General Certificate of Education
January 2004
Advanced Subsidiary Examination

ASSESSMENT and QUALIFICATIONS ALLIANCE

PHYSICS (SPECIFICATION A) **PHA3/P/TN**

Instructions to Supervisors for the Unit 3 Practical Examination

CONFIDENTIAL

OPEN ON RECEIPT

The examination will be held on Tuesday 20th January 2004 Morning Session

- **These *Instructions* are provided to enable centres to make appropriate arrangements for the examination. Copies of the *Instructions* are to be kept at the centre under lock and key when not in use; they are not to be removed from the centre. The question paper packets must not be opened prior to the examination.**
- **These instructions explain how to set up the equipment for Question 2.**
- **Question 2 is printed on pages 3 to 5 of this instruction booklet.**
- **Centres are at liberty to make any reasonable minor modifications to the apparatus which may be required for the successful working of the experiment but a note of all such modifications must be forwarded to the Examiner with the scripts. However, any such modifications must permit the experiment to be carried out in the specified manner.**

Candidates will investigate the equilibrium of a metre ruler suspended from a horizontally clamped beam.

Apparatus required for each candidate:

- ❒ wooden metre ruler, free of warping and otherwise in generally good condition, small diameter holes to be drilled through the median line at the 5.0 cm and 95.0 cm marks
- ❒ thin wooden beam of length 1.0 m (this can be another metre ruler): a small diameter hole should be drilled at a point 95.0 cm from the left-hand end to accommodate a wire hook from which the springs can be suspended: another hole should be drilled at 5.0 cm from the left-hand end to accommodate a 4 mm terminal post
- ❒ 4 mm screw-down terminal post e.g. Maplin FD69A
- ❒ four expendable steel springs e.g. Philip Harris P20430/9
- ❒ two retort stands each with boss and clamp fitted
- ❒ about 1.0 m, 32 swg copper wire, one end fastened to small washer
- ❒ two 100 g slotted masses
- ❒ mass hanger for slotted masses of mass 100 g: centres equipped with 50 g mass hangers should add an additional 50 g slotted mass to the hanger and sellotape these together
- ❒ two wire hooks e.g. fashioned from large paper clips, to attach the springs between the beam and the suspended metre ruler
- ❒ additional metre ruler
- ❒ set square

Assemble the apparatus as shown in **Figure 1** of the question. The beam should be clamped so that it overhangs the edge of the bench. Candidates will be told that the beam has been made horizontal beforehand so it is important that each set of apparatus is checked with a spirit level.

Suspend all four springs connected in series from the right-hand hole in the beam using one of the wire hooks.
Pass the free end of the wire through the hole in the terminal post and then fasten the wire securely to the metre ruler using the hole at the 5.0 cm mark.
The second hook should be attached to the metre ruler using the hole at the 95.0 cm mark.

Place the remaining apparatus on the bench. No other assembly is required beforehand.

Examiners require no information for this question.

2 In this experiment you are required to investigate the equilibrium of a metre ruler, suspended from a horizontally clamped beam, under different loading conditions.
Do not adjust the position of the clamps supporting the beam.

No description of the experiment is required.

You are provided with the arrangement shown in **Figure 1**.

