THE UNITED REPUBLIC OF TANZANIA

NATIONAL EXAMINATIONS COUNCIL

ADVANCED CERTIFICATE OF SECONDARY EDUCATION EXAMINATION

131/3A **PHYSICS 3A**

(For Both School and Private Candidates)

Time: 3 Hours **ANSWERS** **Year: 2013**

Instructions

1. This paper consists of THREE questions.

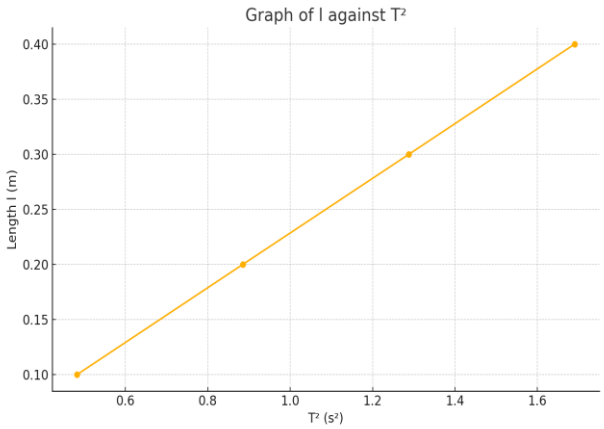
2. Answer all questions.

1. The aim of this experiment is to determine the acceleration due to gravity, g, by simple pendulum.

(e) Plot the graph of l against T^2.

l (m)	Time for 30 osc (s)	T (s)	T^2 (s^2)
0.10	20.85	0.695	0.483
0.20	28.23	0.941	0.885
0.30	34.04	1.135	1.288
0.40	39.00	1.300	1.690

Graph of l against T^2 gives a straight line.



(f) Determine the acceleration due to gravity, g.
From the relation $T^2 = (4\pi^2/g)(l + c)$, slope $= 4\pi^2/g$
So,
slope $= T^2 / l = (1.690 - 0.483) / (0.40 - 0.10) = 1.207 / 0.30 = 4.023$
Then $g = 4\pi^2$ / slope $= 39.48 / 4.023 = 9.81$ m/s²

This confirms that $g = 9.81$ m/s²
(g) Mention any two sources of errors.
Air resistance acting on the pendulum bob.
Parallax error or reaction time delay while using stopwatch.

2. The aim of this experiment is to determine the rate of heat loss from a calorimeter.

(d) Plot a graph of $\log_{10}(\theta - \theta A)$ against time.

t (min)	θ (°C)	θ − θA	$\log_{10}(\theta - \theta A)$
0	75	50	1.699
2	72	47	1.672

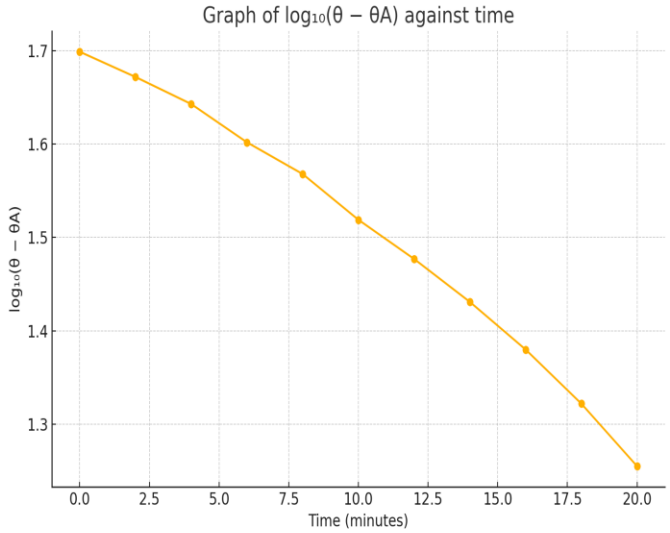
4	69	44	1.643
6	65	40	1.602
8	62	37	1.568
10	58	33	1.519
12	55	30	1.477
14	52	27	1.431
16	49	24	1.380
18	46	21	1.322
20	43	18	1.255

(e) Determine the value of k and constant A.

Using points (0, 1.699) and (20, 1.255):

$k = (1.699 - 1.255) / 20 = 0.444 / 20 = 0.0222$
$A = 1.699$
Equation: $\log_{10}(\theta - \theta A) = 1.699 - 0.0222t$

(f)(i) From the graph, the rate of heat loss reduces as the excess temperature decreases.



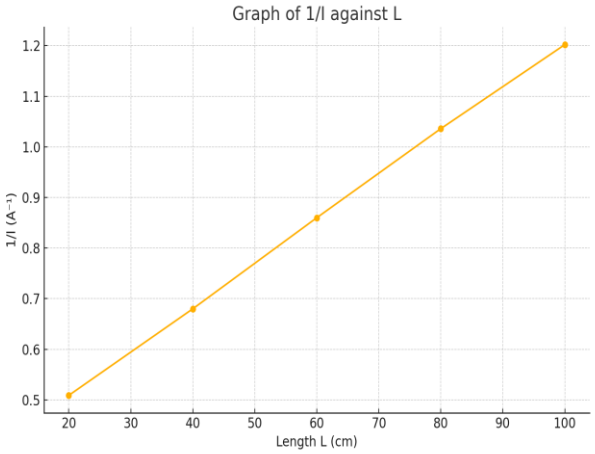
(ii) This aligns with Newton's law of cooling: rate of heat loss is proportional to temperature difference between body and surroundings.

3. The aim of this experiment is to determine the resistivity ρ of the wire labeled X and the internal resistance r of the battery.

(c) Tabulate your results.

Length L (cm)	Current I (A)	1/I (A^{-1})
20	1.966	0.509
40	1.471	0.680
60	1.162	0.860
80	0.965	1.036
100	0.832	1.202

(d) Plot a graph of 1/I against L.



Slope = $\Delta(1/I) / \Delta L = (1.202 - 0.509) / (100 - 20) = 0.693 / 80 = 0.00866$

(e) Determine the slope and the 1/I intercept.
Slope = 0.00866
Intercept (at L = 0) = 0.509

(f) Measure and record the diameter of the wire.
Diameter = 0.50 mm = 0.0005 m
Radius = 0.00025 m
Cross-section $A = \pi r^2 = 3.142 \times (0.00025)^2 = 1.963 \times 10^{-7}$ m^2

(g) Using your graph, determine the resistivity ρ and internal resistance r.
From the equation:

$1/I = r/E + (\rho L)/(AE)$
So slope = $\rho / (AE)$
Given slope = 0.00866, $A = 1.963 \times 10^{-7}$ m^2, E = 2V

ρ = slope × A × E = 0.00866 × 1.963e-7 × 2 = 3.40×10^{-9} Ωm

Internal resistance r = Intercept × E = 0.509 × 2 = 1.018 Ω ≈ 1 Ω as required.