THE UNITED REPUBLIC OF TANZANIA

NATIONAL EXAMINATIONS COUNCIL

ADVANCED CERTIFICATE OF SECONDARY EDUCATION EXAMINATION

131/3B **PHYSICS 3B**

(PRACTICAL B)

(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. Rectangular wooden bars are used for making floors of pedestrian bridges. You are required to investigate the suitability of the wooden bar provided.

   Proceed as follows:

   (a) Locate the centre of gravity G of the given bar.

   (b) Firmly clamp the metre rule at its centre on the retort stand so that its flat side is vertical. Note that the retort stand has to be clamped on the bench.

   (c) Pass the bar through the two loops made on the ends of the two lengths of cotton threads.

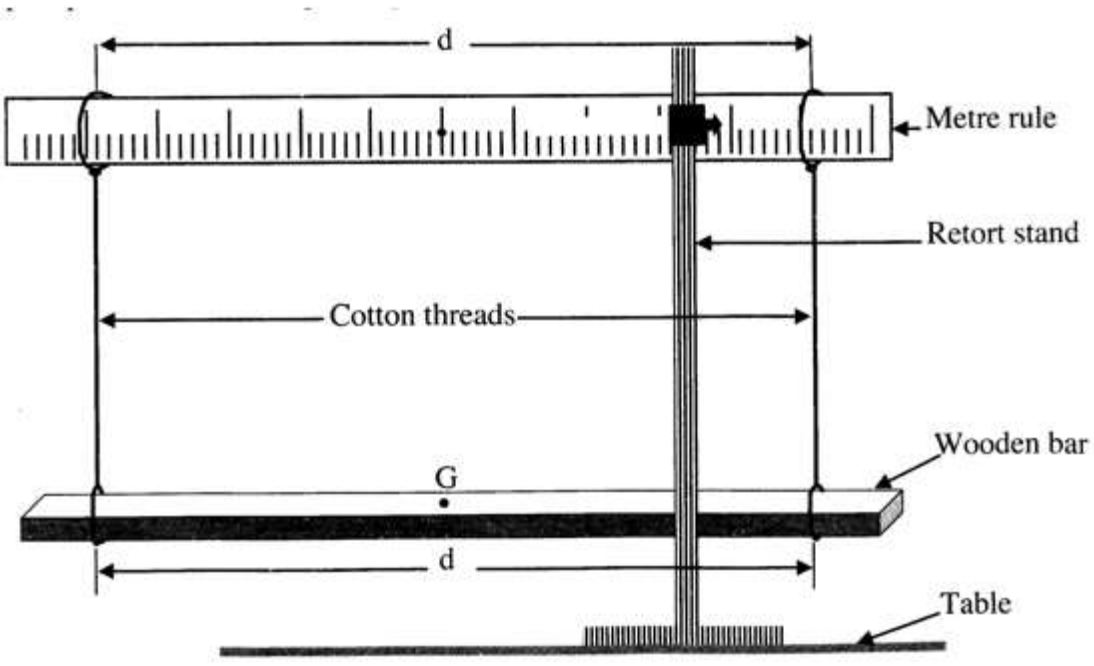
   (d) Arrange the threads so that they are at a distance of d = 90cm apart. Adjust the length of the threads to 100 cm.

   (e) Tie off the loose ends of the threads on the clamped metre rule. Make sure the threads are vertical and parallel as shown in Diagram 7.

   (f) Give the bar a small angular displacement about a vertical axis.

   (g) Record the time, t(s) by timing 10 oscillations and hence determine the periodic time T(s).

   (h) Repeat procedures (d) to (g) using, d=70 cm, 50 cm, 30 cm and 10 cm.



Questions:

1 (i) TABLE OF RESULTS

d (cm)	1/d (cm^{-1})	time t (s) (10 oscillations)	T (s)	T / d (m^{-1})
90	0.0111	12.60	1.26	1.11
70	0.0143	16.20	1.62	1.43
50	0.0200	22.70	2.27	2.00
30	0.0333	37.80	3.78	3.33
10	0.1000	113.40	11.34	10.0

(ii) Slope of the graph

Slope = $\frac{\Delta T\ (s)}{\Delta\ 1/d\ (m^{-1})}$

From graph

A (4, 4.56)

B (8, 9.12)

