UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the May/June 2007 question paper

9701 CHEMISTRY

9701/05 Paper 5 (Planning, Analysis and Evaluation), 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

Question	Sections	Indicative material	Mark	
1 (a)(i)	**PLAN Problem**	Uses collision theory to predict that the rate of formation of H_2(g) increases as the concentration of HC*l* increases	[1]	
(ii)		Uses collision theory to explain how rate of reaction increases with increasing temperature	[1]	**[2]**
(b)	**PLAN Problem**	Concentration of HC*l* identified as independent variable *[HCl] is acceptable*	[1]	**[1]**
(c)	**PLAN Problem**	States that the (total) volume of solution must be kept constant, **or** States that the amount/size/length/mass/surface area of the magnesium ribbon must be kept constant	[1]	**[1]**
(d)(i)	**PLAN Methods**	Lists apparatus for the reaction of Mg/acid, collection and measurement of gas and timing gas collection *Connecting tube does not need to be listed* *gas could be measured by full test-tube etc.* *A diagram is acceptable if a timing device is mentioned in the text*	[1]	
(ii)		Dilutes a range of volumes of HC*l* sufficient for the experiment *A minimum of 5 different concentration solutions is required* *Total volume does not have to be constant*	[1]	
(iii)		Prepares diluted solutions using measuring cylinder, pipette or burette	[1]	
(iv)		Describes how collection of a stated volume of H_2 will be timed in each experiment, **or** Volume of H_2 collected in a stated time is described, **or** Volume of H_2 collected recorded at fixed intervals to enable graph to be plotted	[1]	
(v)		Reference to the way in which total volume being kept constant, **or** temperature kept constant, **or** way in which other variable from **(c)** is controlled	[1]	

Question	Sections	Indicative material	Mark	
(vi)		Candidate selects a range of suitable volumes of acid or states a range of concentrations to be used *Volume of acid should cover the range from starting volume (concentration) to at least half the starting volume (concentration)* *Total volume must be constant <u>unless</u> a correct (relative) concentration has been given* *Ignore starting with a concentration of <u>less</u> than 2 mol dm^{-3} hydrochloric acid.*	[1]	
(vii)		*Do <u>not</u> accept concentrations greater than 2 mol dm^{-3}* The plan is presented logically with an effective way of preventing loss of gas *The use of dropping funnels or thistle funnels is permitted for addition of acid without loss of gas*	[1]	**[7]**
(e)	**PLAN Methods**	Table has columns for volume of acid and volume of water, *** time (if fixed volume of gas is collected) **<u>or</u>** volume of gas (if gas collected after fixed time) <u>rate</u> ****Candidates may tabulate concentration instead of volume of acid and volume of water* ***BUT TO QUALIFY FOR THIS MARK*** *they must have shown numbers (volume of acid and volume of water) when describing a dilution in the text*	[1]	
		Each column shown has correct units	[1]	
		Candidate explains the graph (<u>valid for the method described</u>) which is to be drawn **or** the calculation to be performed **or** how the volume of gas – collected at fixed time interval **or** time – for collection of a fixed volume of gas will provide information in support of or against the prediction in **(a)(i)** *Examiners will expect increased concentration/increased rate* ***or*** *larger volume in fixed time linked to higher concentration* *shorter time for fixed volume linked to higher concentration* *(or reverse argument)*	[1]	**[3]**
(f)	**PLAN Methods**	Candidate repeats the experiment keeping HC*l* constant and varying the temperature Description of how the temperature will be <u>controlled</u> is required	[1]	**[1]**

Question	Sections	Indicative material	Mark	
2 (a)	ACE Data	**Correct headings for two or three of the following columns:** mass of mercury chloride (B–A) mass of mercury (C–A) mass of chlorine (B–C) *Mass of chlorine can be obtained from mass of mercury chloride and mass of mercury (D–E or vice versa)* ***The correct equation must be included but units are not necessary in these columns***	[1]	
		Correct subtractions for all values (Allow 1 error only) ***Each subtraction recorded to 1 decimal place (zero omitted in the 2nd decimal place is a separate error)***	[1]	**[2]**
(b)	ACE Data	Plots, with correct labels – (**not** (D, E, F etc)) and units: mass of mercury against mass of mercury chloride **or** mass of chlorine against mass of mercury chloride *mass of mercury chloride must be on x axis (as independent variable)* **or** mass of mercury against mass of chlorine *(either axes)* *Candidate may convert masses to moles and plot the latter*	[1]	
		Suitable scales selected – data to be plotted over more than half of each axis	[1]	
		Candidate plots all 8 points	[1]	
		Candidate draws a straight line <u>which passes through (0,0) or would pass through (0,0) if extrapolated</u> and has a maximum number of points close to or on the line	[1]	**[4]**

