P510/3
PHYSICS
Paper 3
(Practical)
Nov./Dec. 2024
3¼ hours

UGANDA NATIONAL EXAMINATIONS BOARD

Uganda Advanced Certificate of Education

PHYSICS

Paper 3
(Practical)

3 hours 15 minutes

INSTRUCTIONS TO CANDIDATES:

This paper consists of **three** *questions.*

Answer question **1** *and* **one** *other question.*

Any additional question answered will **not** *be marked.*

You are not allowed to use the apparatus for the **first fifteen minutes**. *This time is to enable you to read the question paper and make sure you have all the apparatus you may need.*

You are expected to record on your scripts in **blue** *or* **black** *ink all your observations as these observations are made and to plan for the presentation of the records so that it is* **not** *necessary to make a fair copy of them. The working of the answers is to be handed in. Any work done in pencil* **except** *graphs will* **not** *be marked.*

Marks are given mainly for a clear record of the observations actually made, for their suitability, accuracy and for the use made of them.

Details on the question paper should **not** *be repeated in the answer, nor is the theory of the experiment required unless specifically asked for. However, you should record any special precautions you have taken and any particular feature of the method of going about the experiment.*

For each question, you will be required to select suitable apparatus from the equipment provided.

Graph paper is provided.

Mathematical tables and silent non-programmable scientific calculators may be used.

Turn Over

1. In this experiment, you will determine the constant, ρ, of the metre rule labelled A. *(40 marks)*

PART I

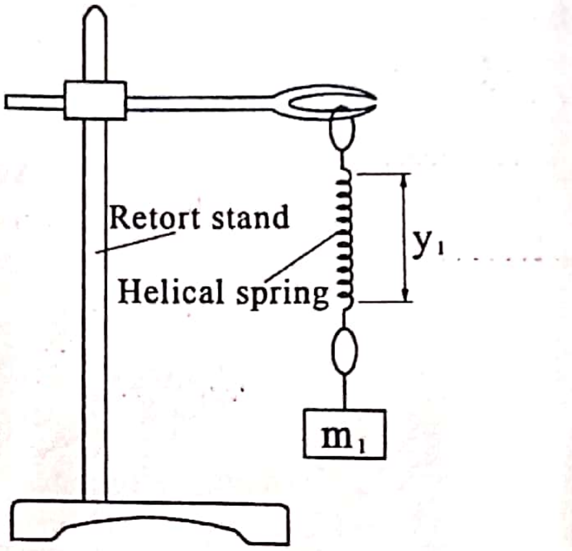

Fig. 1.1

(a) Suspend the helical spring provided from the clamp of the retort stand.

(b) Suspend a mass $m_1 = 100$ g from the lower end of the spring as shown in figure **1.1**.

(c) Measure and record the length, y_1, of the spring.

(d) Remove the mass, m_1, from the spring.

(e) Repeat procedure (b) for mass $m_2 = 200$ g.

(f) Measure and record the new length, y_2, of the spring.

(g) Calculate the constant, k, from the expression:

