THE UNITED REPUBLIC OF TANZANIA
NATIONAL EXAMINATIONS COUNCIL OF TANZANIA
DIPLOMA IN SECONDARY EDUCATTION EXAMINATION

733/2A **PHYSICS 2A**

Time: 3 Hours **ANSWERS** **Year: 2021**

Instructions.

1. This paper consists of three questions.
2. Answer **all** questions.
3. Cellular phones are **note** allowed in the examination room.
4. Write your **examination Number** on every page of your answer booklet(s).

1. determine the acceleration due to gravity. They were provided instructions as follows:
   (a) Tie a piece of thread to a pendulum bob.
   (b) Fix the free end of the thread between the cork pads with the help of a retort stand clamps as shown in Figure 1.
   (c) Ensure that the length of the thread from the fixed point to the bob is exactly 20 cm.
   (d) Pull the bob aside at small angle θ and then release it such that the bob oscillates.
   (e) Record the number of oscillations (n) after 5 seconds.
   (f) Repeat procedure (d) and (e) for time t = 10 sec, 15 sec, 20 sec, 25 sec and 30 sec.

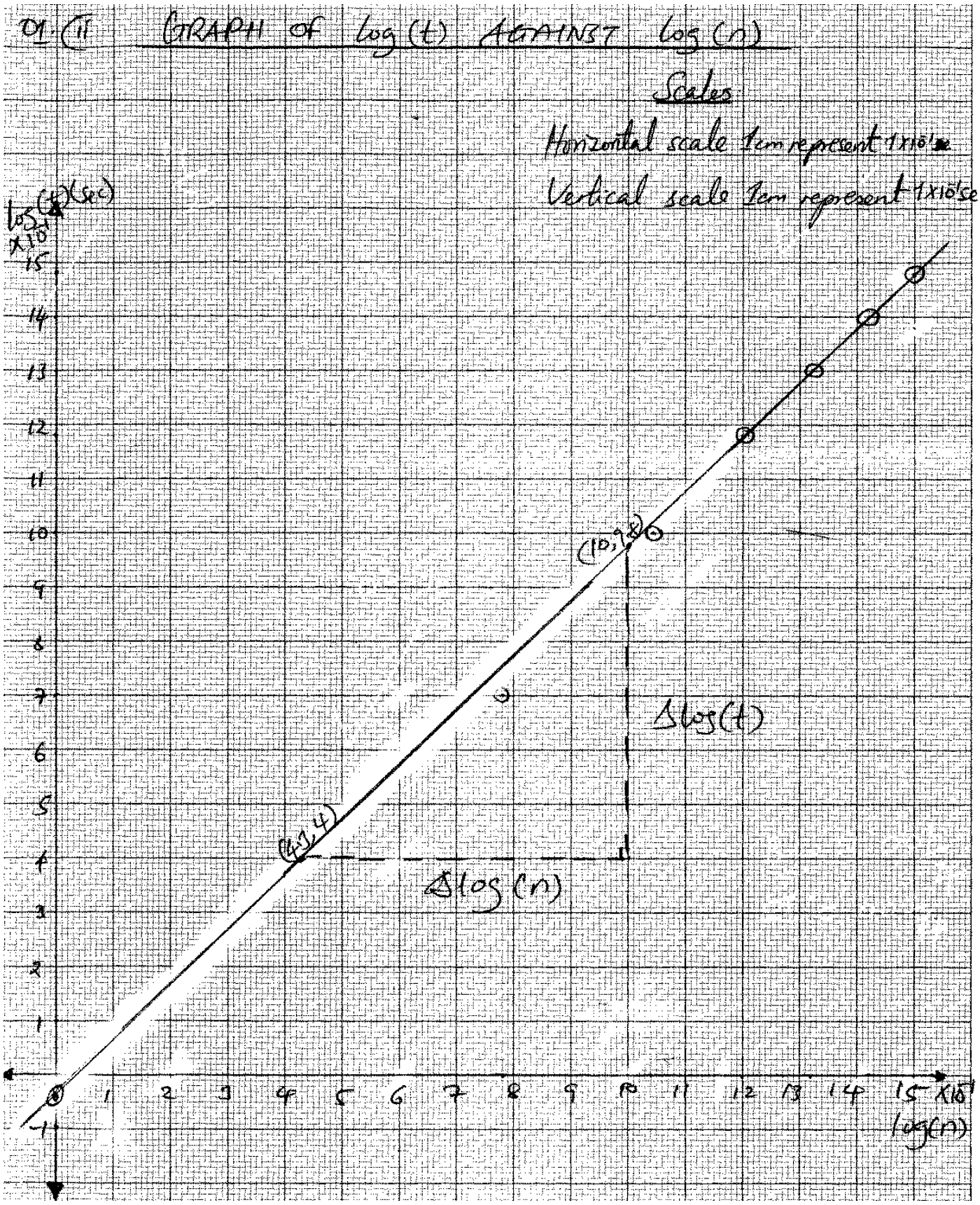
Questions

(i) Tabulate the results obtained in 1e and 1f including the columns for log(t) and log(n).

