CAMBRIDGE INTERNATIONAL EXAMINATIONS

Pre-U Certificate

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.

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Cambridge is publishing the mark schemes for the May/June 2013 series for most IGCSE, Pre-U, GCE Advanced Level and Advanced Subsidiary Level components and some Ordinary Level components.

CAMBRIDGE
International Examinations

Skill	Total marks	Breakdown of marks		Qu. 1	Qu. 2	Qu. 3
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

	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 + **FA 1**, mass of weighing bottle + residue, and correct mass of **FA 1**.	[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 **FA 2** 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 **FA 2** added are given to nearest 0.05 cm^3. (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^3	[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 **FA 1** with supervisor value. Award 3 marks if $\delta \leq 0.20$ cm^3; award 2 marks if 0.20 $cm^3 < \delta \leq 0.40$ cm^3; award 1 mark if 0.40 $cm^3 < \delta \leq 0.60$ cm^3.	[3]

(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. 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 quantites	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]
(c)	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.e.* 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]
				[Total: 13]

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 **FA 3** 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 $\delta \leq 0.50\,°C\,g^{-1}$; award 1 mark if $0.50\,°C\,g^{-1} < \delta \leq 1.00\,°C\,g^{-1}$.	[2]
	(b)	ACE interpretation	Calculates other quantites 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 $°C\,g^{-1}$ 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 **FA 3** – 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^3 measuring cylinder has to be used twice, temperature rise the same.	[2]
					[Total: 12]

FA 5 is $MgCl_2.6H_2O$, FA 6 is $ZnCO_3$, FA 7 is $NaNO_2$				
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	I **FA 5** forms a (colourless) solution or (colourless) liquid on warming / melts / colourless liquid condenses higher up the tube.	[1]
			II White solid remains.	[1]
			III Gas from **FA 5** turns (blue) litmus red.	[1]
			IV **FA 6** turns yellow.	[1]
			V Gas from **FA 6** turns limewater milky. OR Gas from **FA 7** relights a glowing splint.	[1]
			VI **FA 7** melts / forms a liquid. (Ignore **FA 7** turns yellow).	[1]
	ACE conclusion	Draw conclusion from interpretation of observations	VII Identifies carbon dioxide from **FA 6** and oxygen from **FA 7** from correct observations.	[1]
			VIII Identifies HCl from **FA 5**	[1]
			IX Correctly assigns all three salts: $ZnCO_3$ is **FA 6** $MgCl_2.6H_2O$ is **FA 5** $NaNO_2$ is **FA 7.** (No ecf from transposed observations. Must have at least one correct observations for each salt.)	[1]

FA 8 is NaC*l* and Na_2SO_3					
(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 Ba$C l_2$ and $AgNO_3$.	[1]
	MMO decision	Identifies the nature of confirmatory tests	II	Named dilute acid (do not award if H_2SO_4).	[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 Ba$C l_2$ is insoluble if H_2SO_4 was chosen).	[1]
	ACE conclusion	Draw conclusion from interpretation of observations	V	Contains sulfite (no ecf from incorrect observations or use of H_2SO_4, 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 $AgNO_3$).	[1]
					[Total: 15]