Slope, m = $\frac{(9.12 - 4.56)\ s}{(8 - 4)\ m^{-1}}$

= 1.14 s m

∴ The slope of the graph is 1.14 m s

1 (iv). To evaluate the mass, M (kg) of the wooden bar from

$T = 2.81\ \sqrt{(1 / Mg)}$

$T = (2.81\ \sqrt{(1 / Mg)})\ (1 / d)$

Compare with y = mx + c

Slope, $Mo = 2.81\ \sqrt{(1 / Mg)}$

$Mo = 2.81\ \sqrt{(1 / Mg)}$

$Mo^2 = (2.81)^2 (1 / Mg)$

$M = (2.81)^2 / (Mo^2 g)$

But

$g = 981 \text{ cm } s^{-2}$

$g = 9.81 \text{ m } s^{-2}$

also

$Mo = \text{slope} = 1.14 \text{ m s}$

$M = (2.81)^2 / (1.14 \text{ m s})^2 \times 9.81 \text{ m } s^{-2}$

$M = 7.8961 / 12.749076$

1 (iv).

$M = \frac{7.9}{12.7}$

$M = 0.622 \text{ kg}$

∴ The mass, M of the bar is 0.622 kg.

1 (vi). When d = 0

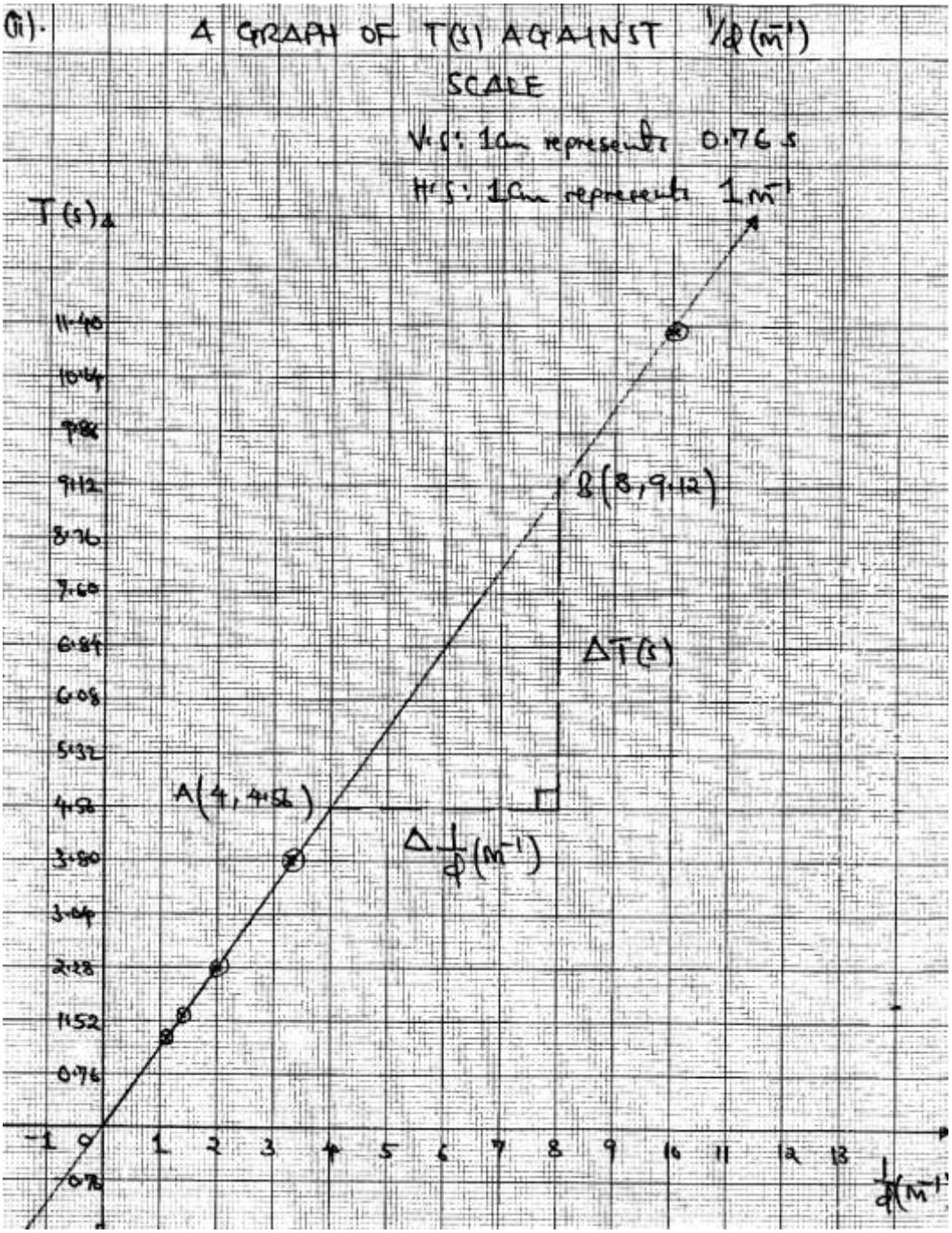
$T = 2.81 / d \sqrt{(1 / Mg)}$

$T = 2.81 / 0 \sqrt{(1 / Mg)}$

$T = \infty \sqrt{(1 / Mg)}$

$T = \infty$

∴ When d = 0, the period of oscillation (T) will be infinity, hence the time taken for a bar to oscillate will increase rapidly up to infinity, hence the bar will rotate.



2. You are required to determine the specific heat capacity of a solid mass using Newton's law of cooling. Proceed as follows:
   (a) Measure and record the mass of the empty calorimeter.
   (b) Record the room temperature θ_R
   (c) Half-filled the calorimeter with hot water and cover it with lid. Insert the thermometer through the opening so as to be able to read the temperature of the water.
