UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Level

MARK SCHEME for the May/June 2011 question paper

for the guidance of teachers

9701 CHEMISTRY

9701/53 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, which would have considered the acceptability of alternative answers.

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

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Question	Sections	Indicative material	Mark
1 (a)	PLAN Problem	Predicts that rate of reaction will be proportional to the temperature/ increasing temperature increases rate Greater frequency/greater chance/greater/energy of collision/more particles have energy greater than the activation energy/more effective collisions/more often. Any graph showing an increasing rate with temperature (curve or straight line) Line may start anywhere. Ignore units but axes must be labelled and can be 'either way round'. Use of 'time' negates (If time is mentioned in the prediction the graph might be worth a mark as an ECF, the prediction of course would be worth zero) Allow a consequential answer from an incorrect prediction.	[1] [1] [1]
(b)	PLAN Problem	**(i)** Temperature as the independent variable **(ii)** Time identified as dependent variable/rate (of reaction). Other incorrect suggestions negate in either part.	[1] [1]
(c)	PLAN Methods	**(i)** A 'container' with liquid and an immersed thermometer being heated. No mark if sealed. (If the candidate chooses at this stage to set up an experiment using a water-bath [which is of course the way many of us would carry out this exercise] with the thermometer immersed in the bath and reaction vessel(s) shown we should give this mark here. However, in **(d)** in order to access the 'temperature' mark using such a water-bath 'equilibration' must be stated or clearly implied.) **(ii)** Volume of 'container' (any conical flask or beaker must have a volume of at least 20 cm^3) and thermometer range (to cover the candidate's expts.) (Upper and lower temps on the thermometer to be given). Allow a boiling/test tube without a volume.	[1] [1]
(d)	PLAN Methods	**(i)** At least 5 experiments (not repeats of the same expt.) To cover at least a 25 ^oC range **(no greater than 100 ^oC)** **(ii)** Maintaining the volumes of both reagents **(not total vol.)** If a candidate states that the experiment should be repeated, (even if it is the same experiment) in the absence of any contrary detail, give this mark. **(iii)** Temperature(s) of both reagents taken/or temperature taken immediately after mixing. (see note above)	[1] [1] [1] [1]

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		(iv) Statement of timing to (first) opacity/determination of the point of opacity (e.g. the disappearing cross). [If it is clear that the timing starts after mixing and heating has taken place do not award this mark]. Some of these points (**(i)**, **(ii)** and **(iii)**)may be available from the table. These first three marks can also be awarded even if the candidate is clearly bent on carrying out a different experiment. E.g. an experiment which involves an apparent rise of temperature during the experiment or one which seems to be measuring the time between the first opacity and a 'final' opacity.	[1]
(e)	PLAN Methods	Reference to 'hot' apparatus/sulfur dioxide evolved/hydrochloric acid (ignore any reference to possible effects) **with** 'use of heat proof gloves/use of tongs'/use of fume cupboard/gloves and goggles. Ignore spillages	[1]
(f)	PLAN Methods	There are four items to be covered here table to include; Temperature; (If candidates record two temperatures per experiment and this is as a result of a 'flawed experimental design' allow the temperature mark even if a Δt is also given. However Δt alone does not gain the mark.) Time to opacity (ignore start times); Rate (allow 1/t or 1/time); All with correct units. Allow /s or seconds, (s or seconds). Allow $/s^{-1}$ or $seconds^{-1}$, (1/s or 1/seconds) Ignore all other columns All four correct 2 marks; Any error 1 mark; Two or more errors zero. If one column missing but others fully correct allow one mark	[2]
	Total		**[15]**

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Question	Sections	Indicative material	Mark
2 (a)	ACE Data	Focus on the solubility column initially then: Correct heading and formula, Correct units,(allow g/100g without the solidus) All calculations correct (allow one calculation or sf error). (No ecf from earlier errors) (no ecf in solubility calc) Give one mark for; two fully correct headings including units/two correct columns/one heading with units and one column correctly calculated (any combination) (allow one error)	 [1] [1] [1]
(b)	ACE Data	Unambiguously labelled axes (ignore units) (Solubility must be on the *y*-axis) If either mass is plotted against temperature all the three subsequent marks are available but not this first mark. But, see below. Appropriate scaling (axes to allow points to cover at least half of the grid in each direction). Check points 1,5, 7 and 12. Points need to be plotted in the correct small square unless the points should be on a line or at a corner (then it has to be there).If the point is on a grid line and should not be it is incorrect. Line of best fit (the correct graph is a curve, hence straight lines gain zero. If however a wrong set of results genuinely produces a straight-line, award the mark for a straight-line) (ignore extrapolation at temperatures lower than 20 ^{o}C) Examiner judgement for best-fit curves.	[1] [1] [1] [1]
(c)	ACE Evaluation	One identified anomaly At least one more anomaly identified (max 6 anomalies) (must include the most anomalous)(any anomaly on the line negates) Correct explanation for the anomaly. If either or both of the anomalies are mentioned here but not 'ringed' on the graph allow the marks. Correct explanation for the second anomaly Anomalies above the line: temperature read too late/super cooling Below the line: water lost (due to evaporation) (so crystals form at a higher temp.)/temperature read before crystallisation. ONE mark for two correct reasons which are not tied to a particular point. Ignore any reference that might be 'human error' e.g. reference to spillage, mass loss, misreading of the balance or thermometer etc. These last two marks are not available if the graph includes a mass and no further marks are available in (d) or (e)	[1] [1] [1] [1]

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(d)	ACE Data ACE Conclusions	Takes readings from the graph at 85 ^{o}C and 35 ^{o}C Calculates the mass of solid (divides by 2 and subtracts or the reverse). Correct answer alone gets both marks.	[1] [1]
(e)	ACE Conclusions	For stating 'endothermic'. For the statement 'solubility increases with temperature' (Allow alternatives for both marks if the graph supports e.g. exothermic if the graph slopes the other way and solubility decreasing with temperature etc.)	[1] [1]
	Total		**[15]**

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