Cambridge International AS & A Level

Cambridge Assessment International Education
Cambridge International Advanced Subsidiary and Advanced Level

PHYSICS **9702/52**

Paper 5 Planning, Analysis and Evaluation **May/June 2018**

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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Generic Marking Principles

These general marking principles must be applied by all examiners when marking candidate answers. They should be applied alongside the specific content of the mark scheme or generic level descriptors for a question. Each question paper and mark scheme will also comply with these marking principles.

GENERIC MARKING PRINCIPLE 1:

Marks must be awarded in line with:

- the specific content of the mark scheme or the generic level descriptors for the question
- the specific skills defined in the mark scheme or in the generic level descriptors for the question
- the standard of response required by a candidate as exemplified by the standardisation scripts.

GENERIC MARKING PRINCIPLE 2:

Marks awarded are always **whole marks** (not half marks, or other fractions).

GENERIC MARKING PRINCIPLE 3:

Marks must be awarded **positively**:

- marks are awarded for correct/valid answers, as defined in the mark scheme. However, credit is given for valid answers which go beyond the scope of the syllabus and mark scheme, referring to your Team Leader as appropriate
- marks are awarded when candidates clearly demonstrate what they know and can do
- marks are not deducted for errors
- marks are not deducted for omissions
- answers should only be judged on the quality of spelling, punctuation and grammar when these features are specifically assessed by the question as indicated by the mark scheme. The meaning, however, should be unambiguous.

GENERIC MARKING PRINCIPLE 4:

Rules must be applied consistently e.g. in situations where candidates have not followed instructions or in the application of generic level descriptors.

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GENERIC MARKING PRINCIPLE 5: Marks should be awarded using the full range of marks defined in the mark scheme for the question (however; the use of the full mark range may be limited according to the quality of the candidate responses seen).
GENERIC MARKING PRINCIPLE 6: Marks awarded are based solely on the requirements as defined in the mark scheme. Marks should not be awarded with grade thresholds or grade descriptors in mind.

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Question	Answer	Marks
1	**Defining the problem**	
	λ is the independent variable and h is the dependent variable **or** vary λ and measure h	**1**
	keep angle of incidence of light on to CD constant	**1**
	Methods of data collection	
	labelled diagram of workable experiment including: • light source, CD and screen • method to support light source • light source labelled and at least one other label	**1**
	method to change wavelength, e.g. use filters, different lasers/LEDs	**1**
	method to determine λ e.g. read from filter/label or experiment e.g. Young's slits, diffraction grating	**1**
	measure h with a rule **or** labelled rule shown in diagram close to screen with h indicated	**1**
	Method of analysis	
	plot a graph of h against λ **or** plot a graph of h against $n\lambda$	**1**
	$d = n$/gradient **or** $d = 1$/gradient (consistent with graph)	**1**
	$B = y$-intercept	**1**

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Question	Answer	Marks
	Additional detail including safety considerations	**Max. 6**
	D1 safety precaution linked to exposure of eyes to (intense) light, e.g. avoid looking (directly) at the (intense) light source or wear dark glasses or wear goggles to protect eyes from light	
	D2 keep distance from CD to screen constant	
	D3 keep *n* constant	
	D4 method to identify same order, e.g. identify the zero order and count the number of maxima to where *h* is measured	
	D5 equation to determine λ e.g. Young's slits/diffraction grating formula with λ as subject	
	D6 use intense light source/collimated light source	
	D7 perform experiment in a dark room	
	D8 clean surface of CD/check that there are no scratches	
	D9 detail on measuring *h* (e.g. measure to the top and bottom of the maximum and average)	
	D10 relationship valid if a straight line (with a *y*-intercept)	

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>2(a)</td><td>gradient = $-C\ln\left(1-\frac{V}{E}\right)$ or $C\ln\left(\frac{E}{E-V}\right)$</td><td>1</td></tr>
<tr><td>2(b)</td><td><table><tr><th>$nR/10^3\Omega$</th><th>absolute uncertainty in nR</th></tr><tr><td>4.7 or 4.70</td><td>0.5 or 0.47</td></tr><tr><td>9.4 or 9.40</td><td>0.9 or 0.94</td></tr><tr><td>14 or 14.1</td><td>1 or 1.4 or 1.41</td></tr><tr><td>19 or 18.8</td><td>2 or 1.9 or 1.88</td></tr><tr><td>24 or 23.5</td><td>2 or 2.4 or 2.35</td></tr><tr><td>28 or 28.2</td><td>3 or 2.8 or 2.82</td></tr></table>First mark for correct column heading and values of nR.
Second mark for absolute uncertainties in nR. Allow a mixture of significant figures.</td><td>2</td></tr>
<tr><td rowspan="2">2(c)(i)</td><td>Six points plotted correctly.
Must be within half a small square. Diameter of points must be less than half a small square.</td><td>1</td></tr>
<tr><td>Error bars in nR plotted correctly.
All error bars to be plotted. Length of bar must be accurate to less than half a small square and symmetrical.</td><td>1</td></tr>
<tr><td rowspan="2">2(c)(ii)</td><td>Line of best fit drawn.

Upper end of line should pass between (25, 90) and (26, 90) and lower end of line should pass between (10.5, 40) and (11.5, 40). Do not allow line from top point to bottom point unless points are balanced.</td><td>1</td></tr>
<tr><td>Worst acceptable line drawn (steepest or shallowest possible line).
All error bars must be plotted.</td><td>1</td></tr>
</table>

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Question	Answer	Marks
2(c)(iii)	Gradient determined with clear substitution of points from the line of best fit into $\Delta y/\Delta x$. Distance between points must be at least half the length of the drawn line.	**1**
	Gradient of worst acceptable line determined. uncertainty = gradient of line of best fit – gradient of worst acceptable line **or** uncertainty = ½ (steepest worst line gradient – shallowest worst line gradient)	**1**
2(d)(i)	*C* determined using gradient **and** given to 2 or 3 significant figures.	**1**
	C determined using: $C = \frac{-\text{gradient}}{\ln\left(1-\frac{V}{E}\right)} = \frac{-\text{(c)(iii)}}{\ln(0.2)} = \frac{-\text{(c)(iii)}}{-1.609438}$	**1**
	C determined correctly using gradient **and** with unit (F or $s\,\Omega^{-1}$) **and** correct power of ten.	**1**
2(d)(ii)	% uncertainty in *C* = % uncertainty in gradient.	**1**

Question	Answer	Marks
2(e)	*K* determined using *C*. Correct substitution of numbers must be seen. $K = \frac{-300}{\ln(1-0.9)\times C} = \frac{-300}{-2.30\times(\text{d})(\text{i})} = \frac{130.3}{(\text{d})(\text{i})}$	**1**
	Absolute uncertainty in *K* determined. Correct substitution of numbers must be seen. $\text{uncertainty} = \left(\frac{\Delta\text{gradient}}{\text{gradient}}\right)\times K = \left(\frac{\Delta C}{C}\right)\times K$ Maximum/minimum methods: $\max K = \frac{-130.3}{\min\ (\text{d})(\text{i})} = \frac{-130.3\times -1.609}{\min\ \text{gradient}} = \frac{209.69}{\min\ \text{gradient}}$ $\min K = \frac{-130.3}{\max\ (\text{d})(\text{i})} = \frac{-130.3\times -1.609}{\max\ \text{gradient}} = \frac{209.69}{\max\ \text{gradient}}$	**1**

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