   (d) Start with temperature of 80^0 C while stirring and fanning using cardboard read and record the temperature, of the water after every 1 minute for ten minutes.
   (e) Measure and record the mass of the calorimeter that is half filled with water then pour it out.
   (f) Quickly transfer the solid, m of mass, X into the calorimeter and repeat the procedures 2 (c), (d) and (e) to obtain the cooling behaviour of the mixture.

Questons:

(a) Mass of empty calorimeter is 32.5 g

(b) Room temperature is 24°C

(e) Mass of the calorimeter that is half-filled with water is 85.1 g

(f) Mass of the calorimeter with half-filled water and a solid of mass X is 184.4 g

(i) Mass of the water that half-filled the calorimeter

85.1 − 32.5 = 52.6 g

(ii) TABLE OF RESULTS

Time (t) min	θ°C without solid mass	θ°C with solid mass
0	80	80
1	78	77
2	76	75

3	74	73
4	72	71
5	70	68
6	68	66
7	66	65
8	64	63
9	62	60
10	60	58

2 (iii)

i) To determine the time taken for water to cool from 80°C after every one minute.

(iv) The graph was plotted on the graph paper.

(v) From the graph the time at which the difference in temperature is at 6 minutes.

(vi) From

$Xs\ (\theta_2 - \theta r) = (Mc\ Cc + Mw\ Cw)\ \Delta\theta$

$\Delta\theta = 68 - 66$

$\Delta\theta = 2°C$

$\theta_2 = 68°C$

2 (vi)

