UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the October/November 2008 question paper

9701 CHEMISTRY

9701/05 Paper 5 (Practical 2), maximum raw mark 30

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.

All Examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes must be read in conjunction with the question papers and the report on the examination.

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UNIVERSITY of CAMBRIDGE
International Examinations

Skill		*Breakdown of marks*	
Planning	15 marks	Defining the problem	5 marks
		Methods	10 marks
Analysis, conclusions and evaluation	15 marks	Dealing with data	8 marks
		Evaluation	4 marks
		Conclusion	3 marks

Statement Bank

PLANNING (PLAN)

Defining the problem (problem)

P1	identify the independent variable in the experiment or investigation
P2	identify the dependent variable in the experiment or investigation
P3	express the aim in terms of a prediction or hypothesis, and express this in words or in the form of a predicted graph
P4	identify the variables that are to be controlled

Methods (methods)

M1	describe the method to be used to vary the independent variable, and the means that they will propose to ensure that they have measured its value accurately
M2	describe how the dependent variable is to be measured
M3	describe how each of the other key variables is to be controlled
M4	explain how any control experiments will be used to verify that is the independent variable that is affecting the dependent variable and not some other factor
M5	describe the arrangement of apparatus and the steps in the procedure to be followed
M6	suggest appropriate volumes and concentrations of reagents
M7	assess the risks in their proposed methods
M8	describe precautions that should be taken to keep risks to a minimum
M9	draw up tables for data that they might wish to record
M10	describe how the data might be used in order to reach a conclusion

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ANALYSIS, CONCLUSIONS AND EVALUATION (ACE)

Dealing with data (data)

D1	identify the calculations and means of presentation of data that are necessary to be able to draw conclusions from provided data
D2	use calculations to enable simplification or explanation of data
D3	use tables and graphs to draw attention to the key points in quantitative data, including the variability of data

Evaluation (evaluation)

E1	identify anomalous values in provided data and suggest appropriate means of dealing with such anomalies within familiar contexts, suggest possible explanations for anomalous readings
E2	within familiar contexts, suggest possible explanations for anomalous readings
E3	identify the extent to which provided readings have been adequately replicated, and describe the adequacy of the range of data provided
E4	use provided information to assess the extent to which selected variables have been effectively controlled
E5	use these evaluations and provided information to make informed judgements on the confidence with which conclusions may be drawn

Conclusions (conclusions)

C1	draw conclusions from an investigation, providing a detailed description of the key features of the data and analyses, and considering whether experimental data supports a given hypothesis
C2	make detailed scientific explanations of the data, analysis and conclusions that they have described
C3	make further predictions, ask informed and relevant questions and suggest improvements

Skill	***Total marks***	***Breakdown of marks***			***Question 1***	***Question 2***
			Statement	***Marks***		
Planning	15 marks	Defining the problem	P	5	5	0
		Methods	M	10	10	0
Analysis, conclusions and evaluation	15 marks	Dealing with data	D	8	0	8
		Evaluation	E	4	0	4
		Conclusion	C	3	0	3

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Question	Sections	Statement	Indicative material	Mark
1 (a) (i)	PLAN Problem	P3	The solubility of cerium sulphate decreases due to the common ion effect/Le Chatelier as the concentration of sulphuric acid increases.	[1]
(ii)		P3	Sketches an appropriate graph (slight curve or straight line) that matches the prediction in the first part of the section. (Graph to start on the *y*-axis but should not extend to the *x*-axis.) (Allow ecf graph from a prediction of increasing solubility – this graph to have a positive gradient beginning at a non-zero point on the *y*-axis)(do not allow ecf from a 'nonsense' statement)	[1]
(b)	PLAN Problem	P1	**Concentration** of sulphuric acid identified as independent variable.	[1]
		P2	Mass/moles of cerium sulphate dissolved identified as the dependent variable/solubility (accept other concentration units).	[1]
		P4	Temperature identified as the variable to be controlled. **(any other suggestion negates any or all of these points)**	[1]
(c) Part 1	PLAN Methods	M5	A. Describes a sequential method for preparing the saturated solution using all of the 60 cm^3 of distilled water, and filtering off **excess** (stated or by implication) solid. (To ensure saturation mention should be made of stirring/leaving the solution for some time/heating and cooling back to the controlled temperature).	[1]
		M3	B. Describes a practical method of controlling temperature e.g. use of a water bath.	[1]
		M5	C. There are several methods of dealing with this experiment. This could involve (i) weighing a sample of solution, an appropriate method for evaporating the water, and weighing the residual solid; (ii) weighing the water/solution (60 cm^3) with excess solid, filtering and then weighing the residue. (Ignore as not relevant any suggestion of water /moisture on the residue or filter paper.)	[1]
		M5	D. Shows how the mass of solid and water are converted to solubility. $\frac{\text{mass of solid (or figures)}}{\text{60/mass of water/eqn which gives mass}} \times 100$	[1]

