THE UNITED REPUBLIC OF TANZANIA

NATIONAL EXAMINATIONS COUNCIL

ADVANCED CERTIFICATE OF SECONDARY EDUCATION EXAMINATION

131/3A **PHYSICS 3A**

(PRACTICAL A)

(For Both School and Private Candidates)

Duration: 3 Hours **ANSWERS** **Year: 2025**

Instructions

1. This paper consists of seven questions.
2. Answer a total of **five (5)** questions. Question number **one (1)** is compulsory.
3. Each question carries **twenty (20)** marks.
4. All writing must be in **black** or **blue** ink except for drawings which must be in pencil
5. Communication devices and any unauthorised materials are **not** allowed in the examination room.
6. Write your **Examination Number** on every page of your answer booklet(s).

1. You are provided with the plastic ruler (30 cm), metre rule, retort stand with its accessories, mass, **M**, thread, masking tape, micro meter screw gauge and weighing balance. Proceed as follows:

    1. By using cork pads on the retort stand, clamp the given 30 cm ruler so that its flat side is horizontal and the protruding length, l = 27 cm. Using a masking tape, fix the thread with length L = 110 cm at the end of the ruler and the mass, **M** hanging at the bottom as shown in Diagram 9.

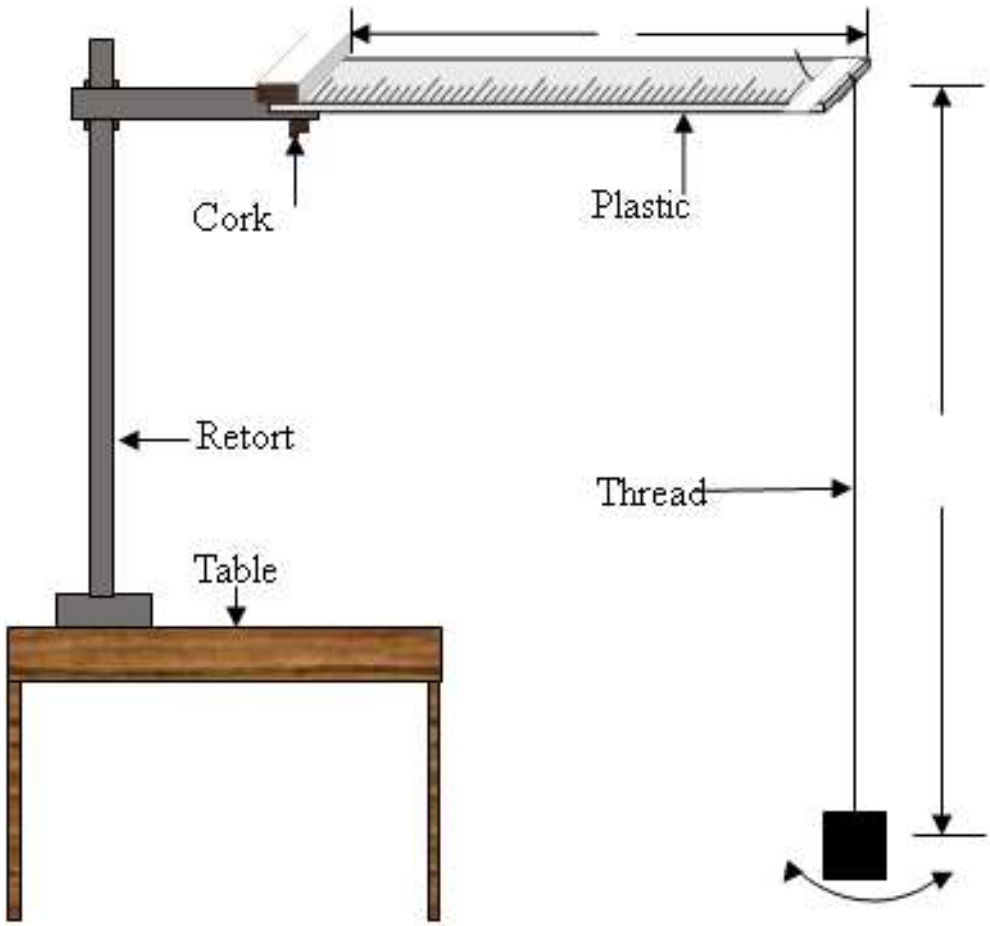


Diagram 6