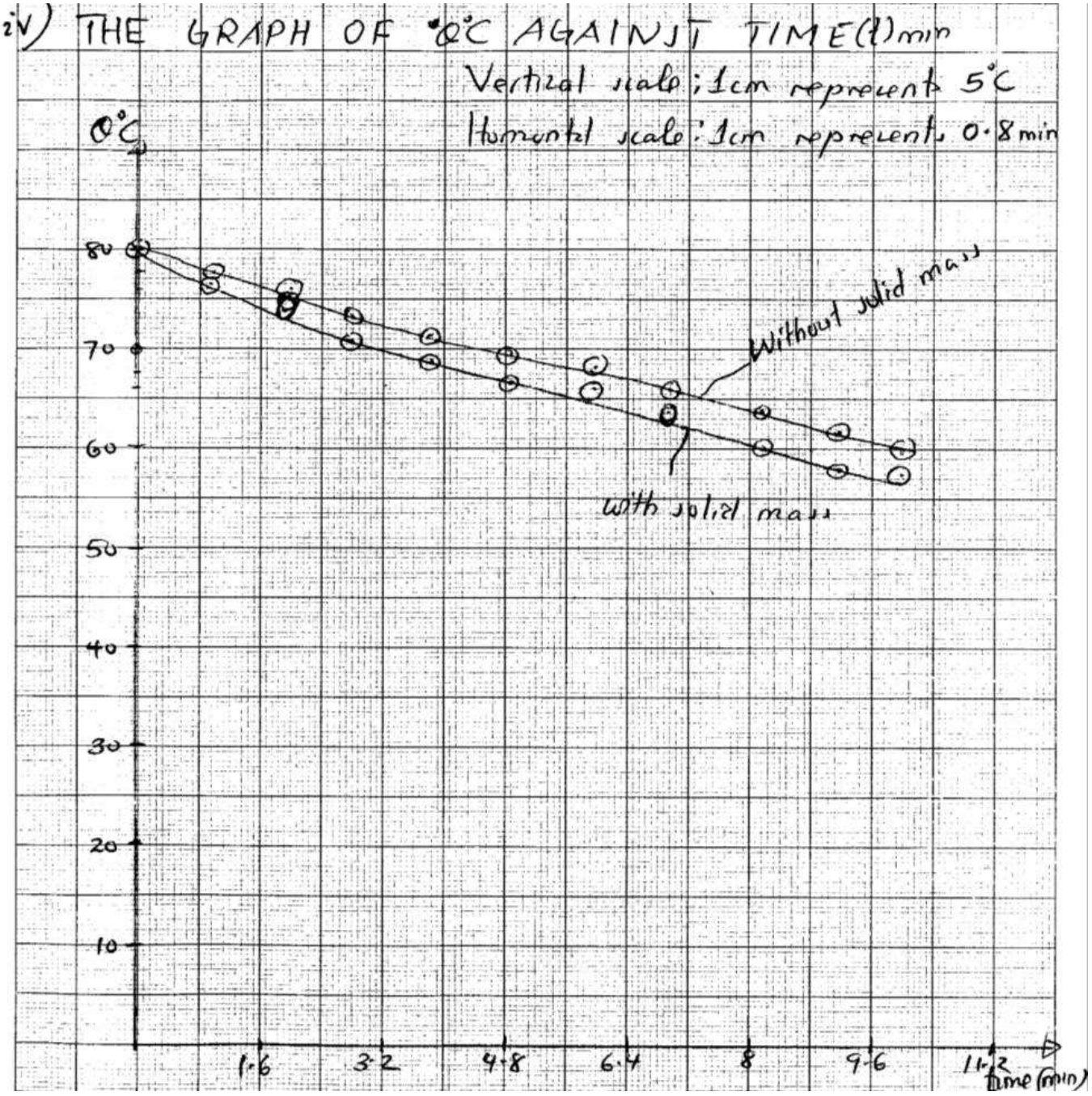
$C = (Mc\ Cc + Mw\ Cw)\ \Delta\theta \times (\theta_2 - \theta r)$

$C = ((52.6 \times 10^{-3} \times 4200) + (32.5 \times 10^{-3} \times 400)) \times 2100 \times 10^{-3}\ (68 - 24)$

$C = 395\ J\ kg^{-1}\ K^{-1}$

∴ The specific heat capacity of a solid mass is $395\ J\ kg^{-1}\ K^{-1}$

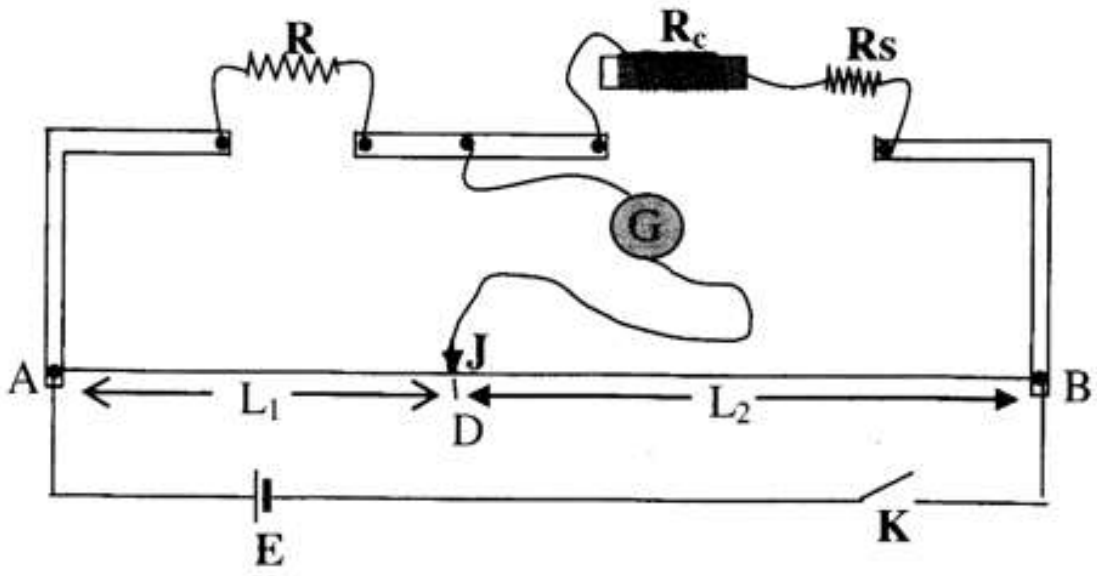
2 iv) THE GRAPH OF °C AGAINST TIME(t) min



