THE UNITED REPUBLIC OF TANZANIA

NATIONAL EXAMINATIONS COUNCIL

ADVANCED CERTIFICATE OF SECONDARY EDUCATION EXAMINATIONS

131/3B **PHYSICS 3B**

(PRACTICAL B)

(For Both School and Private Candidates)

Duration: 3:20 Hours **Year: 2025**

Instructions

1. This paper consists of **three (3)** questions.
2. Answer **all** questions.
3. Question **one (1)** carries **twenty (20)** marks and the other **two (2)** carry **fifteen (15)** marks each.
4. Mathematics tables and non-programmable calculators may be used.
5. All writing must be in **black** or **blue** ink except for drawings which must be in pencil
6. Communication devices and any unauthorised materials are **not** allowed in the examination room.
7. Write your **Examination Number** on every page of your answer booklet(s).

   The following information may be useful:

Pie, $\pi = 3.14$

Specific heat capacity of water = 4.2×10^3 $Jkg^{-1}K^{-1}$

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.

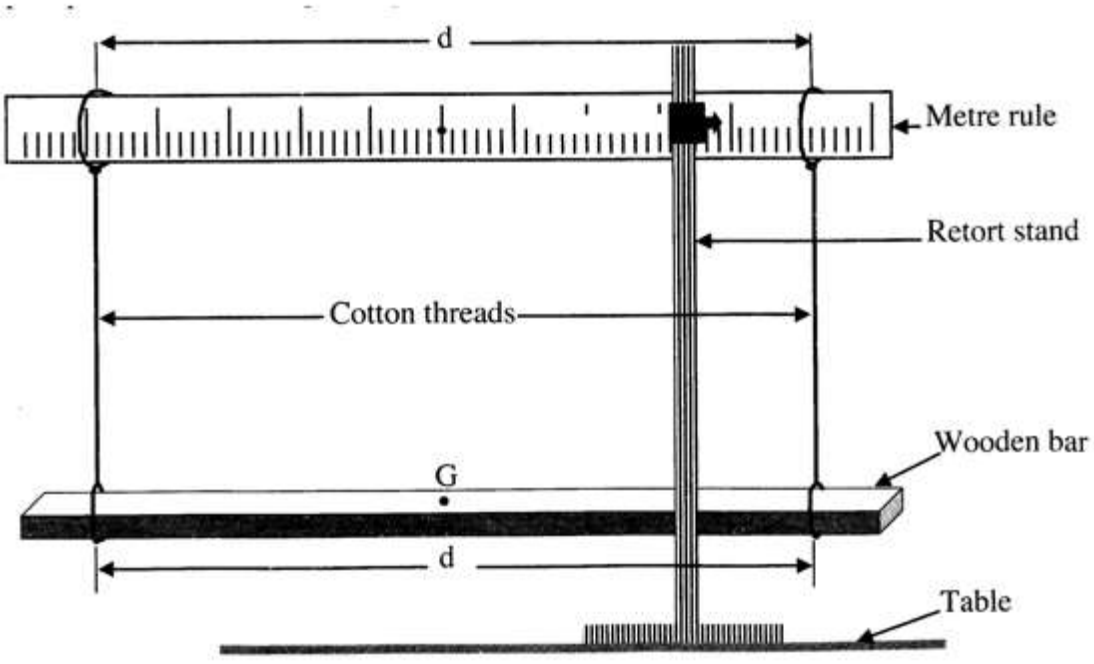
   (d) Arrange the threads so that they are at a distance of d = 90cm apart. Adjust the length of the threads to 100 cm.

   (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:

(i) Prepare a table of results including $\frac{1}{d}$ (m^{-1}), time, t (s) of 10 oscillations and period of oscillation, T (s)

(ii) Plot a graph of T(s) against $\frac{1}{d}$ (m^{-1}).

(iii) Determine the slope of the graph

(iv) Using a slope obtained in 1 (iii), evaluate the mass (kg) of the wooden bar given that d and T are related by the equation $T = \frac{2.81}{d}\sqrt{\frac{1}{mg}}$, where m is the mass of the bar and g is the acceleration due to gravity.

