UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the May/June 2012 question paper

for the guidance of teachers

9702 PHYSICS

9702/31 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 must be read in conjunction with the question papers and the report on the examination.

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International Examinations

1 (a) (iii) Value of x in the range 0.50 – 0.60 m. [1]

(b) (ii) Value of T with unit: $0.9\,\text{s} < T < 1.3\,\text{s}$. [1]
Evidence of repeats. [1]

(c) Six sets of readings of x and T scores 4 marks, five sets scores 3 marks etc.
Incorrect trend –1. Minor help from Supervisor –1; major help –2. [4]

Range of x at least 25 cm. [1]

Column headings:
Each column heading must contain a quantity and a unit where appropriate. [1]
The unit must conform to accepted scientific convention e.g. x/m or x(m) or x in m.

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

Significant figures: [1]
Significant figures for $\sqrt{x}$ should be the same as, or one more than, s.f. for x.

Calculation: $\sqrt{x}$ calculated correctly. [1]

(d) (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 on the grid 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 not be greater than three large squares apart.

Plotting of points: [1]
All the observations in the table must be plotted.
Check the points are plotted correctly.
Work to an accuracy of half a small square.
Do not accept 'blobs' (points with diameter greater than half a small square).

Quality: [1]
All points in the table must be plotted (at least 5) for this mark to be scored. Judge by the scatter of all the points about a straight line. All points must be within 0.04 $m^{½}$ (0.4 $cm^{½}$) on the $\sqrt{x}$ axis from a straight line.

(ii) Line of best fit: [1]
Judge by the balance of all the 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.
Allow one anomalous point if clearly indicated (e.g. circled or labelled) 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.
Do not allow $\Delta x/\Delta y$.

y-intercept: [1]
Either:
Check correct read-off from a point on the line, and substitution into $y = mx + c$. Read-off must be accurate to half a small square in both the *x* and *y* directions. Allow ecf of gradient value.
Or:
Check the read-off of the intercept directly from the graph.

(e) Value of *P* = candidate's gradient and *Q* = value of candidate's intercept. Do not allow fractions. [1]

Unit for *P* ($\mathrm{s\,m^{-½}}$ or $\mathrm{s\,cm^{-½}}$ or $\mathrm{s\,mm^{-½}}$) consistent with value, and *Q* (s). [1]

[Total: 20]

2 (a) (iii) Value of F_0 with unit. [1]
Evidence of repeats. [1]

(iv) Absolute uncertainty in F_0 in range 0.4 – 1 N.
If repeated readings have been taken, then the uncertainty can be half the range.
Correct method of calculation of percentage uncertainty. [1]

(v) Value of μ given to 2 or 3 s.f. [1]

(b) (ii) Value of θ with unit to the nearest degree. [1]

(iii) Correct calculation of $(\sin\theta + \mu\cos\theta)$. [1]

(c) (ii) Value of *F*. [1]

(d) Second value of θ. [1]
Second value of θ < first value of θ. [1]
Second value of *F* < first value of *F*. [1]
Allow $F_2 > F_1$ if $\theta_2 > \theta_1$.

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

(ii) Sensible comment relating to the calculated values of *k*, testing against a specified criterion. [1]

(f)

	(i) Limitations **4 max.**	**(ii)** Improvements **4 max.**	No credit/not enough
A	two readings are not enough (to draw a conclusion)	take more readings and plot a graph/ calculate more *k* values and <u>compare</u>	few readings/ take more readings and calculate average *k*/ only one reading
B	some parts of board rougher than others/ surface of board is uneven/ board not flat	method to ensure same section of board used in each experiment (e.g. mark one section)	board is rough/ there is friction between the block and the board/ use a smoother surface/ references to oil/lubricants
C	large (percentage) uncertainty in *F*	use larger/heavier masses	values of *F* very similar
D	difficulty in arranging newton-meter parallel to board/pulling in line with board	use (long) piece of string to connect the newton-meter to the block	newton-meter touching board when attached
E	block moves suddenly/without warning (so difficult to read newton-meter at the instant the block starts to move) value of *F* changes when block moves	use system of pulley and weights/ sand to measure *F*/ use a newton-meter with a max hold facility/ use video and playback/ use force sensor and datalogger/computer	
F	board tends to slip/ board not stable/ supporting block can topple	method described to secure board/block/support e.g. clamp the board, fix the supporting block to the bench with tape/blu-tack	
G	cannot zero newton-meter when used horizontally	use system of pulley and weights/ sand to measure *F*/ use force sensor and datalogger/computer	zero error in newton-meter

Ignore 'parallax problems', 'use assistant' or references to draughts, fans, a.c.

[Total: 20]