

Cambridge International AS & A Level Cambridge International Examinations Cambridge International Advanced Subsidiary and Advanced Level

## PHYSICS

9702/52 October/November 2016

Paper 5 Planning, Analysis and Evaluation MARK SCHEME Maximum Mark: 30

Published

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Question	Answer		
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 $p$ ) and ruler correctly positioned and 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 <i>p</i> . 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 In <i>B</i> against <i>p</i> .	1	
	$\alpha = -$ gradient	1	
	$k = \frac{e^{y-intercept}}{NI}$	1	

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

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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.				
		lecimal places.	1			
		Uncertainties in lg (V/V) from significant figure.	$n \pm 0.02$ to $\pm 0.01$ .	Allow more than one	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 the half a small square and symmetrical.					
	<ul> <li>(ii) Line of best fit drawn.</li> <li>Line must not be drawn from top point to bottom point unless points are balanced.</li> <li>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).</li> </ul>					
		Worst acceptable line drawn correctly. Steepest or shallowest possible line that passes through <u>all</u> the error bars. Mark scored only if all error bars are plotted.				
	(iii) Gradient determined with a triangle that is at least half the length of the duline. Read-offs must be accurate to half a small square. Gradient must be negative.				1	
		<b>Method</b> of determining absolute uncertainty. uncertainty = gradient of line of best fit – gradient of worst acceptable line or				
		uncertainty = ½(steepest wo	rst line gradient – s	shallowest worst line gradient)		

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