

THE UNITED REPUBLIC OF TANZANIA
NATIONAL EXAMINATIONS COUNCIL
ADVANCED CERTIFICATE OF SECONDARY EDUCATION
EXAMINATION
131/3C
PHYSICS 3C
(PRACTICAL C)

(For Both School and Private Candidates)

Duration: 3 Hours

ANSWERS

Year: 2025

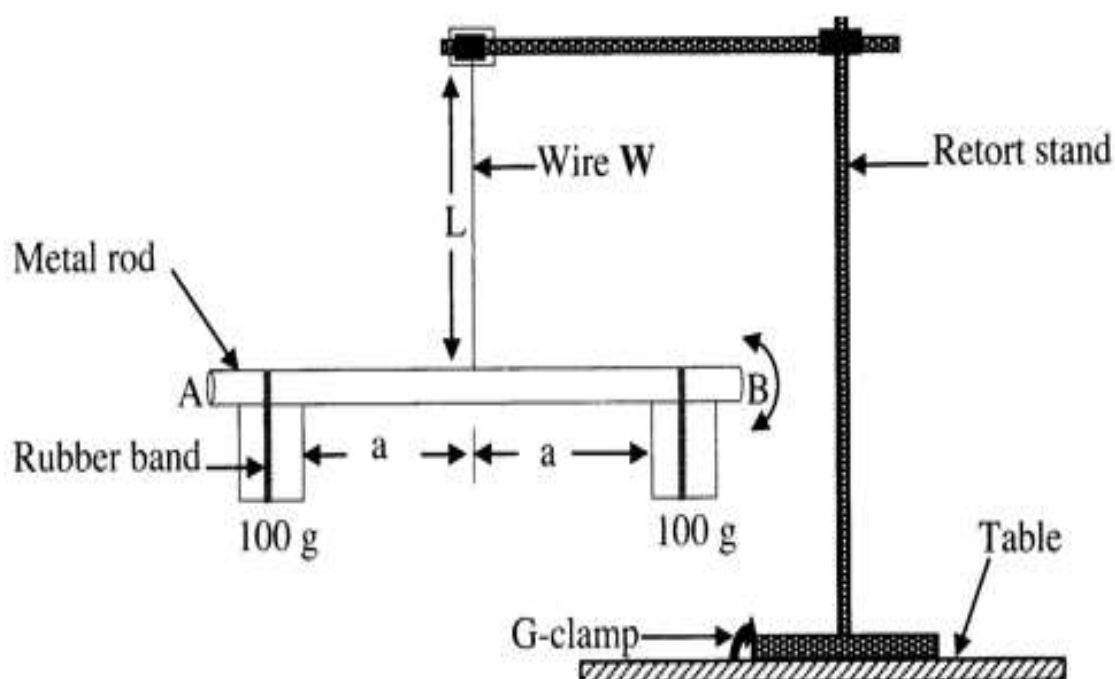
Instructions

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 have been provided with wire **W**. Perform an experiment to determine the shear modulus of the wire given. Proceed as follows:

(a) Arrange the apparatus as shown in Diagram 11.



- (b) Mount a metal rod AB at its centre point, then adjust the length, L of wire, W about 50 cm so that when the metal rod AB is twisted through A at a small angle in the horizontal plane about its centre point, it executes oscillations.
- (c) Fasten the two masses firmly on the rod by using a rubber band, at equal distance in centimetres measured from the suspended wire, W to the mid-point of each mass.
- (d) Twist the metal rod and record the time, t for 10 oscillations of the rod when the distance from the wire to the mass, $a=3$ cm. Hence obtain its periodic time T

- (e) Repeat the procedure outlined in 1 (d) for the values of $a = 5 \text{ cm}$, 7 cm , 9 cm and 11 cm .

