CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the October/November 2013 series

9702 PHYSICS

9702/53 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 should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

Cambridge will not enter into discussions about these mark schemes.

Cambridge is publishing the mark schemes for the October/November 2013 series for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level components and some Ordinary Level components.

CAMBRIDGE
International Examinations

1 **Planning (15 marks)**

Defining the problem (3 marks)

P θ is the independent variable or vary θ. [1]

P R is the dependent variable or measure R. [1]

P Keep length of wire constant. [1]

Methods of data collection (5 marks)

M Labelled diagram of apparatus: wire in oil/water bath or oven or beaker with water and source of heat. [1]

M Circuit diagram to measure resistance. [1]

M Use thermometer to measure the temperature of wire/water/oven. (Could be on diagram if labelled.) [1]

M Method to determine resistance from circuit, e.g. read off ohmmeter/$R = V/I$ [1]

M Method to determine R_0 e.g. use ice-water mixture.
Do not allow ice (allow ice at 0 °C or melting ice). [1]

Method of analysis (2 marks)

Do NOT allow log-log graphs.

A	R against θ	R/R_0 against θ	θ against R	[1]
A	α = gradient/R_0	α = gradient	$\alpha = 1/(R_0 \times \text{gradient})$ $\alpha = -1/y$–intercept	[1]

Safety considerations (1 mark)

S Reasoned method to prevent injury from hot water/hot wire e.g. gloves (to prevent injury) from hot water/wire; goggles to prevent splashes from hot water; do not touch hot wire/beaker. [1]

Additional detail (4 marks)

D Relevant points might include [4]
1 Use insulated wire
2 Use long/thin wire to increase resistance
3 Stir liquid
4 Wait for temperature to stabilise
5 Relationship is valid if straight line, provided plotted graph is correct
6 Relationship is valid if straight line not passing through origin, provided plotted graph is correct (any quoted expression must be correct, e.g. y-intercept = R_0)
7 Use small current to minimise heating effect

Do not allow vague computer methods.

[Total 15]

2 Analysis, conclusions and evaluation (15 marks)

	Mark	Expected Answer	Additional Guidance
(a)	A1	Gradient = 1/2*a* *y*-intercept = *t*	
(b)	T1	*d*/*v* /s	Column heading. Allow equivalent unit.
	T2	1.3 or 1.30 1.6 or 1.63 2.0 or 1.98 2.3 or 2.30 2.6 or 2.63 2.9 or 2.94	A mixture of 2 s.f. and 3 s.f. is allowed.
	U1	±0.2 / ±0.16 to ±0.09 / ±0.1	Uncertainties in *d*/*v*.
(c) (i)	G1	Six points plotted correctly	Must be within half a small square. Ecf allowed from table. Penalise “blobs”.
	U2	All error bars in *d*/v plotted correctly	Must be within half a small square. Ecf allowed from table.
(ii)	G2	Line of best fit	If points are plotted correctly then lower end of line should pass between (9.5, 1.3) and (10.5, 1.3) **and** upper end of line should pass between (34.0, 2.9) and (35.5, 2.9). Allow ecf from points plotted incorrectly – examiner judgement.
	G3	Worst acceptable straight line. Steepest or shallowest possible line that passes through <u>all</u> the error bars.	Line should be clearly labelled or dashed. Should pass from top of top error bar to bottom of bottom error bar **or** bottom of top error bar to top of bottom error bar. Mark scored only if error bars are plotted.
(iii)	C1	Gradient of best fit line	The triangle used should be at least half the length of the drawn line. Check the read offs. Work to half a small square. Do not penalise POT.
	U3	Uncertainty in gradient	Method of determining absolute uncertainty Difference in worst gradient and gradient.

(iv)	C2	*y*-intercept of best fit line	Check substitution in $y = mx + c$. Should be about 0.6 – 0.7. FOX does not score.
	U4	Uncertainty in *y*-intercept	Check substitution in $y = mx + c$. Difference in worst *y*-intercept and *y*-intercept. FOX does not score. Allow ecf from **(c)(iv)**.
(d) (i)	C3	$a = 1/(2 \times \text{gradient})$ <u>and</u> in the range 7.25 to 7.74 <u>and</u> given to 2 s.f. or 3 s.f.	Allow 7.3 to 7.7.
	C4	t = *y*-intercept <u>and</u> units for a [m s^{-2}] <u>and</u> t [s]	
(ii)	U5	Percentage uncertainties in a and t	Percentage uncertainty in gradient. Percentage uncertainty in *y*-intercept.

[Total 15]

Uncertainties in Question 2

(c) (iii) Gradient [U3]

Uncertainty = gradient of line of best fit – gradient of worst acceptable line

Uncertainty = ½ (steepest worst line gradient – shallowest worst line gradient)

(iv) [U4]

Uncertainty = *y*-intercept of line of best fit – *y*-intercept of worst acceptable line

Uncertainty = ½ (steepest worst line *y*-intercept – shallowest worst line *y*-intercept)

(d) (ii) [U5]

Percentage uncertainty in $a = \dfrac{\Delta a}{a} \times 100 = \dfrac{\Delta m}{m} \times 100$

Percentage uncertainty in $t = \dfrac{\Delta t}{t} \times 100 = \dfrac{\Delta c}{c} \times 100$