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)

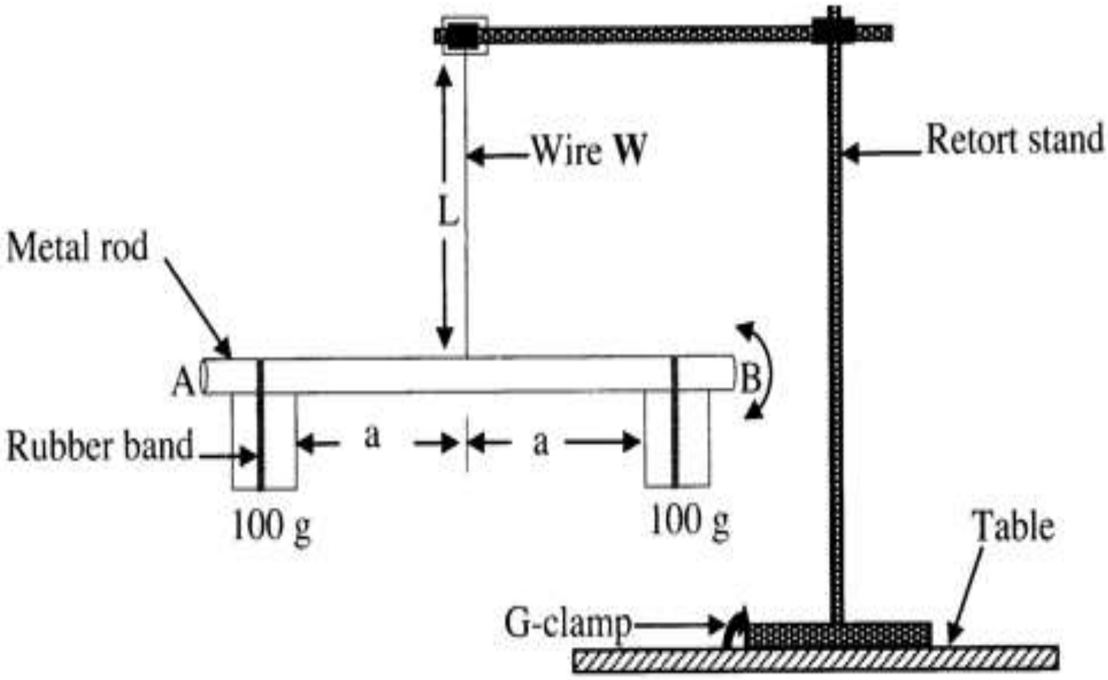
Duration: 3 Hours ANSWERS **Year: 2025**

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 cm, 7 cm, 9 cm and 11 cm.

Questions:

