P510/3
PHYSICS
(PRACTICAL)
Paper 3
July/August 2023
$3^{1}/_{4}$ hours

WAKISSHA JOINT MOCK EXAMINATIONS

Uganda Advanced Certificate of Education

PHYSICS PRACTICAL

(PRINCIPAL SUBJECT)

Paper 3

3 hours 15 minutes

INSTRUCTIONS TO CANDIDATES:

- *Answer **Question 1** and **one** other question.*
- *Candidates are **not** allowed to use the apparatus for the first fifteen minutes.*
- *Graph papers are provided.*
- *Mathematical tables and non-programmable scientific electronic calculators may be used.*
- *Write on one side of the paper only.*
- *Candidates are expected to record on their scripts all their observations as these observations are made and to plan 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.*
- *Details on the question paper should not be repeated in the answer, nor is the theory of the experiment required unless specifically asked for. Candidates should, however, record any special precautions they have taken and any particular feature of their method of going about the experiment.*
- *Marks are given mainly for a clear record of the observations actually made, for their suitability and accuracy, and for the use made of them.*

Turn Over

QUESTION 1

In this experiment, you will determine the moment of inertia, I, of the half metre rule provided by two methods.

Part I

(a) Measure and record the mass, M, of the half metre rule.

(b) Clamp the metre rule such that the scale is facing you.

(c) Tie the pieces of thread at points P and Q, equidistant from the point C; the 25.0 cm of the half metre rule such that the distance, a = 0.200 m.

(d) Suspend the half metre rule with the scale facing up, from the clamped metre rule as shown in figure 1 below.

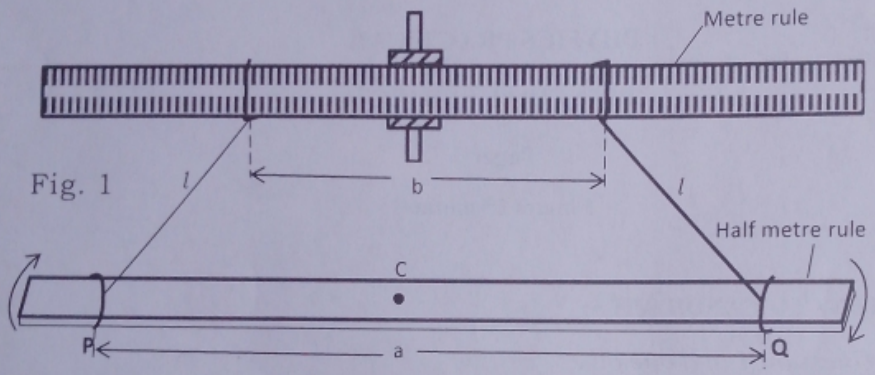


Fig. 1

(e) Adjust the length of the threads *l to 0.500 m* and the separation of the threads on the clamped metre rule to b = 0.100 m.

(f) Turn the half metre rule horizontally through a small angle about its vertical axis through its centre, C and release it to oscillate.

(g) Measure and record the time for 20 oscillations.

(h) Determine the period, T of the oscillations.

(i) Calculate the value of the constant, K_1, from the expression,

$$K_1 = \frac{T}{4\pi}\sqrt{\frac{gab}{l}}$$

Where $\pi = 3.14$, $g = 9.81 ms^{-2}$

(j) Calculate the value of, $\mathbf{I_1}$, from the expression, $\mathbf{I_1 = M(K_1)^2}$.

Part II

(a) Set up the apparatus as shown in figure 2 below.

