General Certificate of Education
January 2005
Advanced Subsidiary Examination

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 Thursday 20th January 2005 Morning Session

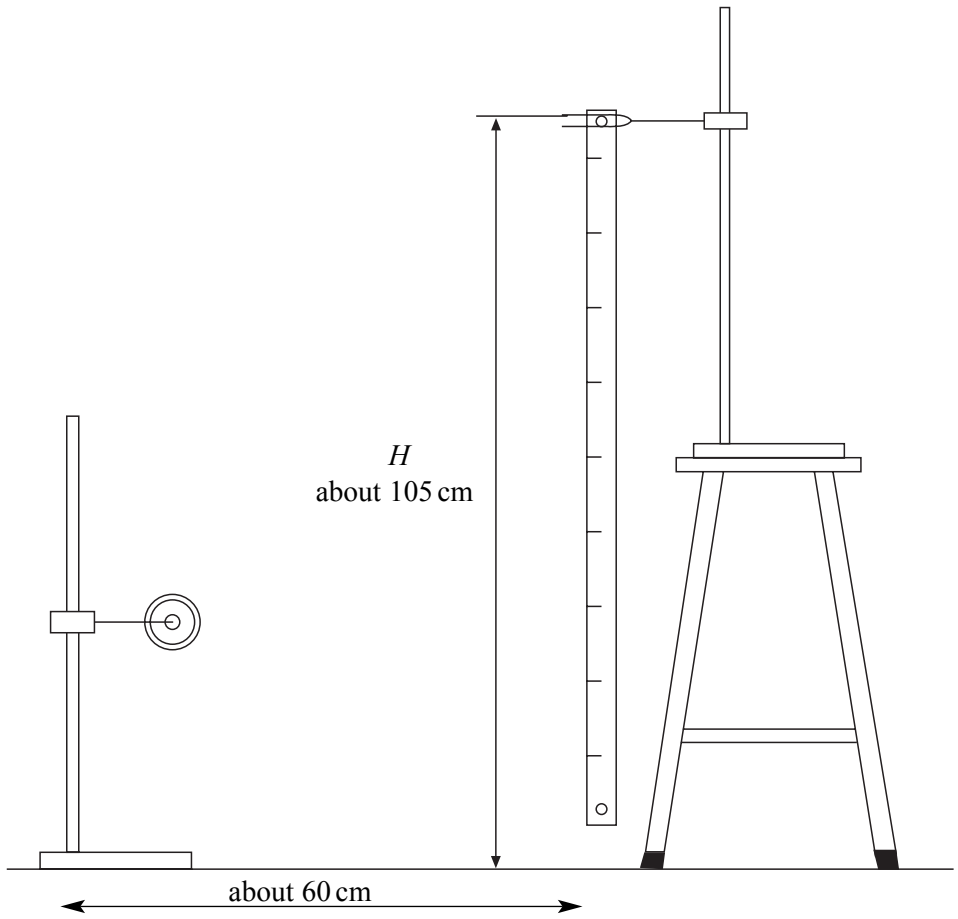
- **These *Instructions* are provided to enable centres to make appropriate arrangements for the examination. Copies of the *Instructions* are to be kept at the centre under lock and key when not in use; they are not to be removed from the centre. The question paper packets must not be opened prior to the examination.**
- **These instructions explain how to set up the equipment for Question 2.**
- **Question 2 is printed on pages 4 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 conditions for a pivoted metre ruler.

Apparatus required for each candidate:

- ❒ wooden metre ruler, in good condition, with small holes drilled in the median section at the 1.0 cm and 99.0 cm marks
- ❒ nail, pin or small screwdriver to act as horizontal pivot: the diameter of the pivot should be such that the ruler can rotate freely when pivoted at the 1.0 cm mark
- ❒ about 80 cm of thin string
- ❒ free-running pulley mounted on a stand with axis horizontal: candidates will be required to move this stand and adjust the height of the pulley to about 60 cm above the bench
- ❒ one 100 g, one 50 g, one or two 20 g and two 10 g masses: candidates will be required to attach these to a light hook (e.g. fashioned from a paper clip) tied to the free end of the string (note that the maximum mass they will be required to use will be 100 g)
- ❒ another metre ruler
- ❒ set square
- ❒ means of clamping the horizontal pivot about 105 cm above the bench: the diagram suggests that this can be done by placing the retort stand on a flat-topped stool but Centres are at liberty to modify this arrangement if the need arises

The apparatus should be arranged for each candidate as shown in the diagram.



