UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the May/June 2009 question paper

for the guidance of teachers

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, which would have considered the acceptability of alternative answers.

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Question	Sections	Indicative material	Mark
1 (a)	PLAN Problem	Selects the second equation The answer must be **comparative**. Cs or Cs^+ is larger/more electropositive/has less polarising power than Na or Li. Accept as a minimum requirement 'the ionic radius increases down the group'.	[1] [1]
(b) (i) **(ii)**	PLAN Problem	Amount/mass/weight/moles of $CsNO_3$ identified as independent variable. **Do not accept concentration or volume.** Volume/amount/mass of gas collected identified as the dependent variable. Alternatively accept mass of residue.	[1] [1]
(c)	PLAN Methods	Give one mark for a suitable apparatus for heating the solid to effect decomposition. Heating needs to be present and labelled but the word 'heat' with or without an arrow is sufficient. The use of a water-bath negates. Give a second mark for apparatus to collect and measure the volume of the gas. The volume of the apparatus must be given. (Maximum volume 5 dm^3). If a gas jar or test tube is used, it must be graduated, even if its total volume is given. Deduct one mark if these two criteria are fulfilled but the two items of apparatus are not connected. If there is a further item of apparatus between the heating and collection it must work otherwise treat it as a 'no connection'. Allow gases from both equations or a chosen one consistent with dry or wet conditions. i.e. O_2 alone or a mixture of O_2/NO_2 justified for apparatus used and the equation chosen. If the gas is collected over water, only O_2 is acceptable. This mark depends on there being a gas collection device.	[1] [1] [1]
(d)	PLAN Problem	Calculates correctly the volume of gas to be expected from 1 mole of $CsNO_3$ *$LiNO_3$ equivalent* *30 dm^3 (NO_2 + O_2)* – gas syringe *6 dm^3 (O_2)* – over water *$NaNO_3$ equivalent* *12 dm^3 (O_2)* – either method Units must be given. This mark is for the result not the method.	[1]
(e)	PLAN Methods	Calculates CORRECTLY maximum mass to use. Accept a min. of 1.d.p. *$LiNO_3$ equivalent* $\frac{\textbf{collected volume in dm}^3}{\textbf{30}} \times \textbf{195}$ *for (NO_2+ O_2)* $\frac{\textbf{collected volume in dm}^3}{\textbf{6}} \times \textbf{195}$ *for (O_2)* *$NaNO_3$ equivalent:* $\frac{\textbf{collected volume in dm}^3}{\textbf{12}} \times \textbf{195}$ *for (O_2)(100cm^3 are evolved from 1.625g)* The M_r (195) must be used in the calculation. A volume, which might have been omitted from **(c)**, could be introduced here but there is no retrospective mark back to **(c)**.	[1]

(f) (i) **(ii)** **(iii)**	PLAN Methods	Give one mark for; uses a known mass/weight of solid. Give one mark for; measures the initial and final volumes. Give one mark for; Collects gas until volume collected is constant or no movement of syringe or no bubbles in water are seen. **Deduct one mark if these steps are not in the correct chronological order.**	[1] [1] [1]
(g)	PLAN Methods	Recognises that gas needs to be cooled to room temperature before measuring its volume or repeats the exercise.	[1]
(h)	PLAN Methods	Identifies a potential risk. NO_2 poisonous; O_2 an oxidant; $CsNO_3$ is an oxidant; $CsNO_2$ is poisonous; Potential suck back if collecting over water **Ignore items such as 'hot apparatus'** ***OXYGEN FLAMMABLE negates*** Suggests way of minimising risk. NO_2 – work in fume cupboard O_2 – remove any oxidisable material Suck Back – remove delivery tube from water when heating stops.	[1] [1]
Qn 1	**Total**		**[15]**

Page 4	Mark Scheme: Teachers' version	Syllabus	Paper
	GCE A/AS LEVEL – May/June 2009	9701	05

2 (a)	ACE Data	All these Marks are dependent on some 'numbers' being in the relevant columns. This mark is for any column, which is complete with correct title (e.g. mass of solid), equation and unit. This mark is for at least one further column with at least two out of the three required headings. This could be awarded for a single column, which does not meet the first mark's criteria. This mark is for a completed solubility column, which must be headed with either with the word solubility or a correct equation.	 [1] [1] [1]
(b)	ACE Data	For the first two marks accept any scales provided they allow the points to be spread over more than half the graph in each direction. Give one mark if temperature is plotted on the x-axis and labelled with either the word temperature/temp or A/column A and units [/°C or (°C)]. If temperature is plotted on the y-axis then allow the x-axis to substitute for the y-axis and the remaining 3 marks could be gained. If the y-axis is labelled solubility (or what the student believes is solubility) or a correct formula is given give a second mark. OR If the y-axis is not labelled solubility allow the second mark if the axis is labelled with a correct unit and either the correct formula or the correct name (e.g. mass of solute/mass of solid etc.) DO NOT NOW AWARD THE THIRD AND FOURTH MARKS. Check the plotting of the points at 45°C, 50°C and 55°C. If these are OK give a third, mark. If one or more of these points has not been plotted, check others as near as possible to the three chosen. Give a fourth mark for drawing 2 intersecting lines, which are reasonable for the points plotted. Ideally, these will be curves but if straight lines are drawn these must be tangential to the expected curves near the intersection point. Additionally they must intercept at a point on the high temperature line, which is before the 70°C point. Do not accept a continuous curve.	 [1] [1] [1] [1]
(c)	ACE Data	Read the transition temperature from the graph (the intercept of any two lines) and then compare your reading with the candidate's value. Award the mark if within +/- 0.5°C. Mark cannot be gained from a point of inflection.	[1]

(d)	ACE Evaluation	Give this mark for identifying one anomalous point anywhere. The three remaining points are only available if solubility has been plotted. Any explanation must relate to the position of the anomalous point(s) relative to the graphs. Refers to solubility/amount of dissolved solid being too low. Refers to loss of solid during heating/"spitting"; Refers to excess water (too much water in the original solution/too dilute/not saturated); Refers to dehydration of the $NaI.2H_2O$. If the anomaly is the left of the curve. Refers to solubility being too high/amount of solid being too high (some undissolved salt transferred); Refers to not all the water in the solution having been evaporated. Candidates are allowed to comment on either or both of these possibilities if there are appropriate points and it is clear to which point(s) they are referring <u>ANY THREE RELEVANT POINTS TO BE REWARDED</u>	[1] [3]
(e)	ACE Conclusions	Give one mark for; takes additional readings (i) around the transition temperature or (ii) at closer temperature intervals over the full range. If a range is specified it must encompass the transition temperature.	[1]
(f)	ACE Conclusions	Describes in detail the shape of the curves – noting a positive steeper gradient at lower temperatures e.g. above the transition temperature the solubility increases gradually while below the solubility increases quite rapidly. Do not accept changes or varies etc unless a direction is stated. Occasionally candidates may describe how the solubility changes starting from the transition temperature. If this is clearly described allow the mark. e.g. decreases rapidly from the transition temp. Concludes that dissolving sodium iodide under equilibrium conditions is endothermic as the solubility increases with temperature. Do not allow statements merely linking solubility to endothermicity or energy change.	[1] [1]
Qn 2	**Total**		**[15]**