2. Displace the mass, **M** a small distance from its equilibrium and release it so that it executes oscillations in a plane parallel to the ruler. Measure and record the time, t_{10} for ten oscillations and hence compute its periodic time T.
3. Repeat the procedures in 1 (b) when the lengths of the thread is L= 90 cm, 70 cm ,50 cm and 30 cm

Questions:

(i) Tabulate your results including the values of L (m), t_{10}(s), T(s) and $T^2(s^2)$

Table of results

L (cm)	t_{10} (sec)	T (sec)	$T^2(sec^2)$
1.1	20.8	2.1	4.3
0.9	18.7	1.9	3.5
0.7	16.8	1.7	2.8
0.5	14.2	1.4	2.0
0.3	11.0	1.1	1.2

(ii) Plot a graph of $T^2(s^2)$ against L(cm)

(iii) If T and L are related by $T^2 = 4.03L + T^2_c$, what is the value of T^2_c?

From the relation

$T^2 = 4.03L + T^2c$,

Relate with the graph.

$T^2 = 4.03L + T^2c$.

$y = m\,x + c$,

So; T^2-intercept = T^2c.

T^2-intercept = 0.067 sec^2.

Hence; T^2c = 0.067 sec^2.

(iv) Physical meaning of T^2c is the periodic time of oscillation of the plastic ruler set to oscillates when the L = 0 cm or mass removed.

Tc is periodic time of oscillating plastic ruler.

(v) To Measure and Record

• Mass of solid M.

M = 100 g.

• Breadth b, of Ruler.

b = 3.1 cm.

b = 0.031 m

• Thickness t.

t = 0.24 cm

t = 2.4 x 10^{-3} m

1 (vi)

To compute Young's modulus.

From;

$E = 16\pi^2 M / bTc (l / t)^3$

$Tc = \sqrt{T^2}$

$Tc = \sqrt{T^2}$-intercept

$Tc = \sqrt{0.067}\ sec^2 \Rightarrow 0.259$ sec

b = 0.031 m l = 27 cm t = 0.24 cm M = 0.11 kg

Hence;

