CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the October/November 2013 series

9702 PHYSICS

9702/36 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 October/November 2013 series for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level components and some Ordinary Level components.

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1 (b) (i) Value for E in range 2.00 to 3.50 V, with unit. [1]

(c) (iii) Value of x (for $V = 0$) with consistent unit, in range 0.250 to 0.400 m. [1]

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

Range: [1]
Range of values to include $x_{min} \leq 20.0$ cm and $x_{max} \geq 80.0$ cm.

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

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

Significant figures: [1]
Every value of V/E must be given to the same number of s.f. (or one more than) the least s.f. in the corresponding values of V and E.

Calculated values: [1]
V/E calculated correctly, including sign.

(e) (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 plotted points must be ≤ half a small square ("no blobs").
Plots must be accurate to half a small square.

Quality: [1]
All points in the table must be plotted on the grid for this mark to be awarded.
All points must be within 2 cm (to scale) on the x-axis of a straight line.

(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.

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(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:
Correct read-off from a point on the line is 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.

(f) Value of *a* = candidate's gradient and value of *b* = candidate's intercept.
$|b|$ in range 0.25 to 0.75. [1]
A value presented as a fraction is not allowed.

Unit for *a* correct (e.g. cm^{-1}) and consistent with value, and no unit given for *b*. [1]

[Total: 20]

2 (a) (i) Value for m_A in range 5.0 to 30.0 g. [1]

(iii) Correct calculation of *R*. [1]

(iv) Justification for s.f. in *R* linked to s.f. in m_A and $(m_A + m_B)$. [1]

(b) Value for h_0, with unit, to nearest mm. [1]

(c) Value for $h_B > h_0$. [1]
Evidence of repeat readings for h_B. [1]

(d) Percentage uncertainty in h_B based on absolute uncertainty of 2 to 5 mm (or half the range provided this is not zero), and correct method of calculation. [1]

(e) Second value of m_B. [1]
Second value of h_B. [1]
Quality: h_B smaller for larger m_B. [1]

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

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

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(g)

	(i) Limitations (4 max)	**(ii)** Improvements (4 max)	Do not credit
A	Two readings are not enough (to draw a conclusion)	Take more readings and plot a graph/take more readings and calculate more *k* values and compare	'few readings'/'take more readings and calculate average'/ 'only one reading'/ 'repeat readings' on its own
B	Difficult to judge highest point/ h_B with reason (e.g. short time at highest point/doesn't stay still for long at highest point)	Method of improved measurement of h_B (e.g. video with scale/multiflash photography with scale/use marker/use pointer/trial and error method/mark track with scale/put scale on board behind/ink or chalk on ball/ motion sensors at top of track)	'too fast'/ ball travelling too quick/high speed camera/ slow motion camera/light gates
C	Error when measuring height(s) because of: parallax/ ruler not vertical/ruler not perpendicular to bench	Detailed explanation of reducing error	'set squares' on own/'view perpendicular'/'parallax error' on own
D	Bottom of ball not visible	Method of improved measurement of height(s) (e.g. measure to top of ball)	
E	Energy lost (e.g. as friction with track or air/sound/hitting sides/not hitting square on)		Lubricate track
F	Difficult to release marble without applying a force/ difficult not to apply (sideways) velocity	Detail of a mechanical release method (e.g. card gate)	Friction on track

Do not allow 'repeated readings' or 'use a computer to improve the experiment'

[Total: 20]

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