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

9702/51 Paper 5 (Planning, Analysis and Evaluation), maximum raw mark 30

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1 **Planning (15 marks)**

Defining the problem (3 marks)

P1 f is the independent variable and V is the dependent variable or vary f and measure V [1]
P2 Keep the current in coil X constant [1]
P3 Keep the number of turns on coil (Y)/area of coil Y constant
Do not credit reference to coil X only. [1]

Methods of data collection (5 marks)

M1 Two independent coils labelled X and Y. [1]
M2 Alternating power supply/signal generator connected to coil X in a workable circuit. [1]
M3 Coil Y connected to voltmeter/c.r.o. in a workable circuit. [1]
M4 Use c.r.o. to determine period/frequency or read off signal generator. [1]
M5 Method to keep current constant in coil X: adjust signal generator/use of rheostat. [1]

Method of analysis (2 marks)

A1 Plot a graph of V against f. [1]
A2 Relationship valid if straight line through origin [1]

Safety considerations (1 mark)

S1 Reference to hot coils – switch off when not in use/use gloves/do not touch coils. Must refer to hot coils. [1]

Additional detail (4 marks)

D1/2/3/4 Relevant points might include [4]

1. Use large current in coil X/large number of coils on coil Y (to increase emf).
2. Use iron core (to increase emf).
3. Detail on measuring emf e.g. height × y-gain.
4. Avoid other alternating magnetic fields.
5. Detail on measuring frequency from c.r.o. to determine period and hence f.
6. Use of ammeter/c.r.o. and resistor to check current is constant
7. Use insulated wire for coils.
8. Keep coil Y and coil X in the same relative positions.

Do not allow vague computer methods.

[Total: 15]

2 Analysis, conclusions and evaluation (15 marks)

Part	Mark	Expected Answer	Additional Guidance
(a)	A1	Gradient = b y-intercept = lg a	Allow log a but not ln a
(b)	T1 T2	1.9777 — 0.292 or 0.2923 1.9294 — 0.265 or 0.2648 1.8751 — 0.241 or 0.2405 1.8129 — 0.210 or 0.2095 1.7404 — 0.170 or 0.1703 1.6532 — 0.127 or 0.1271	T1 for lg l column – ignore rounding errors; min 2 dp. T2 for lg T column – must be values given A mixture is allowed
	U1	From ± 0.004 or ± 0.005 to ± 0.006 or ± 0.007	Allow more than one significant figure.
(c) (i)	G1	Six points plotted correctly	Must be within half a small square; penalise ≥ half a small square. Penalise 'blobs' ≥ half a small square. Ecf allowed from table.
	U2	Error bars in lg (T/s) plotted correctly.	All error bars must be plotted. Check first and last point. Must be accurate within half a small square; penalise ≥ half a small square.
(ii)	G2	Line of best fit	If points are plotted correctly then lower end of line should pass between (1.65, 0.124) and (1.65, 0.128) **and** upper end of line should pass between (2.00, 0.300) and (2.00, 0.306). Allow ecf from points plotted incorrectly; five trend plots needed – 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	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.
	U3	Uncertainty in gradient	Method of determining absolute uncertainty Difference in worst gradient and gradient.
(iv)	C2	y-intercept	Must be negative. Check substitution of point from line into $c = y - mx$. Allow ecf from **(c)(iii)**.

	U4	Uncertainty in *y*-intercept	Method of determining absolute uncertainty Difference in worst *y*-intercept and *y*-intercept. Do not allow ecf from false origin read-off (FOX). Allow ecf from **(c)(iv)**.
(d)	C3	$a = 10^{y \text{ intercept}}$	*y*-intercept must be used. Expect an answer of about 0.19. If FOX expect answer of about 1.3.
	C4	*b* = gradient <u>and</u> in the range 0.495 to 0.520 <u>and</u> to 2 or 3 sf	Allow 0.50 to 0.52 to 2 sf Penalise 1 sf or ≥4 sf
	U5	Absolute uncertainty in *a* and *b*	Difference in *a* and worst *a*. Uncertainty in *b* should be the same as the uncertainty in the gradient.

[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)

(c) (iv) [U4]

1. Uncertainty = *y*-intercept of line of best fit – *y*-intercept of worst acceptable line
2. Uncertainty = ½ (*y*-intercept of steepest worst line – *y*-intercept of shallowest worst line)

(d) [U5]

1. Uncertainty = $10^{\text{best } y \text{ intercept}} - 10^{\text{worst } y \text{ intercept}}$