$$k = \frac{g\,(m_2 - m_1)}{(y_2 - y_1)}, \quad g = 9.81\ \text{ms}^{-2}$$

PART II

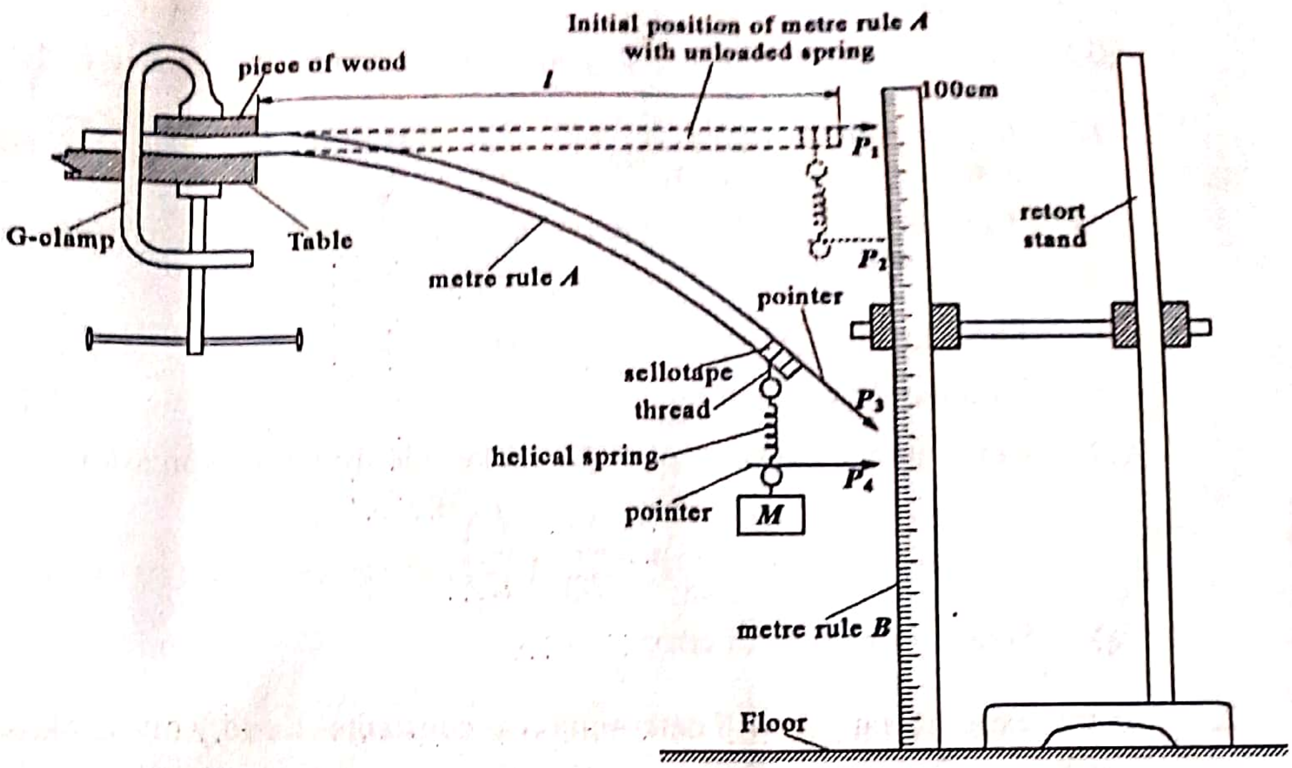

Fig. 1.2

(a) Measure and record the width, b , and thickness, d , of the metre rule labelled ***A***.

(b) Clamp the metre rule A firmly to the edge of the table with its graduated face upwards so that its free length, $l = 80.0$ cm.

(c) Fix a pointer using sellotape or pasticine at the free end of the metre rule ***A***.

(d) Clamp the metre rule labelled ***B*** vertically.

(e) Fix another pointer at one end of the helical spring.

(f) Suspend the end of the helical spring without the pointer from 99.0 cm mark of metre rule ***A*** using a piece of thread or sellotape.

(g) Read and record the initial position, P_1 of the pointer attached to metre rule ***A*** from the scale of the metre rule ***B***.

(h) Read and record the initial position, P_2 , of the pointer attached to the helical spring from the scale of the metre rule ***B***.

(i) Suspend a mass $M = 100$ g from the helical spring as shown in figure **1.2**.

Turn Over

(j) Read and record the new position, P_3, of the pointer attached to metre rule A.

(k) Read and record the new position, P_4, of the pointer attached to the helical spring.

(l) Repeat procedure (i) to (k) for values of M=150, 200, 250, 300 and 350 g.

(m) Tabulate your results including values of $e_1 = (P_1 - P_3)$, $e_2 = (P_2 - P_4)$ and $(e_2 - e_1)$.

(n) Plot a graph of e_1 against $(e_2 - e_1)$.

(o) Find the slope, S, of the graph

(p) Calculate the constant, ρ, of the metre rule from the expression:

$$\rho = \frac{4k}{bs}\left(\frac{l}{d}\right)^3.$$

(q) State **two** sources of error.

2. In this experiment, you will determine two constants λ and γ of the glass block.

PART I

(a) Fix the white plain sheet of paper on a softboard using drawing pins.

(b) Place the glass block in the middle of the white plain sheet of paper, with its broadest face upwards and trace its outline.

(c) Remove the glass block.

(d) Label the outline of the tracing as $PQRS$.

(e) Draw a normal MN at point B, 2.0 cm from P.

(f) Draw a line AB to meet PQ at B, such that angle $\alpha = 20°$.

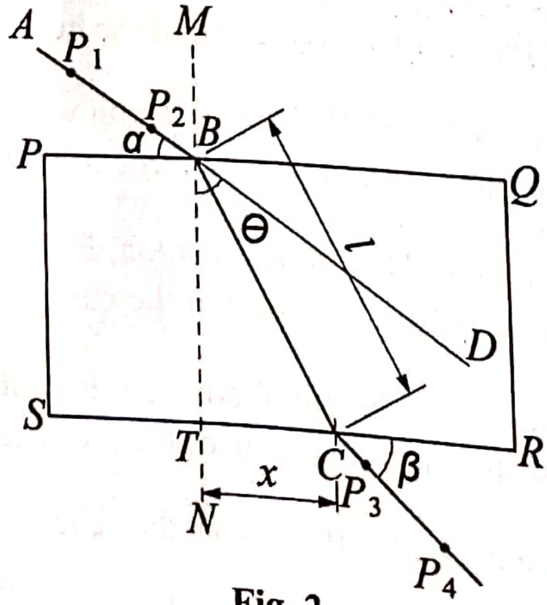

Fig. 2

(g) Replace the glass block onto its outline.

