## UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

## MARK SCHEME for the May/June 2012 question paper for the guidance of teachers

## 9702 PHYSICS

9702/32

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 must be read in conjunction with the question papers and the report on the examination.

• Cambridge will not enter into discussions or correspondence in connection with these mark schemes.

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| . ugo         | _   | GCE AS/A LEVEL – May/June 2012   | 9702                            | 32                     |  |  |
|---------------|---|--|---------------------------------|------------------------|--|--|
| <b>(a)</b> Va | (a) Value of L in range 0.80 m > L > 0.60 m. Consistent with unit.  |  |                                 |                        |  |  |
| (b) (iii)     | <b>(b) (iii)</b> Value of $h_0$ , less than 50 cm, to the nearest mm. [1]   |  |                                 |                        |  |  |
|               | (c) Six sets of readings of <i>d</i> and <i>h</i> scores 5 marks, five sets scores 4 marks etc. Help from Supervisor –1.  |  |                                 |                        |  |  |
|               | Range of <i>d</i> : To include 25.0 cm (0.250 m) or more <b>and</b> 10.0 cm (0.100 m) or less   |  |                                 |                        |  |  |
| Ea<br>Th      | Column headings: [1 Each column heading must contain a quantity and a unit The unit must conform to accepted scientific convention e.g. $d/m$ , $d(m)$ or $d$ in m, $(h-h_0)/m$ , $(L/2-d)^2/m^2$ |  |                                 |                        |  |  |
|               | Consistency: All values of $d$ and $h$ must be given to the nearest mm.   |  |                                 |                        |  |  |
|               |   | nt figures:<br>s of $(L/2 - d)^2$ to 2 or 3 s.f.   |                                 | [1]                    |  |  |
|               | Calculation: [ Values of $(L/2 - d)^2$ calculated correctly.  |  |                                 |                        |  |  |
| (d) (i)       | Sens<br>Scal<br>both  | s: sible scales must be used, no awkward scales (e.g. 3: es must be chosen so that the plotted points occupy x and y directions. es must be labelled with the quantity which is being plo  | at least half the               | [1]<br>e graph grid in |  |  |
|               |   | e markings must be no more than 3 large squares apa  |                                 |                        |  |  |
|               | All o<br>Dian   | ting of points: bservations in the table must be plotted. neter of plots must be < half a small square (no blobs). s must be accurate to half a small square.  |                                 | [1]                    |  |  |
|               |   | lity: points in the table must be plotted (at least 5) for this notes that $0.5  \text{cm}  (0.005  \text{m})$ of $(h - h_0)$ of a state of the state of |                                 | [1]<br>ded. Scatter of |  |  |
| (ii)          | Judg<br>Ther<br>Allov   | of best fit: ge by balance of all points on the grid about the candid re must be an even distribution of points either side of w one anomalous point only if clearly indicated by the must not be kinked or thicker than half a small square   | the line along th<br>candidate. |                        |  |  |

Mark Scheme: Teachers' version

Syllabus

Paper

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|---------|-------------|---|--------------------------------|------------------------|
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| (ii     | É           | radient: [1] be 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 $x$ and $y$ directions. In not allow $\Delta x/\Delta y$ .  |                                |                        |
|         | E<br>(<br>F | <ul> <li>r-intercept:</li> <li>Either:</li> <li>Check correct read off from a point on the line and substituted</li> <li>Read off must be accurate to half a small square in both x</li> <li>Or:</li> <li>Check read-off of the intercept directly from the graph.</li> </ul> | •                              |                        |
| (e) \   | /alue       | e of <i>a</i> = candidate's gradient. Value of <i>b</i> = candidate's inte  | ercept.                        | [1]                    |
| ι       | Jnit f      | for $a$ (e.g. m) and $b$ (e.g. $m^2$ ) consistent with values.  |                                | [1]                    |
|         |             |   |                                | [Total: 20]            |
| 2 (b) ( |             | Value of ball diameter <u>or</u> <i>d</i> to the nearest 0.1 mm (or 0.01 ₪<br>Values of ball diameter <u>and</u> <i>d</i> in range 5 mm < <i>d</i> < 25 mm.   | mm).                           | [1]<br>[1]             |
| (i      | Ĺ           | Absolute uncertainty is between 2mm and 5mm. f repeated readings have been taken, then the absolutange. Correct method shown to find the percentage unce  | •                              | [1]<br>an be half the  |
| (ii     | ii) (       | Correct calculation of A with consistent unit.  |                                | [1]                    |
| (c) (i  |             | Value of <i>F</i> , with unit.<br>Evidence of repeat measurements of <i>F</i> here or in <b>(d)(ii)</b> .   |                                | [1]<br>[1]             |
| (d) (i  | , s         | Second value of <i>d</i> . Second value of <i>A</i> is given to the same number of s.f. (or of Second value of <i>F</i> . Quality: When <i>d</i> increases (second <i>d</i> value is larger than (second <i>F</i> value) and vice versal                                      | first <i>d</i> value) <i>F</i> | [1]                    |
| (e) (   | (i) T       | Two values of $k$ calculated correctly.   |                                | [1]                    |
| (i      | -           | Sensible comment relating to the calculated values of specified by the candidate.   | k, testing agai                | nst a criterion<br>[1] |

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(f)

|   | (i) Limitations 4 max.  | (ii) Improvements 4 max.  | No credit/not enough  |
|---|---|---|---|
| A | two results not enough  | take more readings <u>and plot a</u> <u>graph/</u> calculate more <i>k</i> values and <u>compare</u>  | 'repeat readings' on its own/ few readings/ take more readings and (calculate) average k/ only one reading  |
| В | difficult to form a perfect<br>sphere or disc/diameter of<br>sphere or disc varied  | method to make uniform spheres/discs e.g. moulds  | pre-sized spheres/<br>repeat diameter<br>measurement and average  |
| С | reason for difficulty in measuring <u>d</u> e.g. viewed through ruler/parallax error in <u>d</u>  | method to improve measurement of <u>d</u> e.g. travelling microscope  | eyes in line  |
| D | difficult to pull newton-meter parallel to ruler/bench  | method to ensure force is<br>parallel to ruler e.g. use a<br>long string/pulley and<br>weights*   |   |
| E | difficult to judge reading on newton-meter when detaches with reason e.g. ruler moves suddenly/without warning (so difficult to read newton-meter at the instant the ruler starts to move)/force drops to zero immediately after detachment | method to <u>read force</u> at detachment e.g. newton meter with a 'max hold' facility/video and playback or freeze frame/ use system of pulley and weights or sand to measure $F^*$ / use force sensor and datalogger or computer* | video to take reading/ digital (electronic) newton meter/ parallax related to newton meter/ difficult to measure force/ issue of viewing ruler and meter simultaneously |
| F | contact area less than calculated disc area/bulging disc  |   |   |
| G | difficult to zero newton-meter when used horizontally   | improved method to measure F: e.g. use system of pulley and weights or sand*/use force sensor with datalogger or computer*  | zero error in newton-meter/<br>just a pulley  |

Do not allow: reaction time/human error/using vernier caliper/helpers/use of micrometer screw gauge/effect of temperature/change in stickiness of Blu-Tack.

[Total: 20]

<sup>\*</sup>This answer can be credited as D, E or G (but not more than once).