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 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.

Cambridge International is publishing the mark schemes for the October/November 2018 series for most Cambridge IGCSE™, Cambridge International A and AS Level components and some Cambridge O Level components.

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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. |

| Question | Answer | Marks |
|---|---|---|
| 1(a) | Value of $x$ with unit in the range 23.5–24.5 cm. | **1** |
| 1(b) | Value of $T$ with unit in the range 1.0–1.5 s and to 0.1 s or better. | **1** |
| 1(c) | Six sets of readings of $x$ (different values) and time without help from the Supervisor and showing the correct trend scores 5 marks, five sets scores 4 marks etc. | **5** |
| | Range: Minimum value of $x$ < 10.5 cm. | **1** |
| | Column headings:<br>Each column heading must contain a quantity, a unit and a separating mark where appropriate.<br>The presentation of the quantity and the unit must conform to accepted scientific convention e.g. $T^2x$ / $s^2$ m. | **1** |
| | Consistency: All raw values of $x$ must be given to the nearest mm only. | **1** |
| | Significant figures:<br>All values of $x^2$ must be given to the same number of significant figures as (or one more than) the number of significant figures in raw values of $x$. | **1** |
| | Calculation: Correct calculation of $T^2x$. | **1** |
| 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 plotted points must be ⩽ half a small square (no “blobs”).<br>Points must be plotted to an accuracy of half a small square. | **1** |
| | Quality:<br>General trend of points on graph must be positive.<br>All points in the table (at least 5) must be plotted on the grid.<br>It must be possible to draw a straight line that is within ±0.005 $m^2$ on the $x$-axis of all plotted points. | **1** |

| Question | Answer | Marks |
|---|---|---|
| 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** |
| 1(e) | Value of $A$ = candidate's gradient **and** value of $B$ = candidate's intercept.<br>The values must not be fractions. | **1** |
| | Unit for $A$ correct ($s^2 m^{-1}$, $s^2 cm^{-1}$ or $s^2 mm^{-1}$) **and** unit for $B$ correct ($s^2 m$, $s^2 cm$ or $s^2 mm$). | **1** |

| Question | Answer | Marks |
|---|---|---|
| 2(a)(i) | Value of $M$ with unit and to the nearest 0.1 g or better. | **1** |
| 2(a)(ii) | Correct calculation of $m$ dividing the value in **(a)(i)** by 25. | **1** |
| 2(a)(iii) | Justification for significant figures in $m$ linked to the s.f. in $M$. | **1** |
| 2(b)(i) | Value of $S$ in range $1.0\,g \leqslant S \leqslant 2.0\,g$ with consistent unit. | **1** |
| 2(b)(ii) | Correct calculation of $c$. | **1** |
| 2(c)(i) | Values $p$ and $q$ such that $p + q = 25$. | **1** |
| | Evidence of repeated values of $p$. | **1** |
| 2(c)(ii) | Percentage uncertainty in $p$ based on absolute uncertainty of 1 or 2.<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(d) | Second values of $p$ and $q$. | **1** |
| | Quality: second value of $q$ less than first value of $q$. | **1** |
| 2(e)(i) | Two values of $k$ calculated correctly. | **1** |
| 2(e)(ii) | Valid comment consistent with calculated values of $k$, testing against a criterion stated by the candidate. | **1** |

| Question | Answer | Marks |
|---|---|---|
| 2(f)(i) | A Two readings are not enough to draw a (valid) conclusion (**not** "not enough for accurate results", "few readings").<br><br>B Difficulty linked to board during movement of clips e.g. paper clips flip over when moving affecting friction/clips move to the side/clips catch on end of board/board irregular and clips catch on edge/board moves on table as well as clips.<br><br>C Difficulty linked to placing or keeping the spheres on the clips e.g. spheres fall off/clips too small to hold the sphere/ difficult to get two neighbouring paper clips level enough to take the two spheres/spheres touch table.<br><br>D Difficulty linked to size of clips with a reason e.g. large increments of mass gives large uncertainty in the value of $p$ or $q$/the exact force needed to cause movement may not be equal to a whole number of clips.<br><br>E Masses of clips or spheres may be different.<br><br>*1 mark for each point up to a maximum of 4.* | **4** |
| 2(f)(ii) | A Take many readings (for different values of $n$) and plot a graph **or** take more values of $k$ and compare.<br><br>B Workable method e.g. provide a guide/over a pulley wheel/tape or clamp board to bench/sand the end of the board/sand out irregularities.<br><br>C Workable method of adding/holding spheres e.g. use cuboid/disc shaped plasticine/tie paper clips together with thin cotton to keep flat.<br><br>D Improved method to deal with large clips e.g. use more and smaller/lighter clips.<br><br>E Check masses using a balance.<br><br>*1 mark for each point up to a maximum of 4.* | **4** |