UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the May/June 2010 question paper

for the guidance of teachers

9702 PHYSICS

9702/32 Paper 32 (Advanced Practical Skills), 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.

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1 (b) Six sets of values for N and I scores 5 marks, five sets scores 4 marks, etc. [5]
Incorrect trend –1.

Apparatus set up correctly without help from supervisor. Minor help –1, major help –2 [2]

Range – [1]
To include N = 1 or 2 and N = 11 or 12.

Column headings – [1]
Each column heading must contain a quantity and a unit where appropriate.
Ignore units in the body of the table.
There must be some distinguishing mark between the quantity and the unit (solidus is expected, but accept, for example, I (A))

Consistency of presentation of raw readings of I – [1]
All raw values of I must be given to the same number of decimal places.

Significant figures – [1]
S.f. for $1/I$ must be the same as, or one more than, the s.f. for I.
Check each row.

Values of $1/I$ correct – [1]
Underline and check the specified value of $1/I$. If incorrect, write in the correct value.

(c) (i) Graph
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 occupy at least half the graph grid in both x and y directions. Indicate false origin with FO.
Scales must be labelled with the quantity that is being plotted. Ignore units.
Allow inverted axes but do not allow the wrong graph.
Scale markings should be no more than three large squares apart.

Plots – [1]
All observations must be plotted. Write a ringed total of plotted points.
Do not accept blobs (points > half a small square).
Ring and check a suspect plot. Tick if correct. Re-plot if incorrect.
Work to an accuracy of half a small square.

(ii) Line of best fit – [1]
Judge by the balance of at least 5 trend plots about the candidate's line.
There must be an even distribution of points either side of the line along the whole length. Indicate best line if candidate's line is not the best line.
Line must not be kinked or thicker than 1 mm.

Quality – [1]
Judge by scatter of all points about a straight line.
All plots in the table must be within 10 Ω of a straight line.
Do not award if wrong graph or wrong trend.

(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. If incorrect, write in the correct value.
Check for $\Delta y/\Delta x$ (i.e. do not allow $\Delta x/\Delta y$).

y-intercept – [1]
Either from graph or by substitution of correct read-offs into $y = mx + c$.
Check for and label false origin.

(d) G = gradient value and H = intercept value. [1]
Do not credit if a substitution method is used.

Range of values ($-70\Omega \leqslant H \leqslant -30\ \Omega$ and $3.5\ \text{V} \leqslant G \leqslant 5.5\ \text{V}$) with appropriate units. [1]
Do not credit if a substitution method is used.

[Total: 20]

2 (b) (i) Value of maximum force to 1 d.p. in raw data and greater than 0 N. [1]
Evidence of repeated measurements of F in **(b)(i)** or **(d)**. [1]

(ii) Reaches maximum force suddenly (short time); no notice given when releases. [1]

(iii) Percentage uncertainty in maximum force. [1]
$0.1\text{N} \leqslant \Delta F \leqslant 0.4$ N. If repeated readings have been done then the uncertainty could be half the range. Correct ratio idea required (e.g. $0.2 / F \times 100\%$).

(c) (i) Measurement of raw t to the nearest 0.01 mm. [1]

(ii) Take repeats <u>in different places</u> / (account for) zero errors. [1]

(iii) Maximum force with three slides. Unit required. [1]

(d) Measurement of thickness of one slide. [1]
Measurement of maximum force with one slide. [1]
Quality: $F_{(b)(i)} > F_{(d)} > F_{(c)(iii)}$ [1]

(e) Calculation of two values of k. [1]

Valid conclusion based on the calculated values of k. [1]
Candidates must test against a specified criterion.

(f)(i),(ii) Identify limitations and improvements

	Limitations (4)	**Improvements (4)**	**Do not credit**
A	Two readings are not enough (to support conclusion	Take more (sets of) readings and plot a graph	Repeat readings.
B	Maximum force reached without warning (if not already credited in **(b)(ii)**)	$\mathbf{B_s}$ Practical method of recording maximum value e.g. video with playback in slow motion / max-min newton metre / force sensor with data logger / masses with pulley.	Parallax error. Solution for parallax error. 'Use of computer' to measure maximum force.
C	*t* changes due to compression force of magnets / slide thickness non uniform (if not already credited) / thread thickness adds to separation.	Method of attaching newton meter without thread / measure and add thread thickness.	
D	Zero error on newton meter when used horizontally.	Adjust zero / practical vertical arrangement.	Condition of newton meter.
E	Glass may affect magnetic force / effect of surrounding magnetic materials (e.g. G clamp).	Use a variety of materials to separate magnets and test if material affects results / use a non magnetic clamp / glue first magnet to bench.	Reference to Earth's field.
F	Friction with bench.	Method of reducing friction.	
G	Difficulties with alignment of force with magnets.	Method of raising magnets / longer loop.	
X	Difficult to measure force due to weak magnets / small force (if validated by SR)	More sensitive newton meter.	

[Total: 20]