UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

Specimen for 2007

GCE A/AS LEVEL

MARK SCHEME

MAXIMUM MARK: 40

SYLLABUS/COMPONENT: 9701/31

ADVANCED PRACTICAL SKILLS



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Skill	Total marks	Breakdown of marks/expec	tations	Question 1	Question 2
Manipulation, measurement	16 marks	Successful collection of data and observations	8 marks	2	6
and observation		Decisions relating to measurements or observations	8 marks	5	3
Presentation of data and	12 marks	Recording data and observations	5 marks	3	1
observations		Display of calculation and reasoning	3 marks	3	0
		Data layout	4 marks	4	0
Analysis, conclusions and	12 marks	Interpretation of data or observations and identifying sources of error	6 marks	2	4
evaluation		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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Que	stion	Sections	Learning outcomes	Indicative material	mark
1	(a)	PDO Display	 show their working in calculations, and the key steps in their reasoning 	correct working for volume of H_2SO_4	1
	(b)	MMO decisions	 decide how many tests or observations to perform 	appropriate volume of acid added each time (between 2 and 4 cm ³) volumes spanning a sufficient range each side of calculated end point (between 20 and 30 cm ³ below end point and 10 and 20 cm ³ above end point)	1
	(c)	PDO Recording	 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 	no evidence on script of table having been produced or added to after measurements made; volume, temperature and ΔT columns correctly labelled volumes and temperatures recorded to consistent significant figures	1 1
		MMO collection	 making measurements using burettes and thermometers 	all volumes recorded to 0.05 cm^3 ; all temperatures recorded to 0.5 °C ;	1
		MMO decisions	 make and record sufficient, accurate measurements 	volume at which max temp rise recorded within 5 cm ³ of Supervisor; ΔT for highest temp within 1 °C of that obtained by Supervisor (1 of these two marks if in range +1 °C to 3 °C)	1 2

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(d)	PDO Layout	 plot appropriate variables on clearly labelled x- and y- axes choose suitable scales for 	∆T plotted on y-axis and volume of acid on x-axis, correctly labelled including units;	1
		graph axes • plot all points to an		
		appropriate accuracy.	points plotted as fine cross or encircled dot within ½ small square in either direction:	1
		follow the ASE recommendations for putting lines on graphs	two smooth intersecting curves drawn	1
(e)	ACE Interpretation	 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	 show working in calculations, and the key steps in reasoning 	shows working and explains the steps in the calculation;	1
		 use the correct number of significant figures for calculated quantities 	calculates concentration to same sf as titre/volume information recorded	1
(g)	ACE Conclusions	 draw conclusions from an experiment, giving an outline description of the main features of the data, considering whether experimental data supports a given hypothesis. 	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)	1
			shape of graph described second part of hypothesis is supported as temperature falls after the end-point	1
(h)	ACE Interpretation	 identify the most significant sources of error in an experiment 	comments on the closer spacing of temperatures at higher values or curve with decreasing gradient;	1
			explains that heat loss is greater/more rapid at higher temperatures	1
(i)	ACE Interpretation	 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	 suggest modifications that will improve the accuracy of the experiment 	calculates (total volume x $\Delta T \times 4.3$)	1

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2	(a)	MMO Decisions	;	 selecting a suitable reagent 	use of Pb(NO ₃) ₂ AgNO ₃ /NH ₃ (aq) reagent;	or as	1
		MMO Collection	1	 use apparatus to collect an appropriate quantity of data or observations, including subtle differences in colour, solubility or quantity of materials 	records appropr observation for s reagent	iate selected	1
	(b)	MMO Decisions	;	 selecting a suitable reagent 	use of Pb(NO ₃) ₂ AgNO ₃ /NH ₃ (aq) reagent;	or as	1
		MMO Collection	1	 use apparatus to collect an appropriate quantity of data or observations, including subtle differences in colour, solubility or quantity of materials 	records appropr observation for s reagent	iate selected	1
		ACE conclusion	ns	 draw conclusions from interpretations of observations 	draws a conclus appropriate to th observations in	ion ie (a) and (b)	1
	(c)-(f)	MMO collection		follow instructions given in the form of written instructions	all tests attempt some observation recorded	ed and on	1
				use apparatus to collect an appropriate quantity of data or observations, including subtle	at least three ini precipitates corr recorded	tial ectly	1
				differences in colour, solubility or quantity of materials	colours of precip correctly describ	oitates bed	1
					solubility of prec excess NaOH/N correctly describ	ipitates in H_3	1
		MMO decisions		make appropriate qualitative observations	appropriate test ammonia gas re	for corded	1
		PDO recording		record observations to the same level of detail	consistent stand recording observ all precipitates a solubilities in ex- recorded	lard in vations i.e. and their cess	1

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(g)	ACE Interpretation	 describes and summarises the key points of a set of observations. 	explains how the observations identify and confirm the presence of Ba^{2^+} . explains how the reaction with sodium hydroxide and ammonia identifies Al^{3^+} or Pb^{2^+} as the unknown cation explains which tests eliminate Pb^{2^+}	1
(h)	ACE Improvements	 suggest ways in which to extend the investigation 	suggests dilute acid to liberate NO	1