UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the May/June 2008 question paper

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.

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.

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UNIVERSITY of CAMBRIDGE
International Examinations

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

Question	Sections	Statement	Indicative material	Mark
1 (a)	PLAN Problem	P3	CH_2 identified as structural unit **or** different number of carbon **and** hydrogen atoms	1
1 (b)	PLAN Problem	P3	Accept only (a straight line / points in a straight line / bars in a straight line) showing increasing numerical value from C_1 to C_5. *Freehand sketches are acceptable*	1
1 (c)	PLAN Problem	P1	**Independent (Controlled) variable** (i) mass/moles of alcohol identified as independent variable. (do not accept **amount)** (ii) temperature rise or change identified as independent variable. (iii) (alcohol chosen / number of carbon atoms in alcohol / carbon chain length) identified as independent variable or duration of experiment identified as independent variable	1
		P2	**Dependent variable (consequential to the Independent variable)** (i) (temperature rise or change / heat produced / energy change) identified as dependent variable. (ii) *Ignore any reference to* ΔH_c (iii) mass/moles of alcohol identified as dependent variable. (do not accept **amount)** (iv) (temperature rise or change or final temperature / heat produced / energy change) identified as dependent variable or mass/moles of alcohol identified as dependent variable. *Ignore any reference to* ΔH_c	1

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Question	Sections	Statement	Indicative material	Mark
1 (c) contd.	PLAN Problem	P4	Two variables to be controlled selected from: (i) mass or volume of water, (allow amount here) (ii) initial temperature of water **or** ambient/room temperature (iii) use of same metal can **or** same position of the burner **If alcohol chosen/chain length is chosen as independent variable** (iv) mass/moles is controlled	1
1 (d) Part 1	PLAN Methods	M6 M1 M2 M6 M5 M5	**1** Uses thermometer capable of reading to 1 °C or better **or** balance capable of reading to 0.1 g or better. **2** Burns stated or measured mass or moles of ethanol completely, **or** burns ethanol to get a particular temperature rise, **or** burns ethanol for a particular length of time. **3** Measures initial and final temperature, **or** measures initial and final masses of ethanol. **4** Shows how the mass of ethanol is converted to moles. (Items 3 & 4 can be taken from the table or the calculation.) *(46 must be shown in an expression – not the symbol M_r)* **5** Uses mc∆T to calculate heat absorbed by the water in the can. We need to look for either suggested numbers or algebraic symbols (not just mc∆T. Accept ∆T but not theta unless defined. **6** Scales heat absorbed for 1 mol of ethanol (correct units are needed here)	1 1 1 1 1 1
1 (e)	PLAN Methods	M9 M9	Draws up table(s), for range of alcohols, to show the following headings (with correct units, there is no penalty here for representing the units incorrectly but EACH COLUMN in the table needs to have correct units recorded (even if this means several columns with the same unit). Allow K for °C): (i) two weighings + mass of alcohols or two temperature readings + ∆T (ii) The "other" measured quantity: mass of alcohol used or ∆T. If the table is for less than all the alcohols apply a penalty of 1 mark Safety mark: *If the table only contains the following recordings; initial and final mass and initial and final temperature, give one mark* *<u>On pages 4 & 5 penalise a unit error only once</u>.*	 1 1

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1 (f)	PLAN Methods	M5	One improvement to reduce heat loss given in diagram and by explanation. From: (i) insulation on sides but not bottom of can (ii) lid on can (iii) draught shield fitted (iv) lower tripod **or** raise burner (v) replacement of tripod with insulated support Each suggestion should be supported by an appropriate reason and for such items as 'move the flame closer to the can' we need to know how this is to be done. Heat lost to the surroundings or atmosphere etc., generates no mark. Heat loss could be through the top of the cup (convection) or through the sides of the can (conduction) Second improvement from same list	1
		M5	*Give **one of these two marks** for two listed improvements without explanation.*	1
Qn 1	**Total**			**15**

