UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the October/November 2007 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.

- CIE will not enter into discussions or correspondence in connection with these mark schemes.

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MARK SCHEME

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

Question	Sections	Indicative material	Mark
1 (a)	PLAN Problem	Use of ion size and ionic charge **or** charge density to predict decreasing ΔH_{soln} for LiOH to CsOH *(Do **not** give this mark if reference is to size of atom rather than ion)* Correct sketch for candidate predicted trend. *Accept any appropriate downward or upward trend. Points alone are sufficient.* *If no trend is predicted in the first part of **(a)** the second mark can be given for a downward trend.*	1 1
1 (b)	PLAN Problem	**Independent variable** accept any of the following; **1.** mass/weight/moles/amount of ***M*OH** *(**not** metal)*, **2.** "which *M*OH used", **3.** Group I hydroxide. **Dependent variable** accept any of the following; **1.** temperature rise/change, **2.** heat produced/energy change, **3.** ΔH_{soln}. **Controlled variable** accept either of the following; **1.** volume/weight of water, *(**not** amount)* **2.** mass of hydroxide – ***only allowed** if "which hydroxide" is given as the independent variable*.	1 1 1

Question	Sections	Indicative material	Mark
1 (c)	PLAN Methods	Apparatus diagram showing (insulated) container and thermometer. *Non-insulated beaker is acceptable. (Do **not** give this mark if there is a Bunsen or a water bath)*	1
	ACE Evaluation	Give **one mark** for any **two** of the following; **1.** solid absorbing water vapour, **2.** heat loss from apparatus, *(accept open cup/calorimeter)* *(conduction, convection and radiation are treated as separate errors)* **3.** loss of material – *solution overflows or spray*, **4.** inaccurate temperature measurement, **5.** small temperature rise. *Do **not** give this mark for reference to laboratory temperature or draughts in the laboratory.*	1
	PLAN Methods	Give **one mark** for any **two** of the following - if linked to the source of error above; **1.** keep weighed solid in closed container **or** use as soon as weighed *(**not** kept under oil or in a vacuum)* **2.** practical improvement to insulation, **3.** larger container or smaller quantities used, *(accept use of lid for minimising spray)* **4.** more accurately calibrated thermometer, **5.** use larger mass of the hydroxide **or** smaller volume of water. *(Give one of these two marks for one error and step to minimise the error)*	1
1 (d)	PLAN Methods	Identify the corrosive nature of the solid/aqueous hydroxides. If corrosive is identified as the hazard give **this mark** for using gloves **or** If solution boils over or sprays out but is not described as corrosive give **this mark** for using two of gloves, lab coat, eye protection, (face) mask	1 1

Question	Sections	Indicative material	Mark
1 (e)	PLAN Methods	**1.** weighs a <u>stated mass</u> of <u>named hydroxide</u>. mass to be between 0.05 mol and 0.25 mol (See appendix) **and** candidate describes the weighing of the solid *(two possible methods)* (i) empty bottle/empty (plastic) cup; **and** bottle + solid/(plastic) cup + solid (ii) bottle + solid **and** bottle + residual solid **2.** measures between 50 cm^3 and 200 cm^3 of water **and** describes the measurement of the volume (measuring cylinder, burette, pipette) *(apparatus for measuring the water and the volume used may be shown in the diagram)* *(A larger or smaller volume of water can be accepted if it is related to a specified capacity container.* *e.g. 400 cm^3 water in 500 cm^3 beaker* *30 cm^3 water in 50 cm^3 beaker)* **3.** Initial and <u>highest</u> temperatures recorded **4.** Step by step procedure described **Minimum** steps required: Weigh solid, specified/measured volume of water and measured temperature rise	1 1 1 1
1 (f)	PLAN Methods	Table showing metal hydroxides **two** weighings - unless tare specified, initial and final temperatures. **Ignore units**. *Do **not** give this mark if candidate lists metals for the experiment rather than the metal hydroxides unless the column is headed "metal hydroxide" / "hydroxide"* *or* *metals have been penalised in **(e)**.* *If weighings are missing in **(e)** the mark can be given in **(f)** if the mass of metal hydroxide is tabulated.* *If temperature readings are missing in **(e)** the mark can be given in **(f)** if ΔT is tabulated.*	1

Question	Sections	Indicative material	Mark
1 (g)	PLAN Methods	Shows how enthalpy change of solution is calculated for **one** hydroxide using $\frac{\mathbf{mc\Delta T}}{\mathbf{moles}}$ *Be certain that **m** refers to liquid and **not** solid or liquid + solid* To gain this mark there must be an expression for converting mass of metal hydroxide to moles, including the correct numerical value for the appropriate M_r. *This calculation or numerical evidence for M_r may be found in earlier work – **(e)** or **(f)***	1
		Question 1 Total	**16**

