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Cambridge International Advanced Subsidiary and Advanced Level

MARK SCHEME for the October/November 2015 series

9702 PHYSICS

9702/36 Paper 3 (Advanced Practical Skills 2), maximum raw mark 40

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1 (a) Value of H in the range 13.0 cm to 17.0 cm. [1]

(c) (iii) Value of F to nearest 0.1 N. [1]

(iv) Value of x correct and in range 3.5 cm to 4.5 cm. [1]

(d) Six sets of readings of h_w, h_b and F scores 4 marks, five sets scores 3 marks etc. [4]
Incorrect trend –1. Help from Supervisor –1.

Range: [1]
$x_{max} - x_{min} \geqslant 6.0$ cm.

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. $(H-x)^3 / \text{cm}^3$.

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

Significant figures: [1]
Significant figures for $(H-x)^3$ must be the same as, or one greater than, the number of s.f. for $(H-x)$.

Calculation: [1]
Values of $(H-x)^3$ calculated correctly.

(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 less than $\pm$ 0.2 N from a straight line in the F direction.

(ii) Line of best fit: [1]
Judged 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 used must be greater than half 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-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 in the *y* direction.

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

Unit for *a* is correct (e.g. N cm^{-3}) and unit for *b* is correct (e.g. N). [1]

2 (a) (i) All values of *d* to nearest 0.001 cm and in range 0.100 cm to 0.500 cm. [1]

(ii) All values of *D* to nearest 0.1 cm. [1]

(b) Values of *l*, *h* and *s* present.
Value of *h* to nearest 0.1 cm and in range 7.5 cm to 8.5 cm, with unit. [1]

(c) (ii) *t* on answer line in range 1.00 s to 20.00 s, with unit. [1]

Evidence of repeated readings for *t*. [1]

(iii) Absolute uncertainty in *t* in range 0.2 s to 0.5 s and correct method of calculation to obtain percentage uncertainty. If repeated readings have been taken, then the absolute uncertainty can be half the range (but not zero) if the working is clearly shown. [1]

(iv) Calculation of *g* correct to the second s.f., with consistent unit (e.g. m s^{-2}). [1]

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

t greater for smaller *d*. [1]

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

(ii) Justification for significant figures in *k* linked to significant figures in *t* and *d*. [1]

(iii) Valid comment consistent with the calculated values of *k*, tested 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 more 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/ take more readings and (calculate) average *k*/ two readings not enough for accurate results
B	Parallax error when measuring *h* or *D*	Use calipers/ use set square as pointer	Rule not vertical when measuring *h*
C	Plastic deforms when measuring larger *d*/diameter with tubing	Use larger diameter axle instead of tubing	
D	Push force to start flywheel may vary/push force may affect time	Release mechanism, with detail/ use steeper ramp	"Force may be too large"/ start before top line
E	Flywheel doesn't travel straight/ flywheel hits (sides of) track	Sensible method of preventing collision, e.g. level the track sideways/widen the track	Reduce friction/ mark both sides of track
F		Use video with timer/ view frame by frame/ use light gates <u>at start and end</u>/ use longer track	Reaction time

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