$E = 16\pi^2 \times 0.11\ kg \times (0.27\ m)^3$

$0.031\ m \times 0.259\ sec$

$E = 1964.79609 \times (0.27\ m)^3$

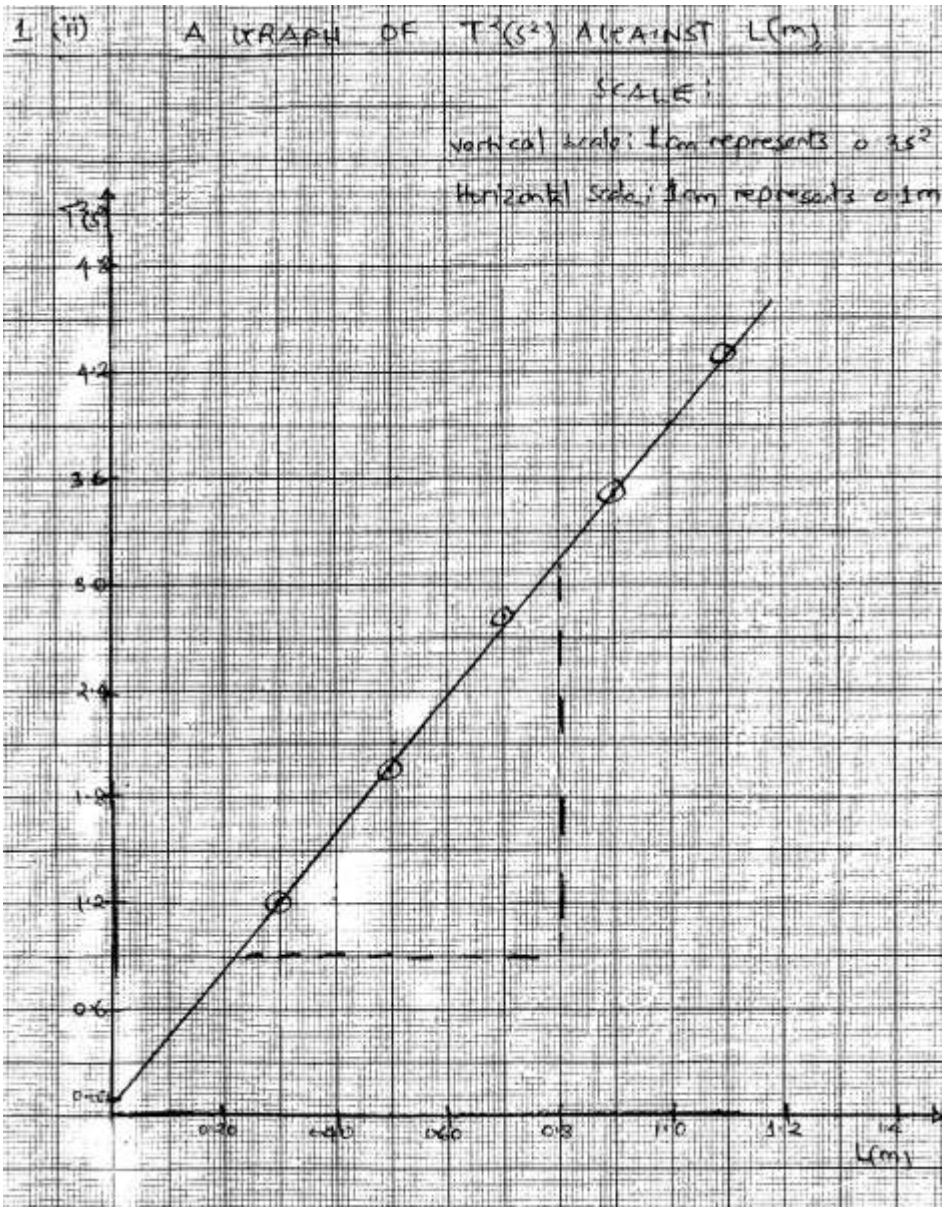
$(2.4 \times 10^{-3}\ m)$

$E = 2797\ 531\ 933$

$E = 2.798 \times 10^9\ N/m$

Young's modulus of plastic ruler

is $2.798 \times 10^9\ N/m$.



2. You are required to investigate the cooling behavior of a copper calorimeter under different conditions. Proceed as follows:
    1. Half-filled the calorimeter with hot water of about 90^0. Cover the calorimeter with a lid and insert the calorimeter through the opening so as to read the temperature of water.
    2. Starting with temperature of 80^o, read and record the temperature of water at the interval of one minute for 10 minutes while stirring and fanning using cardboard.
    3. Wet the given cloth normal tap water.
    4. Repeat the procedures in 2 (a) and (b), but in this case wrap the calorimeter with a wet cloth just before starting recording the temperature.

Questions:

2 (i) TABLE OF RESULTS.

Time interval t (min)	Temperature for Calorimeter without cloth	Calorimeter with wet cloth
0	80°C	80°C
1	72°C	70°C
2	65°C	62°C
3	59°C	55°C
4	54°C	50°C
5	50°C	45°C
6	46°C	41°C
7	43°C	38°C
8	41°C	36°C
9	38°C	34°C

10	36°C	32°C

(ii) A graph for Cooling Curve was plotted.

(iii) The temperature of water at 7th minute is 43°C for Calorimeter without wet cloth and is 38°C for Calorimeter covered with wet cloth.

