UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the October/November 2009 question paper for the guidance of teachers

9702 PHYSICS

9702/33 Paper 33 (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.

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1 (b) (i) Value for l between 0.010 and 0.080 m (1.0–8.0 cm), or ± 2.0 cm of supervisor's value. Raw value(s) **to nearest mm.** [1]

(c) Two values of height given. [1]

Check calculation. Ignore POT error. If method incorrect to work out *v*, final (f) mark not available. [1]

(d) No help from supervisor. [1]

Six sets of values scores 3 marks, five sets scores 2 marks etc. [3]
Add up number of sets of readings for *M* and l and put a ringed total by the table.
Wrong trend –1 (Correct trend *M* increases, l increases).

Range of *M* includes 100 g or 150 g **and** 400 g or 450 g. [1]

Each column heading must contain a quantity and a unit where appropriate. [1]
Ignore units in the body of the table.
There must be a distinguishing mark between the quantity and the unit.
(solidus is expected, accept brackets e.g. *M*/kg, l/m, *v*/m, *M*/*v* / kg m^{-1})

Consistency of presentation of raw readings.
All values of raw l are given to the same number of decimal places. [1]

Significant figures for *M*/*v* must be the same as, or one more than the least number of significant figures used in *M* or *v.* Check each row. If *v* = constant, quality mark not available AND final (f) mark not available. [1]

Check the specified value of *M*/*v* correct. (Expect around 1–3 kg m^{-1} or 10–30 g cm^{-1}) [1]
Ignore POT. If incorrect write in correct value. Allow small rounding errors.

Graph

(e) (i) Axes [1]
Sensible scales must be used. Awkward scales (e.g. 3:10) are not allowed.
Scale markings should be no more than three large squares apart.
Scales must be chosen so that the plotted points must occupy at least half the graph grid in both *x* and *y* directions. Allow inverted axes. Do not allow wrong graph.
Scales must be labelled with the quantity which is being plotted. Ignore units.

All observations must be plotted. Put a ringed total of plotted points. [1]
Ring and check a suspect plot. Tick if correct. Re-plot if incorrect.
Work to an accuracy of not greater than half a small square.
Do not allow blobs (i.e. diameter > half a small square).

(e) (ii) Line of best fit [1]
Judge by scatter of points about the candidate's line.
There must be a fair scatter of points either side of the line.
At least 5 trend plots required.

Quality. This mark is not available for the wrong graph or wrong trend. [1]
Judge by scatter of all the points about a best fit line.
All points in the table (of which there must be at least 5 plots) must be plotted.
Allow ± 0.3 cm to scale on the *x*-axis. (If *v* = constant, quality mark not available AND final (f) mark not available.)

(e) (iii) Gradient. Check *dy/dx* [1]
The hypotenuse must be at least half the length of the drawn line on the graph grid.
Read-offs must be read to at least half a small square.
If read-off incorrect write in correct value. Be prepared to check both read-offs. If both incorrect do not allow ecf in the *y*-intercept if using one of the read-offs from the gradient.

Intercept. Check substitution only. Check both read-offs to half a small square. [1]
or read from graph to half a small square as long as no false origin.

(f) Look for **values** of *y*-intercept and gradient used correctly to find *C*. [1]
i.e. grad = *qk* AND *y*-intercept = *qC* or *y*-intercept = (grad/*k*) × *C*.

Value of *C* in range 0 to ± 1 N, consistent with unit or refer to supervisor's results. [1]
Correct method needed.
If method of working out *v* incorrect or if *v* = constant in table, this mark is not available.

[Total: 20]

2 (a) Evidence of repeat measurements of *d.* [1]

Value of raw *d*(s) given to nearest 0.1 mm or 0.01 mm (–1 if help given by supervisor). [1]

(b) Percentage uncertainty in *d.* [1]
If repeated readings have been done then the uncertainty could be half the range, otherwise absolute uncertainty must be 0.1 mm or 0.01 mm consistent with above.
Correct ratio idea required.

(d) Method of calculation of l correct. 1.5πd [1]

Significant figures in l same or one more than the raw values of *d.* Ignore units. [1]

(e) Value of m_1 in range 60 to 300 g, consistent with unit. [1]
If Supervisor notes that hanger moved at 50 g allow m_1 = 50 g.

(f) Evidence of repeat readings for first or second value of *m.* [1]

Second value of *m.* [1]

Second value of l greater than first l. [1]

Second value of $m \geq 2 \times m_1$. [1]

(g) Calculation of the two values of m^2/l^3 or equivalent.
Check one value and correct substitutions. [1]

Conclusion consistent with candidate's *k* values.
Use 20% permitted variation in *k* if candidate does not suggest a value. [1]

(h) (i) and (ii)

Sources of error or limitation. [4]		**Improvements. Use of other apparatus or different procedures. [4]**	
$\mathbf{A_p}$	Only two readings/Two readings are not enough (to draw a valid conclusion).	$\mathbf{A_s}$	Take many (sets of) readings and plot a graph/find more values of *k*'s. Be clear NOT just repeat readings.
$\mathbf{B_p}$	**Circumference/*l*** imprecise because helical/coiled/slanted/spiral/thickness of thread/non-uniform diameter of rod.	$\mathbf{B_s}$	Mark string and measure length/wrap so coils are closer/allow for thickness of thread/ diameter to be taken at different places along/diameter taken at different angles (at same position).
$\mathbf{C_p}$	Use of (10 g) increments imprecise.	$\mathbf{C_s}$	Use smaller mass increments/use newtonmeter/other valid method (water or sand).
$\mathbf{D_p}$	Difficulty to judge/tell when the string starts to slip/gradual movement.	$\mathbf{D_s}$	Practical method of detecting movement: fixed marker or scale/motion sensor/(travelling) microscope/measure height from table.
$\mathbf{E_p}$	Large scatter in repeated readings of mass/non-uniform surface bar/varying friction.	$\mathbf{E_s}$	
$\mathbf{F_p}$	Difficult to add masses without swinging/pushing the hanger/masses do not fit hanger.	$\mathbf{F_s}$	Lower masses slowly/support underneath and remove hand slowly/scissor jack.

Ignore reference to light gates, video, reaction time, repeat readings, micrometer, fans, parallax or sanding.

[Total: 20]