General Certificate of Education
January 2005
Advanced Level Examination

PHYSICS (SPECIFICATION A) **PHAP/TN**

Instructions to Supervisors for the Practical Examination (Units 5-9)

CONFIDENTIAL

OPEN ON RECEIPT

The examination will be held on Wednesday 2 February 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 3 and 4 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 rotational oscillation of a metre ruler suspended from two threads, as the inclination of the threads is varied.

Apparatus required for each candidate:

- ❒ wooden metre ruler, in good condition, and free from warping: two small eyelets are to be fixed into the edge of one ruler level with the 40.0 cm and 60.0 cm marks: the assembled arrangement candidates will use is shown in the diagram on the question paper
- ❒ two prisms of equal size and shape to support the metre ruler (on the opposite edge to that where the eyelets are inserted) parallel to the bench: the prisms can be made of any material
- ❒ two stands, each fitted with clamp and boss, to support ruler at each end at least 0.60 m above the bench
- ❒ additional metre ruler
- ❒ two large bulldog clips (of the same size)
- ❒ two lengths of strong fine string or thread, each to be about 75 cm
- ❒ stopwatch capable of reading to 0.1 s or better
- ❒ suitable fiducial mark, at the discretion of the Centre

Clamp one metre ruler horizontally between 55 cm and 60 cm above the bench, the clamps to be close to each end of the ruler. The graduated face of the ruler should face the candidate and lie in a vertical plane parallel to the edge of the bench.
Check the position of the clamped ruler with a spirit level.

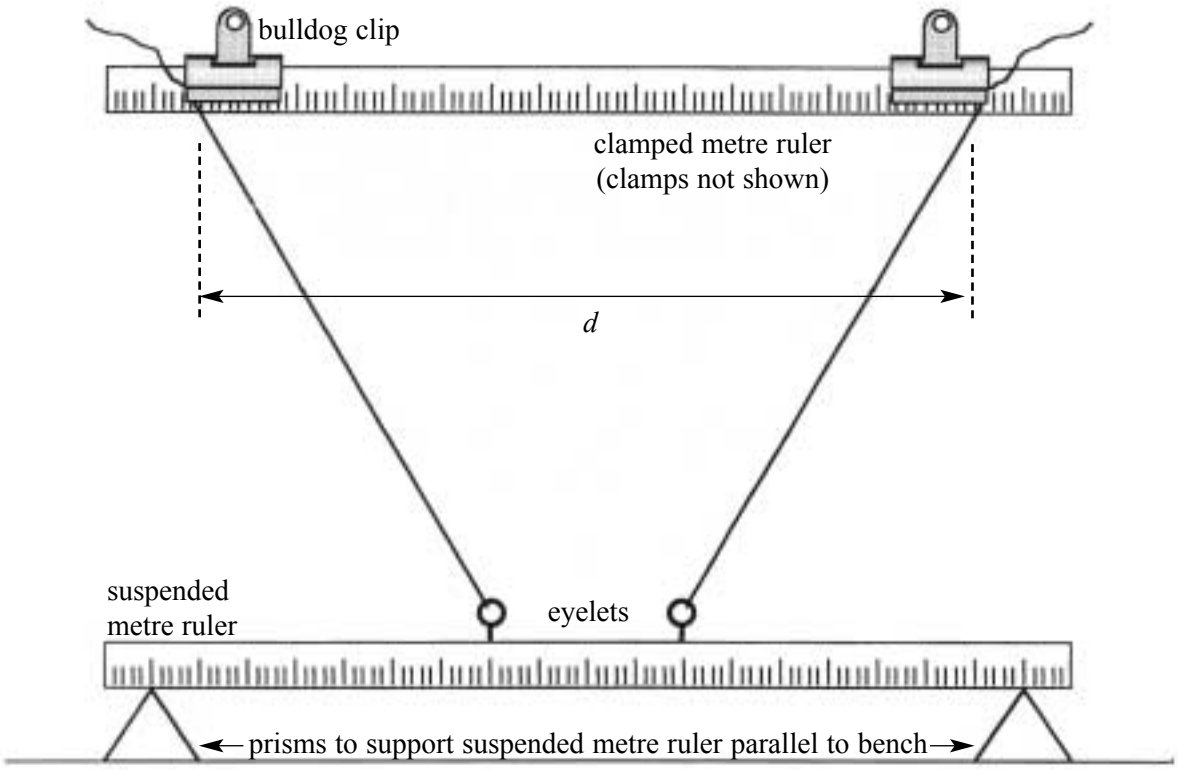
Fasten a length of thread to each eyelet then place the remaining apparatus on the bench.

Examiners require no further information for this question.

2 In this experiment you will investigate the rotational oscillation of a metre ruler suspended from two threads, as the inclination of the threads is varied.
No description of the experiment is required.

The metre ruler is to be suspended above the bench by threads connected to an additional ruler that has been clamped parallel to the bench with its graduated face in a vertical plane.
Do not adjust the position of the clamped ruler during the experiment.

(a) Two lengths of thread have been tied to eyelets fixed into one edge of the metre ruler. Place the two prisms below the horizontal beam then position the metre ruler on the prisms **directly below** the clamped ruler with the graduated face of the ruler towards you and with the eyelets uppermost, as shown in the diagram.
Secure the free ends of the threads to the clamped ruler by trapping each thread between the graduated face of the suspended ruler and a bulldog clip.
The threads should meet the clamped ruler at the 10.0 cm and 90.0 cm graduations so that the distance, d, between their points of suspension is 80.0 cm.



Ensuring that the lengths of thread connecting the two rulers are tight, remove the prisms so that the lower ruler is suspended parallel to the bench.
Keeping this ruler in a horizontal plane, displace each end of the ruler by equal small amounts **in opposite directions**.
Release the system from rest so that it performs small amplitude rotational oscillations about its central vertical axis.
Make suitable measurements to determine the period, T, of these oscillations.

(1 mark)

(b) Replace the prisms then move the points of attachment between the thread and the clamped ruler **by equal amounts** towards the centre of the clamped ruler so that d is reduced.
Ensure that the connecting threads are tight before removing the prisms so that the suspended ruler remains directly below the clamped ruler and at the same height above the bench as before.
Determine the period, T, of the system for this new value of d, and continue until you have a **total of five sets** of d and T.
Record below all your measurements and observations.

(4 marks)

(c) Plot a graph with log d on the vertical axis and log T on the horizontal axis.
Tabulate below the data you will plot your graph.

(8 marks)

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

G = ...

(3 marks)

(e) Theory shows the variables to be connected by an expression of the form

$$d = kT^n,$$

where n is an integer and k is a constant.

(i) Deduce from your graph the value of the **integer**, n.

(ii) Hence deduce the **unit** of the constant, k.

(2 marks)

(f) Describe and explain **two** procedures yo used to reduce the uncertainty in your values of T.

procedure 1

procedure 2 *(4 marks)*

END OF QUESTIONS