3. You are provided with the coiled wire **Rc**, a metre bridge standard resistor **Rs** of 1 Ω, resistance box **R,** dry cell **E**, key **K**, micro meter screw gauge, jockey **J,** galvanometer **G** and connecting wires.

   Perform the experiment to determine the resistivity of the wire according to the following procedures.

(a) Connect your circuit as shown in Diagram 10.



(b) Set R=1Ω, close the key**,** **K** and determine the balancing point D. Record the lengths, L_1 and L_2

(c) Repeat the procedures in 3(b) by setting R=2Ω, 3Ω, 4Ω, 5Ω and 6Ω each time recording lengths, L_1, L_2 corresponding to the value of R used.

Questions

3. Question:

(i) Table of Results;

R (Ω)	L1 (cm)	L2 (cm)	L1/L2
1	26.5	73.5	0.361
2	41.9	58.1	0.721
3	51.9	48.1	1.079
4	57.0	43.0	1.459
5	64.3	35.7	1.801
6	68.4	31.6	2.165

(ii) Diameter of the used wire = 0.375 mm = 0.375 x 10^{-3} m

from cross-sectional area = $\pi r^2 = \pi d^2 / 4$

$$= \frac{3.14 \times (0.375 \times 10^{-3}\ m)^2}{4}$$

$= 1.104 \times 10^{-7}\ m^2$

∴ The cross-sectional area of the coiled wire is 1.104×10^{-7} m².

(iii) Solution:

According to Wheatstone bridge principle,

$R / L_1 = (Rc + Rs) / L_2$

$L_1 / L_2 = R / (Rc + Rs)$

$L_1 / L_2 = (1 / (Rc + Rs)) R$

(v) from slope = $\Delta y / \Delta x$

03 (v)

Slope, $S = \Delta(L1/L2)$
$\Delta R\ (\Omega)$

$= (1.65945 - 0.8658)$
$(4.615 - 2.3998)\ \Omega$

$= 0.79365$
$2.2152\ \Omega$

Slope, $S = 0.35827\ \Omega^{-1}$

∴ The slope of the graph is $0.35827\ \Omega^{-1}$

(vi) Solution:

Length, l = 40 cm = 40/100 m = 0.4 m

Area of cross-section, $A = 1.104 \times 10^{-7}\ m^2$

Slope, $S = 0.35827\ \Omega^{-1}$

from

$L1/L2 = (1 / (Rc + Rs))\ R + 0$

$y = m\ x + c$

On comparing

$m = 1 / (Rc + Rs)$

$0.35827\ \Omega^{-1} = 1 / (Rc + 1\ \Omega)$

$Rc + 1\ \Omega = 1 / 0.35827\ \Omega^{-1}$

$Rc + 1\ \Omega = 2.79\ \Omega$

$Rc = 1.79\ \Omega$

03 (vi) from

$$\rho = \frac{AR}{L}$$

$$\rho c = \frac{Ac\ Rc}{Lc}$$

$$= \frac{1.104 \times 10^{-7}\ m^2 \times 1.79\ \Omega}{0.4\ m}$$

$= 1.9774 \times 10^{-7}\ \Omega\ m$

0.4

$\rho c = 4.94 \times 10^{-7}\ \Omega\ m$

$\therefore$ The resistivity of the wire is $4.94 \times 10^{-7}\ \Omega\ m$