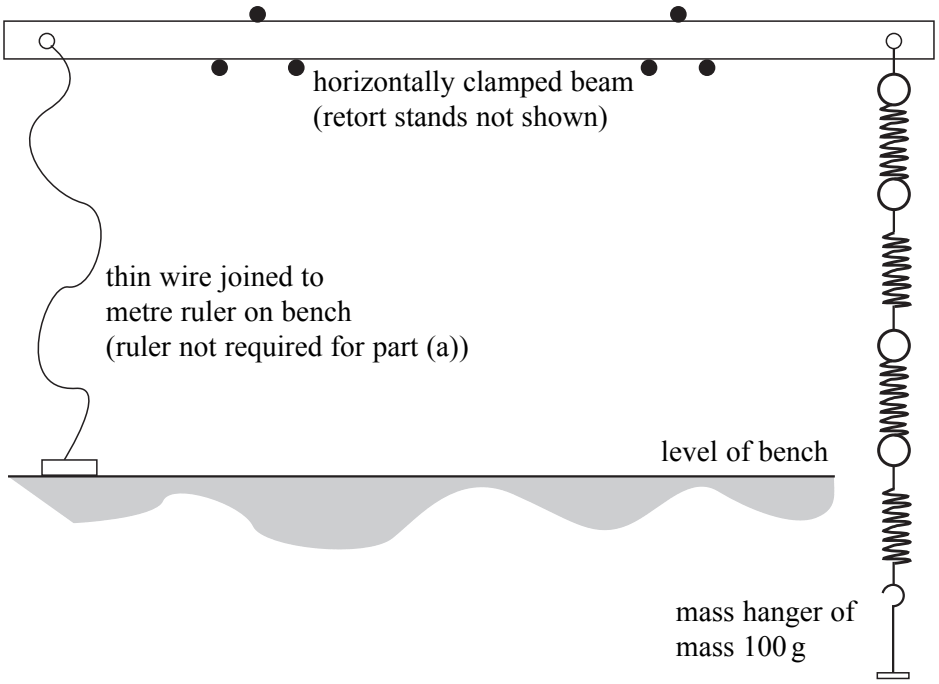

Figure 1

You are also provided with two masses, each of mass 100 g. These can be placed on the mass hanger, also of mass 100 g, that is attached to the lower end of the four connected springs suspended from the right-hand end of the beam.

(a) Make suitable measurements to determine the **change in extension**, Δy, of the four connected springs, when the mass attached to the lower end changes by 100 g. *(2 marks)*

(b) Remove the masses and mass hanger and using the hook at the 95 cm mark, connect the metre ruler to the lower end of the springs. Allow the ruler to hang freely over the edge of the bench suspended by the wire at the left-hand end and by the springs at the right-hand end.

Slacken the terminal T and adjust the length of the wire joining the beam to the ruler until the left-hand end of the ruler is approximately 5 cm below the level of the right-hand end, as shown in **Figure 2**. Tighten terminal T again once this condition is satisfied.

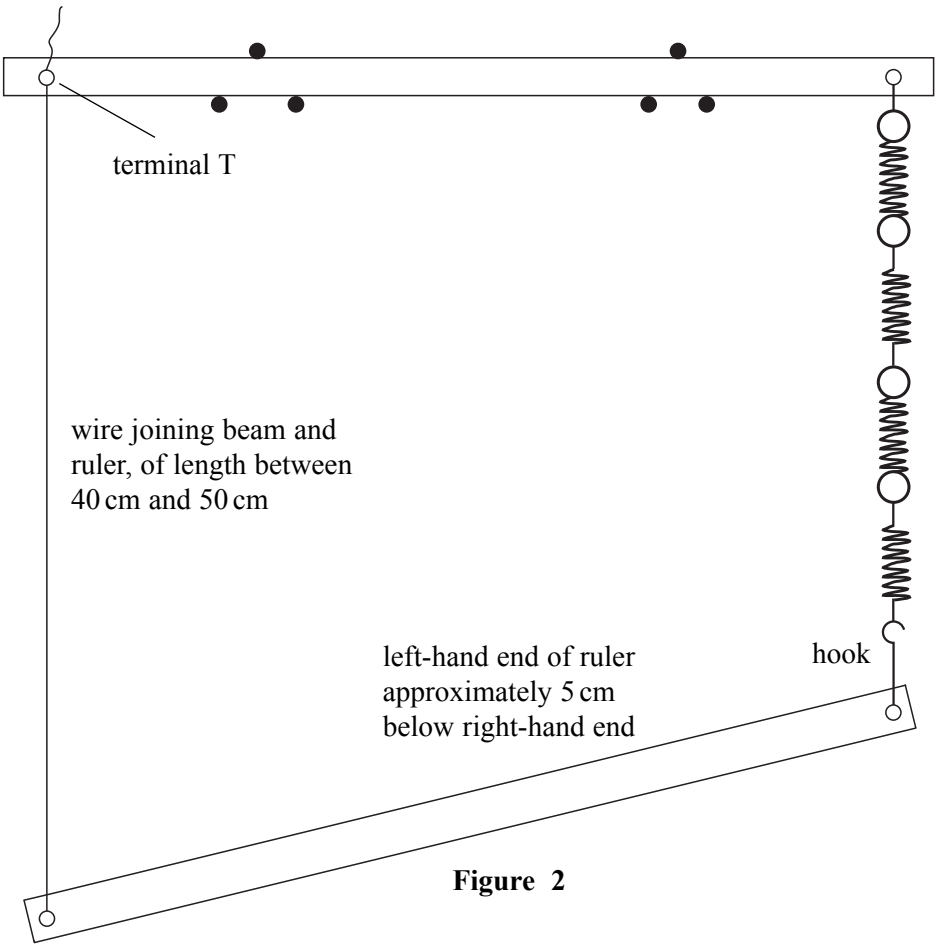

Figure 2

Suspend a 300g mass from the ruler close to the point of attachment between the wire and the ruler. Adjust the position of the mass until the ruler is suspended horizontally, as shown in **Figure 3**.