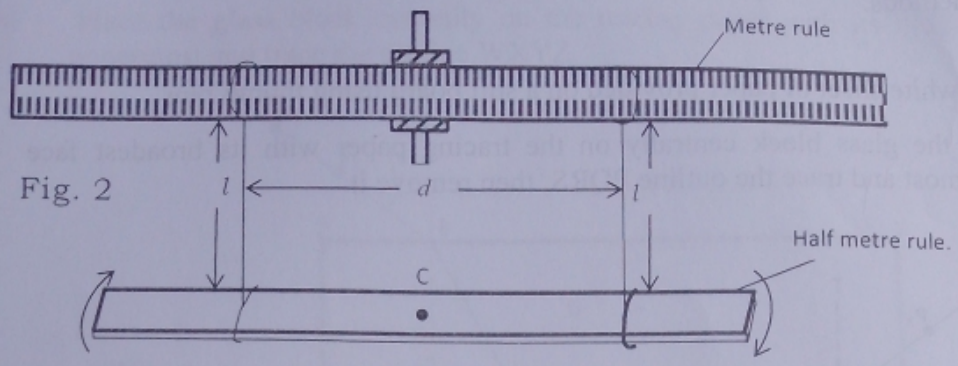


Fig. 2

(b) Tie one piece of thread at the 45.0 cm mark and another at the 55.0 cm mark of the clamped metre rule.

(c) Suspend the half metre rule from the clamped metre rule, with its scale facing upwards using the two threads with length, l = 0.500 m as shown in figure 2 above.

(d) Adjust the distance between the threads tied on the clamped metre rule to, d = 0.100 m; ensuring that the threads are parallel and equidistant from the 25.0 cm mark on the suspended half metre rule.

(e) Turn the half metre rule horizontally through a small angle about its vertical axis through its centre, C and release it to oscillate.

(f) Measure and record the time for 20 oscillations.

(g) Determine the period, **T**.

(h) Repeat procedures (d) to (g) for values of d = 0.150, 0.200, 0.250, 0.300 and 0.350 m.

(i) Tabulate your results including the values of d^2 and $\frac{1}{T^2}$.

(j) Plot a graph of $\frac{1}{T^2}$ against d^2.

(k) Find the slope, s of your graph.

(l) Calculate the value of the constant, K_2, from the expression,

$$K_2 = \frac{1}{4\pi}\sqrt{\frac{g}{ls}}$$

Where $\pi = 3.14$, $g = 9.81\ ms^{-2}$

(k) Calculate the value of, I_2, from the expression, $I_2 = M(K_2)^2$.

(l) Calculate the value of, I, from the expression, $I = \frac{I_1+I_2}{2}$.

Turn Over

QUESTION 2

In this experiment, you will determine the refractive index, n of glass block provided using two methods.

Part I

(a) Fix a white sheet of paper provided on a soft board using thumb pins.

(b) Place the glass block centrally on the tracing paper with its broadest face uppermost and trace the outline PQRS, then remove it.

Fig. 3

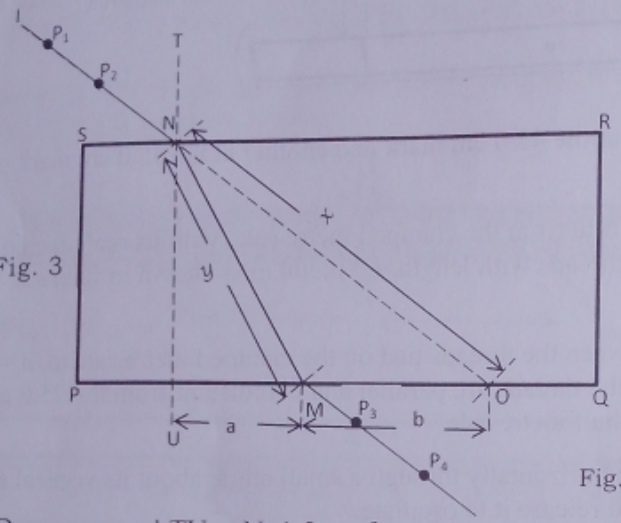


Fig.3

(c) Draw a normal TU at N; 1.5 cm from PS.

(d) Mark a point, O along PQ at a distance of 5.0 cm from the normal, TU and draw a line OI passing through point, N as shown in figure 3 above.

(e) Replace the glass block.

(f) Fix pins P_1 and P_2 vertically along IN.