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Question	Sections	Statement	Indicative material	Mark
2 (a)	ACE Data	D1	Labels all additional columns used, including units (e.g. /g or (g)) and an appropriate equation: the mass of basic copper(II) carbonate **(B–A)** the mass of copper(II) oxide **(C–A)** the mass lost in the expt **(B–C)** (or from additional columns)	1
		D2	Correct subtractions for columns containing plotted data. (ignore any columns which list the number of moles) See appendix 1 (Allow 2 errors) *All values must be correct to 2 decimal places*	1
2 (b)	ACE Data	D3	Plots any two of mass/moles of copper(II) oxide; mass of basic copper(II) carbonate; mass lost in the experiment with correct labels and units. (If unit error is the same as in **2(a)** do not penalise again) *(Accept equations as acceptable labels)*	1
		D3	Suitable scales selected – data to be plotted over more than half of each axis	1
		D3	All 10 points plotted **and** a straight-line passing through the origin and close to the majority of points.	1
2 (c)	ACE Evaluation	E1	Identifies the most significant anomalous point and its coordinates **from the graph drawn by the candidate not from the table**. *If points have been plotted correctly the point identified should be for student 3:* *2.22 g carbonate / 1.13 g (0.0142 mol) CuO / 1.09 g mass loss, otherwise the most anomalous point is the one furthest from the graph in a perpendicular direction*	1
		E2	Suggests an appropriate reason for the anomalous point. **See Appendix 2** (i) if lower than expected mass of CuO, *(higher than expected plotted loss of mass)* Solid blown out of tube (by not heating gently) ***Do not allow this mark for spillage.*** (ii) if higher than expected mass of CuO, (lower than expected plotted loss of mass) Incomplete decomposition	1

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Question	Sections	Statement	Indicative material	Mark
2 (d)	ACE Evaluation	E2	Mark consequentially – see Appendix 2 If points have been correctly plotted they should indicate (*insufficient loss in mass or mass of copper oxide too high)* caused by incomplete decomposition	1
2 (e)	ACE Conclusions	C3	Mark consequentially – see Appendix 2 (this may involve a simple ecf from **(d)**) (i) For a mass of copper oxide that is too high - refers to heating to constant mass (allow any practical technique which would yield constant mass if carried out e.g. more heat; spreading out the solid; heat for a longer time etc.) (ii) For a mass of copper oxide that is too low - refers to heating more gently	1
2 (f)	ACE Data	D3 D2 D2	Construction (lines) on graph and values read from the graph (with units) Two of the following expressions used in a calculation: (221 + 18***x***); 44 + 18(***x*** + 1); 159 (**or** 2 x 79.5) The value of ***x*** correctly evaluated *The expected value of* ***x*** *is approximately* 0.5	1 1 1
2 (g)	ACE Conclusions	C1	Refers to one of the following as supporting evidence: straight line, line through origin, few points off the line, Any reference to direct proportionality. If the plotting is so poor that a reverse comment might be appropriate here **do not reward**	1
2 (h)	ACE Conclusions	C3	Realises that (i) CO_2 gas or CO_2 and gaseous H_2O could be (collected) and its volume (measured) (not amount) (ii) H_2O can be condensed and weighed, (iii) CO_2 and/or H_2O can be absorbed and weighed	1
2 (i)	ACE Evaluation	E5	Candidate refers to or calculates a reduction in the % error if using a balance weighing to 3 dp.	1
Qn 2	**Total**			**15**

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Appendix 1

Qn 2 (b)

student	mass of empty boiling-tube / g	mass of boiling-tube and basic carbonate before heating / g	mass of boiling-tube and residue after heating / g	**mass of basic carbonate before heating / g**	**mass of residue / g**	**mass of material lost on heating / g**
1	10.32	11.19	10.92	**0.87**	**<u>0.60</u>**	**0.27**
2	10.05	11.56	11.09	**1.51**	**1.04**	**0.47**
3	10.11	12.33	11.24	**2.22**	**1.13**	**1.09**
4	9.94	12.39	11.62	**2.45**	**1.68**	**0.77**
5	9.99	13.73	12.56	**3.74**	**2.57**	**1.17**
6	10.23	14.68	13.28	**4.45**	**3.05**	**<u>1.40</u>**
7	10.01	15.19	13.56	**5.18**	**3.55**	**1.63**
8	9.87	15.80	13.97	**5.93**	**<u>4.10</u>**	**1.83**
9	9.96	16.62	14.66	**6.66**	**<u>4.70</u>**	**1.96**
10	9.84	17.83	15.46	**7.99**	**5.62**	**2.37**

