CAMBRIDGE INTERNATIONAL EXAMINATIONS

Cambridge International Advanced Subsidiary and Advanced Level

MARK SCHEME for the October/November 2014 series

9702 PHYSICS

9702/35 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 (a) (ii) Value of $(m - P)$ with consistent unit. [1]

(b) (ii) $10.0\,\text{s} \leqslant t \leqslant 60.0\,\text{s}$, with unit. If out of range allow Supervisor's value $\pm$ 5.0 s. [1]

(c) Six sets of readings of m and t scores 5 marks, five sets scores 4 marks etc. [5]
Incorrect trend –1. Help from Supervisor –1.

Range: [1]
$m_{max} \geqslant 360\,\text{g}$.

Column headings: [1]
Each column heading must contain a quantity and a unit.
The unit must conform to accepted scientific convention e.g. $1/t^2/\text{s}^{-2}$ or $1/t^2$ (s^{-2}).

Consistency: [1]
All values of t must be given to the nearest 0.1 s or all to the nearest 0.01 s.

Significant figures: [1]
Every value of $1/t^2$ must be given to the same s.f. as (or one more than) the s.f. in raw t.

Calculation: [1]
Values of $1/t^2$ calculated correctly to the number of significant figures given by the candidate.

(d) (i) Axes: [1]
Sensible scales must be used, no awkward scales (e.g. 3:10).
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: [1]
All observations in the table must be plotted on the graph grid.
Work to an accuracy of half a small square in both the x and y directions.
Diameter of plotted points must be $\leq$ half a small square (no "blobs").

Quality: [1]
All points in the table must be plotted (at least 5) for this mark to be awarded.
Judge by the scatter of all points about a straight line.
All points must be $\pm$ 0.01 kg ($\pm$ 10 g) from a straight line in the $(m - P)$ direction.

(ii) Line of best fit: [1]
Judge by balance of all points on the grid (at least 5 points) about the candidate's line.
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 small square.

(iii) Gradient: [1]
The hypotenuse of the triangle should be greater than half the length of the line drawn.
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 substituted into $y = mx + c$.
Read-off must be accurate to half a small square in both x and y directions.
Or:
Correct read-off of the intercept directly from the graph.

(e) U = value of candidate's gradient and V = value of candidate's intercept. [1]
Do not allow a value presented as a fraction.

Unit for U ($s^{-2}\,kg^{-1}$ or $s^{-2}\,g^{-1}$) and V (s^{-2}). [1]

[Total: 20]

2 **(a)** Raw value(s) for x to nearest 0.01 mm or 0.001 mm, with unit. [1]
0.10 mm $\leqslant x \leqslant$ 0.30 mm.
If outside this range, allow Supervisor's value $\pm$ 0.10 mm.

(b) **(i)** Value of A in the range 7.0 cm^2 – 15.0 cm^2. There must be a circle drawn on the grid. [1]

(ii) Estimate of percentage uncertainty based on absolute uncertainty in A in range 0.25 cm^2 – 2.0 cm^2 and method of calculation correct.
If repeated readings have been taken, then the uncertainty can be half the range (but not zero) if the working is clearly shown. [1]

(iii) Correct calculation of V. [1]

Correct and consistent unit. [1]

(iv) Correct justification of s.f. in V linked to significant figures in x and A. [1]

(c) **(iii)** Value of T in the range 1.0 s – 10.0 s with unit. [1]

(d) Second value of A. [1]
Evidence of measurement of repeat values of T. [1]
Quality: Second value of T < first value of T. [1]

(e) **(i)** Correct calculation of two values of k. [1]

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

(f)	(i) Limitations (4 max.)	(ii) Improvements (4 max.)	Do not credit
A	Two readings are not enough to draw a conclusion	Take many readings (for different diameters) and plot a graph / take more readings and compare *k* values	'Not enough (repeat) readings' / 'too few readings' / 'two readings' on its own
B	Difficult to measure *A*, with reason e.g. jagged circle / cup moves when drawing circle	Improved method for measuring *A* (e.g. put base of cup in ink and use as stamp on grid) or: improved method for cutting circle e.g. circle cutter / hot wire / laser cutter	Use different cup e.g. harder / stronger cup
C	Effect of cup loaded on one side e.g. movement lopsided / does not fall vertically / cup hits sides on the way down	Method to balance cup e.g. use two equal masses on either side	Put mass on bottom of cup Use a wider bucket
D	Large (percentage) uncertainty in *t* (because times are short)	Use video / film / record / (camera + playback) with timer / view frame-by-frame. Method to increase length of time e.g. taller container, smaller mass, smaller hole (for C)	High speed or slow-motion cameras unless linked to playback
E	Difficult to judge when cup hits bottom	Use transparent / clear bucket	
F	Thickness of base different from rim / plastic deformed when measuring thickness		

Do not credit:
Use a computer / data loggers / sensors
Use an assistant
Force on release
Cup heavier due to water droplets

[Total: 20]