THE UNITED REPUBLIC OF TANZANIA

NATIONAL EXAMINATIONS COUNCIL

ADVANCED CERTIFICATE OF SECONDARY EDUCATION EXAMINATION

131/3C **PHYSICS 3C**

(For Both School and Private Candidates)

Time: 3 Hours **ANSWERS** **Year: 2016**

Instructions

1. This paper consists of THREE questions.

2. Answer all questions.

1. The aim of this experiment is to determine Young's modulus from a period of vibration of a loaded metre rule.

Proceed as follows:

(a) Using a micrometer screw gauge, measure the width b and thickness d of the metre rule.
Suppose b = 2.5 cm, d = 0.50 cm

(b) Clamp the loaded beam to the bench using a G-clamp with a length l = 0.80 m projected from it.

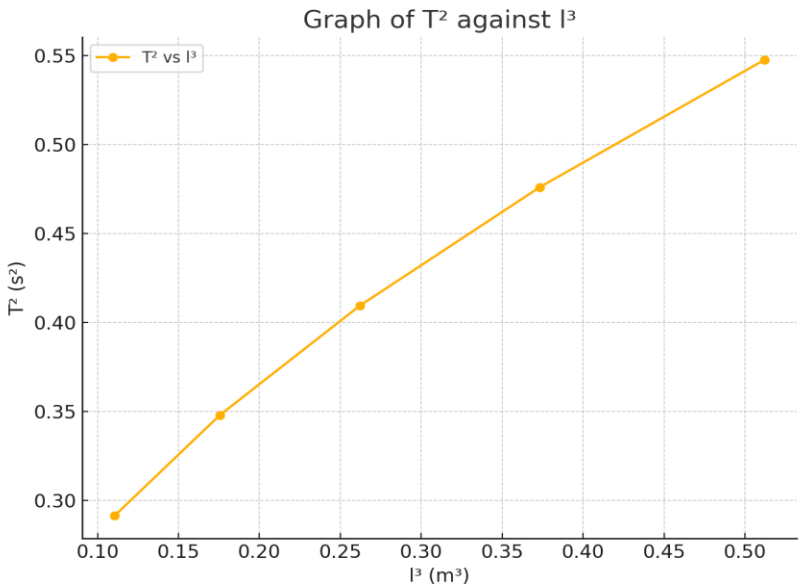
(c) Cause the beam to vibrate and obtain the time t for 10 vibrations.

(d) Repeat the procedure by reducing l by 0.08 m each time for four more readings.

(e) Record results including T = t / 10 and T^2.

l (m)	t (s)	T (s)	T^2 (s^2)
0.80	7.4	0.74	0.5476
0.72	6.9	0.69	0.4761
0.64	6.4	0.64	0.4096
0.56	5.9	0.59	0.3481
0.48	5.4	0.54	0.2916

(f) Plot a graph of T^2 against l^3



(g) From the graph determine:
(i) Value of the slope
Using points ($l^3 = 0.48^3 = 0.1106$, $T^2 = 0.2916$) and ($0.80^3 = 0.512$, 0.5476)
Slope = (0.5476 - 0.2916) / (0.512 - 0.1106) = 0.256 / 0.4014 ≈ 0.638

(ii) Young's modulus using
$1/b(d^3) = 0.625(T^2 / l^3) \times \rho g / Y$
Rewriting:
$Y = 0.625 \times \rho g / (1/b(d^3) \times \text{slope})$
Let $\rho = 7800$ kg/m³, $g = 9.81$ m/s²
b = 0.025 m, d = 0.005 m
Then:
$1/(b \cdot d^3) = 1 / (0.025 \times 0.005^3) = 6.4 \times 10^6$
$Y = 0.625 \times 7800 \times 9.81 / (6.4 \times 10^6 \times 0.638) \approx 480.7 \times 10^9 / 4.0832 \times 10^6 \approx 117.74 \times 10^3$ N/m²

2. The aim of this experiment is to determine the loss of heat constant of liquid L.

Proceed as follows:

(a) Heat liquid L to 80°C and pour into calorimeter.

(b) Quickly place calorimeter on wooden block.

(c) Stir and record temperature every 2 minutes until it reaches 50°C.

