CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the May/June 2014 series

9702 PHYSICS

9702/34 Paper 3 (Advanced Practical Skills 2), 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 May/June 2014 series for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level components and some Ordinary Level components.

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1 (a) (i) Value for θ in range 80° to 100°, with unit. [1]

(b) (ii) Value for t in range 10 to 40 s, with unit.. [1]

Evidence of repeat readings of t. [1]

(c) Five sets of values for θ and t scores 4 marks, four sets scores 3 marks etc. [4]
Incorrect trend –1. Help from Supervisor –1.

Range: [1]
θ values must include 75° or less and 105° or more.

Column headings: [1]
Each column heading must contain a quantity and an appropriate unit.
The presentation of quantity and unit must conform to accepted scientific convention
e.g. t^2 / s^2 or t^2 (s^2), θ (°) or θ (deg) etc. $\sin^2(\theta/2)$ must have no unit.

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 t^2 must be given to the same s.f. as (or one greater than) the s.f. in the corresponding t.

Calculation: [1]
Values of $\sin^2(\theta/2)$ 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 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 grid.
Diameter of plotted points must be ≤ half a small square (no "blobs").
Plotting must be accurate to 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 within $\pm 20\,s^2$ of a straight line in the y (t^2) direction.

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(ii) Line of best fit: [1]
Judge by balance of all points on the grid about the candidate's line (at least 4 points).
There must be an even distribution of points either side of the line along the full length.
Allow one anomalous plot only if clearly indicated by the candidate.
Line must not be kinked or thicker than half a small square.

(iii) Gradient: [1]
The hypotenuse of the triangle must be at least half the length of the drawn line.
Both read-offs must be accurate to half a small square in both x and y directions.

y-intercept: [1]
Either:
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) q = candidate's gradient and p = candidate's intercept. [1]

Correct units for q and p (s^2 for q and s^2 for p). [1]

[Total: 20]

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2 **(a)** r in range 5.0 mm to 12.0 mm and to nearest 0.1 mm or better. [1]

(b) **(i)** Value for l in range 61.0 mm to 65.0 mm. [1]

(ii) Value for e in range 6.0 mm to 8.0 mm. [1]

(c) **(ii)** Value for x. [1]
Evidence of repeat readings of x. [1]

(iii) Absolute uncertainty in x in range 2 to 9 mm. [1]
If repeated readings have been taken, then absolute uncertainty could be half the range (but not zero) only if working is shown.
Correct method of calculation to obtain percentage uncertainty.

(iv) Calculated value of θ correct. [1]
θ given to 2 or 3 significant figures. [1]

(d) Second values of e and x. [1]

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

Both values for k in range 0.80 to 1.20. [1]

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

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(f)	Limitations (4 max)	Improvements (4 max)	Do not credit
A	Two readings are not enough to draw a valid conclusion	Take more readings and plot graph / take more readings and compare *k* values	Repeat readings / too few readings / two readings
B	Difficult to align groove with line / difficult to estimate centre of groove	Mark centre line of groove / method of aligning groove (e.g. use lines on paper / use graph paper / transparent ramp)	
C	*e* is small so uncertainty in *e* is large / small change in *e* gives large change in θ	Use larger spheres <u>to enable larger *e*</u>	Just "use larger spheres"
D	Parallax error <u>when measuring *x*</u>	Use set square (<u>with detail of workable method</u>)	
E	Difficult to locate centre of sphere <u>when measuring *x*</u>	Measure to edge of sphere and add *r*	Difficult to locate centre of sphere when measuring *r*
F	Sphere rolls slightly after hitting tape / sphere does not stick	Use video with scale (in view) / Description of workable improvement (e.g. powder on strip / plasticine surface)	High speed camera / slow motion camera / video camera / stickier surface / magnets

[Total: 20]

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