UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the May/June 2008 question paper

9702 PHYSICS

9702/32 Paper 32 (Advanced Practical Skills 2), maximum raw mark 40

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All Examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

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UNIVERSITY of CAMBRIDGE
International Examinations

1 Manipulation, measurement and observation

Successful collection of data

(b) Value of length 0.470m to 0.490m (to nearest cm or mm). [1]

(c) 10T (or more) has been measured (could be evidence in table of results). [1]

(c) Repeat readings. At least two readings of 10T or T (could be in table). [1]

(d) Results
Write the number of readings as a ringed total next to the table of results.
Six sets of values for T and l scores 3 marks, five sets scores 2 marks.
If raw data shows reverse trend then –1. [3]

(d) Apparatus set up without help from Supervisor. [1]

Range and distribution of values

(d) Range of results (including the value in **(b)**).
Must include 48cm and 18cm (nominal values), with no interval greater than 7cm. [1]

Presentation of data and observations

Table: layout

(d) Column headings.
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, T (s)). [1]

Table: raw data

(d) Consistency of presentation of raw readings.
All values of 10T (or T) must be given to the same number of decimal places.
If these are to the nearest second then –1. Allow trailing zeros. [1]

Table: calculated quantities

(d) Significant figures. Apply to T^2. Take trailing zeros into account.
If 10T is given to 2 sf, then accept T^2 to 2 or 3 sf.
If 10T is given to 3 sf, then accept T^2 to 3 or 4 sf.
If 10T is given to 4 sf, then accept T^2 to 4 or 5 sf. [1]

(d) Values of T^2 correct.
Check a value (from candidate's T). If incorrect, write in the correct value. [1]

Graph: layout

(Graph) Axes.
Sensible scales must be used (not 3:10 etc.), with labels at least every three large squares.
Scales must be such that the plotted points occupy at least half the graph grid in both x and y directions.
Scales must be labelled with the quantity which is being plotted. Ignore units.
Indicate false origin with FO.
Allow reversed axes, but if wrong graph plotted then –1. [1]

Graph: plotting of points

(Graph) All observations must be plotted. Count and circle the number of plots.
Ring and check a suspect plot. Tick if correct. Re-plot if incorrect.
Work to an accuracy of half a small square.
Don't allow blobs (i.e. large dots with diameter ≥ half a small square). [1]

Graph: trend line

(Graph) Line of best fit. Allow 5 trend plots.
Judge by scatter of points about the candidate's line.
Indicate best line if candidate's line is not the best line.
Don't allow a line thicker than half a small square. [1]

Quality of data

(Graph) Judge by scatter of points.
Allow 2cm (scaled) in the l direction either side of any line that could be drawn.
All plots from table are needed for this mark to be scored.
Do not award this mark if the trend is wrong or if wrong graph is drawn. [1]

Analysis, conclusions and evaluation

Interpretation of graph

(f) Gradient.
The hypotenuse of the Δ must be ≥ half the length of the drawn line.
Read-offs must be accurate to half a small square.
Check for $\Delta y/\Delta x$ (do not allow $\Delta x/\Delta y$). [1]

(f) The y-intercept value must be read to the nearest half square.
Check for false origin. The value can be calculated using ratios or $y = mx + c$. [1]

Drawing conclusions

(g) Value for M. Check substitution into "gradient = $4\pi^2 m/g(m+M)$" is correct.
Allow 10 – 70g. Unit required. [1]

(g) Value for z. Must equal the y-intercept. Unit required (s^2). 2 or 3 s.f. [1]

[Total: 20]

2 Manipulation, measurement and observation

Successful collection of data

(b) (i) First measurement of circumference to nearest mm. Unit must be given. [1]

(c) Measurement of t_1. [1]

(c) Repeated measurements for t_1 (or t_2). [1]

(d) Second measurement of c. [1]

(d) Second measurement of circumference < first measurement. [1]

(d) Measurement of t_2. [1]

Quality of data

(d) t decreases when c decreases. [1]

Presentation of data and observations

Display of calculation and reasoning

(b) (iii) Value of first radius calculated correctly. Consistent unit must be given.
Check correct use of $c = 2\pi r$. [1]

(d) Value of second radius, with same s.f. (or one more than) c_2. [1]

(e) Correct calculation to check proportionality.
Possibilities include:
two calculations of t^2/r or
ratio of t^2 values and ratio of r values both calculated. [1]

Analysis, conclusions and evaluation

Drawing conclusions

(e) Sensible comments relating to calculations and suggested relationship.
The only way this mark can be scored without the first **(e)** mark is if the results show the wrong trend and it is argued that this disproves the suggested relationship (but don't credit 'results show inverse proportionality'). [1]

Estimating uncertainties

(b) (ii) Percentage uncertainty in *c.*
Δ*c* must be 0.2–0.5cm (or half the range if repeated readings).
Correct ratio idea required (Δ*c*/circumference) × 100%. [1]

Identifying limitations

(f) (i) Underline and tick relevant point (one from each section):

A - two sets of readings are not enough (to draw a conclusion)

B - difficult to make accurate cylinder shape
- cylinder radius/circumference varies

C - cylinder doesn't roll straight

D - human reaction error (in timing)
- measured time is very short
not 'difficult to release cylinder and start stopwatch together'

E - difficult to judge end point [4 max]

Suggesting improvements

(f) (ii) Underline and tick relevant point (one from each section):

A - test many cylinders and plot a graph
- test many cylinders and find many values of *k*

B - method of making more accurate cylinder

D - time over longer distance
- use shallower angle ramp
- use light gates/pressure switches to measure time
- use freeze-frame photography to measure time
- use motion sensor to measure time
not just 'use video'
not 'repeated readings'
not just 'use computer/data logger'

E - mark distance with lines on ramp (to eliminate parallax)
not 'use a pointer'

X - new method (e.g. vernier calipers) to measure average diameter [4 max]

[Total: 20]