Question	Sections	Indicative material	Mark
2 (a)	ACE Data	Appropriate labels, units and **linear scales** that will accommodate **all points** in the data table Acceptable form of units (from 9701 syllabus) **volume** / cm^3 (cm^3) volume **in** cubic centimetres **time** / min (min) accept mins time **in** minutes Do **not** accept volume cm^3 time min Points <u>plotted correctly</u> *Points should be within ½ small square, in either direction) of the correct position and within the correct half of the appropriate small square.* **To gain this mark there must be an attempt to draw a smooth curve**	1 1

Question	Sections	Indicative material	Mark
2 (b)	ACE Evaluation ACE Evaluation	Data at **either 5.0** or **7.5** minutes identified *(Ignore any other point)* **and** suggests one of the following **1.** irregular movement of syringe (sticking), **2.** H_2 gas lifts Mg out of the acid solution, **3.** reading taken before indicated time.	1
2 (c)	ACE Data	Constructs initial "tangent". Accept **either** of the following; **1.** an attempted tangent to the curve at (t = 0), **2.** a straight line drawn through the plotted points at 0.5, 1.0, 1.5 and 2.0 minutes. Reads coordinates from any tangent correct to ½ small square in either direction from the tangent and uses the coordinates in a correct expression for the gradient.	1 1
2 (d)	ACE Evaluation	Award the mark for **either** of the following; **1.** stopwatch started after magnesium ribbon dropped into flask, (flask sealed and gas collected), **2.** gas pushed into the syringe when inserting the bung.	
2 (e)	ACE Conclusions	Identifies as a further source of error **one** of the following – and gives an appropriate method of reducing the error; **1.** gas collected before timing starts **or** gas pushed into syringe when bung inserted – **if not already given in (d)**, **2.** use of 500 cm^3 measuring cylinder to measure 100 cm^3 of acid, **3.** 0.01 g of magnesium weighed on a balance weighing to 2 decimal places. 4. loss of gas before the bung is inserted	1
2 (f)	ACE Data	Calculates relative concentration of acid in each mixture. (See appendix) (1 or 2 sig fig acceptable) *(N.B. not all of the experiments have a total volume of 100 cm^3)*	1

Question	Sections	Indicative material	Mark
2 (g)	ACE Data	Plots initial rate v relative concentration with appropriate labels, units and scales. Scales – points must be plotted over ½ length of each available axis. Do **not** penalise "awkward" scales. Points <u>for students 3 4 and 8</u> correctly plotted and no others obviously wrong *Points plotted to ½ small square in either direction and within correct half square* Straight line drawn through points for students 2 – 8. *Does not have to pass through 0,0.* *The straight line should have points either side of the line.*	1 1 1
2 (h)	ACE Conclusions	Concludes that prediction is wrong for a straight line (or right for a curve) **and** refers to the shape of the graph. **Only give this mark if the candidate has drawn a straight line through the points in (g)** Concludes **one** of the following: **1.** the rate of reaction = k[HC*l*], **2.** reaction is first order wrt HC*l*, **3.** reaction is directly proportional to [HC*l*] *(even if straight line does not pass through 0,0),* **4.** the graph/line for a 2nd order reaction would be a curve/parabola.	1 1
2 (i)	ACE Evaluation	Award this mark for any answer that is acceptable for the points plotted, line drawn by the candidates. *If the data has been correctly processed there should be a good distribution of points for a best-fit straight line.* **Ignore student 1** – unless the candidate refers to this point. *If the relative concentration has been calculated to only 1 significant figure there is lower confidence in the point plotted for Student 2.*	1
		Question 2 Total	**14**

Appendix

Question 1 (e)

		mass of metal hydroxide / g				
metal hydroxide	**M_r**	**0.05 mol**	**0.10 mol**	**0.15 mol**	**0.20 mol**	**0.25 mol**
LiOH	**23.9**	**1.195**	**2.39**	**3.585**	**4.78**	**5.975**
NaOH	**40.0**	**2.00**	**4.00**	**6.00**	**8.00**	**10.00**
KOH	**56.1**	**2.805**	**5.61**	**8.415**	**11.22**	**14.025**
RbOH	**102.5**	**5.125**	**10.25**	**15.375**	**20.50**	**25.625**
CsOH	**150.0**	**7.50**	**15.00**	**22.50**	**30.00**	**37.50**

Question 2 (f)

student	volume of acid used / cm^3	volume of water used / cm^3	mass of magnesium / g	initial rate / cm^3 min^{-1}	relative concentration of acid	
1	100	0	0.01		1.0	1.0
2	45	55	0.01	8.0	**0.45**	**0.5**
3	90	10	0.01	16.4	**0.90**	**0.9**
4	60	40	0.01	11.5	**0.60**	**0.6**
5	100	100	0.01	9.3	**0.50**	**0.5**
6	35	75	0.01	6.8	**0.35**	**0.4**
7	80	20	0.01	15.2	**0.80**	**0.8**
8	60	240	0.01	3.3	**0.20**	**0.2**
					2 sig fig	***1 sig fig***