

**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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<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	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

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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	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 <sup>3</sup> (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 <sup>3</sup> (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 <sup>3</sup> or less Award 1 mark if difference to supervisor is between 0.2 and 0.5 cm <sup>3</sup>	[2]
	(b)	ACE interpretation	Calculate other quantities from data	Selects correct titre values within 0.2 cm <sup>3</sup> . 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 <sup>3</sup> . 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 <sub>2</sub> :S <sub>2</sub> O <sub>3</sub> <sup>2-</sup> 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]

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	<b>(d)</b>	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]
					<b>[Total: 13]</b>

		Sections	Learning outcomes	Indicative material	Mark
<b>2</b>	<b>(a)</b>	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 + <b>FA 3</b> 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 <sup>-1</sup> of supervisor's value. Award 1 mark if corrected T/m is between 0.5 °C g <sup>-1</sup> and 1.0 °C g <sup>-1</sup> of supervisor's value.	[2]
	<b>(b)</b>	ACE interpretation	Calculate other quantities from data	Calculates correct value from candidate's values of T and m (minimum of 2 sf)	[1]
	<b>(c)</b>	ACE interpretation	Calculates other quantities from data	Calculates correct value (minimum of 2 sf) Allow ecf from incorrect value in <b>(b)</b>	[1]
<b>(d)</b>	ACE interpretation	Calculates other quantities from data	-216.6 kJ mol <sup>-1</sup>	[1]	

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	(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]
<b>[Total: 11]</b>					

FA 5:  $\text{MgCl}_2 \cdot 6\text{H}_2\text{O}$  FA 6:  $\text{Al}_2(\text{SO}_4)_3 \cdot 16\text{H}_2\text{O}$   
 FA 7:  $\text{Na}_2\text{SO}_3$  and  $\text{NaCl}$  FA 8:  $\text{Pb}(\text{NO}_3)_2$  FA 9:  $\text{HCOOH}$

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 $\text{NH}_3$ (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 $\text{NH}_3(\text{aq})$	[1]
				FA 6 gives a white ppt with both NaOH and $\text{NH}_3(\text{aq})$	[1]
				Ppt with FA 5 is insol in both excess NaOH and excess $\text{NH}_3(\text{aq})$ Ppt with FA 6 is sol in excess NaOH but insol in excess $\text{NH}_3(\text{aq})$	[1]
ACE conclusion	Draw conclusion from interpretation of observations	FA 5 may contain $\text{Mg}^{2+}(\text{aq})$ and FA 6 may contain $\text{Pb}^{2+}(\text{aq})$ / $\text{Al}^{3+}(\text{aq})$ No ecf from incorrect observations	[1]		

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	<b>(b) (i)</b>	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 <b>FA 8</b> , settles to heavy white ppt with $\text{HCl}(\text{aq})$	[1] [1] [1]
	<b>(b) (ii)</b>	ACE conclusion	Draw conclusion from interpretation of observations	<b>FA 7</b> contains $\text{Cl}^-(\text{aq})$ and $\text{SO}_3^{2-}(\text{aq})$ No ecf from incorrect observations	[1] [1]
	<b>(b) (iii)</b>	ACE conclusion	Draw conclusion from interpretation of observations	<b>FA 8</b> contains $\text{Pb}^{2+}(\text{aq})$ Allow $\text{Ag}^+(\text{aq})$	[1]
	<b>(c)</b>	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 $\text{NaHCO}_3$ (Do not allow gas evolved, gives off $\text{CO}_2$ )	[1] [1]
		ACE conclusion	Draw conclusion from interpretation of observations	<b>FA 9</b> contains methanoic acid as it can be oxidised AND reacts with $\text{NaHCO}_3$	[1]
<b>[Total: 16]</b>					