Cambridge International AS & A Level

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PHYSICS **9702/33**

Paper 3 Advanced Practical Skills 1 **May/June 2016**

MARK SCHEME

Maximum Mark: 40

Published

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1 (b) (ii) Value for y with unit in range $2.0 \leq y \leq 8.0$ cm. [1]

(iii) Raw values of θ to the nearest degree.
Value of θ in the range 40° to 50°. [1]

(d) Six sets of readings of m, y and θ with correct trend scores 5 marks, five sets scores 4 marks etc. [5]
Help from supervisor –1.

Range: [1]
Range of values to include $m \leq 150$ g and $m \geq 400$ g.

Column headings: [1]
Each column heading must contain a quantity and a unit where appropriate.
The unit must conform to accepted scientific convention, e.g. $m \sin\theta$ / g or θ (°).

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

Significant figures: [1]
Every value of $m \sin\theta$ must be given to 2 or 3 s.f.

Calculation: [1]
Values of $m \sin\theta$ calculated correctly to the number of s.f. 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 of points: [1]
All observations must be plotted.
Diameter of plotted points must be ≤ half a small square (no "blobs").
Plotted points must be accurate to half a small square.

Quality: [1]
All points in the table (at least 5) must be plotted on the grid for this mark to be awarded.
All points must be within ±0.25 cm in the y 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 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 of the length of the drawn line.
The method of calculation must be correct.
Both read-offs must be accurate to half a small square in both the *x* and *y* directions.

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

(f) Value of *P* = candidate's gradient and value of *Q* = candidate's intercept. [1]
Do not allow fractions.

Unit for *P* correct ($m\,kg^{-1}$ or $cm\,kg^{-1}$ or $mm\,kg^{-1}$ or $m\,g^{-1}$ or $cm\,g^{-1}$ or $mm\,g^{-1}$) and consistent with value.
Unit for *Q* correct (m or cm or mm) and consistent with value. [1]

2 (a) (ii) All raw values of *d* either to the nearest 0.01 or 0.001 mm with unit and in the range 0.250 mm to 0.450 mm. [1]

(iii) Correct calculation of *A* with consistent unit and power of ten. [1]

(b) (iii) Value of *L* with appropriate unit in range 10.0 cm ≤ *L* ≤ 20.0 cm. [1]

(iv) Percentage uncertainty in *L* based on absolute uncertainty of 2 mm to 8 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]

(c) (i) Correct calculation of *C* to the s.f. given by the candidate. [1]

(ii) Correct justification for s.f. in *C* linked to s.f. in *d* and *L*. [1]

(d) (ii) Raw values for time to the nearest 0.1 s or better.
T with unit and in range 0.5 s ≤ *T* ≤ 2.0 s. [1]

(e) (ii) Second values of *d* and *L*. [1]

Second value of *T*. [1]

Quality: If $d_1 > d_2$ then second value of *T* > first value of *T*. [1]

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

(ii) Sensible comment relating to the calculated values of k, testing against a criterion specified by the candidate. [1]

(g)	**(i)** Limitations [4]	**(ii)** Improvements [4]	Do not credit
A	Two readings not enough to draw a conclusion	Take many readings <u>and</u> plot a graph/ obtain more k values and <u>compare</u>	"Repeat readings" on its own/few readings/only one reading/not enough readings for accurate value
B	Difficult to judge beginning and/or end of a cycle/a complete cycle	Draw a line/mark on the mass/ (fiducial) marker <u>at equilibrium position</u>	
C	Wire not straight/kinked	Method of straightening wire e.g. use larger mass	
D	Difficult to measure <u>L</u> with reason e.g. metre rule awkward to position/parallax error	Improved method of measuring L e.g. marking L before putting into clip/ detailed method using set squares or ruler/ use a length guide (e.g. 15 cm wood)/ use string with detail/ use tape measure	Vernier calipers on its own/ set square on its own/ 30 cm ruler on its own
E	Wire slips (in clip)	Better method of gripping wire e.g. wrap wire around clamp/ use two wooden blocks and wire	Any reference to attaching the mass to the wire
F	Mass swings as well as rotates/ clip moves around rod/ there is a force on release	Better method of attaching clip to rod e.g. glue	
G	Shorter/thicker wire has too few cycles/dampens quickly/ (percentage) uncertainty greater for shorter/thicker wire	Video and timer/replay frame by frame	Repeats Longer wire

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