Questions:

$$\begin{aligned} \text{(iv) Slope} &= (986.10 - 692) \text{ cm}^2 / (607.38 - 418) \text{ s}^2 \\ &= 1.56 \text{ cm}^2/\text{s}^2 \end{aligned}$$

$$= 1.56 \times 10^{-2} \text{ cm}^2/\text{s}^2$$

$$\text{(v) Slope} = \frac{\eta \times r^4}{8 \times \pi \times L}$$

$$8 \times \pi \times L$$

$$\eta = \text{slope} \times 8\pi L r^4$$

$$r = d/2$$

$$= 0.320 \text{ mm}$$

$$2$$

$$= 0.016 \text{ mm}$$

$$= 0.016 \times 10^{-3} \text{ m}$$

$$= \frac{1.56 \times 10^{-2} \text{ m}^2 \text{ s}^{-2} \times 8 \times 3.14 \times 0.5}{(0.016 \times 10^{-3})^4}$$

$$(0.016 \times 10^{-3})^4$$

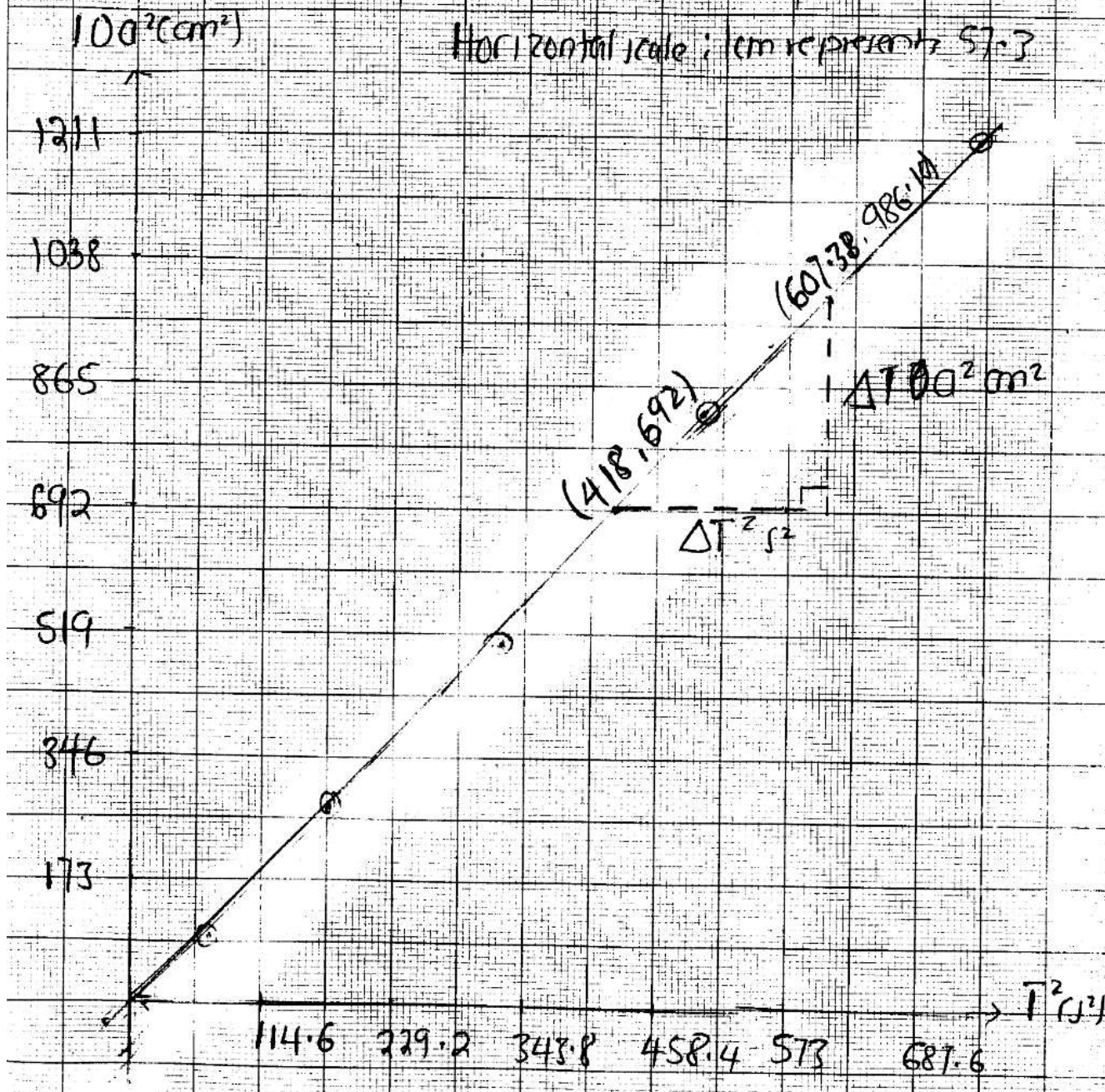
$$= 2.98 \times 10^{18} \text{ N/m}^2$$

1iii)