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Question	Sections	Statement	Indicative material	Mark
Part 2	PLAN Methods	M1	E. An appropriate method for diluting the sulphuric acid described. (Measurement by any means of each volume – acid and water [any volumes are acceptable].)	[1]
		M5	F. Burettes (and graduated flasks) or other suitable precision apparatus used to measure volumes.	[1]
		M6	G. Four or more solutions with different concentrations prepared (the range should cover at least a fourfold increase in concentration e.g. 1M to 4M and at least one should be greater than 2.5M. 5M could be one of these). (This mark can be accessed from the table in **(e)**.)	[1]
		M6	H. Concentrations of the solutions specified (minimum of three concentrations needed) or relative volumes given (provided a minimum of 60 cm^3 of acid/solution is available).	[1]
(d)	PLAN Methods	M7	***Corrosive nature of sulphuric acid*** identified as the hazard or any risk associated with this hazard. Alternatively, accept reference to the toxicity of cerium compounds or any risk associated with the use of this reagent.	[1]
(e)	PLAN Methods	M9	Draws up table to show concentration of acid or the appropriate volumes as in **(c) Part 2** and either (i) mass of solid taken and the mass of the solid remaining undissolved or (ii) mass of water/acid solution/acid/solvent and the mass of the solution formed. Appropriate units should be recorded in the column headings. (If the dissolved salt is isolated and they know the mass of solvent/solution, this also would be appropriate.) (Ignore other columns even if nonsense.)	[1]
				[Total :15]

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Question	Sections	Statement	Indicative material	Mark
2 (a)	ACE Data	D1	Labels additional columns: the charge passed through the electrolysis cell and the mass of copper deposited on the cathode. (Accept either a correct name or the correct equation.)	[1]
		D2	Appropriate units, however, must be given (accept 'Q' instead of charge). Must have two derived columns. Correct subtractions for the mass of copper deposited. (Allow 2 errors and 0 for 0.00, all data to 2 dp. If only the various intermediate masses are recorded, this second mark is not to be awarded.)	[1]
(b)	ACE Data	D3	A. Plots mass of copper deposited (*y*-axis) against charge passed (*x*-axis) with correct unambiguous labels and units. (Any other plot can access marks B, C and D)	[1]
		D3	B. Suitable scales selected – data to be plotted over more than half of each axis. This mark stands separate from A.	[1]
		D3	C. Line of best-fit drawn – passing through origin or through an intercept of 115.74. (Some part of the line drawn must cut/touch the origin or the 115.74 intercept.)	[1]
		D3	D. Check that all the points are on or **very close** to the line except the 1.75/5040 point whose plotting accuracy must be checked. If they are, award the mark. At least nine points must have been plotted. (For very unusual graphs, check the plotting of the first three points from the table.) The 'best' straight line is between the origin and the last point (2.40/7200). ***Do not penalise the same unit error twice.***	[1]
			Plots of (i) mass difference vs time (ii) mass of cathode vs charge (iii) mass of cathode vs time can access the marks in **2(c)**, **2(d)**, **2(e)** and **2(f)**.	
(c)	ACE Evaluation	E1	Identifies the single point that does not lie on the line of best-fit (1.75 g Cu at 5040 coulomb) (either by giving the figures here or by suitably marking the graph). If there is another more anomalous point due to erroneous plotting accept this point instead.) (If time has been plotted, allow this also if correctly dealt with.)	[1]
		E2	Suggests an appropriate reason. (Mass of copper is too high – **has some residual liquid on the copper)**. The comment must relate to the position of the selected point. If no point is identified there is no second mark.	[1]

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A	B	C	D	E
time /minutes	mass of cathode /g	mass of copper deposited (B -115.74) /g	time (A × 60) /seconds or /s	charge (D × 0.3) or (18A) /C
0	115.74	0.00	0.00	0.00
40	115.97	0.23	2400	720
80	116.22	0.48	4800	1440
120	116.46	0.72	7200	2160
160	116.70	0.96	9600	2880
200	116.94	1.20	12000	3600
240	117.19	1.45	14400	4320
280	117.49	1.75	16800	5040
320	117.67	1.93	19200	5760
360	117.92	2.18	21600	6480
400	118.14	2.40	24000	7200

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Question	Sections	Statement	Indicative material	Mark
(d)	ACE Evaluation	E5	% error is decreased for the small masses involved.	[1]
(e)	ACE Data	D2	Enough construction lines on the graph to lead to the correct readings of the mass of copper and the charge.	[1]
		D2	Calculation of the correct answer (to 2 s.f. [however, allow the candidate to give the answer to no more than 5 s.f.]) corresponding to the readings from the graph. The reading should be within 50 C and 0.01 g of the Examiners values. (An answer must be given – the correct value is about 9.5×10^4 C mol^{-1}.)	[1]
(f)	ACE Conclusions	C1	Refers to **straight line** through origin (or 115.74) or few points off the line as supporting evidence.	[1]
		C1	If the candidate's answer is 9.5×10^4 to 2 sf allow the mark for comments referring to 'close agreement' with the real/given value etc. (must be comparative)	[1]
(g)	ACE Conclusions	C3	Candidate realised that the (loss in) mass of the anode could also have been measured and recorded. (Ignore all other suggestions.)	[1]
(h)	ACE Evaluation	E1	Any comment should refer to a decrease in the current or an increased resistance in the circuit.	[1]
				[Total: 15]

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