

UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

Pre-U Certificate

**MARK SCHEME for the May/June 2011 question paper
for the guidance of teachers**

9791 CHEMISTRY

9791/04

Paper 4 (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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Page 2	Mark Scheme: Teachers' version	Syllabus	Paper
	Pre-U – May/June 2011	9791	04

Skill	Total marks	Breakdown of marks		Qu. 1	Qu. 2	Qu. 3
Manipulation, measurement and observation	15 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	2 marks	1	0	1
Presentation of data and observations	7 marks	Recording data and observations	3 marks	1	2	0
		Display of calculations and reasoning	2 marks	2	0	0
		Data layout	2 marks	1	0	1
Analysis, conclusions and evaluation	18 marks	Interpretation of data or observations and identifying sources of error	10 marks	5	5	0
		Drawing conclusions	6 marks	1	0	5
		Suggesting improvements	2 marks	0	2	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

Page 3	Mark Scheme: Teachers' version	Syllabus	Paper
	Pre-U – May/June 2011	9791	04

	Sections	Learning outcomes	Indicative material	Mark	
1	(a)	PDO layout	Use the appropriate presentation medium to produce a clear presentation of the data	Records initial and final burette readings with correct units	[1]
		PDO recording	Record raw readings of a property to the same degree of precision	All accurate burette readings in the titration table recorded to the nearest 0.05 cm ³ (May take first titration as rough unless used in calculating average titre)	[1]
		MMO decision	Identify where repeated readings are appropriate.	Has two or more uncorrected titres within 0.1 cm ³ (titres must be recorded)	[1]
		MMO quality	Make accurate and consistent measurements and observations	Award 2 marks if difference to supervisor is 0.2 cm ³ or less Award 1 mark if difference to supervisor is between 0.2 and 0.5 cm ³	[2]
	(b)	ACE interpretation	Calculate other quantities from data	Selects correct titre values within 0.2 cm ³ . Values must be shown in (b) or indicated in the titration table. Average must be calculated correctly to 2 dp or nearest 0.05 if burette read to nearest 0.05 cm ³ . For burette readings consistent to 1 dp then average may be to 1 or 2 dp.	[1]
	(c)	ACE interpretation	Calculates other quantities from data	Calculates correctly moles of thiosulfate	[1]
		PDO display	Show their working in calculations, and the key steps in their reasoning	Correct use of 1:2 ratio in I ₂ :S ₂ O ₃ ²⁻ calculation AND 1:6 (25:150) ratio in subsequent calculation.	[1]
		ACE interpretation	Calculates other quantities from data	Calculates correctly moles of iodine	[1]
		ACE interpretation	Calculates other quantities from data	Calculates correctly concentration in reaction mixture. Allow ecf from missing ratio(s)	[1]
		PDO display	Use the correct number of significant figures for calculated quantities	3 or 4 sig fig given in final answer.	[1]

Page 4	Mark Scheme: Teachers' version	Syllabus	Paper
	Pre-U – May/June 2011	9791	04

	(d)	ACE interpretation	Describes the pattern and trends shown by tables and graphs	Notes that concentration decreases linearly with time	[1]
		ACE conclusion	Draw conclusions from interpretations of observations, data and calculated values.	Reaction is zero order with respect to iodine	[1]
					[Total: 13]

		Sections	Learning outcomes	Indicative material	Mark
2	(a)	PDO recording	Record raw readings of a property to the same degree of precision	Records initial and final temperatures to 0.5 °C.	[1]
		PDO recording	Record raw readings of a property to the same degree of precision	Records to a consistent number of dp the mass of bottle + FA 3 and the mass of bottle + residue	[1]
		MMO quality	Make accurate and consistent measurements and observations	Award 2 marks if corrected T/m for candidate is within 0.5 °C g ⁻¹ of supervisor's value. Award 1 mark if corrected T/m is between 0.5 °C g ⁻¹ and 1.0 °C g ⁻¹ of supervisor's value.	[2]
	(b)	ACE interpretation	Calculate other quantities from data	Calculates correct value from candidate's values of T and m (minimum of 2 sf)	[1]
	(c)	ACE interpretation	Calculates other quantities from data	Calculates correct value (minimum of 2 sf) Allow ecf from incorrect value in (b)	[1]
(d)	ACE interpretation	Calculates other quantities from data	-216.6 kJ mol ⁻¹	[1]	