(iv) Slope = (986.10 − 692) cm^2 /(607.38 − 418) s^2

= 1.56 cm^2/s^2

= 1.56×10^{-2} cm^2/s^2

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

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

r = d/2

$= \dfrac{0.320 \text{ mm}}{2}$

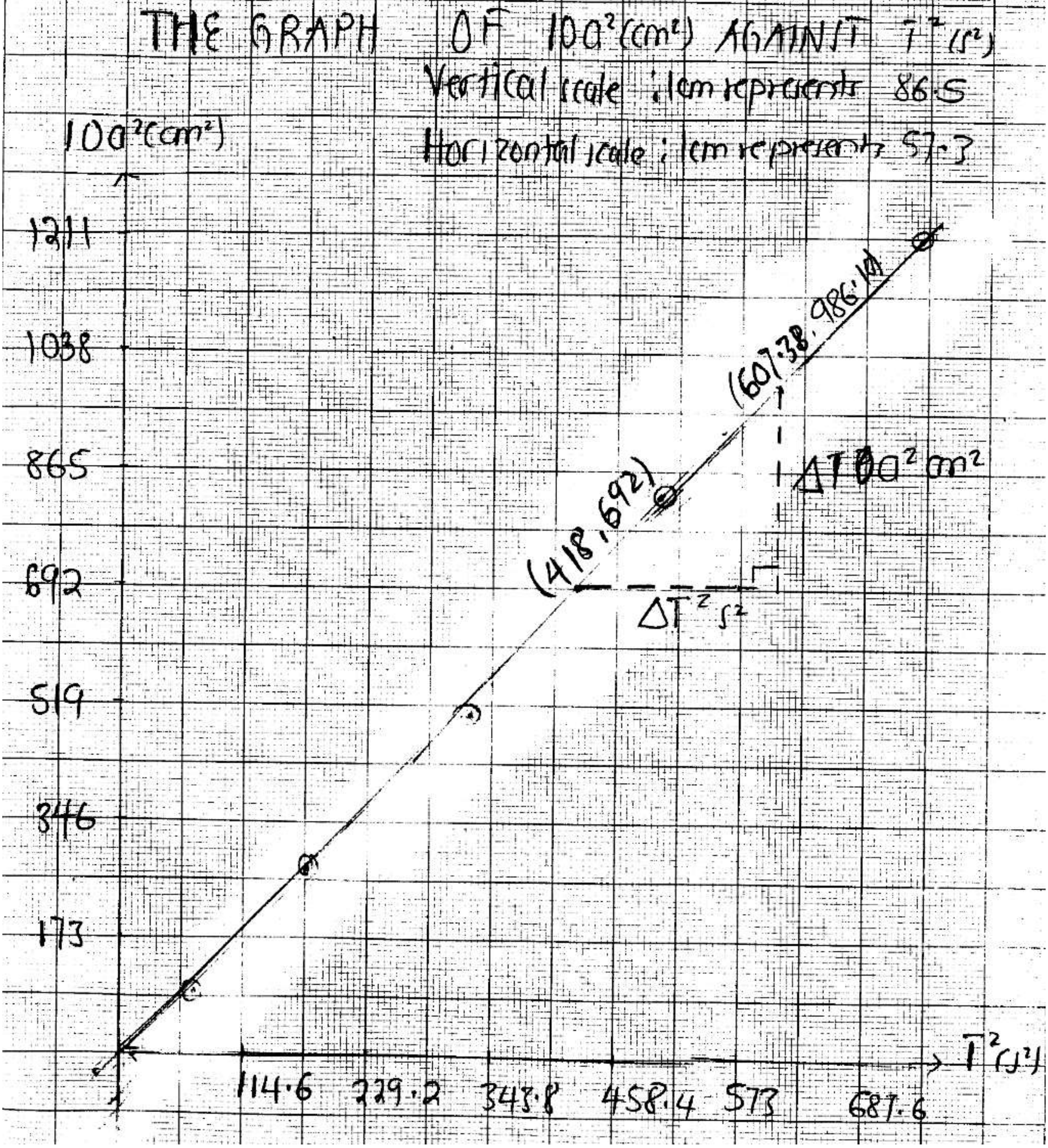
= 0.016 mm

= 0.016×10^{-3} m

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

= 2.98×10^{18} N/m^2

1 iii)


THE GRAPH OF 100^2 (cm²) AGAINST T^2 (s²)
Vertical scale: 1cm represents 86.5
Horizontal scale: 1cm represents 57.3
100^2 (cm²)
1211
1038
865
692
519
346
173
(607.38, 986.14)
(418, 692)
$\Delta 100^2$ cm²
ΔT^2 s²
114.6
229.2
343.8
458.4
573
687.6
T^2 (s²)

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:
   (a) Measure and record the mass of the empty calorimeter.
   (b) Half filled the calorimeter with hot water of about 70° C
   (c) Observe and record the temperature of water at an interval of 2 minutes as water cools from 60^0 C to 45^0 C.
   (d) Weigh the calorimeter that is half filled with hot water.
   (e) Repeat the procedures in 2 (c) and (d) when the calorimeter is 2/3 full of hot water.

Questions.

(i) What are the masses of water obtained in 2 (d) and (e)?

(ii) Tabulate the results obtained in 2 (c) and (e).