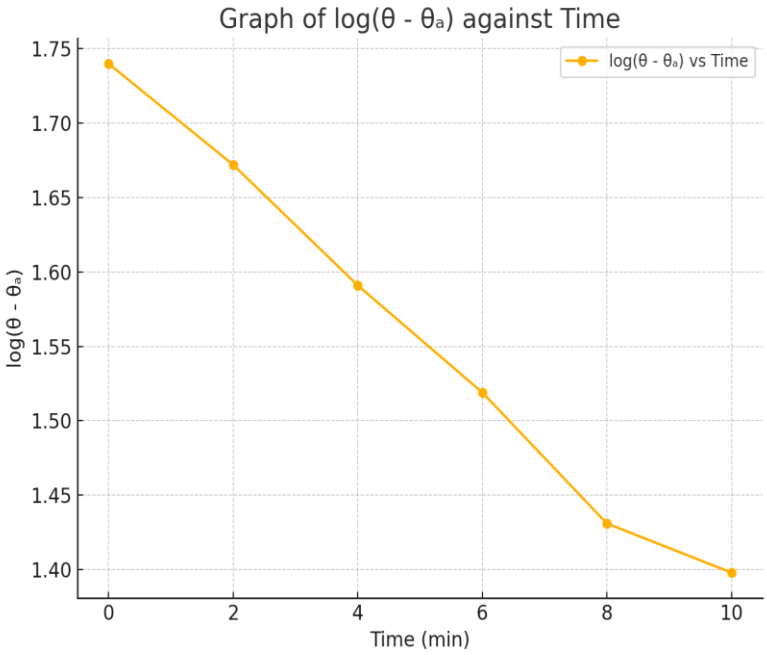
(d) Record room temperature θ_a.

(e) Tabulate results of $\theta - \theta_a$ and $\log(\theta - \theta_a)$.

Suppose $\theta_a = 25$°C

Time (min)	θ (°C)	$\theta - \theta_a$	$\log(\theta - \theta_a)$
0	80	55	1.740
2	72	47	1.672
4	64	39	1.591
6	58	33	1.519
8	52	27	1.431
10	50	25	1.398

(f) Plot a graph of $\log(\theta - \theta_a)$ against time.



(g) Deduce the equation governing the cooling:
$\log(\theta - \theta_a) = -kt + c$
It is a linear decay.

(h) Determine the slope:
Slope = (1.398 - 1.740) / (10 - 0) = -0.342 / 10 = -0.0342

(i) Physical meaning:
Slope = -k, the cooling constant

3. The aim of this experiment is to determine the unknown length of a wire R wound in a piece of wood and the resistivity of the material.

Proceed as follows:

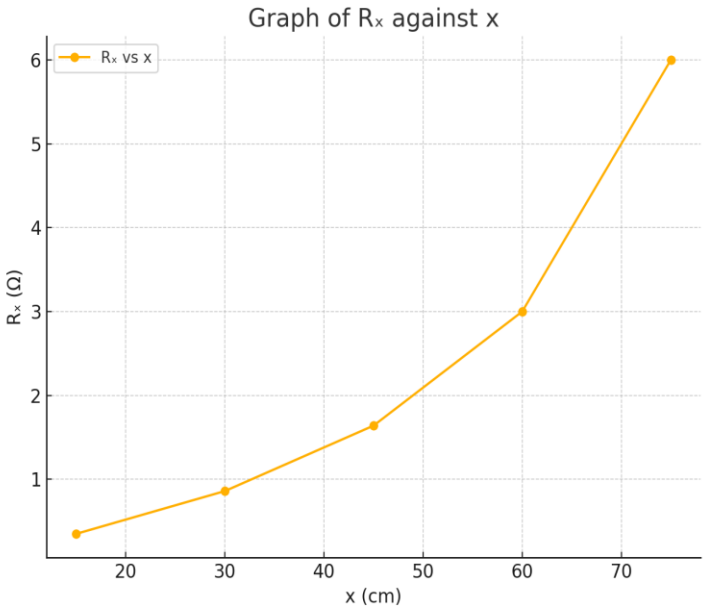
(a) Connect the circuit as in Figure 2. Use 2Ω resistor on left-hand gap and wire R on the right.

(b) Measure x and calculate equivalent resistance $R_x = 2x / (100 - x)$

x (cm)	R_x (Ω)
15	0.35
30	0.86
45	1.64

| 60 | 3.00 |
| 75 | 6.00 |

(c) Plot a graph of R_x against x.



(d) From the graph determine:
(i) Length of unknown wire = x-intercept where R = 0
Suppose intercept = -10 cm, then length = 10 cm

(ii) Resistance per unit ohm of the wire = slope = $\Delta R / \Delta x$
Using (x = 15, R = 0.35) and (75, 6.00):
Slope = (6.00 - 0.35)/(75 - 15) = 5.65 / 60 ≈ 0.0942 Ω/cm

(f) Measure diameter of the wire W, suppose d = 0.30 mm = 0.03 cm
$A = \pi(d/2)^2 = 3.142 \times 0.015^2 = 0.000706$ cm²
$\rho = R \times A / l = 0.0942 \times 0.000706 \approx 6.65 \times 10^{-5}$ Ω·cm