CAMBRIDGE INTERNATIONAL EXAMINATIONS

Cambridge International Advanced Subsidiary and Advanced Level

MARK SCHEME for the May/June 2015 series

9702 PHYSICS

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

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) (iv)** Value of y in the range 10.0 cm to 11.0 cm with unit. [1]

(c) (ii) Value of y > value in (**b)(iv)**. [1]

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

Range: [1]
Range of m to include m = 0 g <u>and</u> m = 50 g or 60 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. $y(C+m)$ / cm g.

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

Significant figures: [1]
Every value of value of $y(C+m)$ must be given to the same number of s.f. as (or one more than) the least s.f. in the corresponding values of y, C and m as stated in the candidate's table and **(a)(ii)**.

Calculation: [1]
Values of $y(C+m)$ 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: [1]
All observations must be plotted.
Diameter of plotted points must be ≤ half a small square (no "blobs").
Plotted points must be accurate to within 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 ±40 g cm of a straight line in the $y(C+m)$ 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 point only if clearly indicated by the candidate.
Lines must not be kinked or thicker than half a 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.
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 and substituted into $y = mx + c$.
Read-offs 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).

(f) Value of *A* = candidate's gradient and value of *B* = 2 × candidate's intercept / *A*. [1]
Do not allow fractions or final answer to 1 s.f.

Unit for *A* (m, cm or mm) and *B* (g or kg) correct and consistent with value, with correct power of ten. [1]

2 (a) (i) Raw values of *d* and *D* to nearest 0.1 mm and with consistent SI unit, in ranges:
$10.0\text{ mm} \le d \le 25.0\text{ mm}$
$20.0\text{ mm} \le D \le 40.0\text{ mm}$. [1]

(ii) Value of *h* with consistent unit in range $40.0\text{ mm} \le h \le 60.0\text{ mm}$. [1]

(iii) Percentage uncertainty in *d* based on absolute uncertainty of 0.1 or 0.2 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]

(b) (iii) Correct calculation of *x*. Answer must be correct when rounded to 2 s.f. [1]

(c) Correct justification of s.f. in x linked to s.f. in *D*, *d* <u>and</u> *h*. [1]

(d) (ii) Value of average $t \ge 0.5$ s with unit. [1]

Evidence of repeated readings (here or in **(e)**). [1]

(e) Second value of *x*. [1]

Second value of *t*. [1]

Second value of *t* < first value of *t*. [1]

(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 max.)	**(ii)** Improvements (4 max.)	Do not credit
A	Two readings not enough to draw a valid conclusion	Take many readings and plot a graph/ take more readings and compare *k* values.	"repeat readings"/ "too few readings"
B	Difficulty in release of cylinder from same position every time with reason, e.g. placing fingers in water, level of water surface changing, difficult to judge start point	Better method of holding and releasing cylinder e.g. stop gate/ use mark to ensure the water level is the same for each release	Clamps Force on release
C	Cylinder doesn't always fall vertically (i.e. path at an angle or cylinder tilted)/ hits sides on descent	Method of attaching string symmetrically/ method of symmetrical distribution of mass e.g. use glass beads or sand/ modelling clay distributed evenly/ glue marbles in symmetrically	Ignore string effects Sand on its own Narrow cylinder
D	Times short/ large uncertainty in time	Use longer tube/ video with timer (or video and view frame by frame)	Reaction time is short "too fast/quick" High speed camera Light gate(s) Slow motion camera Terminal velocity
E	Difficulty in identifying end point with reason e.g. refraction, glass curvature, tray in the way, bottom of cylinder not flat	Method to identify end point e.g. time to a mark on cylinder/listening to impact	Flat bottomed cylinder Sensors
F	Limited number of marbles to fit in container/ different diameter marbles/ bubbles or air in container/ container deforms when measuring *D*	Use different shapes e.g. cubes/smaller spheres to occupy more space/ use sand/modelling clay to fill more space/ measure and account for different diameter of marbles in equation for *x*	Sand on its own without explanation