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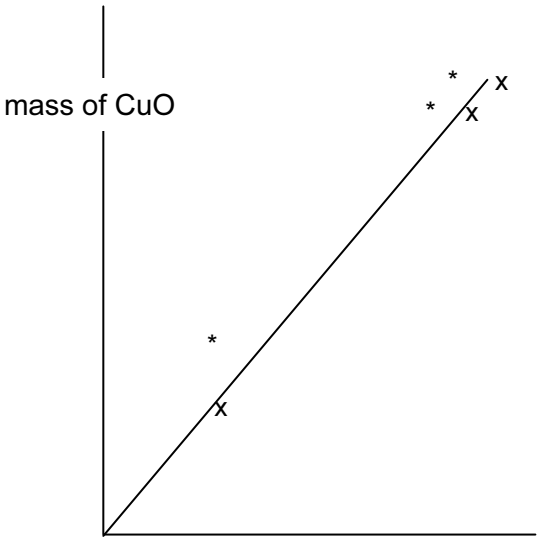
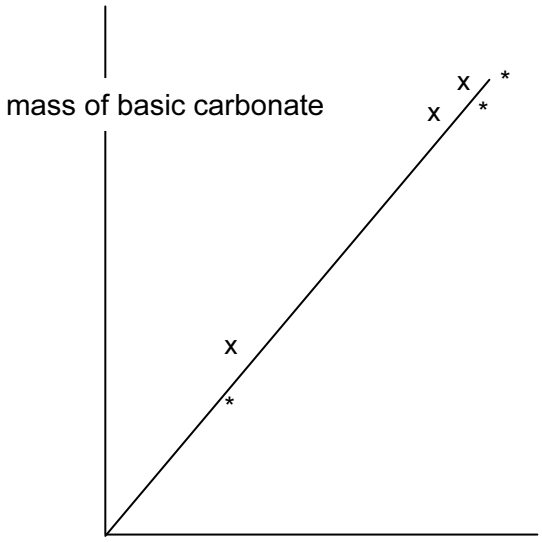
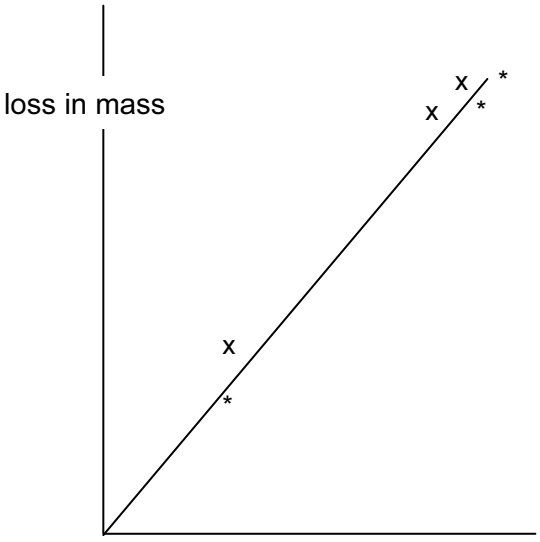
Appendix 2

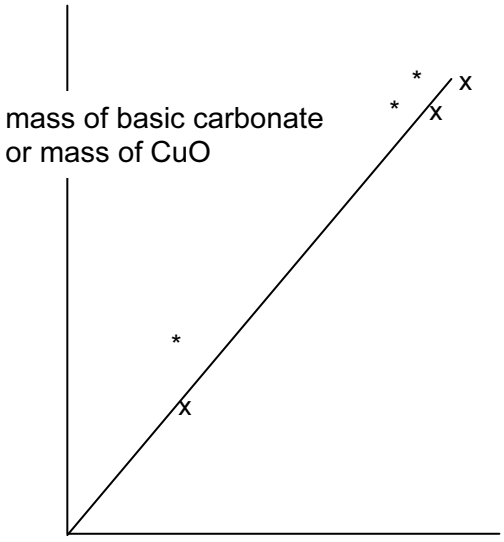
x represents copper oxide/residue blown out of the tube

* represents insufficient decomposition









If labelled axes are reversed, points will be on the opposite side of the line drawn.

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