In constructing the apparatus, centres should ensure that the protruding end of the pivot does not present a hazard to the candidate, e.g. if a pin is used a cork should be fitted or if a screwdriver is used, the blade end should be inserted in the boss of the clamp.
It may be advisable to stabilise the retort stand, if placed on a stool, with a G-clamp.

Candidates will be required to attach the string to the ruler through the hole in the lower end.
The pulley stand should be about 60 cm from the ruler with the top of the pulley about 30 cm above the bench.
The maximum distance between the two stands should be 150 cm.

Candidates will require the mass, M, of the pivoted metre ruler. This should be displayed on a card for the candidates to use.

Examiners require no information for this question.

2 In this experiment you are required to investigate the equilibrium conditions for a pivoted metre ruler. **No description of the experiment is required.**

Record the mass, *M*, of the metre ruler that has been provided for your use.

The metre ruler is suspended above the bench from a horizontal pivot passing through a hole near the upper end of the ruler. The pivot is held in a clamp fixed to a retort stand, placed on a stool. **Do not adjust the height of the clamp or the position of the stand during the experiment**.

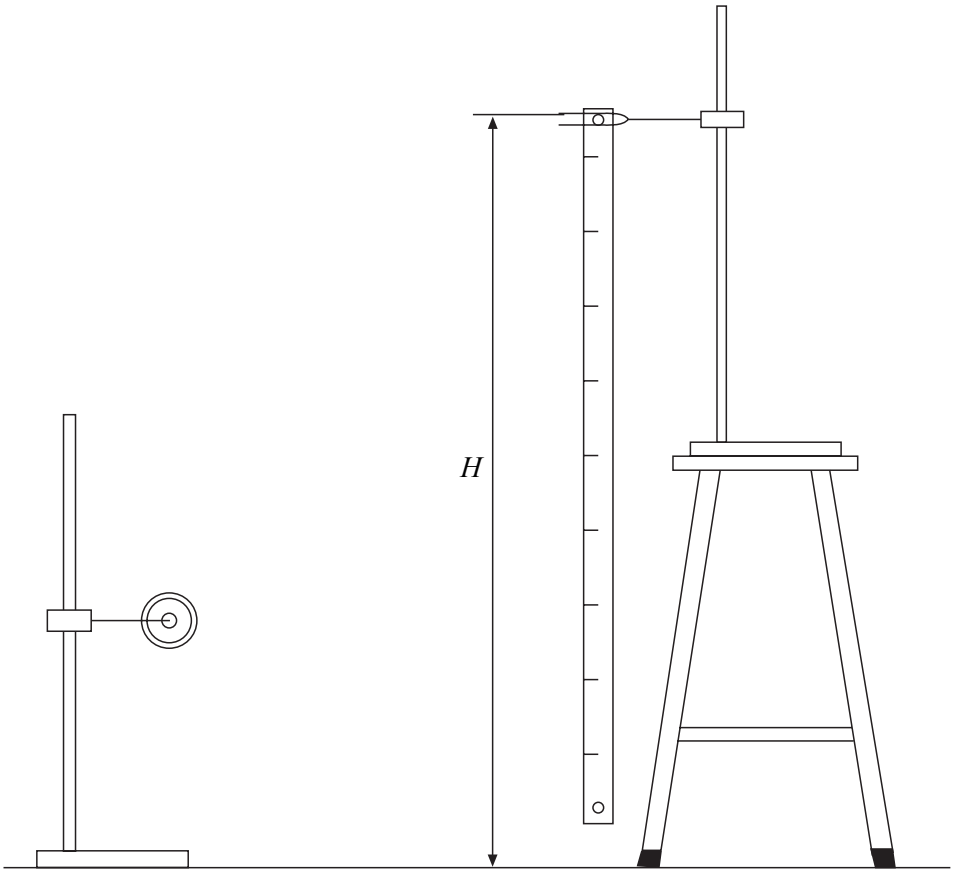


Figure 4

(a) Using the additional metre ruler, make suitable measurements to determine *H*, the vertical distance between the top surface of the pivot and the bench, as shown in **Figure 4**.

(1 mark)