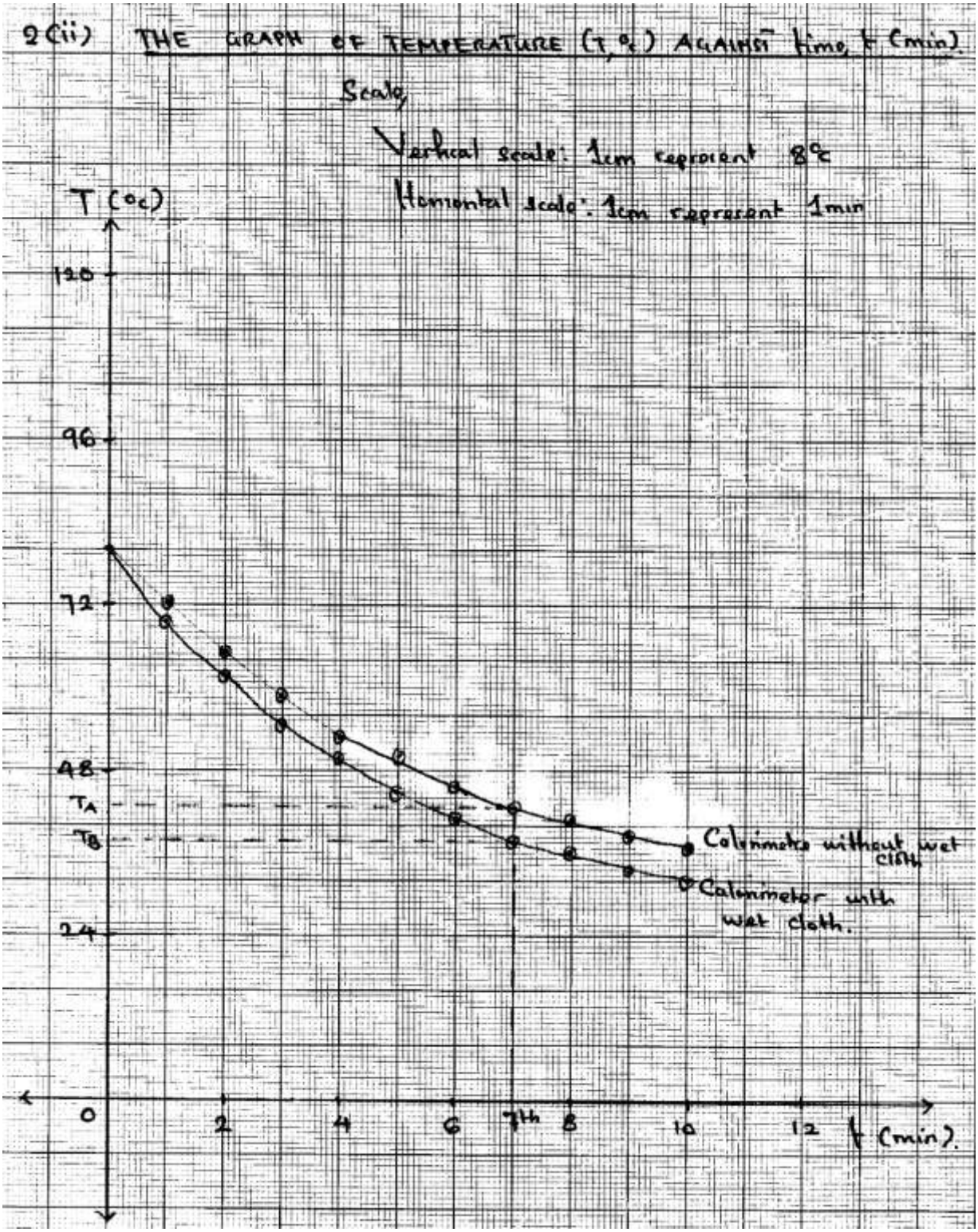
TA = 43°C

TB = 38°C

(iv) Water cooled faster in a setting with wet cloth because;

a) The wet cloth absorb heat from the Calorimeter hence facilitate cooling.

