Cambridge International AS & A Level

Cambridge Assessment International Education
Cambridge International Advanced Subsidiary and Advanced Level

PHYSICS **9702/31**

Paper 3 Advanced Practical Skills 1 **October/November 2019**

MARK SCHEME

Maximum Mark: 40

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(a)	Value of $V < 2.0$ V with unit.	**1**
1(b)	Value of d with unit and in the range 20.0–90.0 cm.	**1**
1(c)	Six sets of readings of R and d (different values) showing the correct trend and without assistance from the Supervisor scores 5 marks, five sets scores 4 marks etc.	**5**
	Range: Values of R must include 12 Ω **and** 39 Ω.	**1**
	Column headings: Each column heading must contain a quantity and a unit where appropriate. The presentation of quantity and unit must conform to accepted scientific convention e.g. d / m and R / Ω and R / d / Ω m^{-1}.	**1**
	Consistency: All values of d must be given to the nearest mm.	**1**
	Significant figures: All values of R / d must be given to either 2 or 3 s.f.	**1**
	Calculation: Values of R / d are correct.	**1**
1(d)(i)	Axes: Sensible scales are used, no awkward scales (e.g. 3:10). Scales must be chosen so that the plotted points occupy at least half the graph grid in both x and y directions. Scales must be labelled with the quantity that is being plotted. Scale markings should be no more than three large squares apart.	**1**
	Plotting of points: All observations must be plotted on the grid. Diameter of plotted point must be ⩽ half a small square. Points must be plotted to an accuracy of half a small square.	**1**
	Quality: All points in the table (at least 5) must be plotted on the grid for this mark to be awarded. Trend of points on graph must be positive. All points must be within 2.5 Ω on the R-axis of a straight line.	**1**

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Question	Answer	Marks
1(d)(ii)	Line of best fit: Judge by the balance of all points on the grid (at least 5) about the candidate's line. There must be an even distribution of points either side of the line along its full length. One anomalous point is allowed only if clearly indicated (i.e. circled or labelled) by the candidate. There must be at least 5 points left after the anomalous point is disregarded. Line must not be kinked or thicker than half a square.	**1**
1(d)(iii)	Gradient: The hypotenuse of the triangle used should be greater than half the length of the drawn line. Both read-offs must be accurate to half a small square in both the *x* and *y* directions. The sign of the gradient on the answer line must match the graph. Method of calculation must be correct, e.g. not $\Delta x / \Delta y$.	**1**
	y-intercept: Correct read-off from a point on the line substituted into $y = mx + c$ or an equivalent expression. Read-off must be accurate to half a small square in both *x* and *y* directions. **or** Intercept read directly from the graph, with read-off at $R = 0$, accurate to half a small square in the *R* direction.	**1**
1(e)	Value of *A* = candidate's gradient **and** value of *B* = candidate's intercept. The values must not be fractions.	**1**
	Unit for *A* is correct (e.g. m^{-1} or cm^{-1} or mm^{-1}) **and** unit for *B* is correct (e.g. $\Omega\, m^{-1}$ or $\Omega\, cm^{-1}$ or $\Omega\, mm^{-1}$).	**1**

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Question	Answer	Marks
2(a)(i)	Value of x to the nearest mm with unit in the range 9.0–11.0 cm.	**1**
2(a)(ii)	Percentage uncertainty in x based on absolute uncertainty of 2–4 mm. If repeated readings have been taken, then the uncertainty can be half the range (but not zero) if the working is clearly shown. Correct method of calculation to obtain percentage uncertainty.	**1**
2(b)(i)	Value of raw L to the nearest mm with unit and in the range 20.0–30.0 cm.	**1**
2(b)(ii)	Correct calculation of $\sqrt{L}$.	**1**
2(b)(iii)	Justification for s.f. in $\sqrt{L}$ linked to s.f. in L.	**1**
2(c)	Second value of x.	**1**
	Second value of L.	**1**
	Quality: Second value of L > first value of L.	**1**
2(d)(i)	Two values of k calculated correctly.	**1**
2(d)(ii)	Valid comment consistent with calculated values of k, testing against a criterion stated by the candidate.	**1**
2(e)(i)	Value of T in the range 1.0–2.0 s.	**1**
2(e)(ii)	Correct calculation of g with correct consistent unit using second value of k.	**1**

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Question	Answer	Marks
2(f)(i)	A Too few readings/(only) two readings not enough to draw a (valid) conclusion (**not** 'not enough for accurate results', 'few readings'). B Difficult to determine x or L_0 or L with reason e.g. parallax error/locating centre of bob/lower curved edge of wooden rod/holding ruler by hand. C Difficult to release two bobs at same instant/time. D Pendulums have different amplitudes/displacements **or** Two oscillations have different motions so difficult to compare. E Difficult to judge when the two pendulums are exactly in phase/difficult to adjust to the exact length so that the pendulums are in phase/trial and error process needed to identify when length gives same phase. F Difficult to judge start of/end of/complete oscillation. *1 mark for each point up to a maximum of 4.*	**4**
2(f)(ii)	A Take more readings and plot a graph or take more readings and compare k values (**not** 'repeat readings' on its own). B Measure to top and bottom of ball and take average **or** Take string off and measure on table **or** Clamp a ruler (vertically). C Improved method of release e.g. card gate release. E Use stop-watch and test for same period for each pendulum. F Video/record/film and view with timer/frame-by-frame. *1 mark for each point up to a maximum of 4. There is no marking point labelled D.*	**4**

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