THE UNITED REPUBLIC OF TANZANIA

NATIONAL EXAMINATIONS COUNCIL

ADVANCED CERTIFICATE OF SECONDARY EDUCATION EXAMINATION

131/3A **PHYSICS 3A**

(For Both School and Private Candidates)

Time: 3 Hours **ANSWERS** **Year: 2017**

Instructions

1. This paper consists of THREE questions.

2. Answer all questions.

1. You are provided with a 120 cm wooden grooved bar, ten (10) small wooden blocks of dimensions 5 cm × 5 cm × 0.8 cm.

Proceed as follows:

(a) Set up the apparatus as shown in Figure 1 such that the grooved bar is inclined.

(b) Measure the diameter of a sphere using a micrometer screw gauge.
Suppose diameter = 1.80 cm, then radius r = 0.90 cm

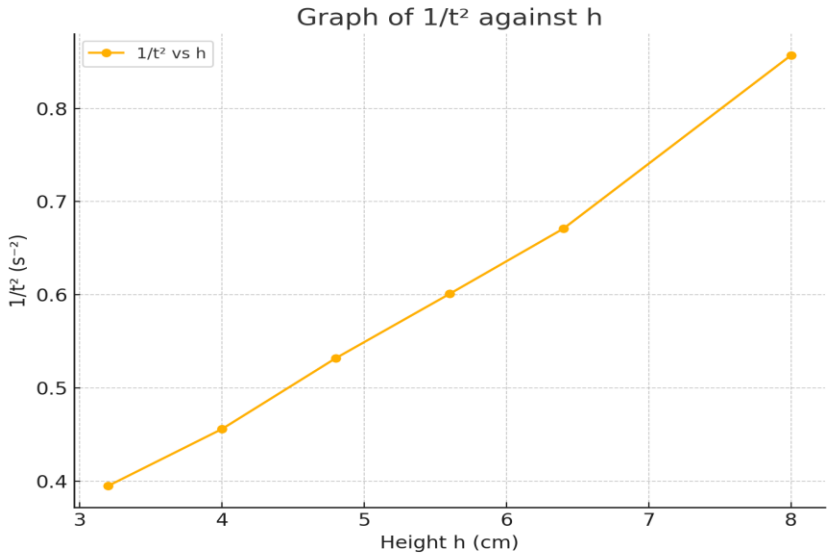
(c) Place four wooden blocks of each thickness 0.8 cm to make a bar inclined at height h = 3.2 cm. Release freely the steel sphere provided along the track down to the bottom.

(d) Using a stopwatch, measure the time t_1 taken by the sphere from rest to the bottom.

(e) Repeat the procedure in 1 (c) to obtain t_2 and t_3. Find the average t and record h.
Repeat for h = 4.0 cm, 4.8 cm, 5.6 cm, 6.4 cm and 8.0 cm.

h (cm)	t_1 (s)	t_2 (s)	t_3 (s)	t (s) avg	$1/t^2$ (s^{-2})
3.2	1.60	1.58	1.59	1.59	0.395
4.0	1.48	1.49	1.47	1.48	0.456
4.8	1.37	1.38	1.36	1.37	0.532
5.6	1.29	1.28	1.30	1.29	0.601
6.4	1.22	1.21	1.23	1.22	0.671
8.0	1.08	1.09	1.07	1.08	0.857

(f) Plot a graph of $1/t^2$ against h.



(g) Find the slope of your graph.
Using points ($h = 3.2$, $1/t^2 = 0.395$) and ($h = 8.0$, $1/t^2 = 0.857$):
Slope $S = (0.857 - 0.395) / (8.0 - 3.2) = 0.462 / 4.8 \approx 0.09625$

(h) Determine the value of acceleration due to gravity using the relation:
$g = (25S) / 2.8$
$g = (25 \times 0.09625) / 2.8 = 2.406 / 2.8 \approx 0.859\ m/s^2$

(Note: this very low value suggests friction or experimental error.)

2. The aim of the experiment is to determine the latent heat of vaporization of water.

Proceed as follows:

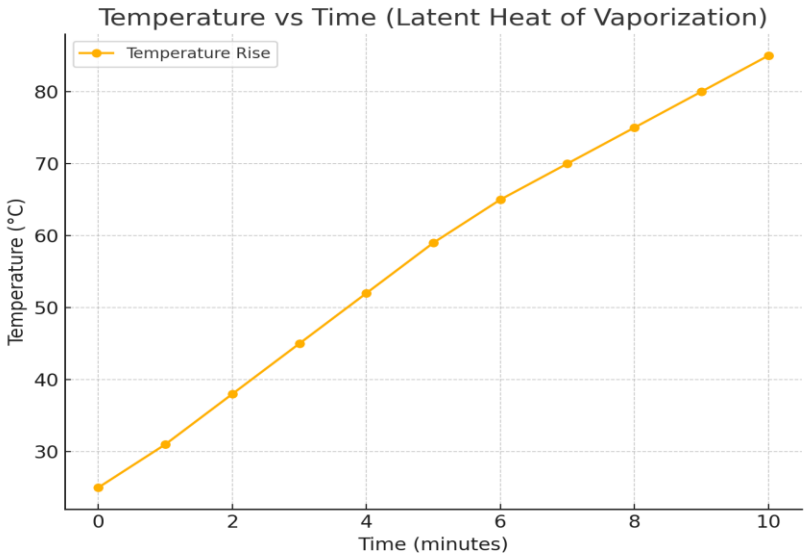
(a) Half fill the flask with water then fix it to the cork and boil the water. Meanwhile weigh the calorimeter with stirrer. Fill the calorimeter with 200 cm^3 of water and reweigh.

