

UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

Specimen for 2007

GCE A/AS LEVEL

MARK SCHEME

MAXIMUM MARK: 40

SYLLABUS/COMPONENT: 9701/31

ADVANCED PRACTICAL SKILLS



UNIVERSITY of CAMBRIDGE
International Examinations

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Skill	Total marks	Breakdown of marks/expectations		Question 1	Question 2
Manipulation, measurement and observation	16 marks	Successful collection of data and observations	8 marks	2	6
		Decisions relating to measurements or observations	8 marks	5	3
Presentation of data and observations	12 marks	Recording data and observations	5 marks	3	1
		Display of calculation and reasoning	3 marks	3	0
		Data layout	4 marks	4	0
Analysis, conclusions and evaluation	12 marks	Interpretation of data or observations and identifying sources of error	6 marks	2	4
		Drawing conclusions	5 marks	3	1
		Suggesting improvements	3 marks	1	1

MMO = Manipulation, measurement and observation

Collection = Successful collection of data and observations

Decisions = Decisions relating to measurements or observations

PDO = Presentation of data and observations

Recording = Recording data and observations

Display = Display of calculation 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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Question	Sections	Learning outcomes	Indicative material	mark	
1	(a)	PDO Display	<ul style="list-style-type: none"> show their working in calculations, and the key steps in their reasoning 	correct working for volume of H ₂ SO ₄	1
	(b)	MMO decisions	<ul style="list-style-type: none"> decide how many tests or observations to perform 	<p>appropriate volume of acid added each time (between 2 and 4 cm³)</p> <p>volumes spanning a sufficient range each side of calculated end point (between 20 and 30 cm³ below end point and 10 and 20 cm³ above end point)</p>	1 1
	(c)	PDO Recording	<ul style="list-style-type: none"> draw up table in advance of taking readings so that they do not have to copy results use column headings that include both the quantity and the unit and that conform to accepted scientific conventions record raw readings of a quantity to the same degree of precision 	<p>no evidence on script of table having been produced or added to after measurements made;</p> <p>volume, temperature and ΔT columns correctly labelled</p> <p>volumes and temperatures recorded to consistent significant figures</p>	1 1 1
		MMO collection	<ul style="list-style-type: none"> making measurements using burettes and thermometers 	<p>all volumes recorded to 0.05 cm³;</p> <p>all temperatures recorded to 0.5 °C;</p>	1 1
		MMO decisions	<ul style="list-style-type: none"> make and record sufficient, accurate measurements 	<p>volume at which max temp rise recorded within 5 cm³ of Supervisor;</p> <p>ΔT for highest temp within 1 °C of that obtained by Supervisor</p> <p>(1 of these two marks if in range +1 °C to 3 °C)</p>	1 2

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	(d)	PDO Layout	<ul style="list-style-type: none"> plot appropriate variables on clearly labelled x- and y- axes choose suitable scales for graph axes plot all points to an appropriate accuracy. <p>follow the ASE recommendations for putting lines on graphs</p>	<p>ΔT plotted on y-axis and volume of acid on x-axis, correctly labelled including units;</p> <p>suitable scales selected;</p> <p>points plotted as fine cross or encircled dot within $\frac{1}{2}$ small square in either direction;</p> <p>two smooth intersecting curves drawn</p>	1 1 1 1
	(e)	ACE Interpretation	<ul style="list-style-type: none"> find an unknown value by using intercept on a graph 	reading the volume of H_2SO_4 at the end-point from the intercept of the graph	1
	(f)	PDO Display	<ul style="list-style-type: none"> show working in calculations, and the key steps in reasoning use the correct number of significant figures for calculated quantities 	<p>shows working and explains the steps in the calculation;</p> <p>calculates concentration to same sf as titre/volume information recorded</p>	1 1
	(g)	ACE Conclusions	<ul style="list-style-type: none"> draw conclusions from an experiment, giving an outline description of the main features of the data, considering whether experimental data supports a given hypothesis. 	<p>first part of hypothesis not supported as the graph is not a straight line. (hypothesis supported is acceptable if the graph is a straight line)</p> <p>shape of graph described</p> <p>second part of hypothesis is supported as temperature falls after the end-point</p>	1 1 1
	(h)	ACE Interpretation	<ul style="list-style-type: none"> identify the most significant sources of error in an experiment 	<p>comments on the closer spacing of temperatures at higher values or curve with decreasing gradient;</p> <p>explains that heat loss is greater/more rapid at higher temperatures</p>	1 1
	(i)	ACE Interpretation	<ul style="list-style-type: none"> estimate, quantitatively, the uncertainty in quantitative measurements express such uncertainty as an actual or percentage error 	calculates 0.05 or 0.10 as a % of the end-point volume	1
	(j)	ACE Improvements	<ul style="list-style-type: none"> suggest modifications that will improve the accuracy of the experiment 	calculates (total volume x ΔT x 4.3)	1

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2	(a)	MMO Decisions	<ul style="list-style-type: none"> selecting a suitable reagent 	use of $\text{Pb}(\text{NO}_3)_2$ or $\text{AgNO}_3/\text{NH}_3(\text{aq})$ as reagent;	1
		MMO Collection	<ul style="list-style-type: none"> use apparatus to collect an appropriate quantity of data or observations, including subtle differences in colour, solubility or quantity of materials 	records appropriate observation for selected reagent	1
	(b)	MMO Decisions	<ul style="list-style-type: none"> selecting a suitable reagent 	use of $\text{Pb}(\text{NO}_3)_2$ or $\text{AgNO}_3/\text{NH}_3(\text{aq})$ as reagent;	1
		MMO Collection	<ul style="list-style-type: none"> use apparatus to collect an appropriate quantity of data or observations, including subtle differences in colour, solubility or quantity of materials 	records appropriate observation for selected reagent	1
		ACE conclusions	<ul style="list-style-type: none"> draw conclusions from interpretations of observations 	draws a conclusion appropriate to the observations in (a) and (b)	1
	(c)-(f)	MMO collection	follow instructions given in the form of written instructions	all tests attempted and some observation recorded	1
			use apparatus to collect an appropriate quantity of data or observations, including subtle differences in colour, solubility or quantity of materials	at least three initial precipitates correctly recorded	1
				colours of precipitates correctly described	1
				solubility of precipitates in excess NaOH/NH_3 correctly described	1
		MMO decisions	make appropriate qualitative observations	appropriate test for ammonia gas recorded	1
	PDO recording	record observations to the same level of detail	consistent standard in recording observations i.e. all precipitates and their solubilities in excess recorded	1	

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	(g)	ACE Interpretation	<ul style="list-style-type: none"> describes and summarises the key points of a set of observations. 	<p>explains how the observations identify and confirm the presence of Ba^{2+}.</p> <p>explains how the reaction with sodium hydroxide and ammonia identifies Al^{3+} or Pb^{2+} as the unknown cation</p> <p>explains which tests eliminate Pb^{2+}</p>	<p>1</p> <p>1</p> <p>1</p>
	(h)	ACE Improvements	<ul style="list-style-type: none"> suggest ways in which to extend the investigation 	suggests dilute acid to liberate NO	1