with sodium hydroxide evolves a gas which turns damp red litmus paper blue. IV Appropriate observations test for acid: effervescence with sodium carbonate, litmus paper etc.). Do not award if observations for any reagent other than NaOH or NH_3 are incorrect.	[1] [1] [1] [1]
	ACE conclusion	Draw conclusion from interpretation of observations	V **FA 5** contains NH_4^+ (from test for NH_3) VI Fe^{2+} (from green ppt or ppt turning brown) VII and H^+ (from correct obs)	[1] [1] [1]
(b) (i)	MMO decision	Identifies the nature of confirmatory tests	I Ba^{2+}(aq) followed by appropriate dilute named acid. (Allow Pb^{2+}(aq) followed by appropriate dilute named acid) OR Add dilute acid and test for gas with acidified dichromate	[1]
(ii)	MMO collection	Use their apparatus to collect an appropriate quantity of data or observations, including differences in colour, solubility or quantity of materials	II White ppt III Insoluble in added acid (allow sulfuric but not in I) OR no effervescence observed Orange dichromate does not change colour Ignore results with other reagents as long as the observations are correct.	[1] [1]
	ACE conclusion	Draw conclusion from interpretation of observations	IV **FA 5** contains sulfate	[1]

(c) (i)	MMO collection	Use their apparatus to collect an appropriate quantity of data or observations, including differences in colour, solubility or quantity of materials	Solution turns yellow on adding peroxide On adding hydroxide get a red-brown ppt (Allow dark red, orange-brown) Re-lights a glowing splint	[1] [1] [1]
(ii)	ACE conclusion	make scientific explanations of the data, observations and conclusions	Oxidation of Fe^{2+} to Fe^{3+} (Allow Fe^{3+} is formed if Fe^{2+} was identified in (a)) Decomposition of H_2O_2 (Allow balanced equation. Allow reduction of H_2O_2)	[1] [1]
				[Total: 16]