# THE UNITED REPUBLIC OF TANZANIA
# NATIONAL EXAMINATIONS COUNCIL OF TANZANIA
# ADVANCED CERTIFICATE OF SECONDARY EDUCATION EXAMINATION

**131/3A** **PHYSICS 3A**

**(PRACTICAL A)**

(For Both School and Private Candidates)

**Time: 3:20 Hours** **Year: 2024**

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**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. Mathematical tables and non-programmable calculators may be used.
5. All writing should be in **blue** or **black** ink, **except** 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 = $4.2 \times 10^3 \text{ Jkg}^{-1}\text{K}^{-1}$

Specific heat capacity of copper = $3.8 \times 10^2 \text{ Jkg}^{-1}\text{K}^{-1}$

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1. A Physics teacher found you pushing your friend who sat in the metal basin tied to a branch of a tree swinging in a to and fro motion; and he was shocked because there was a practical session going on in the class. Unexpectedly, your teacher took the idea of swinging and brought you to the Physics laboratory. He gave you retort stand and its accessories, two wooden pads, cotton thread of 110 cm long, a pendulum bob, metre rule and stopwatch/clock.

The teacher instructed you to set the given equipment and perform the same way you were doing when playing with your friend outside. But this time, you tie a pendulum bob to a thread of length, L = 1.0 m and attach it to the retort stand. Moreover, you were instructed to displace a bob at a small angle and release it so that it moves to and fro motion and you were required to record the time, t (s) for which to and fro makes 10 oscillations, hence determine its periodic time, T. Repeat the experiment for the length of the thread, L equals to 0.8 m, 0.6 m, 0.4 and 0.2 m.

**Questions**

(i) Draw a well labelled sketch showing the set-up of your experiment.

(ii) Tabulate your results as shown in the following Table:

| L (m) | t (s) | T(s) | Log L | Log T |
|---|---|---|---|---|
| 1.0 | | | | |
| 0.8 | | | | |
| 0.6 | | | | |
| 0.4 | | | | |
| 0.2 | | | | |

(iii) Plot a graph of log T against log L.

(iv) Considering the approximate law given as $T \alpha L^m$ and using the graph you plotted in 1 (iii), deduce the values of m and k correct to one decimal place.

(v) Re-write the values of m and k in the form of $a/b$ where $b \neq 0$ and $a$ is an integer.

(vi) Suggest the equation of the approximate law governing this experiment.

(vii) Validate the value of acceleration due to gravity, g.

(viii) Recommend two possible ways of improving this experiment.

2. You are provided with copper calorimeter, lid, stirrer, liquid **A**, liquid **B**, thermometer (0 – 100°C), beaker of 250 ml and stopwatch.

**Proceed as follows:**

(a) Assemble the apparatus as shown in Figure 1.

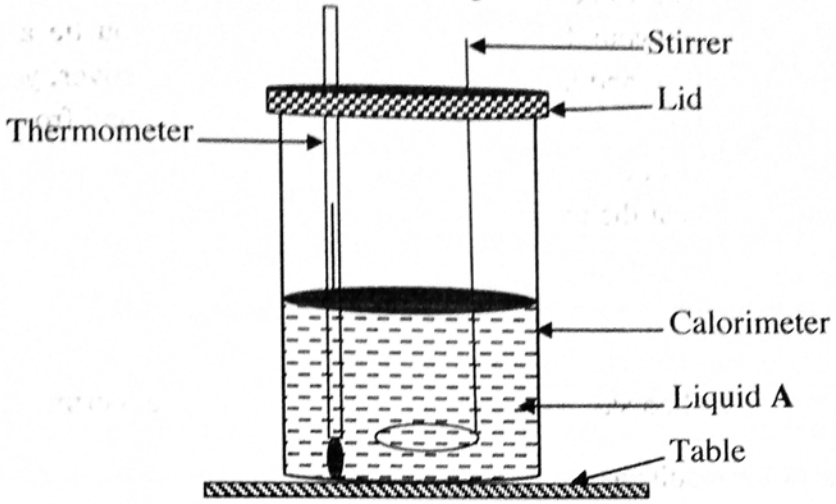


**Figure 1**

(b) Weigh the calorimeter with its stirrer and lid.

