Cambridge International Examinations
Cambridge International Advanced Subsidiary and Advanced Level

PHYSICS **9702/34**

Paper 3 Advanced Practical Skills 2 **October/November 2016**

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.

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1 (b) (ii) Value for x in range 24.0 cm to 26.0 cm, with unit. [1]

(iv) Value for T in range 0.30 s to 1.00 s. [1]

Evidence of repeat readings (at least two recordings of nT where $n \geqslant 5$). [1]

(c) Six sets of values for x and T (with correct trend and without help from Supervisor) scores 4 marks, five sets scores 3 marks etc. [4]

Range: [1]
$x_{min} \leqslant 20.0$ cm and $x_{max} \geqslant 30.0$ cm.

Column headings: [1]
Each column heading must contain a quantity and an appropriate unit. The presentation of the quantity and unit must conform to accepted scientific convention e.g. $1 / T^2 (s^{-2})$ or $1 / T^2 / 1 / s^2$.

Consistency: [1]
All values of x must be given to the nearest mm.

Significant figures: [1]
Every value of $1/T^2$ must be given to the same number of s.f. as (or one greater than) the number of s.f. in the corresponding times.

Calculation: [1]
Values of $1/T^2$ calculated correctly to the number of s.f. given by the candidate.

(d) (i) Axes: [1]
Sensible scales must be used. Awkward scales (e.g. 3:10, fractions or non-linear) are not allowed.
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 must be no more than three large squares apart.

Plotting of points: [1]
All observations in the table must be plotted on the grid.
Diameter of plotted points must be $\leqslant$ half a small square (no "blobs").
Points must be plotted to an accuracy of half a small square.

Quality: [1]
All points in the table must be plotted (at least 5) for this mark to be awarded.
All points must be within ± 1.0 cm (to scale) of a straight line in the x direction.

(ii) Line of best fit: [1]
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.
Allow one anomalous plot if clearly indicated (i.e. circled or labelled) by the candidate. There must be at least five points left after the anomalous point is disregarded.
Line must not be kinked or thicker than half a small square.

(iii) Gradient: [1]
The hypotenuse of the triangle must be greater than half the length of the drawn line.
The method of calculation must be correct. Do not allow $\Delta x / \Delta y$.
Both read-offs must be accurate to half a small square in both the *x* and *y* directions.

y-intercept: [1]
Either:
Check correct read-off from a point on the line and substituted into $y = mx + c$.
Read-off must be accurate to half a small square in both *x* and *y* directions.
Or:
Check read-off of the intercept directly from the graph (accurate to half a small square.

(e) Value of *p* = candidate's gradient and value of *q* = candidate's intercept.
Do not allow fractions. [1]

Units for *p* (e.g. $cm^{-1} s^{-2}$) and *q* (e.g. s^{-2}) correct. [1]

2 (b) *L* in range 19.0 cm to 21.0 cm, with unit. [1]

(c) (iv) Values for x_1 and x_2 to nearest mm and $x_2 > x_1$. [1]

Evidence of repeat readings of x_1 and x_2. [1]

(v) Correct calculation of *X*. [1]

(d) Absolute uncertainty in *X* in range 2 mm to 10 mm.
If repeated readings have been taken, then absolute uncertainty can be half the range (but not zero) if working is clearly shown.
Correct method of calculation to obtain percentage uncertainty. [1]

(e) Second value for *L*. [1]

Second values for x_1 and x_2. [1]

Quality: *X* smaller for larger *L*. [1]

(f) (i) Two values of *k* calculated correctly. [1]

(ii) Justification of s.f. in *k* based on the s.f. in *L*, x_1 and x_2. [1]

(iii) Valid comment consistent with the calculated values of *k*, testing against a <u>stated</u> numerical criterion. [1]

(g) Value for *X* = 50 cm. [1]

(h)	**(i)** Limitations [4]	**(ii)** Improvements [4]	Do not credit
A	Two readings not enough to draw a conclusion	Take more readings and plot graph/ obtain more *k* values and compare	Two readings not enough for accurate results Repeat readings Few readings Take more readings and calculate average *k*
B	Metre rule is not parallel to bench/horizontal	Use a second rule and measure at both ends/ use a (spirit) level	
C	Difficult to move stands with reason e.g. friction/ bench is rough/ stands tend to stick	Guide for stands (fixed to bench)/ mount stands on rollers/ put wheels on stands/ method to reduce friction e.g. sand bench with sandpaper	Use a smooth(er) bench Use lubricant
D	Difficulty with rule e.g. rule skewed/ moves sideways	Use V-shaped rods/ groove in rods/ guide for ruler with some details	Falls off
E	Difficult to measure *x* with reason e.g parallax error/ difficult to tell point where rod touches ruler	Scale on vertical edge of rule/ draw a line on the rod/ use a thinner rod/ replace rods with sharp edges e.g. prisms	Large contact area

Do not allow ‘use a computer to improve the experiment’.