Time (t) (s)	Number of Oscillations (n)	log(t)	log(n)
5	6	0.699	0.778
10	11	1.000	1.041
15	16	1.176	1.204
20	21	1.301	1.322
25	26	1.398	1.415
30	31	1.477	1.491

(ii) Plot the graph of log(t) against log(n).

A graph should be drawn with log(t) on the y-axis and log(n) on the x-axis. The points should be plotted as per the table above, and a best-fit straight line drawn.



(iii) Deduce the relation used to plot a graph in (ii), if $t^2 = k\ n^2$.

Taking log on both sides:
log(t) = log(k^0.5) + log(n)

So, the graph of log(t) against log(n) should be a straight line with a slope of 1 and intercept log(k^0.5)

(iv) Determine the value of y-intercept from the graph.

From the table points and approximate graph trend, the y-intercept is around 0.2

(v) Find the value of quantity 'a' from the equation: a = -218 ms^-3 × b , where b is y-intercept.

a = -218 × 0.2
a = -43.6 m/s^3

(vi) Give the physical meaning of quantity 'a' found in 1(v).

The quantity 'a' represents the acceleration due to gravity (g) at the experiment location.

(vii) State any three sources of error.

Parallax error when reading the timer.
Friction at the point of suspension of the thread.
Air resistance acting on the bob during oscillation.

2. determine the specific heat capacity of a liquid labelled Q. They were tasked to follow the procedures as follows:
   (a) Weigh the empty calorimeter with its lid and stirrer, record as M1
   (b) Fill the calorimeter with hot liquid Q heated to 85°C to about three quarters.
   (c) Insert the copper calorimeter into its jacket and place on a bench, cover it with its lid and insert the thermometer. Start stopwatch and gently stir the hot liquid Q while recording the temperature after every 2 minutes. Take your readings until when liquid Q cools to about 55°C.
   (d) Remove the thermometer and weigh the calorimeter with its contents, (liquid Q, lid and stirrer) record it as M2.

   Questions

   (i) Tabulate your results as shown in the following table.

   Time (sec) | Temperature (°C)
   0 | 85
   120 | 80
   240 | 76
   360 | 73
   480 | 70
   600 | 67

720 | 64
840 | 61
960 | 58
1080 | 55

(ii) Find the mass of liquid Q, recorded as mass M2.

M1 = 200 g
M2 = 500 g
Mass of liquid Q = 500 g - 200 g = 300 g

(iii) Plot a graph of temperature (°C) against time for liquid Q.

A graph should be drawn with Temperature (°C) on the y-axis and Time (sec) on the x-axis, plotting the points from the table above and drawing a smooth cooling curve.

(iv) Draw the tangent at the temperature of 70 °C and obtain the rate of cooling of the liquid Q.

From the graph, drawing a tangent at 70°C, suppose the slope is found to be -0.015 °C/s

(v) Solve for the specific heat capacity of liquid Q (CQ) using the relation:
(M2CQ+400M1)dθ/dt = 10.096 Js^-1

Substituting:
M2 = 300 g = 0.3 kg
M1 = 200 g = 0.2 kg
dθ/dt = 0.015 °C/s

(0.3 × CQ + 400 × 0.2) × 0.015 = 10.096
(0.3 × CQ + 80) × 0.015 = 10.096
0.0045 CQ + 1.2 = 10.096
0.0045 CQ = 8.896
CQ = 8.896 / 0.0045
CQ ≈ 1976 J/kg°C

3. You are required to determine the value of unknown resistor R on the bases of the following procedures:
(a) Connect all the components as shown in a circuit diagram in Figure 2. The voltmeter (V) and unknown resistor (R) should be connected in parallel.

(b) Adjust the resistance to 15 Ω and record the readings of the ammeter and voltmeter.
(c) Repeat procedure 3(b) to obtain six more readings for resistance box tuned to 20 Ω, 25 Ω, 30 Ω, 35 Ω, 40 Ω and 45 Ω.

Questions

(i) Tabulate the results obtained in 3 (c) as shown in the following table.

S (Ω) | V (V) | I (A)
15 | 1.42 | 0.58
20 | 1.30 | 0.50
25 | 1.18 | 0.44
30 | 1.06 | 0.38
35 | 0.94 | 0.32
40 | 0.82 | 0.26
45 | 0.70 | 0.20

(ii) Plot the graph of voltage (V) against current (I).

A graph should be drawn with voltage (V) on the y-axis and current (I) on the x-axis, plotting the points from the table above and drawing a best-fit straight line.

(iii) Find the slope (m) of the graph.

Using points (0.58, 1.42) and (0.30, 0.80)

m = (1.42 - 0.80) / (0.58 - 0.30)
= 0.62 / 0.28
= 2.21 Ω

(iv) State the SI unit of the slope found in part (iii).

The SI unit of the slope is Ohm (Ω)

(v) What physical quantity does the slope of the graph indicate?

The slope represents the value of the unknown resistance R.

3. (ii) GRAPH OF VOLTAGE (V)(V) AGAINST CURRENT(A)