Cambridge International AS & A Level

**Cambridge Assessment International Education**
Cambridge International Advanced Subsidiary and Advanced Level

**PHYSICS** **9702/34**

Paper 3 Advanced Practical Skills 2 **October/November 2018**

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:<br><br>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:<br><br>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 $V$ with unit and in the range $2.00\,\text{V} \leqslant V \leqslant 4.00\,\text{V}$. | **1** |
| 1(b) | Value of $t$ with unit and in range 1.00–25.00 s. | **1** |
| | Evidence of repeat readings of $t$. | **1** |
| 1(c) | Six sets of readings of $n$ and $t$ collected with correct trend ($t$ decreases as $n$ increases) and collected without help from the Supervisor scores 5 marks, five sets scores 4 marks, etc. | **5** |
| | Range: $n_{max} \geqslant 7$ **and** $n_{min} = 1$. | **1** |
| | Column headings:<br>Each column heading must contain a quantity and a unit where appropriate.<br>The presentation of quantity and unit must conform to accepted scientific convention e.g. $t$/s.<br>There must be no unit for $n$ or $\frac{1}{n}$. | **1** |
| | Consistency: All values of $t$ must be given to 0.01 s or all to 0.1 s. | **1** |
| | Calculation: Values of $\frac{1}{n}$ calculated correctly. | **1** |

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| Question | Answer | Marks |
|---|---|---|
| 1(d)(i) | Axes:<br>Sensible scales must be used, no awkward scales (e.g. 3:10 or fractions).<br>Scales must be chosen so that the plotted points occupy at least half the graph grid in both *x* and *y* directions.<br>Scales must be labelled with the quantity that is being plotted.<br>Scale markings should be no more than three large squares apart. | **1** |
| | Plotting of points:<br>All observations in the table must be plotted on the grid.<br>Diameter of points must be $\leqslant$ half a small square (no "blobs").<br>Points must be accurate to within half a small square in both *x* and *y* directions. | **1** |
| | Quality:<br>General trend of points on graph must be positive.<br>All points in the table (at least 5) must be plotted for this mark to be awarded.<br>It must be possible to draw a straight line that is within ±1.0 s from a straight line in the *t* direction. | **1** |
| 1(d)(ii) | Line of best fit:<br>Judge by balance of all points on the grid about the candidate's line (at least 5 points). There must be an even distribution of points either side of the line along the full length.<br>Allow one anomalous point only if clearly indicated by the candidate (i.e. circled or labelled).<br>Line must not be kinked or thicker than half a small square. | **1** |
| 1(d)(iii) | Gradient:<br>The hypotenuse of the triangle used must be greater than half the length of the drawn line.<br>The method of calculation must be correct. Do not allow $\Delta x / \Delta y$.<br>Both read-offs must be accurate to half a small square in both the *x* and *y* directions.<br>Sign of gradient on answer line must match graph. | **1** |
| | *y*-intercept:<br>Correct read-off from a point on the line substituted into $y = mx + c$.<br>Read-off must be accurate to half a small square in both *x* and *y* directions.<br>**or**<br>Intercept read directly from the graph with read-off at $x = 0$, accurate to half a small square. | **1** |

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| Question | Answer | Marks |
|---|---|---|
| 1(e) | Value of *a* equal to candidate's gradient **and** value of *b* equal to candidate's intercept.<br>The values must not be fractions. | **1** |
| | Unit for *a* is s **and** unit for *b* is s. | **1** |

| Question | Answer | Marks |
|---|---|---|
| 2(a)(i) | Raw value(s) for $d$ with unit and to nearest 0.01 mm.<br>Answer on answer line in range 20.00 mm $\leqslant d \leqslant$ 30.00 mm. | **1** |
| 2(a)(ii) | Value for $w$ with unit and in range 10.0–15.0 mm. | **1** |
| 2(b)(i) | Value for $x$ to nearest mm.<br>Answer in range 55.0 cm $\leqslant x \leqslant$ 65.0 cm. | **1** |
| 2(b)(ii) | Value for $t$ with unit and in range 2.00–4.00 s. | **1** |
| 2(b)(iii) | Percentage uncertainty in $t$ based on an absolute uncertainty in the range 0.2–0.5 s.<br>If repeated readings have been taken, then the uncertainty can be half the range (but not zero) if the working is clearly shown.<br>Correct method of calculation to obtain percentage uncertainty. | **1** |
| 2(b)(iv) | Correct calculation of $v$ with consistent unit. | **1** |
| 2(b)(v) | Justification linked to significant figures in $x$ and $t$. | **1** |
| 2(c) | Second value of $w$. | **1** |
| | Second value of $t$. | **1** |
| | Quality: $t$ greater for greater $w$. | **1** |
| 2(d)(i) | Two values of $k$ calculated correctly. | **1** |
| 2(d)(ii) | Valid comment consistent with the calculated values of $k$, testing against a criterion stated by the candidate. | **1** |

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| Question | Answer | Marks |
|---|---|---|
| 2(e)(i) | A Two readings are not enough to draw a (valid) conclusion (**not** "not enough for accurate results", "few readings").<br><br>B Large percentage uncertainty in *w* **or** large uncertainty in *w* because *w* is small<br>**or**<br>*w* varies along the length of the track.<br><br>C Difficult to align sphere in correct starting position.<br><br>D Sphere won't start without push/force applied when releasing sphere.<br><br>E Large percentage uncertainty in *t* **or** large uncertainty in *t* because *t* is small.<br><br>*1 mark for each point up to a maximum of 4.* | **4** |
| 2(e)(ii) | A Take more readings <u>and</u> plot a graph **or** calculate more *k* values and <u>compare</u> (not "repeat readings" on its own).<br><br>B Use (vernier/digital) calipers (to measure *w*).<br><br>C Use a stop/card gate.<br><br>D Use steeper slope/use steel ball and electromagnet.<br><br>E1 Use longer track/use shallower slope.<br><br>E2 Improved method of measuring *t*, e.g. use light gates at top and bottom/use motion sensor in direction of rolling<br>**or** video/film/record experiment with timer in view/view frame-by-frame.<br><br>*1 mark for each point up to a maximum of 4.* | **4** |

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