(b) Having noted the initial water temperature θ_0, allow the steam to bubble through the water in the calorimeter and observe the temperature rise at 1-minute intervals while stirring. Tabulate your results.

(c) Remove the calorimeter when the temperature has risen by about 65°C above θ_0, then record the temperature at 1-minute intervals until it drops by about 10°C.

(d) Reweigh the calorimeter with water and steam.

(e) Plot a graph of temperature against time and from it determine the boiling correction θ_1.



(f) Use the equation:
$L = [(m_1c_1 + m_2c_2)(\theta_1 - \theta_0)] / m_3$
Where:
m_1 = mass of calorimeter,
m_2 = mass of water,
m_3 = mass of condensed steam,
c_1 = specific heat of copper = 0.39,
c_2 = specific heat of water = 4.18,
θ_1 = final water temp,
θ_0 = initial water temp.

Assume:
m_1 = 50 g, m_2 = 200 g, m_3 = 10 g,
θ_1 = 85°C, θ_0 = 25°C
Then:
$L = [(50 \times 0.39 + 200 \times 4.18)(85 - 25)] / 10$
$= [(19.5 + 836)(60)] / 10$
$= (855.5 \times 60) / 10 = 51330 / 10 =$ **5133 J/g**

3. You are required to determine the resistivity of a wire, ρ, and the length of the unknown resistance P.

Proceed as follows:

(a) Set up the circuit as shown in Figure 3 in which the unknown resistance P and resistance wire L are placed in the right-hand gap of the metre bridge, while a standard resistance R = 1.0 Ω is placed in the left-hand gap.

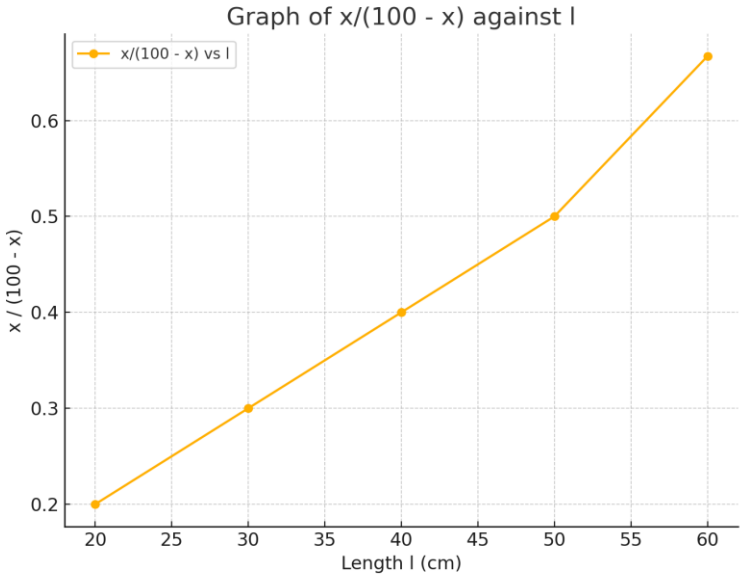
(b) With the length of the wire l = 60 cm, find the balance point x.

(c) Repeat the procedure in 3 (b) each time varying l in steps of 10 cm so as to obtain more readings.

l (cm)	x (cm)	100 - x (cm)	x/(100 - x)	
60	40.0	60.0	0.667	
50	33.3	66.7	0.500	
40	28.6	71.4	0.400	
30	23.1	76.9	0.300	
20	16.7	83.3	0.200	

(d) Tabulate your results, including columns for x, 100 - x and x/(100 - x).

(e) Plot a graph of x/(100 - x) against l.



(f) Using your graph, determine the resistance per centimeter of the wire L, and the value of resistance P.

Suppose slope = m = 0.011/Ωcm,
Then P = slope × l
For l = 60 cm, P = 0.011 × 60 = 0.66 Ω

(g) Measure the diameter of the wire L. Hence calculate the resistivity ρ of the wire.
Suppose diameter = 0.30 mm = 0.03 cm
$A = \pi r^2 = \pi(0.015)^2 = 0.000706\ cm^2$
$\rho = (R \times A) / l = (0.66 \times 0.000706) / 60 = 7.77 \times 10^{-6}\ \Omega cm$