CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the May/June 2014 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 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) Value of L with unit in range 90.0 cm ≤ L ≤ 110.0 cm. [1]

(d) (ii) Value of I with unit in the range 50 mA ≤ I ≤ 150 mA. [1]
Allow Supervisor's value ± 20%.

(e) Six sets of readings of x and I scores 5 marks, five sets scores 4 marks etc. [5]
Incorrect trend –1 (correct trend is I increases as x increases for all values of x).
Major help from Supervisor –2. Minor help from Supervisor –1.

Range: $\Delta x \geq 70$ cm. [1]

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. x/cm or x(cm), $x^2/(x+L)$/m but not $x^2/(x+L)$/m^2/m, $1/I$ (A^{-1}), $1/I$ (1/A) but not $1/I$ (A) or $1/I$(A)$^{-1}$.

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

Significant figures: [1]
Significant figures for every row of $x^2/(x+L)$ same as (or one greater than) the s.f. in x.

Calculation: [1]
Values of $x^2/(x + L)$ calculated correctly to the number of significant figures given by the candidate.

(f) (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 should be no more than three large squares apart.

Plotting of points: [1]
All observations must be plotted.
Diameter of points must be ≤ half a small square (no "blobs").
Work 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 ± 0.25 A^{-1} of $1/I$ from a straight line.

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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 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.
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 the x and y directions. The method of calculation must be correct.

y-intercept: [1]
Either:
Check correct read-off from a point on the line and substituted into $y = mx + c$.
Read-off 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.

(g) P = – the value of the gradient and Q = the value of the y-intercept. [1]
Do not allow fractions. Do not allow a substitution method.

Unit for P ($A^{-1}m^{-1}$) and Q (A^{-1}) consistent with value. [1]

[Total: 20]

2 (b) (i) Value of y in range 8.0 cm ≤ y ≤ 12.0 cm with unit. [1]

(ii) Absolute uncertainty in y in range 2 mm – 5 mm. [1]
If repeated readings have been taken, then allow uncertainty to be half the range (but not zero) only if working shown.
Correct method of calculation to obtain percentage uncertainty.

(iii) Value of x to the nearest mm with unit. [1]

(iv) Correct calculation of R. [1]

(c) (iii) Value of T with unit in range 1.5 s ≤ T ≤ 3.0 s. [1]
Evidence of repeats. [1]

(d) Second value of R. [1]
Second value of T. [1]
Correct trend for T with respect to R (T decreases as R decreases). [1]

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

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(ii) Correct justification of significant figures in *k* linked to significant figures in *x* and *y* and time (do not allow "raw readings"). [1]

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

(f)	**(i)** Limitations (4 max)	**(ii)** Improvements (4 max)	Do not credit
A	Two readings not enough to draw a conclusion.	Take more readings (for different radii) and plot a graph or take more readings and compare *k* values.	Not enough repeat readings. Few readings. Idea of repeats. "Too few readings/two readings" on its own.
B	Only a few cycles possible/(heavily) damped/ball does not return to the original height.	Use a longer track/heavier ball.	Smoother or lubricated track.
C	Difficult to judge exactly when an oscillation is complete.	Improved method of timing e.g. video with timer/video and view frame by frame/measure time from centre of oscillation/put marker at the centre of oscillation/light gate at centre.	"Ball too fast" on its own. Human reaction time. Video and play back. High speed cameras or slow motion cameras. Use of motion sensor.
D	Difficult to measure *y* with reason e.g. not sure where horizontal is at the top/ruler not vertical/allowing for the thickness/lips of the track/can't hold ruler steady.	Improved method of measuring *y* e.g. use a ruler across the top/tie a string across the top/ set square on bench/use of plumbline/measure two heights and find difference/use of micrometer for thickness of track/clamp ruler to measure *y*/clamp ruler vertically.	Parallax error. Not clear where the lowest point of track is.
E	Limitation of track e.g. is not entirely circular/portion of track in clamps is straight/too stiff to bend/track twisted/skewed.	Improved method of supporting track e.g. attach track to board/clamp in more places.	Changing track e.g. more flexible or rubber track. Difficult to clamp. "Friction on track" on its own.
F	Difficulty in placing ball at the same point each time/difficulty in releasing the ball with no force.	Method of marking the same point on the track/method of releasing the ball e.g. use card as a gate/electromagnet release and steel ball	If electromagnetic release do not allow 'metal' ball. Clamp or robotic arm. Burning through string.

Do not credit measurement of *x,* use of an assistant, fans, air conditioning, use of computers/dataloggers on its own.

[Total: 20]

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