THE GRAPH OF $100^2(\text{cm}^2)$ AGAINST $T^2(\text{s}^2)$

Vertical scale : 1cm represents 86.5

Horizontal scale : 1cm represents 57.3



2. You are provided with hot water of about 70°C , a copper calorimeter and a thermometer. You are required to determine the effect of the mass of an object on the cooling process. Proceed as follows:
- Measure and record the mass of the empty calorimeter.
 - Half filled the calorimeter with hot water of about 70°C
 - Observe and record the temperature of water at an interval of 2 minutes as water cools from 60°C to 45°C .
 - Weigh the calorimeter that is half filled with hot water.
 - Repeat the procedures in 2 (c) and (d) when the calorimeter is $2/3$ full of hot water.

Questions.

- What are the masses of water obtained in 2 (d) and (e)?
- Tabulate the results obtained in 2 (c) and (e).

2 (ii) Table of results

when $1/2$ filled with water

time (min)	temperature ($^{\circ}\text{C}$)
0	60
2	57
4	54
6	51
8	49
10	48
12	45

when $2/3$ filled with water

time (min)	temperature ($^{\circ}\text{C}$)
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0	60
2	58
4	56
6	54
8	52
10	50
12	48
14	46
16	45

(iv) Ratio of time taken to cool from

(a) $60^{\circ}\text{C} - 50^{\circ}\text{C}$

(b) $60^{\circ}\text{C} - 45^{\circ}\text{C}$

when half filled with water $t_1 = 7$

(a) $60^{\circ}\text{C} - 50^{\circ}\text{C}$

Half filled water (t_1) = 7 minutes

2/3 filled water (t_2) = 10 minutes

Ratio = t_1 / t_2

= $7 / 10$

= 0.7

Ratio (R_1) = 0.7

(b) $60^{\circ}\text{C} - 45^{\circ}\text{C}$

Half filled water (t_1) = 12 minutes

2/3 filled water (t_2) = 16 minutes

Ratio (R_2) = $12 / 16$

= 0.75

$\therefore$ Ratio (R_2) = 0.75

(vi) Thermal capacities of water

from

(i) when half filled with water

$$\text{Thermal capacity} = M_w C_w + M_c C_c$$

$$M_w = 52.88 \text{ g} = 0.05288 \text{ kg}$$

$$C_w = 4200 \text{ J kg}^{-1} \text{ K}^{-1}$$

$$M_c = 36.02 \text{ g} = 0.03602 \text{ kg}$$

$$C_c = 420 \text{ J kg}^{-1} \text{ K}^{-1}$$

Then

$$Q = 0.05288 \times 4200 + 0.03602 \times 420$$

$$Q = 243.096 \text{ J K}^{-1} + 15.1284 \text{ J K}^{-1}$$

$$Q = 258.2244 \text{ J K}^{-1}$$

$\therefore$ Thermal capacity of water when calorimeter is half filled with water =
258.2244 J K⁻¹

(ii) when 2/3 filled with water

from

$$\text{Thermal capacity} = M_c C_c + M_w C_w$$

$$M_w = 86.23 \text{ g}$$

2 (vi)

$$Q = 0.03602 \times 420 + 0.08632 \times 4200$$

$$Q = 15.128 + 362.166$$

$$Q = 377.294 \text{ J K}^{-1}$$

$\therefore$ Thermal capacity when calorimeter is filled with 2/3 water = 377.294 J
K⁻¹

