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

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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.

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UNIVERSITY of CAMBRIDGE
International Examinations

MARK SCHEME

Skill	*Total marks*	*Breakdown of marks*	*Marks*	*Question 1*	*Question 2*
Planning	15 marks	Defining the <u>problem</u>	5	5	0
		<u>Methods</u>	10	10	0
Analysis, conclusions and evaluation	15 marks	Dealing with <u>data</u>	8	0	8
		<u>Evaluation</u>	4	1	3
		<u>Conclusion</u>	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 <u>candidate predicted trend.</u> A*ccept 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

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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

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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

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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** **time** / cm^3 / min (cm^3) (min) accept mins volume **in** cubic centimetres time **in** minutes Do **not** accept volume cm^3 time min	1
		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

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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

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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**

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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***

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