UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Level

MARK SCHEME for the October/November 2011 question paper for the guidance of teachers

9701 CHEMISTRY

9701/51 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 the solubility increases (with temperature). If gave "decreasing" then ecf into sketch and do not mark explanation. KNO_3 needs energy to dissolve OR supplying heat or energy or increasing temperature will promote the endothermic change/ reaction. Any graph showing an increasing solubility with temperature (curve or straight line) that reflects the prediction. Do not accept a concave curve that becomes vertical. Accept a convex curve (accept with a max or an end decline). There can be a plateau in solubility. Have solubility on the *y* axis and temperature on the *x* axis. Ignore units unless the unit is the label. If gave "decreasing" above then ecf into sketch. If the prediction is irrelevant e.g. rate then can mark sketch as stand alone	[1] [1] [1]
(b)	PLAN Problem	**(i)** Temperature as the independent variable. **(ii)** Solubility as the dependent variable. Has to be a double quantity, not just mass or amount of solute. Ecf "concentration" if given as *y*-axis in sketch.	[1] [1]

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(c)	PLAN Methods	There are four different approaches, all of which share the first five marking points. Use 7 number labelled ticks and crosses for these points. **(i)** At least 5 experiments. **(ii)** Uses a range of at least 40^{o}C. **(iii)** Pilot run to choose relative amounts of materials. **(iv)** Mass by balance. Water by measuring cylinder/pipette/ burette or mass of water by balance. **(v)** stirs Alternate 1 **(vi)** Heat mixture to dissolve all the solute. **(vii)** Cool and measure the temperature at which first crystals appear. OR Alternate 2 **(vi)** Heats mixture to a particular temperature. **(vii)** Filters the solution (not cooled or decanted) and weighs the residue. OR Alternate 3 **(vi)** Heats mixture to a particular temperature. **(vii)** filters the solution (not cooled or decanted) and evaporates the filtrate and weighs solid. OR Alternate 4 **(vi)** Heats mixture to dissolve the solute. **(vii)** Records temperature at which the solute dissolves.	[1] [1] [1] [1] [1] [1] [1]
(d)	PLAN Methods	Reference to 'hot' apparatus, not Bunsen or water with Handle with tongs/heat resistant gloves/cool before handling	[1]

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(e)	PLAN Methods	**1(c)(i)** & **(ii)** could award here. Mass of solid dissolved; volume/mass of water; solubility; temperature (solution) and units. Only accept a final temperature if it relates to the temperature of solution. All five correct 2 marks; Three or four correct (one/two errors) 1 mark; Two or less correct (more than two errors) zero.	[2]
	Total		**[15]**

Question	Sections	Indicative material	Mark
2 (a)	ACE Data	Log_{10}(rate) or Log_{10}(1/time) or Log_{10}(1/t). One of these labels also serves as expression, full column no units. Accept log with no base. Reciprocal absolute temperature or reciprocal Kelvin temperature or 1/T (not temp etc.). One of these labels also serves as expression, full column with unit, K^{-1}. Don't accept $1/T \times 10^{-3}/K^{-1}$ but $/10^{-3}K^{-1}$ OK Data in both columns above to 3 sig figs and correct, allow 2 errors. Allow salvage mark for rate column if ALL correct. A heading of 1/time or 1/t or 1/C also serves as expression.	[1] [1] [1]
(b)	ACE Data	Unambiguously labelled axes. 1/T on the *x*-axis and log_{10}(rate) on the *y* axis AND appropriate scaling. Ignore units unless it is the label. Correctly plotted points. Ecf incorrectly calculated data. All 10 points need to be plotted. Check points 3 & 7 and 1 & 10 and any others off the line. Line of best fit. Allow plot and line marks if other axes used.	[1] [1] [1]

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(c)	ACE Evaluation	Allow the candidate to select up to five anomalies which must include that furthest from the line. This mark is available if other axes used. The data has two anomalies, Points 3 & 7. Point 3, Timed to past opacity (not late stopping the clock alone), or solutions not equilibrated with water bath temperature or clock started early. Point 7, Timed to prior to opacity (not early stopping the clock alone), or clock started late. Give a rescue mark if both correct anomalies present but not linked to their points. These last two marks not available if other axes used.	[1] [1] [1]
(d)	ACE Evaluation	Either no repeats OR five or more points not on line hence unreliable OR most points on line OR points produce straight line hence reliable. This mark not available if other axes used.	[1]
(e)	ACE Data	Has construction lines on the plot. States intercept readings from them. (Could be to data points if the line and construction is to that point. Powers of 10 (e.g. × 10^{-3}) must be included if necessary) then calculates the slope (around –1050). Slope is $(y_1 - y_2)/(x_1 - x_2)$. The sign of the gradient must be correct from the sign produced from the intercept calculations. Allow these marks if other axes used.	[1] [1]
(f)	ACE Conclusions	Correct calculation. Any calculation that has slope above multiplied by 19 i.e. $-E_A$ = slope × 19. Or slope = $-E_A/19$. Ignore units. Also accept that calculation subsequently divided by 1000 i.e. about 19950 or 19.95. T is not in this calculation. Allow this mark for other plots.	[1]
(g)	ACE Conclusions	Increased K.E/energy/speed. More collisions/unit time or more frequent collisions or more chance of collisions or more energetic collisions or more collisions exceeding activation energy or more successful collisions or more effective collisions. NOT just more collisions.	[1] [1]
	Total		**[15]**

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