vii) Ratio of thermal capacities obtained

from

$$\text{Ratio} = Q_1 / Q_2$$

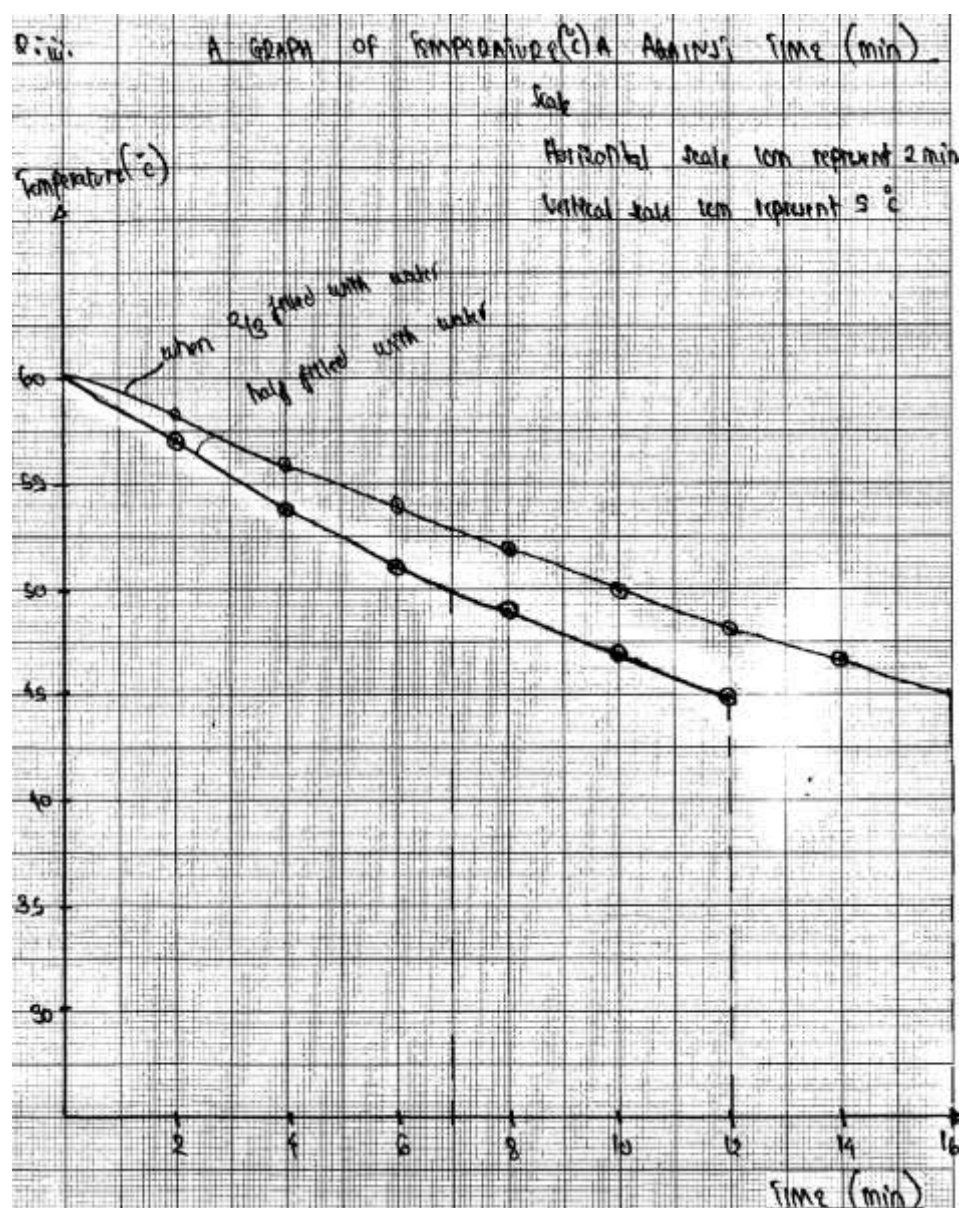
$$\text{Ratio} = 258.224 \text{ J K}^{-1}$$