2 (ii) Table of results

when 1/2 filled with water

time (min)	temperature (°C)
0	60
2	57
4	54
6	51
8	49
10	48
12	45

when 2/3 filled with water

time (min)	temperature (°C)

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°C – 50°C

(b) 60°C – 45°C

when half filled with water $t_1 = f_1$

(a) 60°C – 50°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°C – 45°C

Half filled water (t_1) = 12 minutes

2/3 filled water (t_2) = 16 minutes

Ratio (R_2) = 12 / 16

= 0.75

∴ Ratio (R_2) = 0.75

(vi) Thermal capacities of water

from

(i) when half filled with water

Thermal capacity = Mw Cw + Mc Cc

Mw = 52.88 g = 0.05288 kg

Cw = 4200 J kg^{-1} K^{-1}

Mc = 36.02 g = 0.03602 kg

Cc = 420 J kg^{-1} K^{-1}

Then

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

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

Q = 258.2244 J K^{-1}

∴ Thermal capacity of water when calorimeter is half filled with water = 258.2244 J K^{-1}

(ii) when 2/3 filled with water

from

Thermal capacity = Mc Cc + Mw Cw

Mw = 86.23 g

2 (vi)

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

Q = 15.128 + 362.166

Q = 377.294 J K^{-1}

∴ Thermal capacity when calorimeter is filled with 2/3 water = 377.294 J K^{-1}

vii) Ratio of thermal capacities obtained

from

Ratio = Q_1 / Q_2

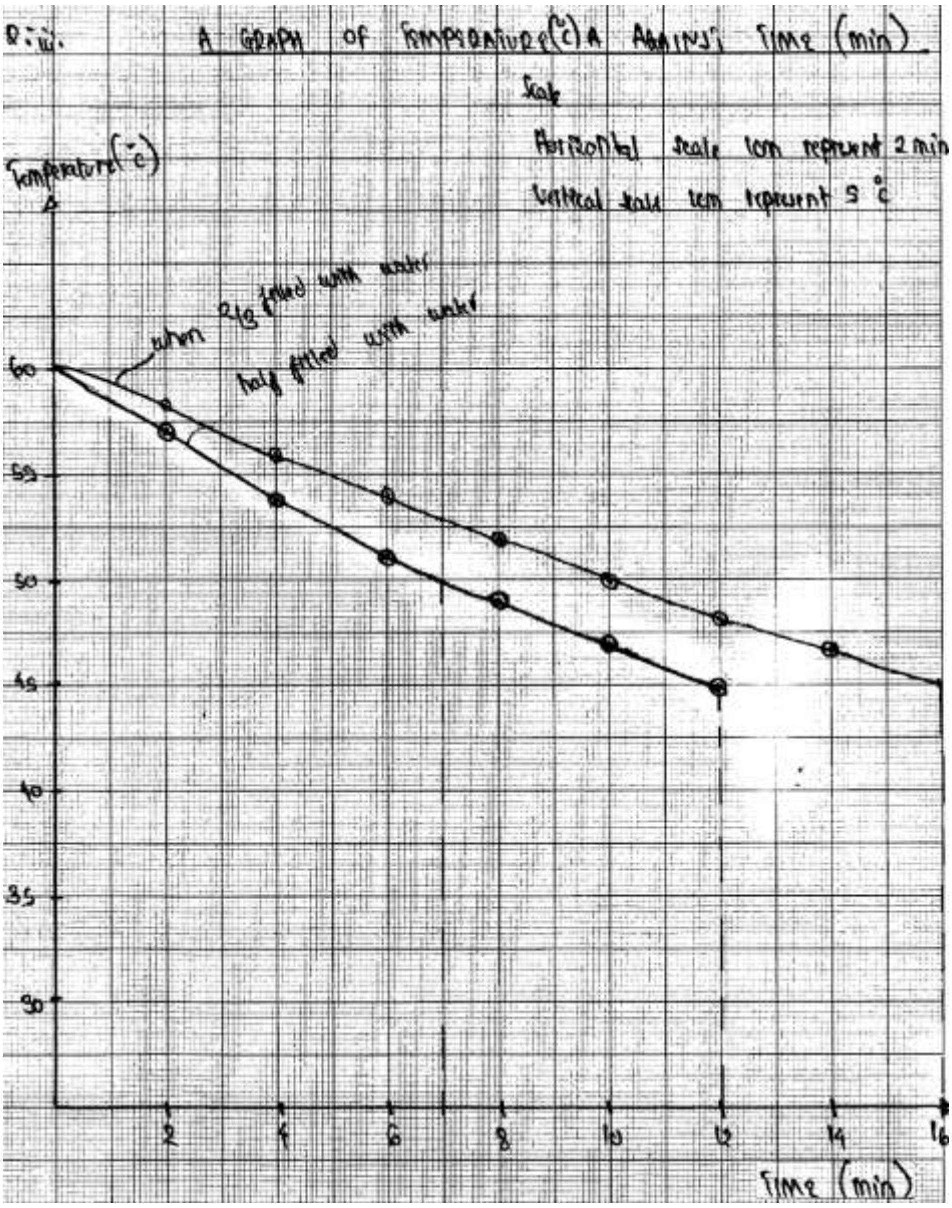
Ratio = 258.224 J K^{-1}

377.294 J K^{-1}

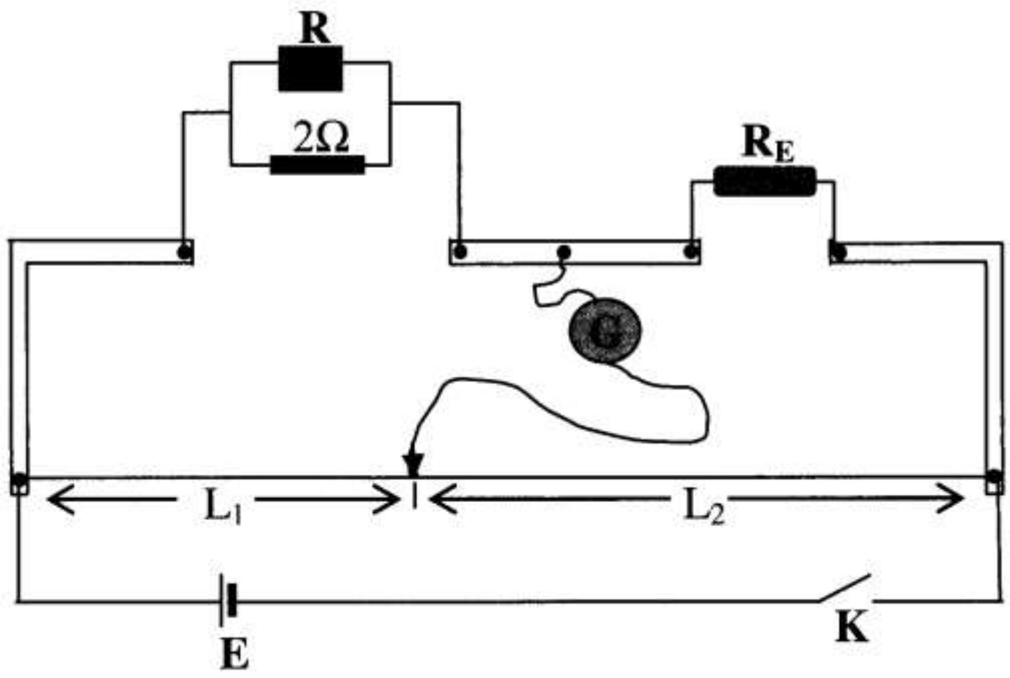
Ratio = 0.7

∴ 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 2/3 takes long time to cool as compared to that filled with 1/2.



3. You are provided with a meter bridge with its accessories, resistance box (1Ω-10Ω) labelled R, 2 Ω standard resistor, galvanometer labelled **G**, dry cell soldered both ends labelled E, key **K**, connecting wires and hard paper wrapped with wires of resistance 6 Ω 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 6 Ω as follows in Diagram.



(a) Starting with R =10 Ω, 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 Ω, 3 Ω, 2 Ω, and 1 Ω.

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.

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

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

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

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

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

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

3 (iii)

$\frac{RT}{L1} = \frac{RE}{L2}$

RT / RE = L1 / L2

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

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

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

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

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

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

$$y = m\,x - c$$

(iv) from slope = 1 / RE

slope = 0.51 Ω^{-1}

0.51 Ω^{-1} = 1 / RE

RE = 1 / 0.51 Ω^{-1} = 2 Ω