CAMBRIDGE INTERNATIONAL EXAMINATIONS

Cambridge International Advanced Subsidiary and Advanced Level

MARK SCHEME for the March 2016 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.

Cambridge will not enter into discussions about these mark schemes.

Cambridge is publishing the mark schemes for the March 2016 series for most Cambridge IGCSE® and Cambridge International A and AS Level components.

CAMBRIDGE
International Examinations

1 **(b)** **(i)** Value for θ in range 40° to 50°, to nearest degree, with unit. [1]

(iii) Value for T in range 1.0 to 2.0 s. [1]

Evidence of repeat readings. [1]

(c) Six sets of values for θ and time (with correct trend) scores 4 marks, five sets scores 3 marks etc. [4]

Range: [1]
θ values must include 35° or less and 55° or more.

Column headings: [1]
Each column heading must contain a quantity and a unit where appropriate.
The presentation of quantity and unit must conform to accepted scientific convention
e.g. $1 / T^3 / s^{-3}$, θ(°) or θ (deg) etc.

Consistency: [1]
All values of T (or nT) must be given to the nearest 0.1 s, or all to the nearest 0.01 s.

Significant figures: [1]
Every value of $1 / T^3$ must be given to the same number of significant figures as (or one greater than) the significant figures in the corresponding raw time.

Calculation: [1]
Values of $1 / T^3$ calculated correctly.

(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 which is being plotted.
Scale markings should be no more than 3 large squares apart.

Plotting of points: [1]
All observations must be plotted on the grid.
Diameter of plotted points must be $\leqslant$ half a small square (no blobs).
Plots must be accurate to within half a small square in both x and y directions.

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 ± 5° from a straight line in the y (θ) direction.

(ii) Line of best fit: [1]
Judged by balance of all points on the grid (at least 5) about the candidate's line. There must be an even distribution of points either side of the line along the full length.
One anomalous point is allowed only if clearly indicated (i.e. circled or labelled) by the candidate.
Lines must not be kinked or thicker than half a small square.

(iii) Gradient: [1]
The hypotenuse of the triangle used must be greater than half the length of the drawn line.
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 substituted into $y = mx + c$ or an equivalent expression, with read-off accurate to half a small square in both x and y directions.

Or
Intercept read directly from the graph, with read-off at x = zero accurate to half a small square in y direction.

(e) Value of a equal to candidate's gradient. Value of b equal to candidate's intercept. [1]
The values must not be fractions.

Unit for a is correct and consistent with value. [1]
Unit for b is correct and consistent with value.

[Maximum mark: 20]

2 (b) (i) ϕ in range 10 to 20°, with unit. [1]

(ii) Value for h_1 to nearest mm. [1]

(iv) Correct calculation of v, with correct unit. [1]

(c) Justification based on number of significant figures in h_1 and h_2. [1]

(d) (ii) Value of R to nearest mm. [1]

Evidence of repeat readings of R. [1]

(e) Absolute uncertainty in R in range 2 to 10 mm. [1]
If repeated readings have been taken, then the absolute uncertainty can be half the range if the working is shown (but not zero if values are equal).
Correct method of calculation to obtain percentage uncertainty.

(f) Second values of ϕ, h_1 and h_2. [1]

Second value of R. [1]

Quality: [1]
Second R less than first R.

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

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

(h) **(i)** Two readings are not enough to draw a valid conclusion [4 max]

Difficult to measure ϕ /
parallax error when measuring ϕ

Difficult to measure R with reason e.g.
parallax error /
estimating centre of sphere

Sphere rolls after landing

ϕ deflects with marble /
ramp not steady /
ramp flexible /
ball rolls off side /
block moves

Difficult to release marble from same position each time /
difficult to release marble without a force

(ii) Take more readings <u>and</u> plot a graph / calculate more *k* values and <u>compare</u> [4 max]

Workable alternative method for ϕ e.g.
measure ϕ on photo or shadow /
larger protractor /
draw tangent on block /
hold ruler as tangent

Use two setsquares to measure *R* (with description of method) /
measure to edge of sphere and add half diameter

Video with scale /
dye on ball to mark paper /
clay to show landing mark /
sticky surface to stop rolling

Detail of method to make ramp rigid /
match sizes of ball and track so that ball runs straight /
method of fixing block

Use a stop on the ramp /
use electromagnetic release

[Maximum mark: 20]