THE UNITED REPUBLIC OF TANZANIA
NATIONAL EXAMINATIONS COUNCIL
ADVANCED CERTIFICATE OF SECONDARY EDUCATION EXAMINATION

131/3A

PHYSICS 3A
ALTERNATIVE A PRACTICAL
(For Both School and Private Candidates)

Time: 3 Hours **Tuesday 07 May 2002 a.m.**

Instructions

1. This paper has **THREE (3)** questions.
2. Answer **ALL** questions.
3. All calculations must be clearly shown.
4. Mathematical tables and non-programmable calculators may be used.
5. Cellular phones are not allowed in the examination room.
6. Write your Examination Number on every page of your answer boo
7. The following may be used:

$\pi = 3.14$

This paper consists of 4 printed pages

1. The aim of this experiment is to determine the acceleration, g due to gravity by means of a pendulum bob, B.

1.1 Tie a thread to the given pendulum bob. Make a knot at a short distance from the bob. This distance should be of the order of 10 cm. Measure and record the distance, b, between the knot N and the pendulum bob B.

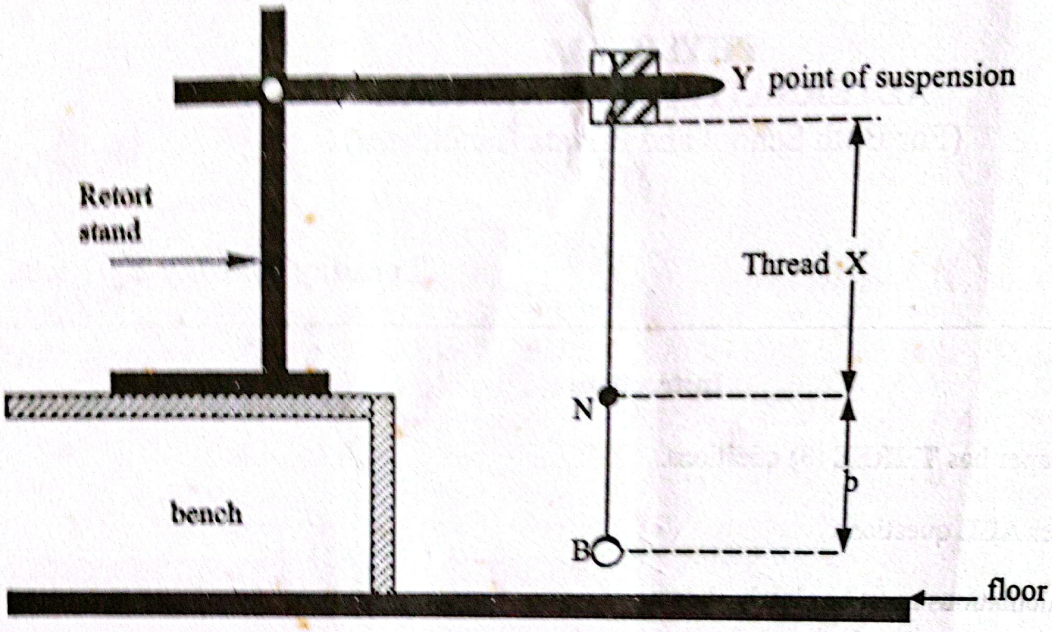


Fig 1. Simple Pendulum.

The distance between the knot N and the point of suspension Y is denoted by X as indicated in Fig 1. Adjust X to be 10 cm. Displace the pendulum by a small angle and then release it so that it swings to and fro with a small amplitude of vibration. Find the time t for 30 oscillations and hence determine the periodic time T for one oscillation.

1.2 Repeat this process for values of X = 30, 50, 70 and 90 cm.

1.3 Tabulate the values of X, t, T and T^2.

If the periodic time T^2 is related to X by

$$T = 2\pi \sqrt{\frac{X+b}{g}}$$

(a) plot a graph of T^2 against X

(b) find the slope of your graph

(c) calculate a value of the acceleration, g due to gravity

(d) read and record a value of the x-axis intercept

(e) what is the physical significance of the x-axis intercept?

(f) read and record the T^2 –axis intercept, Y_o

(g) show that, Y_o is related to b by $Y_o = \frac{4\pi^{-2}b}{g}$

(h) calculate a value of b, using the value of g calculated in 1(c) above

(i) use a metre rule to accurately measure the value of b_o between N and B on the simple pendulum

(j) calculate the percentage error resulting from the true value b_o and the experimental value b as follows: % age error $= \frac{(b_o - b) \times 100}{b_o}$

where:

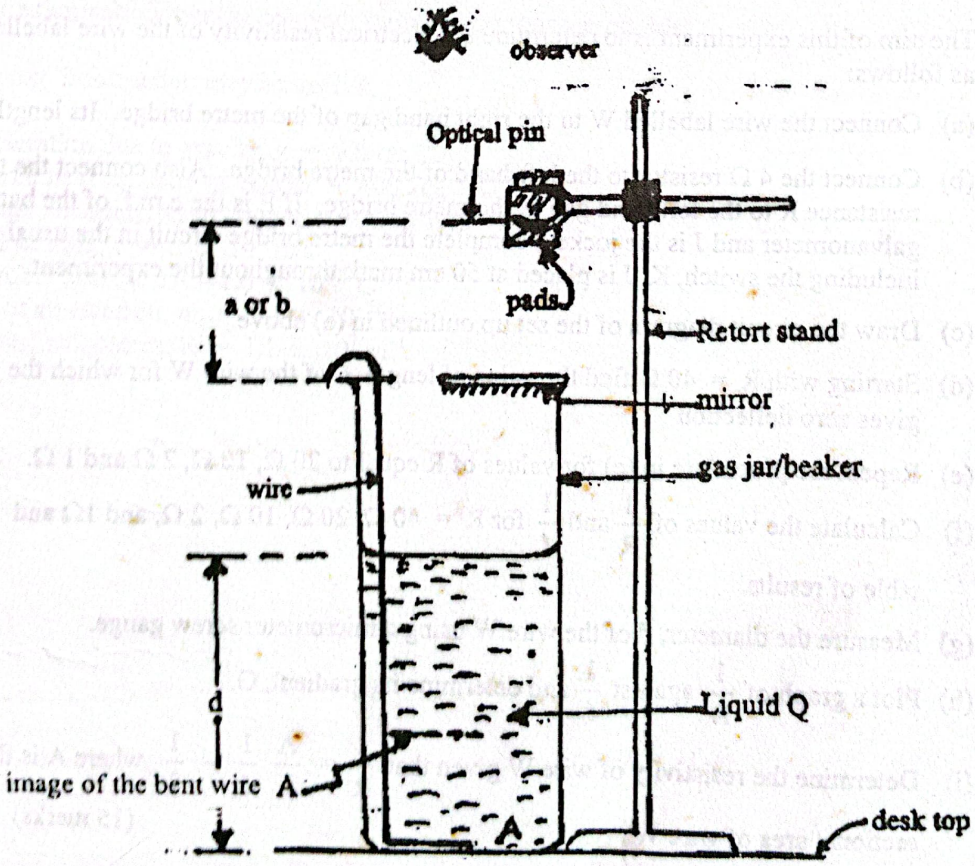
b_o is the experimental value obtained from 1.(d), the x-axis intercept

b is the experimental value obtained from 1. (h), a quantity deduced from the T^2 – axis intercept

(g) list down possible sources of errors. (20 marks)

2. The aim of this experiment is to determine the refractive index n of the liquid provided and labelled Q. Proceed as follows.

(a) Set up the apparatus given as shown in the diagram below where a bent wire A lies on the bottom of the gas jar or beaker.



(b) Lay a plane mirror with the reflecting side facing upwards, flat across the top of the jar, approximately along the diameter of the jar, and have it fastened to the jar with adhesive tape.

(c) Clamp horizontally the optical pin given using pads to the clamps of the retort stand.

(d) Adjust the retort stand so that the pin is vertically above the jar.

(e) Arrange the height of the pin so that its image in the plane mirror coincides with the bent end A of the wire

(f) Measure the distance a from the pin to the plane mirror in centimetres using metre rule.

(g) Pour the given liquid Q carefully down through the side of the jar until it is about one-third full.

(h) Lower the pin until its image in the plane mirror coincides with the image of A seen through the liquid

(i) Measure and record the distance b from the pin to the mirror and the depth d of the liquid measured from A to the liquid surface.

(j) Repeat steps (g) (for any amount poured into a jar), (h) and (i) and each time take readings of b and d for 5 different depths of liquid altogether.

(k) Tabulate b, d, and (d + b – a).

(l) Plot the graph of d (cm) against (d + b – a) cm.

(m) Given that (d + b – a) is the apparent depth of A below the liquid surface, use the graph obtained to determine the refractive index n of liquid Q.

(n) Write 2 sources of errors in this experiment. (15 marks)

3. The aim of this experiment is to determine the electrical resistivity of the wire labelled W. Proceed as follows:

(a) Connect the wire labelled W to the right hand gap of the metre bridge. Its length is ℓ.

(b) Connect the 4 Ω resistor to the left-hand of the metre bridge. Also connect the terminals of the resistance R to the left hand gap of the metre bridge. If E is the e.m.f. of the battery, G is the galvanometer and J is the jockey, complete the metre bridge circuit in the usual manner including the switch, K. J is placed at 50 cm mark throughout the experiment.

(c) Draw the circuit diagram of the set up outlined in (a) above.

(d) Starting with R = 40 Ω find the value of length ℓ of the wire W for which the galvanometer gives zero deflection

(e) Repeat the procedure in (c) for values of R equal to 20 Ω, 10 Ω, 2 Ω and 1 Ω.

(f) Calculate the values of $\frac{1}{R}$ and $\frac{1}{\ell}$ for R = 40 Ω, 20 Ω, 10 Ω, 2 Ω, and 1Ω and prepare a table of results.

(g) Measure the diameter, d of the wire W using a micrometer screw gauge.

(h) Plot a graph of $\frac{1}{R}$ against $\frac{1}{\ell}$ and determine its gradient, G.

(i) Determine the resistivity of wire W given that $\frac{1}{R} = \frac{A}{\rho}\frac{1}{\ell} - \frac{1}{2}$, where A is the cross-sectional area of wire W (15 marks)