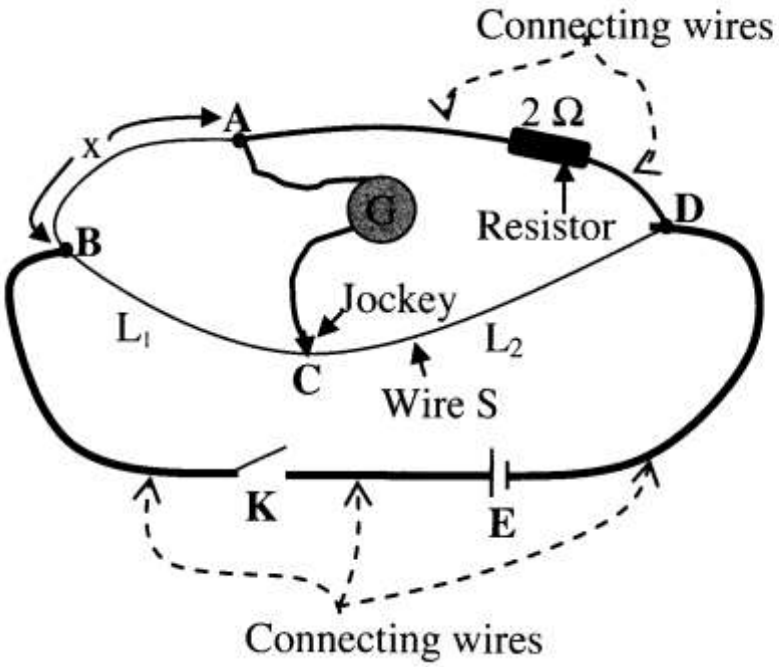
b) The wet cloth contained cold water which has high specific heat capacity hence facilitate heat loss from calorimeter.



3. You have been provided with a 2 Ω standard resistor, resistance wire **S**, galvanometer G, dry cell E (1.5 V, size D), switch K, jockey and connecting wires. Determine the resistivity of wire, **S** through the following procedures.

(a) Connect 80 cm of wire S together with 2 Ω resistor in series to make a loop.

(b) Connect wires from the terminals of the dry cell E, at junction B and junction D, then connect resistance wire **S** from the junction A to junction B and complete the circuit as shown in a Diagram 9.



(c) Close the switch, K and determine the balancing point C. Read and record the lengths, L_1 and L_2

(d) Repeat the procedures in 3(b) and (c) for the value of x equal to 20cm, 30cm, 40cm, and 50cm.

Questions:

3 (i) THE TABLE OF RESULTS

X (cm)	L1 (cm)	L2 (cm)	L1/L2
10	16.3	53.7	0.304
20	22.5	37.5	0.600
30	23.7	26.3	0.901
40	21.8	18.2	1.198
50	18.2	11.8	1.542

(ii) A graph of x (cm) against L1/L2 was plotted.

(iii) The slope

from

slope (s) = $\Delta x / \Delta(L1/L2)$

$(s) = \frac{(42.5 - 15)\text{ cm}}{(1.3 - 0.455)}$

s = 32.54 cm

∴ The slope of the graph was

32.54 cm.

3 (iv) The diameter of wire S was

0.32 mm

(v) The resistivity of wire S.

from

$Rx / L1 = 2\Omega / L2$

but $Rx = \rho x / A$

3 (vi) Since

$\rho x / A\ L1 = 2\Omega / L2$

$\rho x = 2\ A\ L1$

$L2$

$x = 2\ A \cdot L1$

$\rho \quad L2$

$y \quad m \quad x$

Slope (s) = $2A / \rho$ Where ρ is resistivity of wire S.

$\rho = 2A / s$

but

$A = \pi d^2 / 4 = 8.04 \times 10^{-4}\ cm^2$

$\rho = 2 \times \pi\ d^2$

$4\ s$

$d = 0.32\ mm$

$= 0.032\ cm$

$\rho = 2 \times \pi \times (0.032\ cm)^2$

$4 \times 32.54\ cm$

$\rho = 6.43 \times 10^{-3}\ cm^2\ \Omega$

$4 \times 32.54\ cm$

$\rho = 4.9 \times 10^{-5}\ \Omega\ cm$

∴ The resistivity of wire S was

$4.9 \times 10^{-5}\ \Omega$ cm.