UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the October/November 2010 question paper for the guidance of teachers

9702 PHYSICS

9702/53

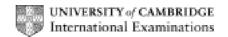
Paper 5 (Planning, Analysis and Evaluation), maximum raw mark 30

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1 Planning (15 marks)

Def	ining the	e problem (3 marks)	
P1	c, d or measure	A is the independent variable and R is the dependent variable or vary c , d or A a e	nd [1]
P2	If c varie	ed then (t and) d or A kept constant, if d varied then (t and) c or A kept constant, if	
			[1]
P3		·	[1]
Met	thods of	data collection (5 marks)	
		,	[1]
M2	Use mid	crometer screw gauge to measure <i>d</i> or <i>t</i> . (Allow digital or vernier callipers)	[1] [1]
M4	or d or t	of making contact with the strip e.g. use electrodes of at least same dimension as t or conducting paint methods. Do not allow crocodile clips, unless it is clear that the area of the end of the strip is covered.	
M5	Method		[1]
Met	thod of a	analysis (2 marks)	
		graph of R against c , $1/d$ or $1/A$ depending on orientation. Other alternatives possib	le.
			[1]
A2	_	· · ·	[1]
		Iternatives possible, e.g. $\rho = d \times \text{gradient}/t$	
Saf	ety cons	siderations (1 mark)	
	•	,	[1]
Add	ditional d	detail (4 marks)	
D1/	2/3/4 Re	elevant points might include	[4]
		ulate aluminium strip	
		ke many readings of <i>t</i> or <i>d</i> and average	
		e a protective resistor/circuit designed to reduce current	
		arrange equation to determine graph using <i>c</i> , <i>d</i> and <i>t</i> or A	
		termine typical resistance of aluminium strip	
		ely meter range of ammeter/voltmeter/ohmmeter	
		tail on cutting strip e.g. mark using set square	

Do not allow vague computer methods.

[Total: 15]

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2 Analysis, conclusions and evaluation (15 marks)

Part	Mark	Expected Answer	Additional Guidance
(a)	A1	$-\frac{t}{C}$	Must be negative. Allow $-\frac{15}{C}$.
(b)	T1 T2	150	T1 for 1/R column – ignore sf and rounding errors T2 for ln (V/V) column – must be values given A mixture is allowed
	U1	From \pm 0.05 or \pm 0.06 to \pm 0.02 or \pm 0.03	Allow more than one significant figure.
(c) (i)	G1	Five points plotted correctly	Must be within half a small square; penalise ≥ half a small square. Ecf allowed from table. Penalise 'blobs' ≥ half a small square.
	U2	Error bars in ln(V/V) plotted correctly.	All plots to have error bars; penalise ≥ half a small square. Check first and last point. Must be accurate within half a small square.
(ii)	G2	Line of best fit	If points are plotted correctly then upper end of line should pass between (20, 2.16) and (20, 2.18) and lower end of line should pass between (160, 1.20) and (160, 1.225). 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 all error bars are plotted.
(iii)	C1	Gradient of best fit line Must be negative	The triangle used should be at least half the length of the drawn line. Check the read offs. Work to half a small square; penalise ≥ half a small square. Do not penalise POT.
	U3	Uncertainty in gradient	Method of determining absolute uncertainty. Difference in worst gradient and gradient.
(d) (i)	C2	C = -15/gradient	Gradient must be used. Allow ecf from (c)(iii). Do not penalise POT.
	C3	2.14 × 10 ⁻³ F to 2.24 × 10 ⁻³ F and to 2 or 3 sf	Must be in range – penalise POT. Allow equivalent unit including s Ω^{-1} , C V $^{-1}$, A s V $^{-1}$

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(ii)	U4	Determines % uncertainty in C	Uses worst gradient or worst calculated <i>C</i> value. Do not check calculation.
(e)	C4	Determines R correctly	Expect to see an answer about 3000 Ω . R = 6.514/candidate's C ; allow ecf from (d)(i)
	U5	Determines absolute uncertainty	Determines worst value of R or (d)(ii) × R

[Total: 15]

Uncertainties in Question 2

(c) (iii) Gradient [U3]

- 1. Uncertainty = gradient of line of best fit gradient of worst acceptable line
- 2. Uncertainty = ½ (steepest worst line gradient shallowest worst line gradient)

(d) (ii) [U4]

- 1. Works out worst *C* then determines % uncertainty
- 2. Works out percentage uncertainty in gradient

(e) [U5]

1. Works out worst *R* then determines difference

2.
$$\Delta R = \left(\frac{\Delta \text{gradient}}{\text{gradient}}\right) R = \left(\frac{\Delta C}{C}\right) R$$