(g) Looking through the glass block from the face PQ, fix pins P_3 and P_4 such that they appear to be in line with the images of pins P_1 and P_2.

(h) Remove the glass block and the pins.

(i) Draw a line through P_3 and P_4 to meet PQ at M, and join M to N.

(j) Measure and record distances, a, b, x and y.

(k) Calculate the value of, n_1 from the expression,

$$n_1 = \frac{y}{x}\left(\frac{b}{a} + 1.0\right).$$

Part II

(a) Fix another white sheet of paper provided on the soft board using thumb pins.

(b) Place the glass block centrally on the tracing paper with its broadest face uppermost and trace the outline WXYZ.

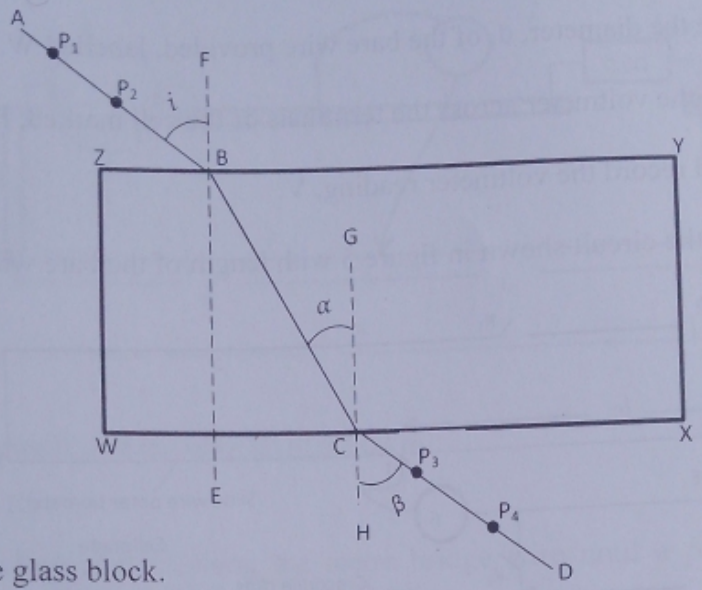


Fig. 4

(c) Remove the glass block.

(d) Draw a perpendicular line FE at B; where ZB = $\frac{1}{4}(ZY)$.

(e) Draw a line AB such that angle, $i = 20^0$ as shown in figure 4 above and replace the glass block on its outline.

(f) Fix pins P_1 and P_2 vertically on the line AB.

(g) While looking through the glass block from the face WX; fix pins P_3 and P_4 such that they appear to be in line with the images of pins P_1 and P_2.

(h) Remove the glass block and the pins.

(i) Draw a line through P_3 and P_4 to meet WX at C, and join C to B.

(j) Draw a perpendicular line GH at C.

(k) Measure and record angles, α and β.

(l) Repeat procedures (e) to (k) for values of, $i = 30^0, 40^0, 50^0, 60^0$ and 70^0.

(m) Tabulate your results including values of $\theta = \frac{1}{2}(i + \beta)$, $\cos^2 \alpha$ and $\sin^2 \theta$.

(n) Plot a graph of $\cos^2 \alpha$ against $\sin^2 \theta$.

(o) Find the slope, **s** of the graph.

(p) Calculate the value of, n_2 from the expression, $n_2 = \sqrt{\frac{-1}{s}}$.

(q) Calculate the refractive index, **n**, of the glass block from the expression,
$$n = 0.50(n_1 + n_2).$$

(r) What is the importance of procedure / step (q)?

NB: ***HAND IN THE TRACING PAPER***

Turn Over

QUESTION 3

In this experiment, you will determine the resistivity, ρ of the material of the wire provided using two methods.

