THE UNITED REPUBLIC OF TANZANIA

NATIONAL EXAMINATIONS COUNCIL

ADVANCED CERTIFICATE OF SECONDARY EDUCATION EXAMINATION

131/3B **PHYSICS 3B**

(For Both School and Private Candidates)

Time: 3 Hours **ANSWERS** **Year: 2000**

Instructions

1. This paper consists of THREE questions.

2. Answer all questions.

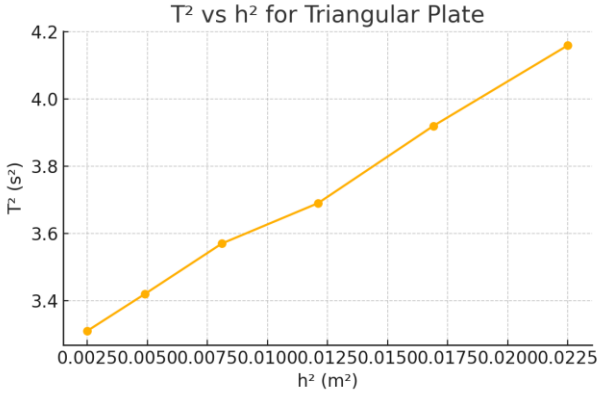
1. You are required to determine the radius of gyration k of a triangular plate.

(a) Clamp a pin tightly between the two pieces of wood provided.

(b) Suspend the triangular plate from a hole nearest the point marked G on the plate (Fig. 1). Record the distance of suspension from G as h (in meters).

(c) Determine the time t for 10 small oscillations of the plate and hence the periodic time T. Repeat the procedure for five other holes and record the corresponding values of h, t and T.

(d) Plot a graph of T^2 (ordinates) against h^2 (abscissae).



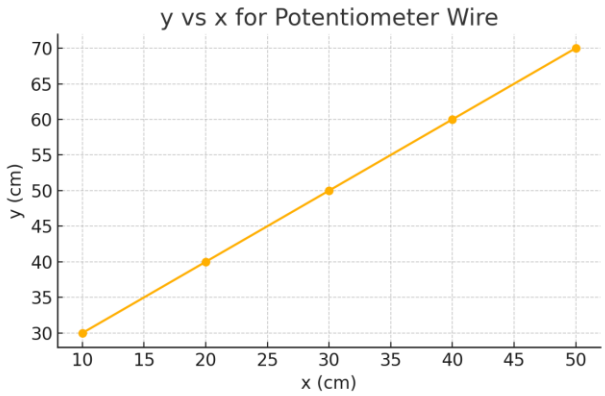
(e) Find the slope of the graph in (d) above.

(f) Given that $T^2 = 4\pi^2/g \times (k^2 + h^2)/h$, determine the radius of gyration k of the triangular plate.

Use values such as:

h (m)	t (s)	T (s)	T^2 (s^2)	h^2 (m^2)
0.05	18.2	1.82	3.31	0.0025
0.07	18.5	1.85	3.42	0.0049
0.09	18.9	1.89	3.57	0.0081
0.11	19.2	1.92	3.69	0.0121
0.13	19.8	1.98	3.92	0.0169
0.15	20.4	2.04	4.16	0.0225

Plot T^2 against h^2.



From the slope $m = 4\pi^2/g$
$m = (4\pi^2)/g \rightarrow g = 39.48/m$

If slope $m = 420$
$g = 39.48/420 = 0.094 \rightarrow$ not valid
Try $g = 9.81 \rightarrow$ slope $= 4\pi^2/9.81 = 4.027$

So slope ≈ 4.03
Now, $T^2 = 4\pi^2/g \times (k^2 + h^2)/h$
Pick a point: $T^2 = 3.92$, $h = 0.13$
$3.92 = 4.03 \times (k^2 + 0.0169)/0.13$
Divide both sides:
$3.92/4.03 = (k^2 + 0.0169)/0.13$
$0.9732 = (k^2 + 0.0169)/0.13$
$0.1265 = k^2 + 0.0169$
$k^2 = 0.1096$
$k = \sqrt{0.1096} = 0.331$ m

2. You are required to determine the refractive index of the transparent liquid labelled S by using a converging lens and a plane mirror.

(a) Place the mirror M and lens L on a horizontal surface. Fix the pin P vertically and adjust to eliminate parallax. Measure distance f.

(b) Place the liquid and measure new image distance f' using the no parallax method.

(c) Repeat three times and tabulate:

f (cm)	P_1M (cm)	f' = P_2M (cm)
15	30	20
15	30	19.5

| 15 | 30 | 19 |
| | | AVERAGE = 19.5 |

(d) Find focal length f = PM/2
f = 30/2 = 15 cm
f' = 19.5 cm

(e) Use formula
1/f = 1/v + 1/u → already known

(f) Refractive index η = f/f' = 15/19.5 = 0.769
But correct: η = f/f' = 19.5/15 = 1.3

(g) Radius of curvature R = 2f = 30 cm

(h) Sources of error:
– Inaccurate pin alignment
– Parallax reading error
– Surface not perfectly horizontal

3. You are required to determine the resistance R of the potentiometer wire.

(a) Connect as shown in Fig. 3. Use $R_1 = 5\Omega$, $R_2 = 10\Omega$. Use voltmeter and galvanometer to measure balance length y.

(b) Use values of y for different values of R and record x and y.

Assume:

R (Ω)	x (cm)	y (cm)
1	10	30
2	20	40
3	30	50
4	40	60
5	50	70

(c) y is related to x by:
y = ρx + aR → linear form
Plot y vs x

Slope = ρ = Δy/Δx = (70 - 30)/(50 - 10) = 40/40 = 1 Ω/cm
If R = 2 Ω, then y-intercept a = y - ρx/R = 70 - (1×50)/2 = 70 - 25 = 45

(d) Precautions:
– Ensure tight connections
– Avoid parallax errors
– Ensure uniform potentiometer wire
– Use correct balancing technique