(h) Fix pins P_1 and P_2 vertically on AB.

(i) While looking through the glass block from side SR, fix pins P_3 and P_4 such that they appear to be in line with the images of P_1 and P_2.

(j) Remove the glass block and the pins.

(k) Draw a line through P_3 and P_4 to meet SR at C.

(l) Join C to B as shown in figure **2**.

(m) Measure and record angle β and length l.

(n) Repeat procedure (f) to (m) for values of $\alpha = 30°$, $40°$, 50^0, $60°$, and $70°$.

(o) Enter your results in a suitable table including values of $\frac{1}{l^2}$ and $\text{Cos}^2\beta$

(p) Plot a graph of $\frac{1}{l^2}$ against $\text{Cos}^2\beta$.

(q) Read and record the intercept, C, on the $\frac{1}{l^2}$ – axis.

(r) Calculate the constant, γ, of the glass block from the expresssion,

$$\gamma = \sqrt{\frac{1}{C}}\ .$$

(s) Find the slope, S, of the graph.

(t) Calculate the constant, λ_1, of the glass block from the expression;

$$\lambda_1 = \sqrt{\frac{-C}{S}}$$

Turn Over

PART II

(a) Use the set up in Figure **2**, for the value of $\alpha = 20^{\circ}$.

(b) Measure and record angle θ.

(c) Measure and record lengths x and l.

(d) Calculate the value of λ_2 from the expression; $\lambda_2 = \frac{\sin\theta}{x/l}$.

(e) Find, λ, the average of λ_1 and λ_2 .

(f) State **two** sources of error.

3. In this experiment, you will determine the constant, σ using two bare wires labelled X and Y.

(a) Connect the standard resistor, $R = 2\ \Omega$ across the right-hand gap of the metre bridge.

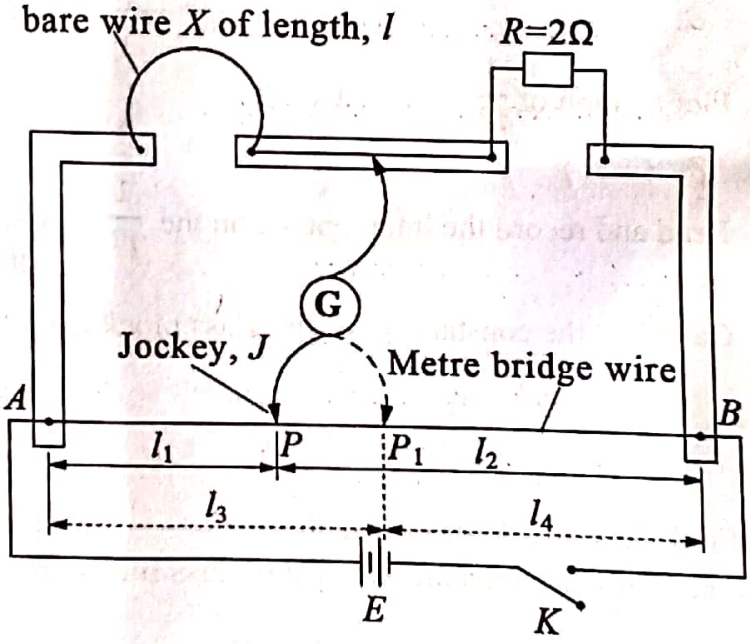

Fig. 3

(b) Connect the bare wire X across the left-hand gap of the metre bridge.

(c) Connect the batteries E, switch K, galvanometer G and the Jockey J, as shown in Figure **3**.

(d) Adjust the length of the bare wire to $l = 0.200$ m.

(e) Close switch, K.

(f) Move the Jockey, J, along the metre bridge wire AB to locate a point P for which the galvanometer, G, shows no deflection.

(g) Read and record the balance lengths, l_1 and l_2 in metres.

(h) Open switch, K.

(i) Repeat procedure (d) to (h) for values of $l = 0.300,\ 0.400,\ 0.500,\ 0.600$ and 0.700 m.

(j) Replace the bare wire X, with the bare wire Y.

(k) Adjust the length, l of the bare wire Y to 0.200 m.

(l) Close switch, K.

(m) Move the Jockey, J, along the metre bridge wire AB to locate a point P_1 for which the galvanometer, G, shows no deflection.

(n) Read and record the balance length l_3 and l_4 in metres.

(o) Open switch K.

(p) Repeat procedure (k) to (o) for values of $l = 0.300, 0.400, 0.500, 0.600$ and 0.700 m.

(q) Record your results in a suitable table including values of

$$Z_x = \frac{2l_1}{l_2} \text{ and } Z_y = \frac{2l_3}{l_4}.$$

(r) Plot a graph of Z_x against Z_y.

(s) Determine the slope σ of the graph.

(t) State **two** possible sources of error.