GradeMax

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 **March 2019**

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.

Cambridge International will not enter into discussions about these mark schemes.

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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**	
	R is the independent variable and *T* is the dependent variable, or vary *R* and measure *T*	**1**
	keep *C* constant	**1**
	Methods of data collection	
	labelled diagram or correct symbols of workable circuit including: • (d.c.) power supply correctly positioned • (neon) lamp correctly positioned do not accept ohmmeter in circuit	**1**
	circuit diagram to determine resistance of resistors e.g. using ammeter and voltmeter OR ohmmeter	**1**
	method to determine period or *T*, e.g. use a stopwatch / timer / oscilloscope do not accept counting the flashes in a specified time	**1**
	circuit diagram showing voltmeter(s) or oscilloscope(s) to determine V_i and V_F	**1**
	Method of Analysis	
	plots a graph of *T* against *R*	**1**
	$K = \frac{\text{gradient}}{C}$	**1**
	$V_L = V_i - (V_i - V_F)e^K = V_i - (V_i - V_F)e^{\frac{\text{gradient}}{C}}$	**1**

Question	Answer	Marks
1	**Additional detail including safety considerations**	**Max 6**
	switch off (high voltage) circuit (before changing the resistor) / wear insulating gloves to prevent electrocution / shock	**D1**
	resistance of resistors linked to diagram is V / I for ammeter / voltmeter method or gradient of appropriate graph or resistance from ohmmeter	**D2**
	input voltage or V_i is constant	**D3**
	repeat experiment for each value of R and average T	**D4**
	90 V (or larger) power supply do not accept a.c. or signal generator	**D5**
	for stopwatch method: time 10 or more flashes and divide by number of flashes for oscilloscope method: length of wave × timebase	**D6**
	record value of capacitance from the capacitor or method to determine capacitance	**D7**
	appropriate circuit to enable capacitance to be determined	**D8**
	relationship valid if a straight line passing through the origin is produced	**D9**
	method to obtain a measurable time period e.g. do a preliminary experiment to choose appropriate resistors, use large values of R or C	**D10**

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>2(a)</td><td>gradient = q
y-intercept = lg p</td><td>1</td></tr>
<tr><td>2(b)</td><td><table><tr><td>1.58 or 1.580</td><td>1.61 or 1.613</td></tr><tr><td>1.66 or 1.663</td><td>1.51 or 1.505</td></tr><tr><td>1.74 or 1.740</td><td>1.40 or 1.398</td></tr><tr><td>1.81 or 1.806</td><td>1.30 or 1.301</td></tr><tr><td>1.86 or 1.857</td><td>1.23 or 1.230</td></tr><tr><td>1.90 or 1.898</td><td>1.15 or 1.146</td></tr></table></td><td>1</td></tr>
<tr><td></td><td>absolute uncertainties in lg η: $\pm$ 0.01 to $\pm$ 0.03</td><td>1</td></tr>
<tr><td>2(c)(i)</td><td>six points plotted correctly
must be accurate to the nearest half small square
diameter of points must be less than half a small square</td><td>1</td></tr>
<tr><td></td><td>error bars in lg η plotted correctly
all error bars to be plotted
total length of bar must be accurate to less than half a small square and symmetrical</td><td>1</td></tr>
<tr><td>2(c)(ii)</td><td>line of best fit drawn
points must be balanced
do not allow line from top plot to bottom plot
if points are plotted correctly then lower end of line should pass between (1.820, 1.275) and (1.835, 1.275) and upper end of line should pass between (1.640, 1.525) and (1.650, 1.525)</td><td>1</td></tr>
<tr><td></td><td>worst acceptable line drawn
steepest or shallowest possible line
mark scored only if all error bars are plotted</td><td>1</td></tr>
</table>

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Question	Answer	Marks
2(c)(iii)	gradient determined with clear substitution of data points into $\Delta y / \Delta x$; distance between data points must be at least half the length of the drawn line must be negative	**1**
	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(c)(iv)	*y*-intercept determined by substitution of correct point into $y = mx + c$	**1**
	y-intercept of worst acceptable line determined by substitution into $y = mx + c$ 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**
2(d)	$p = 10^{y\text{-intercept}}$ and given to 2 or 3 sf	**1**
	q = gradient and q and p have correct power of ten from **(c)(iii)** and **(c)(iv)**	**1**
	absolute uncertainty in p = $10^{y\text{–intercept of WAL}} - p$ absolute uncertainty in q = uncertainty in gradient correct substitution of numbers must be seen	**1**
2(e)	$\theta = \sqrt[q]{\frac{100}{p}}$ or $\lg\theta = \frac{\lg(100) - \lg p}{q} = \frac{2 - y\text{ – intercept}}{\text{gradient}}$ correct substitution of numbers must be seen	**1**

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