Page 5	Mark Scheme: Teachers' version	Syllabus	Paper
	Pre-U – May/June 2011	9791	04

	(e) (i)	ACE interpretation	Calculates other quantities from data	Calculates correct value (minimum of 2 sf) Allow ecf from incorrect value in (c) and/or (d).	[1]
	(e) (ii)	ACE interpretation	Identifies sources of error in an experiment	Accuracy of volume, mass or temperature measurements <i>etc.</i> Do not credit non-standard conditions	[1]
	(e) (iii)	ACE improvement	Suggest modifications to an experiment that will improve the accuracy	Use of burette to measure volume. Scale up reaction. More accurate thermometer <i>etc.</i> Allow any improvement apart from those relating to heat loss <i>i.e.</i> improvement does not need to relate to suggested source of error.	[2]
[Total: 11]					

**FA 5: $MgCl_2 \cdot 6H_2O$ FA 6: $Al_2(SO_4)_3 \cdot 16H_2O$
FA 7: Na_2SO_3 and $NaCl$ FA 8: $Pb(NO_3)_2$ FA 9: $HCOOH$**

3	(a)	PDO layout	Use the appropriate presentation medium to produce a clear presentation of the data	Draws up a clear table showing observations for all 4 tests	[1]
		MMO decision	Identifies the nature of confirmatory tests	Adds excess of NaOH and NH_3 (if ppt noted)	[1]
		MMO collection	Use their apparatus to collect an appropriate quantity of data or observations, including differences in colour, solubility or quantity of materials	FA 5 gives a white ppt with both NaOH and $NH_3(aq)$	[1]
				FA 6 gives a white ppt with both NaOH and $NH_3(aq)$	[1]
				Ppt with FA 5 is insol in both excess NaOH and excess $NH_3(aq)$	[1]
		Ppt with FA 6 is sol in excess NaOH but insol in excess $NH_3(aq)$	[1]		
	ACE conclusion	Draw conclusion from interpretation of observations	FA 5 may contain $Mg^{2+}(aq)$ and FA 6 may contain $Pb^{2+}(aq)$ / $Al^{3+}(aq)$ No ecf from incorrect observations	[1]	

Page 6	Mark Scheme: Teachers' version	Syllabus	Paper
	Pre-U – May/June 2011	9791	04

	(b) (i)	MMO collection	Use their apparatus to collect an appropriate quantity of data or observations, including differences in colour, solubility or quantity of materials	White ppt with $\text{AgNO}_3(\text{aq})$, soluble in $\text{NH}_3(\text{aq})$ White ppt with $\text{Ba}(\text{NO}_3)_2(\text{aq})$, soluble in excess $\text{HCl}(\text{aq})$ White ppt with FA 8 , settles to heavy white ppt with $\text{HCl}(\text{aq})$	[1] [1] [1]
	(b) (ii)	ACE conclusion	Draw conclusion from interpretation of observations	FA 7 contains $\text{Cl}^-(\text{aq})$ and $\text{SO}_3^{2-}(\text{aq})$ No ecf from incorrect observations	[1] [1]
	(b) (iii)	ACE conclusion	Draw conclusion from interpretation of observations	FA 8 contains $\text{Pb}^{2+}(\text{aq})$ Allow $\text{Ag}^+(\text{aq})$	[1]
	(c)	MMO collection	Use their apparatus to collect an appropriate quantity of data or observations, including differences in colour, solubility or quantity of materials	Turns colourless with $\text{KMnO}_4(\text{aq})$ Effervescence / bubbles / fizzes with NaHCO_3 (Do not allow gas evolved, gives off CO_2)	[1] [1]
		ACE conclusion	Draw conclusion from interpretation of observations	FA 9 contains methanoic acid as it can be oxidised AND reacts with NaHCO_3	[1]
[Total: 16]					