Part I

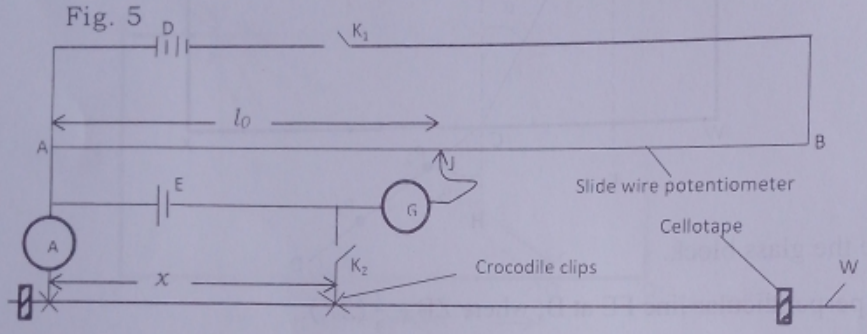
(a) Measure the diameter, d, of the bare wire provided, labelled W.

(b) Connect the voltmeter across the terminals of the cell marked, E.

(c) Read and record the voltmeter reading, V.

(d) Connect the circuit shown in figure 5 with length of the bare wire, $x = 0.750$m.

Fig. 5



(e) Close switch K_1 and move the sliding contact, J, along the wire AB to locate a point on it for which galvanometer, G shows no deflection.

(f) Measure and record the balance length l_0.

(g) Close switch K_2

(h) With both K_1 and K_2 closed, read and record the ammeter reading, I.

(i) Move the sliding contact, J, along the wire AB to locate a point on it for which galvanometer, G shows no deflection.

(j) Measure and record the balance length, l_1.

(k) Calculate the resistivity, ρ_1 of the bare wire from the expression,

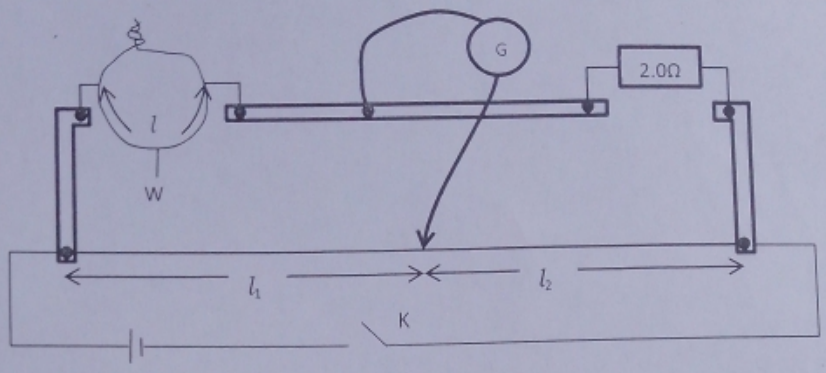
$$\rho_1 = \frac{\pi d^2 l_1}{4I \times l_0} V.$$

Part II

a) Joint the two ends of the bare wire, W provided and twist the last 1.0 cm length.

b) Connect the circuit as shown in the figure 6, with the bare wire, W in the left-hand gap and the 2.0 Ω standard resistor in the right-hand gap of the metre bridge.

Fig. 6



c) Start with a length, l of the wire W of 0.100 m.

d) Close switch K.

e) Move the sliding contact along the metre bridge wire until a point is found where the galvanometer, **G**, shows no deflection.

f) Record the balance lengths l_1 and l_2.

g) Open switch K.

h) Repeat procedures (c) to (f) for values of l = 0.200, 0.300, 0.400, 0.500, 0.600, 0.700, 0.800 and 0.900 m.

i) Tabulate your results including values of $\frac{l_1}{l_2}$ and $R = 2\frac{l_1}{l_2}$.

j) Plot graph of R against l.

k) Determine the maximum value R_m of R from your graph.

l) Find the value l_m of l at which $R = R_m$.

m) Calculate the resistivity, ρ_2 of the bare wire W from the expression,

$$\rho_2 = \frac{\pi d^2 R_m}{2l_m}.$$

n) Determine the resistivity of the material of the wire from, $\rho = \frac{\rho_1 + \rho_2}{2}$.

o) State two possible sources of errors encountered.

END