(b) Attach one end of the string to the suspended ruler through the hole at the lower end. Pass the string over the pulley and fasten the hook to the free end of the string.
Hang a mass, m, (=100g) from the hook. Adjust the height of the pulley, and, if necessary, the position of its stand until the string between the ruler and the pulley is horizontal, with the ruler, string and pulley in the same vertical plane.
Measure and record the vertical height, h, defined in **Figure 5**, between the top of the string and the bench.

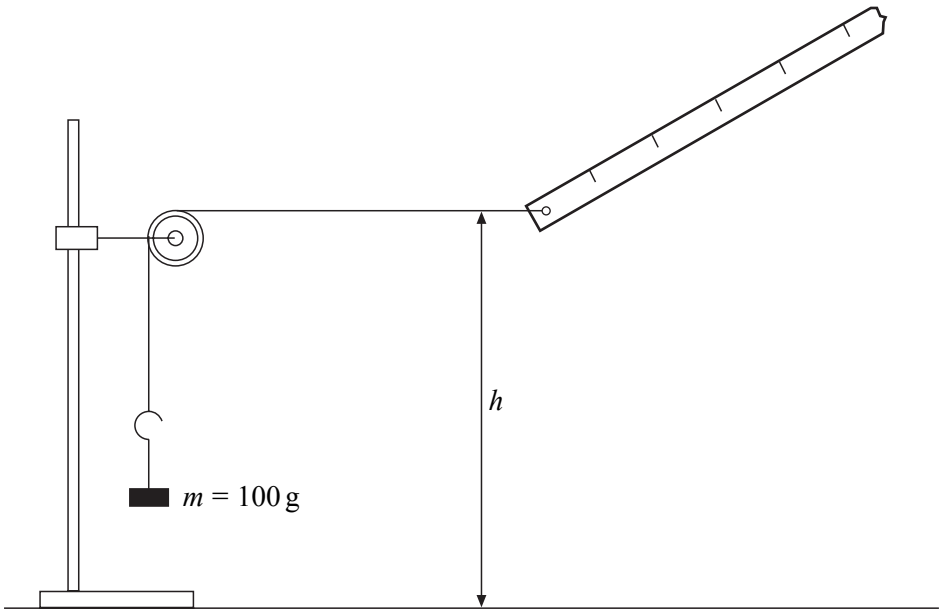


Figure 5

Repeat the procedure for additional **smaller** values of m.
Record your measurements and observations.

(4 marks)

(c) Plot a graph with $\frac{1}{(H-h)^2}$ on the vertical axis and m^2 on the horizontal axis.

Tabulate below the data you will plot on your graph.

(8 marks)

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

(ii) Evaluate $M\sqrt{G}$.

(3 marks)

Turn over ▶

(e) (i) Describe the procedure you used to ensure that the string between the ruler and the pulley was horizontal.

(ii) Suppose that a mass equal to $\frac{M}{2}$ is connected to the end of the string passing over the pulley. The apparatus is adjusted until the string between the pulley and the ruler is horizontal.
Showing your working clearly, use your graph to determine (H - h'), where h' is the vertical height between the top of the string and the bench.

(iii) Draw a diagram showing the approximate position of the ruler for the situation described in part (e)(ii).
Label and show on your diagram the directions of the forces acting on the ruler.

(6 marks)

END OF QUESTIONS