General Certificate of Education
January 2002
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 Friday 1 February 2002 Morning Session

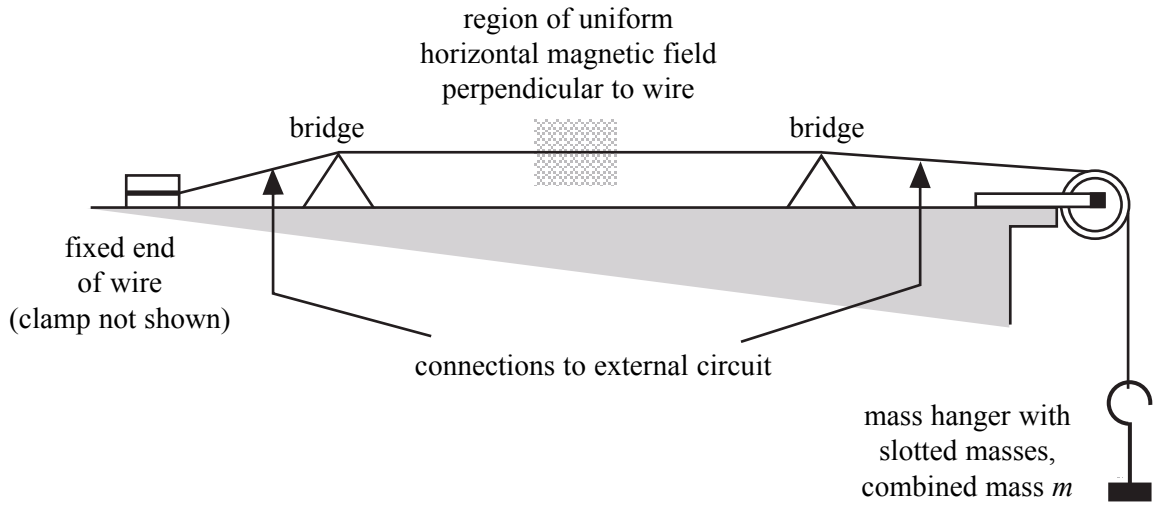
- **These *Instructions* are provided to enable centres to make appropriate arrangements for the examination. Copies of the *Instructions* are to be kept at the centre under lock and key when not in use; they are not to be removed from the centre. The question paper packets must not be opened prior to 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 specific manner.**
- **Supervisors are required to complete a Data Sheet (see page 7).**

Candidates are to investigate transverse stationary waves on a wire undergoing forced vibration at the fundamental frequency.

Apparatus required for each candidate:

- ❒ 50 Hz continuously variable ac voltage supply to provide sinusoidal current of about 0.5 A, fitted with suitable connecting wires to attach to the ends of the constantan wire (equivalent arrangement using a stepped voltage supply with potentiometer may be used as a substitute)
- ❒ about 1.5 m 28 SWG constantan wire with a small loop tied at one end to attach hanger for slotted masses
- ❒ two Magnadur (slab) magnets, 50 × 19 × 6 mm (Philip Harris Q66550/4) and mild steel yoke (to hold slab magnets) as per Westminster Electromagnetism kit, to provide horizontal uniform magnetic field (check that the opposing faces of the magnets are of opposite polarity)
- ❒ micrometer screw gauge capable of reading to 0.01 mm (see note on page 3)
- ❒ metre ruler and set square
- ❒ two bridges, e.g. glass bridges to define vibrating section of wire: candidates should be able to vary this distance between 0.20 m and 0.80 m
- ❒ two small blocks of wood and G-clamp to secure fixed end of wire
- ❒ pulley, supported in a suitable fashion to enable the slotted masses to hang freely as shown in the diagram
- ❒ mass hanger of mass 50 g or 100 g and slotted masses of values 1 × 50g and 3 × 100 g (to provide maximum mass of 450 g)

The apparatus is shown in the diagram.



There is **no insistence** that the fixed end should be at the left-hand end of the arrangement as presented to the candidate. Note that each set will need to be set up parallel with, and close to, the edge of the bench, with the pulley overhanging the end of the bench. Ensure that the sections of the wire between bridge and fixed end, and between bridge and pulley, are not too steeply inclined, to enable ease of movement of the bridges.

Prior to the examination, the output of the power supply should be adjusted so that when the length of the vibrating section is about 0.5 m, the wire oscillates in fundamental mode with amplitude between 1 cm and 2 cm at the mid-point.
The variable voltage control should then be taped over.
If the number of micrometer screw gauges available is limited, the supervisor may ask the candidates to share instruments but must ensure that when transfer takes place, the screw gauge is reset. There is **no insistence** that the measurement with the micrometer (part (a) in the question) should be made by the candidates at the beginning of the experiment.

Examiners require the following information for this question.
The **typical** mass, to 0.01 g, of 1.000 m ($\pm$ 0.005 m) of the 28 SWG constantan wire used by the candidates.

Question 2 is printed on pages 4 and 5.

