

CAMBRIDGE INTERNATIONAL EXAMINATIONS

Pre-U Certificate

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## MARK SCHEME for the May/June 2013 series

### 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.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

Cambridge will not enter into discussions about these mark schemes.

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<b>Skill</b>	<b>Total marks</b>	<b>Breakdown of marks</b>		<b>Qu. 1</b>	<b>Qu. 2</b>	<b>Qu. 3</b>
Manipulation, measurement and observation	17 marks	Successful collection of data and observations	8 marks	0	0	8
		Quality of measurements or observations	5 marks	3	2	0
		Decisions relating to measurements or observations	4 marks	2	0	2
Presentation of data and observations	8 marks	Recording data and observations	4 marks	2	2	0
		Display of calculations and reasoning	2 marks	1	1	0
		Data layout	2 marks	2	0	0
Analysis, conclusions and evaluation	15 marks	Interpretation of data or observations and identifying sources of error	8 marks	3	5	0
		Drawing conclusions	5 marks	0	0	5
		Suggesting improvements	2 mark	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

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	Sections	Learning outcomes	Indicative material	Mark
1 (a)	PDO layout	Use the appropriate presentation medium to produce a clear presentation of the data	I Records clearly the mass of weighing bottle + <b>FA 1</b> , mass of weighing bottle + residue, and correct mass of <b>FA 1</b> .	[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 <b>FA 2</b> added.	[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 for titration results. If 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 <b>FA 2</b> added are given to nearest 0.05 cm <sup>3</sup> . (Treat all titres as accurate unless labelled otherwise). Do not award if 50.(00) is used as an initial reading or if more than one final reading is 50.(00).	[1]
	MMO decision	Identify where repeated readings are appropriate	V Two or more uncorrected titres within 0.20 cm <sup>3</sup>	[1]
	MMO quality	Make accurate and consistent measurements and observations	VI + VII + VIII Examiner checks subtractions and selects best titres to calculate mean (ignoring any labelled rough). Examiner compares corrected mean titre scaled to 3.00 g from corrected mass of <b>FA 1</b> with supervisor value. Award 3 marks if $\delta \leq 0.20$ cm <sup>3</sup> ; award 2 marks if $0.20$ cm <sup>3</sup> < $\delta \leq 0.40$ cm <sup>3</sup> ; award 1 mark if $0.40$ cm <sup>3</sup> < $\delta \leq 0.60$ cm <sup>3</sup> .	[3]

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<b>(b)</b>	MMO decision	Identify where repeated readings are appropriate	Selects correct titre values within 0.2 cm <sup>3</sup> . Must use more than one value. If no calculation shown then titres must be indicated (e.g. with a tick) in the table. Do not award this mark if any subtraction for an accurate titre is incorrect.	[1]
	PDO display	Use correct number of significant figures for calculated quantities	Correct mean given to same decimal places as most precise burette reading recorded in the table. Allow mean to 3 dp for 0.025, 0.075.	[1]
<b>(c)</b>	ACE interpretation	Calculate other quantities from data	I $\frac{\text{titre}}{1000} \times 0.200$ Answer given to at least 2 sig figs but ignore trailing zeroes <i>i.e.</i> 0.005 (00).	[1]
	ACE interpretation	Calculate other quantities from data	II Answer to (i) x 10.	[1]
	ACE interpretation	Calculate other quantities from data	III Correctly calculates m.	[1]
				<b>[Total: 13]</b>