(c) Fill the beaker with liquid **A** and heat it with its content until the temperature is about 80 °C (liquid **A** is inflammable, do not heat beyond 80 °C). Pour 60 ml of liquid **A** into the calorimeter.

(d) Stir the liquid until the temperature falls to 70 °C. Starting at the temperature of 70 °C record the time of the temperature drop at an interval of 2 °C down to 56 °C.

(e) Remove the thermometer and reweigh the calorimeter with its content. Empty and clean the calorimeter.

(f) Repeat the procedures in 2 (c) to (e) using liquid **B** (water).

**Questions**

(i) Record the pair of values as shown in the following table:

| Temperature (°C) | Liquid A ($t_A$) min) | Liquid B ($t_B$) (min) |
|---|---|---|
| | | |
| | | |
| | | |

(ii) Plot a graph of $t_A$ against $t_B$.

(iii) Deduce the slope of the graph.

(iv) Estimate the specific heat capacity of liquid **A** from the equation,

$$\frac{M_1C_1 + M_AC_A}{t_A} = \frac{M_1C_1 + M_BC_B}{t_B}$$

Where;

$M_1$ = Mass of calorimeter + lid + stirrer
$M_A$ = Mass of liquid A
$M_B$ = Mass of liquid B
$C_A$ = Specific heat capacity of liquid **A**
$C_B$ = Specific heat capacity of liquid **B**
$C_1$ = Specific heat capacity of copper

(v) Compare the rates of heat loss for the liquid **A** and liquid **B**.

(vi) It is desirable that the experimental values for specific capacities should be close or equal to theoretical values. Recommend two precautions that need to be considered in order to attain this status in the experiment which you have done.

3. A Scientist needed a 5 Ω resistor for fixing a microphone. However, the Scientist managed to get a resistance wire **W** of length 100 cm, aiming to seek an expert to determine exact length of the wire, which will have a resistance equals to 5 Ω. In the Physics laboratory, you managed to get metre bridge, standard resistor of 4 Ω, two dry cells connected in series, zero centred galvanometer, switch, metre rule and several pieces of connecting wires. Perform the following experiment to determine the required length of the wire for the Scientist.

(a) Set up your circuit as shown in Figure 2, where **W** is the wire bought by the Scientist.

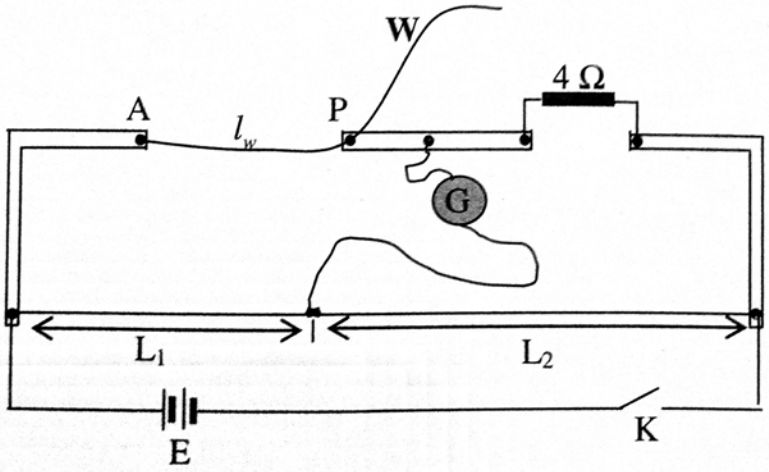


**Figure 2**

(b) Balance and fix a wire connected to galvanometer in such a way that, length $L_1$ is exactly 20 cm. Fix one end of wire W at point A, then close a key K. Connect the wire **W** at point P and find the length $l_w$ of the wire which will make the galvanometer read zero (i.e. balance point). Measure and record the length $l_w$ of wire **W** in cm.

(c) Repeat the procedure in 3 (b) for $L_1$ = 30 cm, 40 cm, 50 cm and 60 cm and record the values of $l_w$ and $L_2$ in each case.

**Questions**

(i) Tabulate your result of $L_1$, $L_2$, $l_w$ and $\frac{L_1}{L_2}$.

(ii) Plot a graph of $l_w$ against $\frac{L_1}{L_2}$.

(iii) Determine the slope of your graph.

(iv) Using the slope obtained in 3 (iii), calculate the length of a wire, **W** which will produce a resistance required by the Scientist.