Question	Sections	Indicative material	Mark	
(c)	ACE Evaluation	Identifies any point(s) that do not lie on the line drawn **Do not give this mark unless experiment 4 is one of the points identified** If there are more points on the same side of the graph as (correctly plotted) data for experiment 4 the mass of Hg is too low Award marks as follows: (i) Refers to loss of mercury **or** if mass of chlorine has been plotted on one axis refers to too high a mass of chlorine [1] (ii) Reference to experimental method – describes mercury being poured away or reaction not going to completion [1] **OR** If there are more points on the opposite side of the graph as (correctly plotted) data for experiment 4 the mass of Hg is too high Award marks as follows: (i) Refers to mass of mercury being greater than expected/it should be **or** if mass of chlorine has been plotted on one axis refers to too low a mass of chlorine (ii) Reference to experimental method – describes mercury not being adequately dried (water or propanone) [1] If there are equal numbers of points on either side of the line only award marks if the explanation is linked to relative position of the points and the line. [1]	[1] [2]	**[3]**
(d)	ACE Evaluation	Refers to balance error or % error being less significant if larger masses are weighed	[1]	**[1]**
(e)	ACE Data	Two construction lines to graph **or** one construction line to graph are seen on the graph **and** values of a pair of points **or** a single point are **correctly read** from the graph The points read from the graph should be used in some form of calculation e.g. calculating a gradient. Correctly calculates (using the candidate's figures from the graph) the value of **x** in $HgCl_x$ and gives the formula with an integral value of **x** in the final answer *Where a candidate obtains a ratio of Hg:Cl of 1:1.5 accept Hg_2Cl_3 or Cl rounded up or down to 1 or 2 as appropriate.*	[1] [1]	**[2]**

Question	Sections	Indicative material	Mark	
(f)	**ACE Conclusions**	Supporting evidence must be given <u>from and fit the data plotted</u> Suitable experimental method: Refers to a straight line, (passing through the origin), with few points off the line or Experimental method not suitable: Reverse argument to above or Suitable experimental method: Experimental data gives a value of **x** that is very close to an integer or Experimental method not suitable: Experimental data does not give an integral value of **x**	[1] [1]	**[2]**
(g)	**ACE Conclusions**	Soluble silver salt named e.g. silver nitrate/ $AgNO_3$ *Accept Ag^+(aq), solution containing Ag^+ or solution containing silver(I)* *Do <u>not</u> accept Ag^+ or silver* **or** Soluble lead(II) salt named e.g. lead nitrate/ $Pb(NO_3)_2$ *Accept Pb^{2+}(aq), solution containing Pb^{2+} or solution containing lead(II)* *Do <u>not</u> accept Pb^{2+} or lead* ***If formula or cation is given it must be correct*** *Ignore any potential reaction of an anion in the reagent with Hg^{2+}*	[1]	**[1]**
				[Total: 15]

Appendix

Data for Question 2

	A	B	C	D	E	F
expt	mass of beaker /g	mass of beaker + mercury chloride /g	mass of beaker + mercury /g	mass of mercury chloride /g	mass of mercury /g	mass of chlorine /g
				(B–A)	(C–A)	(B–C) (D–E)
1	54.87	55.52	55.30	0.65	0.43	0.22
2	54.64	55.88	55.59	1.24	0.95	0.29
3	56.70	58.38	57.94	1.68	1.24	0.44
4	51.03	53.34	52.53	2.31	1.50	0.81
5	55.33	58.74	57.84	3.41	2.51	0.90
6	53.05	57.20	56.10	4.15	3.05	1.10
7	53.92	58.57	57.17	4.65	3.25	1.40
8	55.26	61.09	59.57	5.83	4.31	1.52

Zero required as second decimal place. Treat each error as a separate error

Candidate plots the following masses:

y axis	x axis	equation
mercury	mercury chloride	slope x (201 + 35.5x) = 201
mercury chloride	mercury	slope x 201 = (201 + 35.5x)
chlorine	mercury chloride	slope x (201 + 35.5x) = 35.5x
mercury chloride	chlorine	slope x 35.5x = (201 + 35.5x)
mercury	chlorine	slope x 35.5x = 201
chlorine	mercury	slope x 201 = 35.5x