

CAMBRIDGE INTERNATIONAL EXAMINATIONS

Pre-U Certificate

MARK SCHEME for the May/June 2014 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.

Cambridge is publishing the mark schemes for the May/June 2014 series for most IGCSE, Pre-U, GCE Advanced Level and Advanced Subsidiary Level components and some Ordinary Level components.

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Skill	Total marks	Breakdown of marks		Qu. 1	Qu. 2	Qu. 3
Manipulation, measurement and observation	15 marks	Successful collection of data and observations	8 marks	0	1	7
		Quality of measurements or observations	4 marks	2	2	0
		Decisions relating to measurements or observations	3 marks	2	0	1
Presentation of data and observations	6 marks	Recording data and observations	2 marks	2	0	0
		Display of calculations and reasoning	2 marks	2	0	0
		Data layout	2 marks	1	1	0
Analysis, conclusions and evaluation	19 marks	Interpretation of data or observations and identifying sources of error	11 marks	6	5	0
		Drawing conclusions	7 marks	0	3	4
		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

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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 All balance readings clearly shown in a single table including mass of FA 1 and the mass of water.	[1]
	ACE interpretation	Calculate other quantities from data	II Calculates correctly the mass of FA 1 and the mass of water.	[1]
	MMO quality	Make accurate and consistent measurements and observations	III + IV Ratio of corrected mass water: corrected initial mass compared to supervisor value. Award both marks for $\delta \leq 0.010$. Award 1 mark for $0.010 < \delta \leq 0.020$.	[2]
(b)	ACE interpretation	Calculate other quantities from data	I In (ii), calculates correctly moles of $\text{BaCl}_2 \cdot 2\text{H}_2\text{O}$ from $\frac{[\text{mass of water lost}]}{18} \times 0.5$	[1]
	ACE interpretation	Calculate other quantities from data	II In (ii) use of 244 for RFM of $\text{BaCl}_2 \cdot 2\text{H}_2\text{O}$.	[1]
	ACE interpretation	Calculate other quantities from data	III In (ii) calculates correctly % by mass of $\text{BaCl}_2 \cdot 2\text{H}_2\text{O}$ from $\frac{[\text{mol of salt} \times 244.3]}{\text{mass of salt heated}} \times 100$	[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	Salt dissolves with effervescence AND limewater turns milky.	[1]
	MMO decision	Identifies the nature of confirmatory tests	Selects limewater (allow other reagents that test for gases).	[1]
	ACE conclusion	Draw conclusion from interpretation of observations	Carbonate or CO_3^{2-}	[1]

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(d)	ACE conclusion	Draw conclusion from interpretation of observations	BaCO ₃ or second salt is thermally stable/does not decompose on heating/is anhydrous (not a hydrate).	[1]
	ACE conclusion	Draw conclusion from interpretation of observations	All the mass lost is from water OR no other gases are evolved OR mass loss is only because of BaCl ₂ .2H ₂ O.	[1]
				[Total: 12]

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	Sections	Learning outcomes	Indicative material	Mark
2 (a)	PDO layout	Use the appropriate presentation medium to produce a clear presentation of the data	I Tabulates initial burette reading, final burette readings and volume of FA 3 added.	[1]
	PDO recording	Use column headings that include both the quantity and the unit and that conform to accepted scientific conventions	II 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	III All accurate burette readings and volumes of FA 3 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	IV Two or more uncorrected titres within 0.20 cm ³ .	[1]
	MMO quality	Make accurate and consistent measurements and observations	V + VI Examiner checks subtractions and selects best titres to calculate mean (ignoring any labelled rough). Examiner compares corrected mean titre with supervisor value. Award 2 marks if difference to supervisor is 0.20 cm ³ or less; award 1 mark if difference to supervisor is between 0.20 and 0.30 cm ³ .	[2]
(b)	ACE interpretation	Calculate other quantities from data	Calculates correct mean from 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]

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	Sections	Learning outcomes	Indicative material	Mark
(c)	ACE interpretation	Calculate other quantities from data	I In (i) $\frac{\mathbf{(b)}}{1000} \times 0.100$ AND in (ii) ans to [ans (i) × 10]	[1]
	ACE interpretation	Calculate other quantities from data	II In part (iii) $\frac{250}{1000} \times 0.200 = 0.0500$ AND ans to [0.0500 – ans to (ii)]	[1]
	ACE interpretation	Calculate other quantities from data	III In part (iv) ans to [ans (iii) × 53.5]	[1]
	ACE interpretation	Calculate other quantities from data	IV In part (iv) ans to $\frac{[\text{ans to } \mathbf{(iii)} \times 53.5]}{1.40} \times 100$	[1]
	PDO display	Use correct number of significant figures for calculated quantities	V All final answers to parts (i) to (iii) given to 3 or 4 sig fig. (minimum 2 attempted answers)	[1]
(d)	ACE interpretation	Estimate, quantitatively, the uncertainty in quantitative measurements	Evidence of doubling of individual burette readings: ± 0.10 as $2 \times \pm 0.05$	[1]
	ACE interpretation	Express such uncertainties as an actual or percentage error	$\pm 0.10 / \text{titre} \times 100$ AND $0.06 / 25.00 \times 100 = 0.24\%$	[1]

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(e)	ACE improvement	Suggest modifications to an experimental arrangement that will improve the accuracy of the experiment	Identifies the problem of evaporation in the first method.	[1]
	PDO display	Show their working in calculations and the key steps in their reasoning	In method 1 the sodium hydroxide solution is concentrated by evaporation. Thus it appears that there was less NH_4Cl present in the sample and so the percentage is smaller.	[1]
				[Total: 16]

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FA 4 is $Al(NO_3)_3(aq)$, FA 5 is glucose solution, FA 6 is ethanol, FA 7 is water (tertiary alcohol)

	Sections	Learning outcomes	Indicative material	Mark
3 (a) (i)	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 NaOH and NH_3 .	[1]
			II White ppt soluble in excess NaOH and insoluble in excess NH_3	[1]
(ii)	ACE conclusion	Draws conclusions from interpretation of observations, data and calculated values	III Al^{3+} or Pb^{2+}	[1]
(iii)	MMO decision	Identifies the nature of confirmatory tests	IV Selects HCl or H_2SO_4 or other appropriate reagent.	[1]
	MMO collection	Use their apparatus to collect an appropriate quantity of data or observations, including differences in colour, solubility or quantity of materials	V Appropriate observation for selected reagent.	[1]
(iv)	ACE conclusion	Draws conclusions from interpretation of observations, data and calculated values	VI Al^{3+} (Must follow from correct test and observations in (iii).)	[1]
(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	I Silver mirror with Tollens' and FA 5 .	[1]
			II No reaction with Tollens' and FA 6 or FA 7 .	[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	(Ignore observations for FA 5 .) III Goes colourless with acidified manganate(VII) and FA 6 .	[1]
			IV No reaction with acidified manganate(VII) and FA 7 .	[1]

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(iii)	ACE conclusion	Draws conclusions from interpretation of observations, data and calculated values	V FA 6 is the primary alcohol. FA 7 is the tertiary alcohol. FA 5 is the solution of glucose. If candidate had a positive Tollens' test in (b)(i) for FA 6 then allow: FA 5 is the primary alcohol, FA 7 is the tertiary alcohol, FA 6 is the solution of glucose.	[1]
(iv)	ACE conclusion	Draws conclusions from interpretation of observations, data and calculated values	VI Correct comparisons for given observations with those for aldehyde i.e. silver mirror for Tollens' and reaction with manganate(VII)	[1]
				[Total: 12]