

# CIE A-Level Physics 9702 Paper 3 Practice

## Paper (AS Advanced Practical Skills) -

## ANSWERS

Total: 40 marks · 2 h · 2 questions · 11 parts

| Q | Part | Answer                                                                                                                                                                                                                                                                                                                                                                               | Mark points                                                                                                                                                     | marks |
|---|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 1 | (a)  | Independent variable = length $l$ , measured with a metre rule from the support to the centre of the bob, using five values from 0.200 m to 1.000 m; dependent variable = period $T$ , from the time $t$ for 20 complete oscillations divided by 20; control variables = mass of the bob and the angle of swing (less than 10 degrees), with the same thread and support throughout. | All three variables named with measuring instruments, 2 marks<br>Centre of bob and five lengths stated, 1 mark<br>Sensible controls (mass, small angle), 1 mark | 4     |
| 1 | (b)  | Pull the bob aside to less than 10 degrees and release it from rest, time 20 complete oscillations with a stopwatch to give $t$ , repeat twice and average, then $T = t / 20$ ; change the length and repeat for five lengths, always releasing from the same position.                                                                                                              | Small angle and timing 20 oscillations, 2 marks<br>Repeat and average, 1 mark<br>Five lengths with same release point, 1 mark                                   | 4     |
| 1 | (c)  | Six columns: $l$ / m, $t_1$ / s, $t_2$ / s, mean $t$ / s, $T$ / s and $T$ squared / s squared; lengths to 3 decimal places (0.200), times to 2 decimal places (for example 17.94 s for 20 oscillations), and $T$ and $T$ squared to 3 significant figures.                                                                                                                           | All six columns with units, 2 marks<br>Consistent significant figures, 1 mark                                                                                   | 3     |
| 1 | (d)  | Plot $T$ squared on the y-axis against $l$ on the x-axis, because squaring $T = 2\pi \sqrt{l/g}$ gives $T$ squared = $(4\pi^2 / g)$ times $l$ , so the graph of $T$ squared against $l$ is a straight line through the origin.                                                                                                                                                       | Plot $T$ squared against $l$ , 2 marks<br>Quote the linear relation, 1 mark                                                                                     | 3     |
| 1 | (e)  | Gradient = change in $T$ squared / change in $l = 4.025$ s squared per metre; $g = 4\pi^2 / \text{gradient} = 9.81$ m per second squared, about 0.0% from the accepted 9.81 m per second squared.                                                                                                                                                                                    | Correct gradient with unit, 2 marks<br>Correct substitution $g = 4\pi^2 /$                                                                                      | 4     |

|   |     |                                                                                                                                                                                                                                                                    |                                                                                                                                           |   |
|---|-----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|---|
|   |     |                                                                                                                                                                                                                                                                    | gradient, 1 mark<br>Comparison with accepted value, 1 mark                                                                                |   |
| 1 | (f) | The length is read to about 1 mm in 0.200 m, which is 0.5%, and the gradient from the best-fit line is good to about 2%, so the percentage uncertainty in g is about 2 to 3%; the timing reaction and the line fitting dominate.                                   | Two specific sources, 1 mark<br>Percentage uncertainty 2 to 3% with combination, 1 mark                                                   | 2 |
| 2 | (a) | Connect the cell, switch, rheostat and ammeter in series with the wire, with the voltmeter in parallel across the wire; measure the diameter d at three places with a micrometer and average; for each length l read V and I, then $R = V / I$ .                   | Correct circuit (ammeter in series, voltmeter in parallel), 2 marks<br>Micrometer readings averaged, 1 mark<br>$R = V / I$ stated, 1 mark | 4 |
| 2 | (b) | The current is kept at 0.200 A; V rises from 0.32 V to 1.59 V (2 decimal places), giving R from 1.60 ohms to 7.95 ohms.                                                                                                                                            | All five sets of readings, 2 marks<br>Units and significant figures consistent, 1 mark                                                    | 3 |
| 2 | (c) | Plot R on the y-axis against l on the x-axis; from $R = \rho l / A$ the gradient equals $\rho / A$ , so the gradient multiplied by the cross-sectional area gives the resistivity.                                                                                 | R against l, 2 marks<br>Gradient equals $\rho / A$ , 1 mark                                                                               | 3 |
| 2 | (d) | Gradient = change in R / change in l = 7.92 ohm per metre, using two points on the line, for example (0.200 m, 1.60 ohm) and (1.000 m, 7.95 ohm).                                                                                                                  | Correct gradient, 1 mark<br>Unit ohm per metre, 1 mark                                                                                    | 2 |
| 2 | (e) | $A = \pi d^2 / 4 = \pi \text{ times } (0.280 \text{ times } 10 \text{ to the minus } 3) \text{ squared} / 4 = 6.158\text{e-}08 \text{ m squared}$ ; $\rho = \text{gradient times } A = 7.92 \text{ times } 6.158\text{e-}08 = 4.88\text{e-}07 \text{ ohm metre}$ . | Area correct using the radius, 2 marks<br>Correct substitution, 1 mark<br>Unit ohm metre, 1 mark                                          | 4 |
| 2 | (f) | The diameter contributes 0.01 mm in 0.280 mm, which is 3.6%; the area uncertainty is twice that, 7.1%; the gradient contributes about 0.4%, giving about 7.6% in rho.                                                                                              | Diameter and doubling for area, 2 marks                                                                                                   | 3 |

|   |     |                                                                                                                                                                                             |                                                    |   |
|---|-----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------|---|
|   |     |                                                                                                                                                                                             | Total percentage given, 1 mark                     |   |
| 2 | (g) | The current heats the wire so its resistance rises with temperature, making R and rho too high; use a smaller current or switch off between readings so the wire stays at room temperature. | Specific cause with a workable improvement, 1 mark | 1 |