$$377.294 \text{ J K}^{-1}$$

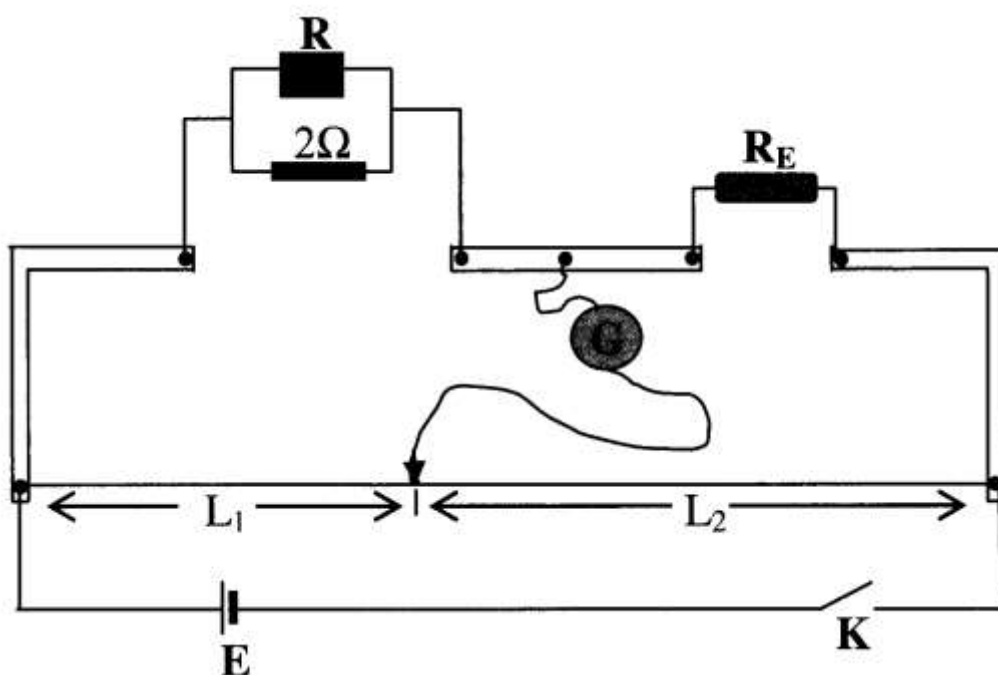
$$\text{Ratio} = 0.7$$

∴ Ratio of thermal capacities = 0.7

viii) Ratio obtained in 2(iv) and (v) are nearly the same. Hence, it implies that water in the calorimeter filled $\frac{2}{3}$ takes long time to cool as compared to that filled with $\frac{1}{2}$.



3. You are provided with a meter bridge with its accessories, resistance box (1Ω - 10Ω) labelled **R**, 2Ω standard resistor, galvanometer labelled **G**, dry cell soldered both ends labelled **E**, key **K**, connecting wires and hard paper wrapped with wires of resistance 6Ω labelled **RE**. Referring to the information provided, perform the experiment in order to determine the number of wires that the resistor, **RE** contains if each wire has a resistance of 6Ω as follows in Diagram.



- (a) Starting with $R = 10\Omega$, close the key, **K** and determine the length, L_1 where by, the galvanometer reads 0 and hence determine the corresponding value of length, L_2 .
- (b) Repeat the procedure ion 3(a) for values of $R = 5\Omega$, 3Ω , 2Ω , and 1Ω .

Questions

3 (i) Table of Results.

R (Ω)	1/R (Ω^{-1})	L ₁ (cm)	L ₂ (cm)	L ₂ /L ₁
10	0.1	45.8	54.2	1.18
5	0.2	42.2	57.8	1.37
3	0.33	37.3	62.7	1.68
2	0.5	33.9	66.1	1.95
1	1	24.7	75.3	3.05

(ii) Graph.

$$\text{Slope} = \Delta y / \Delta x = \Delta(1/R (\Omega^{-1})) / \Delta(L_2/L_1)$$

$$\text{Slope} = \frac{(0.6 - 0.2) \Omega^{-1}}{(2.16 - 1.37)}$$

$$\text{Slope} = 0.506 \Omega^{-1}$$

$\therefore$ The slope of the graph is $0.506 \Omega^{-1}$

(iii) R and 2Ω are in parallel so the equivalent resistance will be

$$R_t = 2R / (2 + R)$$

3 (iii)

$$R_T = R_E \frac{L_1}{L_2}$$

$$R_T / R_E = L_1 / L_2$$

$$2R / (2 + R) : R_E = \frac{2R}{(2 + R) R_E}$$

$$\frac{2R}{(2 + R) RE} = \frac{L1}{L2}$$

$$\frac{(2 + R) RE}{2R} = \frac{L2}{L1}$$

$$\frac{2}{2R} + \frac{R}{2R} = \frac{L2}{L1} \cdot \frac{1}{RE}$$

$$\frac{1}{R} + \frac{1}{2} = \frac{L2}{L1} \cdot \frac{1}{RE}$$

$$\frac{1}{R} = \frac{1}{RE} \cdot \frac{L2}{L1} - \frac{1}{2}$$

$$y = m x - c$$

(iv) from slope = 1 / RE

$$\text{slope} = 0.51 \, \Omega^{-1}$$

$$0.51 \, \Omega^{-1} = 1 / RE$$

$$RE = 1 / 0.51 \, \Omega^{-1} = 2 \, \Omega$$