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2	(a)	PDO recording	Use column headings that include both the quantity and the unit and that conform to accepted scientific conventions	I Correct headings and units (to include change of temperature in °C and mass of <b>FA 3</b> in g.)	[1]
		PDO recording	Record raw readings of a quantity to the same degree of precision	II All temperature readings recorded to at least 0.5 °C but not more precise than 0.05 °C.	[1]
		MMO quality	Make accurate and consistent measurements and observations	III – V Compare $\Delta T/M$ to supervisor. Award 2 marks if $\delta \leq 0.50 \text{ °C g}^{-1}$ ; award 1 mark if $0.50 \text{ °C g}^{-1} < \delta \leq 1.00 \text{ °C g}^{-1}$ .	[2]
(b)		ACE interpretation	Calculates other quantities from data	I Value of $\Delta T/M$ correctly calculated with correct sign. (Do not award if subtraction for mass or temperature change is incorrect.)	[1]
		ACE interpretation	Calculates other quantities from data	II Use of given values of $\text{°C g}^{-1}$ multiplied by a mass.	[1]
		PDO display	Show their working in calculations, and the key steps in their reasoning	III Use of (total mass of <b>FA 3</b> – mass of hydrogen carbonate) in calculation.	[1]
		ACE interpretation	Calculates other quantities from data	IV Correct value for mass of hydrogen carbonate.	[1]
		ACE interpretation	Calculates other quantities from data	V Correct value for % by mass (given to a minimum of 2 sf).	[1]
(c)		ACE interpretation	Express uncertainty in a measurement as an actual or percentage error	Correctly evaluates $(2 \times \text{error recorded}/M) \times 100$ .	[1]
(d)		ACE improvement	Suggest modifications to an experimental arrangement that will improve the accuracy of the experiment	Any two from: smaller % error in mass, greater error in volume as 25 cm <sup>3</sup> measuring cylinder has to be used twice, temperature rise the same.	[2]
<b>[Total: 12]</b>					

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FA 5 is $\text{MgCl}_2 \cdot 6\text{H}_2\text{O}$ , FA 6 is $\text{ZnCO}_3$ , FA 7 is $\text{NaNO}_2$			
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	<p>I <b>FA 5</b> forms a (colourless) solution or (colourless) liquid on warming / melts / colourless liquid condenses higher up the tube. [1]</p> <p>II White solid remains. [1]</p> <p>III Gas from <b>FA 5</b> turns (blue) litmus red. [1]</p> <p>IV <b>FA 6</b> turns yellow. [1]</p> <p>V Gas from <b>FA 6</b> turns limewater milky. OR Gas from <b>FA 7</b> relights a glowing splint. [1]</p> <p>VI <b>FA 7</b> melts / forms a liquid. (Ignore <b>FA 7</b> turns yellow). [1]</p>
	ACE conclusion	Draw conclusion from interpretation of observations	<p>VII Identifies carbon dioxide from <b>FA 6</b> and oxygen from <b>FA 7</b> from correct observations. [1]</p> <p>VIII Identifies <math>\text{HCl}</math> from <b>FA 5</b> [1]</p> <p>IX Correctly assigns all three salts: <math>\text{ZnCO}_3</math> is <b>FA 6</b> <math>\text{MgCl}_2 \cdot 6\text{H}_2\text{O}</math> is <b>FA 5</b> <math>\text{NaNO}_2</math> is <b>FA 7</b>. [1]</p> <p>(No ecf from transposed observations. Must have at least one correct observations for each salt.)</p>

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FA 8 is NaCl and Na <sub>2</sub> SO <sub>3</sub>					
(b)	MMO collection	Use their apparatus to collect an appropriate quantity of data or observations, including differences in colour, solubility or quantity of materials	I	White ppt with both BaCl <sub>2</sub> and AgNO <sub>3</sub> .	[1]
	MMO decision	Identifies the nature of confirmatory tests	II	Named dilute acid (do not award if H <sub>2</sub> SO <sub>4</sub> ).	[1]
			III	(Dilute) aqueous ammonia.	[1]
	MMO collection	Use their apparatus to collect an appropriate quantity of data or observations, including differences in colour, solubility or quantity of materials	IV	Both solids dissolve (allow ppt with BaCl <sub>2</sub> is insoluble if H <sub>2</sub> SO <sub>4</sub> was chosen).	[1]
	ACE conclusion	Draw conclusion from interpretation of observations	V	Contains sulfite (no ecf from incorrect observations or use of H <sub>2</sub> SO <sub>4</sub> , do not award from incorrect observations).	[1]
			VI	Contains chloride (no ecf from incorrect observations but allow identification of chloride from only white ppt with AgNO <sub>3</sub> ).	[1]
<b>[Total: 15]</b>					