**UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS**

**GCE Advanced Subsidiary Level and GCE Advanced Level**

# MARK SCHEME for the October/November 2010 question paper for the guidance of teachers

## 9702 PHYSICS

**9702/34** Paper 32 (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 must be read in conjunction with the question papers and the report on the examination.

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**1 (c)** Measurements for $h_1$ and $h_2$ to nearest mm
Check raw values if readings are repeated.

The difference between $h_1$ and $h_2$ is < 2 mm. [1]

**(d) (iii)** Six sets of readings of $n$, $h_1$ and $h_2$ scores 5 marks, five sets scores 4 marks etc. [5]
Incorrect trend then –1.
Help from supervisor then –1.

Range – [1]
$n$ values must include 10 or greater.

Column headings – [1]
Each column heading must contain a quantity and a unit where appropriate.
There must be some distinguishing mark between the quantity and the unit.
E.g. $h_1$/cm or $h_1$(cm) but not 1/(($h_1$ – $h_1$)/cm).

Consistency of presentation of raw readings – [1]
All values of $h_1$ and $h_2$ must be given to the same precision.

Significant figures – [1]
S.f. for 1/($h_1$ – $h_2$) must be the same as, or one more than, the s.f. in the difference ($h_1$ – $h_2$).

Calculation – [1]
1/($h_1$ – $h_2$) calculated correctly.

(Graph) Axes – [1]
Sensible scales must be used, no awkward scales (e.g. 3:10). Scales must be chosen so that the plotted points must 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.
Scale markings must be no more than 3 large squares apart.

Plotting of points – [1]
All observations must be plotted.
Do not accept blobs (points with diameter > 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.

Line of best fit – [1]
Judge by balance of at least 5 trend points about the candidate's line. There must be an even distribution of points either side of the line along the full length.
Line must not be kinked.

Quality – [1]
Scatter of points must be less than ±0.02 on the 1/$n$ axis about the examiner's line.
All points must be plotted (at least 5) for this mark to be scored.

**(e) (iii)** Gradient
The hypotenuse must be at least half the length of the drawn line.
Both read-offs must be accurate to half a small square.

Intercept [1]
Check that the read-off or the method of calculation is correct.

**(f)** Value of $a$ = value of gradient and value of $b$ = value of intercept. [1]
Do not allow a value presented as a fraction.

Units for $a$ and $b$ are correct. [1]
E.g. $cm^{-1}$ or $m^{-1}$ but must be consistent with the values.
Allow no unit for $b$ if $b = 0$.

**[Total: 20]**

**2 (a) (i)** Value of $d$ in range 5 cm to 15 cm. [1]
Help from supervisor then –1.

Evidence of repeated measurements of $d$. [1]

**(ii)** Correct calculation of $A$. [1]
Do not allow a value in terms of $\pi$.

**(b) (i)** Measurement for $x$ in range $0.8\,cm < x < 1.0\,cm$ to nearest mm. [1]

**(ii)** Absolute uncertainty 1 or 2 mm (or half the range of repeats), and correct method of calculation. [1]

**(c) (ii)** Measurement for $h$ to nearest mm. [1]

**(d) (iii)** Value for $t > 1$ s and given to 0.1 s or 0.01 s. [1]
Check raw data if there are repeats.

**(iv)** Correct calculation of $R$, with consistent unit (e.g. $cm^3\,s^{-1}$). [1]

**(e) (i)** Values for $x$, $V$ and $h$. [1]

**(ii)** Correct trend ($R$ increases with $h$). [1]

**(f) (i)** Values of $k$ calculated correctly. [1]

**(ii)** Valid conclusion based on the calculated values of $k$. Candidate must test against a stated criterion. [1]

**(g)**

| | **(i)** Problems **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. | More readings and calculate the average/ only one reading. |
| B | Bottle not circular/ diameter at P different to that at Q. | Collect water and measure volume/remeasure diameter at P. | |
| C | Bottle deforms when measuring *d*. | Use vernier callipers to measure *d*. | Use string to measure *d*. |
| D | Difficult to see water level/meniscus problems/refraction problems. | Use coloured water/liquid. | Use oil. |
| E | Labels get wet/ink runs | Use waterproof labels/ink | |
| F | Difficult to judge when to start/stop timing. | Use video, with timing method. | Human reaction time error. |
| G | Large uncertainty in *x*. | Use travelling microscope to measure *x*. | |
| X | Another valid point E.g. Flowrate calculated is not the flowrate at *h*. | E.g. Measure *h* to point midway between marks. | Move marks closer together. |

Ignore 'parallax problems' unless there is a convincing diagram.
Ignore 'use assistant'.
Ignore 'use distance sensor' unless there is a convincing diagram.
Ignore 'use a computer/datalogger/light gates'.
Ignore 'bottle not vertical'.

**[Total: 20]**