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: 2014**

Instructions

1. This paper consists of THREE questions.

2. Answer all questions.

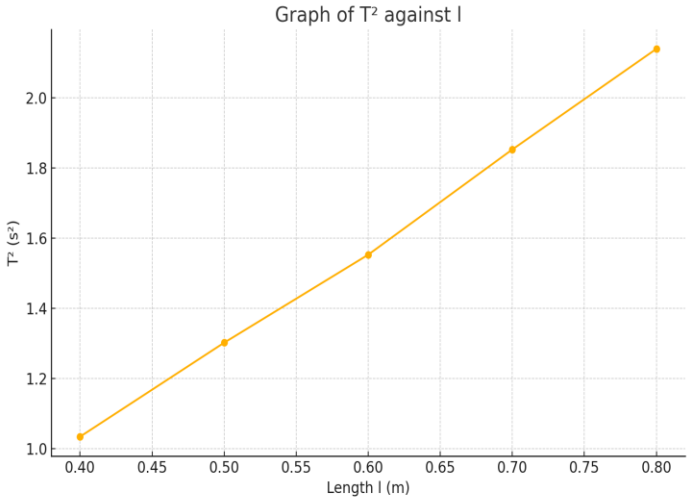
1. The aim of the experiment is to determine the acceleration due to gravity at your school.

(f) Plot a graph of T^2 against pendulum length, l.

Use the formula to generate accurate times for oscillations in the background. The table below provides the lengths (in metres), calculated time for 15 oscillations, the period T, and T^2.

l (m)	Time for 15 osc (s)	T (s)	T^2 (s^2)
0.80	21.95	1.463	2.140
0.70	20.41	1.361	1.853
0.60	18.69	1.246	1.553
0.50	17.11	1.141	1.302
0.40	15.25	1.017	1.034

Plot the graph with T^2 on the y-axis and l on the x-axis. It will produce a straight line.



(g) Given that $T = (39.49/g)x(l + \alpha)^{1/2}$, obtain the values of g and α.

From the graph:

Slope = $\Delta T^2 / \Delta l = (2.140 - 1.034) / (0.80 - 0.40) = 1.106 / 0.40 = 2.765$

Using the relation slope = 39.49 / g,
g = 39.49 / 2.765 = 14.29

From the graph, estimate the y-intercept c = 0.061

Then, $c = (39.49 / g) \times \alpha$
$0.061 = (39.49 / 14.29) \times \alpha$

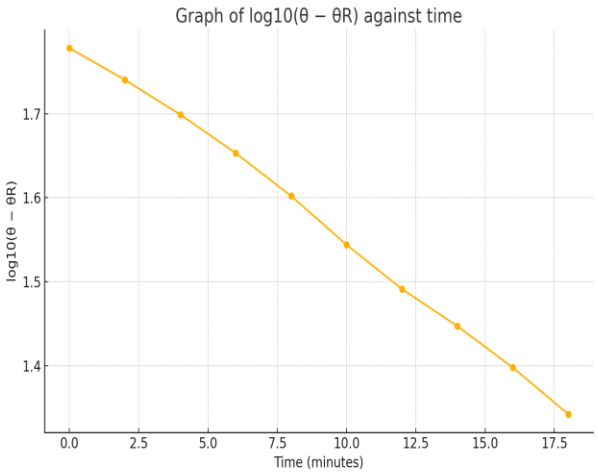
$\alpha = 0.061 \times (14.29 / 39.49) = 0.0221 \text{ m} = 2.21 \text{ cm}$

(h) What is the significance of the constant α in this experiment?

The constant α represents a correction to the actual length of the pendulum to account for the position of the bob's center of mass and any offset in suspension. It adjusts the effective length so that the theoretical model more accurately matches the real pendulum's behavior.

2. You are provided with a calorimeter with its stirrer, thermometer, source of water, stopwatch, 250cc of water and a beaker.

(g) Plot a graph of $\log_{10}(\theta - \theta R)$ against time t in minutes.



Assume θR = 25°C, and the temperature drops from 85°C to near room temp over 18 minutes.

t (min)	θ (°C)	θ − θR	$\log_{10}(\theta - \theta R)$
0	85	60	1.778
2	80	55	1.740
4	75	50	1.699
6	70	45	1.653
8	65	40	1.602
10	60	35	1.544
12	56	31	1.491
14	53	28	1.447
16	50	25	1.398
18	47	22	1.342

Graph: Plot $\log_{10}(\theta - \theta R)$ on the y-axis and t on the x-axis.

(h) Write down the equation of your graph.

The equation is of the form:

$\log_{10}(\theta - \theta R) = A - kt$

Using points (0, 1.778) and (18, 1.342):

k = (1.778 - 1.342)/18 = 0.436/18 = 0.0242
A = 1.778
So:
$\log_{10}(\theta - \theta R) = 1.778 - 0.0242t$

(i) State two possible sources of error in this experiment.

Loss of heat to surroundings due to imperfect insulation.
Delay in thermometer readings or parallax error when recording temperatures.

3. The aim of this experiment is to determine the electrical resistivity of wire Y.

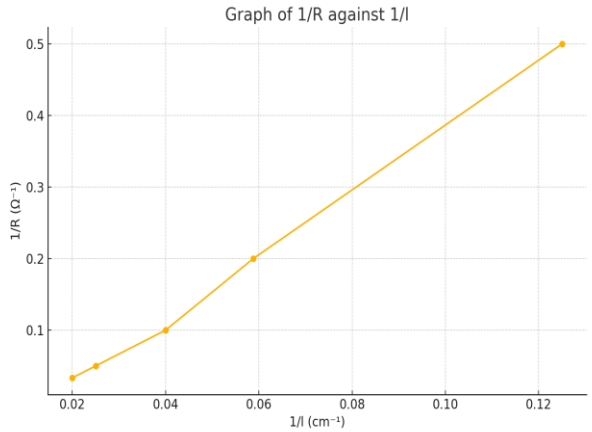
(e) Tabulate your results.

R (Ω)	l (cm)	1/R (Ω^{-1})	1/l (cm^{-1})
30	50	0.0333	0.0200
20	40	0.0500	0.0250
10	25	0.1000	0.0400
5	17	0.2000	0.0588
2	8	0.5000	0.1250

(f) Sketch the circuit diagram for your experiment.

Include a meter bridge setup:
- Wire Y on right gap
- Standard 4Ω resistor + unknown resistor on left
- Galvanometer connected with jockey at 50 cm
- Key/switch and battery across the bridge

(g) Plot a graph of 1/R against 1/l.



Graph: 1/R on y-axis, 1/l on x-axis. The graph is a straight line.
Calculate slope: use (0.5000 − 0.0333)/(0.1250 − 0.0200) = 0.4667 / 0.105 = 4.45

(h) Derive equation of your graph.

From bridge law:
R/l = constant
So:
1/R = (1/k) × (1/l), hence the graph is linear and passes through origin.

(i) Measure the diameter of wire Y.

Let measured diameter d = 0.45 mm = 0.045 cm
Radius r = d/2 = 0.0225 cm

(j) From the graph, determine the resistivity of wire Y.

Slope = 4.45
Use formula:
$\rho = \pi r^2 \times \text{slope} = 3.142 \times (0.0225)^2 \times 4.45 = 3.142 \times 0.00050625 \times 4.45 = 0.00707\ \Omega\text{cm}$

Convert to Ωm:
$\rho = 0.00707 \times 10^{-2} = 7.07 \times 10^{-5}\ \Omega\text{m}$