In the examination paper, space is provided for the answer to each part-question. The spaces for candidates' answers have been omitted in this version. The graph paper grid for part (c) has been similarly omitted.

Apparatus

General equipment for the examination may be obtained from:

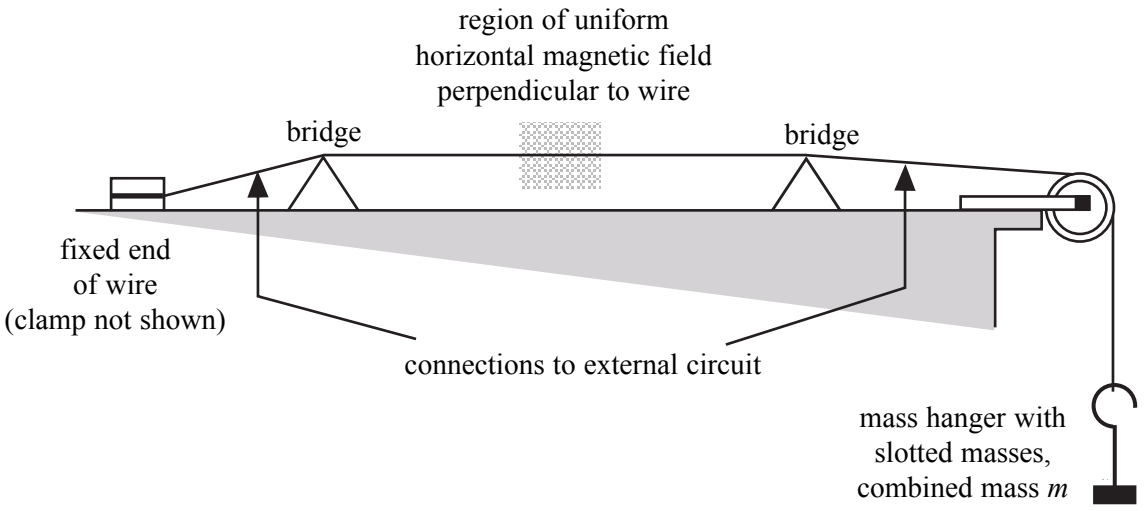
Philip Harris Education
Novara House
Excelsior Road
Ashby Park
Ashby-de-la-Zouch
Leicestershire
LE65 1NG

Griffin Education
Griffin & George
Bishop Meadow Road
Loughborough
Leicestershire
LE11 5RG

2 This question is divided into parts (a) to (e) printed on pages 8 to 12.

In this experiment you are required to investigate transverse stationary waves on a wire undergoing forced vibration at the fundamental frequency.
No description of the experiment is required.

You are provided with the arrangement shown below.



(a) (i) Use the micrometer screw gauge to determine the diameter, *d*, of the wire.

(ii) Wire is manufactured in certain diameters that are identified by SWG (standard wire gauge) numbers. With reference to the table below, identify the SWG number of the wire you are provided with.

diameter/mm	0.711	0.559	0.457	0.376	0.315	0.274	0.234	0.193
SWG number	22	24	26	28	30	32	34	36

(b) Place sufficient slotted masses on the hanger so the total mass, *m*, supported by the wire is equal to 100 g.
Adjust the separation of the bridges so that the length of the wire, *l*, between them is approximately 0.20 m then turn on the ac power supply.
With the horizontal magnetic field at the centre of the vibrating section of the wire, **increase** *l* until the wire is seen to vibrate at the fundamental frequency.
Record below your measurements of *m* and *l* then repeat the procedure for **five larger** values of *m*.
When you have completed your measurements, **turn off** the ac power supply.

(7 marks)

(c) Plot a graph with l on the vertical axis and $\sqrt{m}$ on the horizontal axis. Tabulate your data for $\sqrt{m}$ in the space above.

(6 marks)

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

(ii) Calculate the mass per unit length of the wire, μ, given by

$$\mu = \frac{g}{(2fG)^2}$$, where $g = 9.81\,\text{m s}^{-2}$ and $f = 50\,\text{Hz}$.

(3 marks)

(e) (i) Describe any precautions you took to ensure that your result for d was accurate.

(ii) State and explain the effect, if any, on your graph, if the experiment were repeated with a wire made of the same material but with a higher SWG number.

(iii) Use your data to deduce l if a stationary wave with **two** loops (i.e. the second harmonic) is to be produced when $m = 100\,\text{g}$.

(6 marks)

(Total: 22 marks)

END OF QUESTIONS

THERE ARE NO INSTRUCTIONS PRINTED ON THIS PAGE

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ASSESSMENT and QUALIFICATIONS ALLIANCE

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

Information to be supplied by the Superivsors

Question 2

The **typical** mass, to 0.01 g, of 1.000 m (±0.005 m) of the 28 SWG constantan wire used by the candidates. .....

Signed .....

Centre Number ..... **Date** .....

THERE ARE NO INSTRUCTIONS PRINTED ON THIS PAGE