Cambridge International Examinations
Cambridge International Advanced Subsidiary and Advanced Level

PHYSICS **9702/52**

Paper 5 Planning, Analysis and Evaluation **October/November 2016**

MARK SCHEME

Maximum Mark: 30

Published

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.

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Question	Answer	Marks
1	**Defining the problem**	
	p is the independent variable and *B* is the dependent variable, or vary *p* and measure *B*.	1
	Keep the current/I (in the electromagnet) constant.	1
	Methods of data collection	
	Labelled diagram showing Hall probe correctly positioned (along *p*) <u>and</u> ruler correctly positioned <u>and</u> either Hall probe or rule supported.	1
	Correct circuit diagram to include <u>d.c</u>. power supply in series with coil and ammeter. Must be a workable circuit diagram to measure current through the coil.	1
	Measure *p* with ruler.	1
	Method to determine an accurate value of *p*. Examples include: Height of P above bench – height of electromagnet Height of P measured from ruler across the top of the electromagnet	1
	Method of analysis	
	Plot a graph of ln *B* against *p*.	1
	α = – gradient	1
	$k = \dfrac{e^{y\text{–intercept}}}{NI}$	1

Question	Answer	Marks
	Additional detail including safety considerations	**6**
	1. Keep the number of turns/N constant. 2. Use large number of turns/current (to increase B). 3. Avoid overheating the coil/do not touch hot coil. 4. Use of variable resistor to keep ammeter reading constant. 5. <u>Method</u> to ensure that Hall probe is equidistant from the poles, e.g. determine centre of electromagnet and use of plumb line/ruler <u>and</u> spirit level/set square. 6. Adjust Hall probe until maximum reading obtained/perpendicular to field. 7. <u>Repeat</u> each experiment for the same value of p and <u>reverse</u> the current/Hall probe and <u>average</u> 8. $\ln B = -\alpha p + \ln kNI$ 9. Relationship is valid if the graph is a straight line. 10. Calibrate Hall probe <u>using a known field</u>.	

Question	Answer	Marks
2 (a)	gradient = *q* *y*-intercept = lg *p*	**1**
(b)	2.80 or 2.799 or 2.7993 — 0.28 or 0.279 2.79 or 2.792 or 2.7924 — 0.30 or 0.301 2.77 or 2.771 or 2.7709 — 0.36 or 0.362 2.72 or 2.716 or 2.7160 — 0.49 or 0.491 2.69 or 2.690 or 2.6902 — 0.57 or 0.568 2.67 or 2.672 or 2.6721 — 0.61 or 0.613 All first column correct – either 2 and 3 decimal places or 3 and 4 decimal places. All second column correct. Allow a mixture of decimal places. Uncertainties in lg (*V*/V) from ± 0.02 to ± 0.01. Allow more than one significant figure.	 **1** **1** **1**
(c) (i)	Six points plotted correctly. Must be within half a small square. No "blobs".	**1**
	All error bars in lg (*V*/V) plotted correctly. All error bars to be plotted. Total length of bar must be accurate to less than half a small square and symmetrical.	**1**
(ii)	Line of best fit drawn. Line must not be drawn from top point to bottom point unless points are balanced. Upper end of line should pass between (2.694, 0.55) and (2.700, 0.55) **and** lower end of line should pass between (2.770, 0.35) and (2.776, 0.35).	**1**
	Worst acceptable line drawn correctly. Steepest or shallowest possible line that passes through all the error bars. Mark scored only if all error bars are plotted.	**1**
(iii)	Gradient determined with a triangle that is at least half the length of the drawn line. Read-offs must be accurate to half a small square. Gradient must be negative.	**1**
	Method of determining absolute uncertainty. uncertainty = gradient of line of best fit – gradient of worst acceptable line *or* uncertainty = ½(steepest worst line gradient – shallowest worst line gradient)	**1**

Question	Answer	Marks
(iv)	y-intercept determined by substitution into $y = mx + c$. Read-offs must be accurate to half a small square.	**1**
	Method of determining absolute uncertainty. uncertainty = y-intercept of line of best fit – y-intercept of worst acceptable line *or* uncertainty = ½(steepest worst line y-intercept – shallowest worst line y-intercept) No ECF from false origin method.	**1**
(d)	Use of $p = 10^{\text{answer to } \mathbf{2(c)(iv)}}$ *or* lg p = answer to **2(c)(iv)**	**1**
	q = gradient <u>and</u> in the range –2.50 to –2.70 <u>and</u> given to 2 or 3 s.f.	**1**
(e)	Use of $V = p \times 950^{q}$ *or* lg $V = q$ lg 950 + lg p *or* lg $V = q$ lg 950 + y-intercept Correct substitution of numbers must be seen to give V.	**1**