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Cambridge International Advanced Subsidiary and Advanced Level

MARK SCHEME for the October/November 2015 series

9702 PHYSICS

9702/33 Paper 3 (Advanced Practical Skills 1), maximum raw mark 40

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1 (b) (i) Value for L to the nearest mm, with unit. [1]

(c) Second value of h > first value of h. [1]

(d) (ii) Six sets of readings of m, h and θ scores 5 marks, five sets scores 4 marks etc. [5]
Help from Supervisor –1.
Incorrect trend –1. Correct trend is h increases as m increases.

Range: [1]
Range of values to include $m_{min} < 60\,g$ and $m_{max} > 80\,g$.

Column headings: [1]
Each column heading must contain a quantity and a unit.
The presentation of quantity and unit must conform to accepted scientific convention e.g. $h / \cos\theta$ (cm).

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

Significant figures: [1]
Every value of $h / \cos\theta$ must be given to 2 or 3 significant figures only.

Calculation: [1]
Values of $h / \cos\theta$ calculated correctly to the number of significant figures given by the candidate.

(e) (i) Axes: [1]
Sensible scales must be used. Awkward scales (e.g. 3:10) 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 should be no more than three large squares apart.

Plotting: [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.
Scatter of points must be no more than 10 g in the m direction of a straight line.

(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 point only if clearly indicated (i.e. circled or labelled) by the candidate.
Lines must not be kinked or thicker than half a square.

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

y-intercept: [1]
Either:
Correct read-offs from a point on the line substituted into $y = mx + c$ or an equivalent expression.
Read-offs must be accurate to half a small square in both *x* and *y* directions.
Or:
Intercept read directly from the graph, with read-off accurate to half a small square.

(f) Value of *A* = candidate's gradient and value of *B* = candidate's intercept. [1]

Unit for *A* correct (e.g. $\mathrm{m\,kg^{-1}}$ or $\mathrm{cm\,g^{-1}}$) and unit for *B* correct (m or cm or mm). [1]

2 (a) (iii) Values of *x*, *y* and *z* to the nearest mm with unit. [1]

Value of $z >$ value of *x*. [1]

(iv) Absolute uncertainty in *y* of 1 mm to 4 mm and correct method of calculation to obtain percentage uncertainty. If repeated readings have been taken, then the uncertainty can be half the range (but not zero) if working is clearly shown. [1]

(b) Correct calculation of *C* with consistent unit. [1]

(c) (ii) Value for *T* with unit in range $5.0\,\mathrm{s} > T > 0.5\,\mathrm{s}$. [1]

Evidence of repeat readings for *T*. [1]

(iv) Justification for significant figures in T^2 linked to significant figures in the (raw) times. [1]

(d) Second values of *x, y* and *z*. Value of *y* within 5 mm of value in **(a)(iii)**. [1]

Second value of *T*. [1]

Second value of $T <$ first value of *T*. [1]

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

(ii) Valid comment consistent with the calculated values of *k*, testing against a criterion specified by the candidate. [1]

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(f)	(i) Limitations (4 max.)	(ii) Improvements (4 max.)	Do not credit
A	Not enough readings to draw a conclusion	Take many readings (for different masses) and plot a graph/ obtain more *k* values and compare	"Repeat readings" on its own/ few readings/ only one reading/ not enough readings for an accurate result/ take more readings and (calculate) average *k*
B	Rod is bent when loaded	Use smaller masses/ rigid/stiff/thick rod	Just "rod is bent"/ shorter rod
C	Difficult to get horizontal	Use a spirit level or named instrument.	
D	Difficult to measure distances with reason e.g. rod unstable/awkward with metre rule/rod moves/holding ruler mid-air	Add a scale on rod/ use travelling microscope/ clamp ruler	Parallax Do not award if reason given is bent rod.
E	*y* not constant with a reason e.g. spring/loop moves around during oscillations	Cut groove or drill hole in wooden rod/ tape to wooden rod	
F	Difficult to judge the start/end of an oscillation **or** Difficult to judge when to start/stop the stopwatch	(Fiducial) marker at centre/ video and timer/view frame by frame/ motion sensor placed below/above	More oscillations/ high speed camera/ reaction time/ human error
G	Oscillation in more than one plane/irregular oscillations		Wind/draughts/ switch off air conditioning/ close doors and windows

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