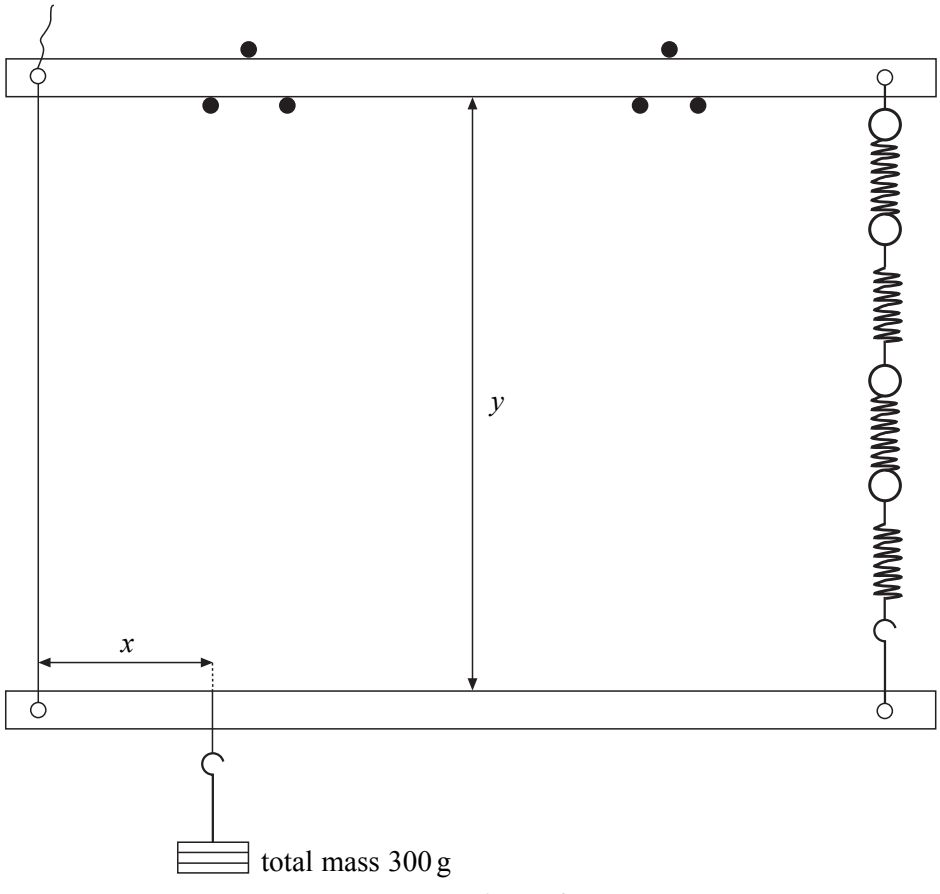

Figure 3

Measure and record x, the horizontal distance between the wire and the point of attachment of the 300 g mass to the ruler and y, the vertical distance between the lower edge of the beam and the upper edge of the suspended metre ruler.

Increase the length of the wire between the beam and the ruler so that the left-hand end is again lower than the right-hand end.
Adjust the 300g mass as before to make the ruler horizontal and repeat the procedure to find **four** additional values of x and y. *(5 marks)*

Record the measurements you make.

(c) Using the grid, plot a graph with y on the vertical axis and x on the horizontal axis.

(6 marks)

(d) (i) Measure and record the gradient, G, of your graph.

(ii) Evaluate $\frac{G}{\Delta y}$.

(3 marks)

(e) (i) Explain how you ensured that the suspended metre ruler was horizontal before making measurements of y.

(ii) State and explain how you would use your graph to deduce the value of y if the 300 g mass were to be completely removed from the ruler.

(iii) State and explain how the gradient, G, would be affected, if at all, if in part (b) of the experiment the mass suspended from the ruler had been 200 g rather than 300 g.

(6 marks)

END OF QUESTION