(v) What will happen to the oscillation of the bar if, d = 0?

(vi) If the floor of the bridge is and the sample supporting pillar has a breaking stress of 12 Nm^{-2}, estimate the least number of pillars needed to erect the bridge.

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:

(i) Determine the mass of the water that half-filled the calorimeter.

(ii) Tabulate the results obtained in 2 (d) and (f).

(iii) Briefly explain the importance of the procedure (d) in this experiment.

(iv) Plot on the same axis the cooling curves for the results tabulated in 2 (ii)

(v) Using the graph, determine the time at which the difference in temperature between the two curves is highest.

(vi) Evaluate the specific heat capacity of the solid, m of mass X from the equation, $XC(\theta_2 - \theta_R) = (m_cC_c - m_wC_w)\Delta\theta$

Where;

X Represents the mass of the solid, **m**

C Represents the specific heat capacity of the solid, **m**

m_c Represents the mass of empty calorimeter.

C_c Represents the specific heat capacity of copper

m_w Represents the mass of water

C_W Represents the specific heat capacity of water.

θ_R Represents room temperature.

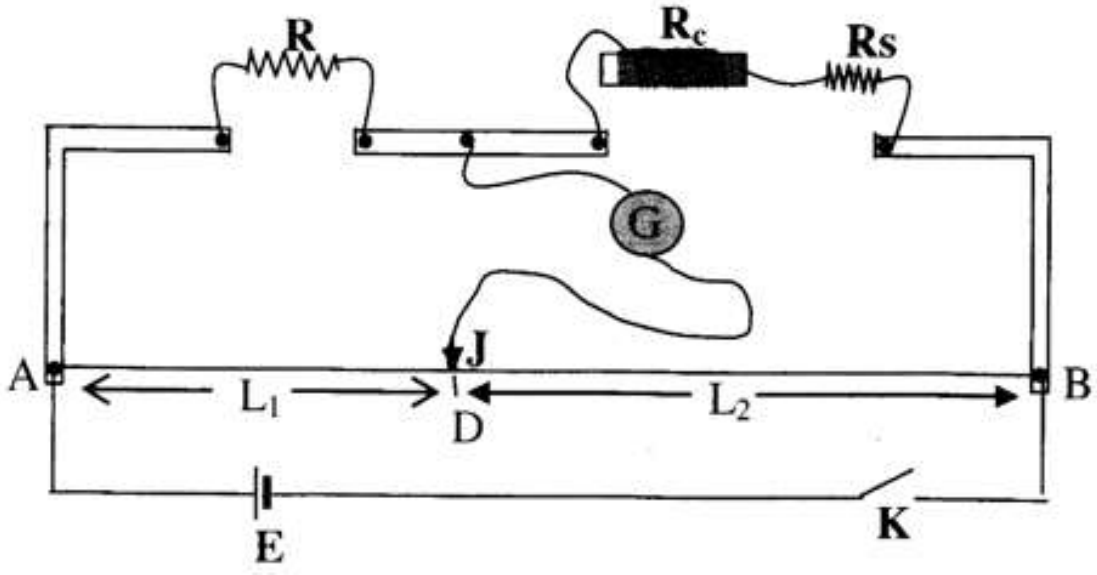
$\Delta\theta$ Represents the difference in temperature for the time obtained in 2 (v).

θ_2 Represents the temperature of the mixture at the highest temperature difference.

8. 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

   (i) Tabulate your results including the values of R, L_1, L_2 and $\frac{L_1}{L_2}$

   (ii) Measure the diameter of the coiled wire and calculate its cross-sectional area.

   (iii) Establish a formula, which relates L_1, L_2, R, R_c and R_S

(iv) Plot the graph of $\frac{L_1}{L_2}$ versus R

(v) Determine the slope, S of the graph in 3(iv).

(vi) If the length of a coiled wire, R_C is 40cm, use the answer obtained in 3(ii) and to determine the resistivity of the wire.