THE UNITED REPUBLIC OF TANZANIA

NATIONAL EXAMINATIONS COUNCIL

ADVANCED CERTIFICATE OF SECONDARY EDUCATION EXAMINATION

131/3B **PHYSICS 3B**

(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. In this experiment you are required to investigate the gravitational field intensity.

Proceed as follows:

(a) Set up the apparatus as shown in Figure 1 such that a 150 g slotted mass m_1 hangs vertically from the lower end of the spring by a hanger. Measure the distance h between the floor and the lower end of the spring.

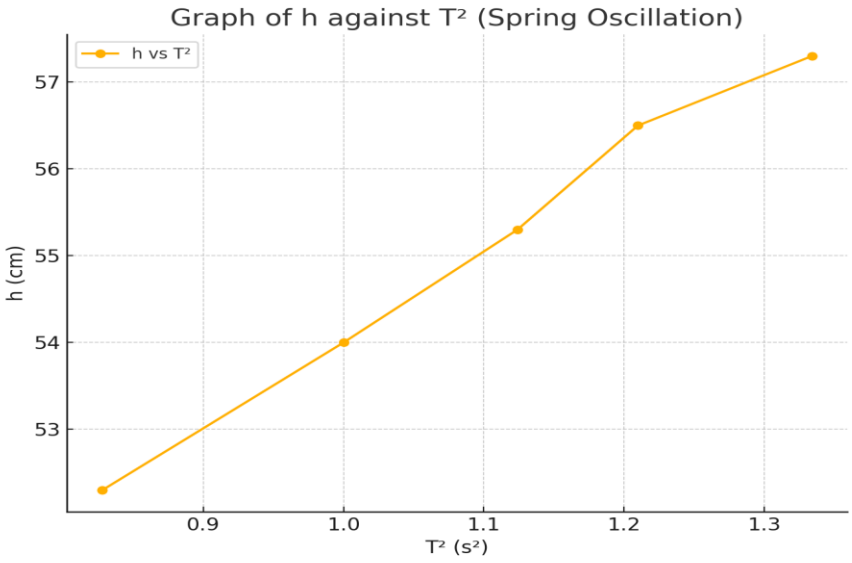
(b) Pull the slotted mass with hanger downwards through a short distance and release it to perform simple harmonic motion.

(c) Measure the time t taken for 20 complete oscillations and hence determine the corresponding period T = t / 20.

(d) Repeat the procedures (a)–(c) above using mass m = 200 g, 250 g, 300 g, and 350 g.

m (g)	h (cm)	t (s)	T (s)	T^2 (s^2)
150	52.3	18.2	0.910	0.828
200	54.0	20.0	1.000	1.000
250	55.3	21.2	1.060	1.124
300	56.5	22.0	1.100	1.210
350	57.3	23.1	1.155	1.334

(f) Plot a graph of h against T^2.



(g) From your graph determine:
(i) The slope of the graph

Using ($T^2 = 0.828$, $h = 52.3$) and ($T^2 = 1.334$, $h = 57.3$)
Slope $S = (57.3 - 52.3) / (1.334 - 0.828) = 5.0 / 0.506 \approx 9.88$ cm/s²

(ii) Using the relation $H = a(T^2) + x$, where $a = 2.533 \times 10^{-3}$, calculate the value of x
$52.3 = 2.533 \times 10^{-3} \times 0.828 + x$
$x = 52.3 - (0.002533 \times 0.828) = 52.3 - 0.0021 = 52.298$ cm

(iii) What does x represent?
x is the extension due to the hanger alone without any additional mass.

(h) State any three sources of error in this experiment:
- Misreading the scale for h due to parallax
- Friction in the spring motion
- Reaction time when timing oscillations

2. The aim of this experiment is to determine the specific latent heat of fusion, L of wax provided.

Proceed as follows:

(a) Weigh the test tube while it is empty and then when it is with some amount of piece of wax. Record the mass of wax as m_1.

(b) Weigh the insulated calorimeter when it is empty and record its mass as m_2.

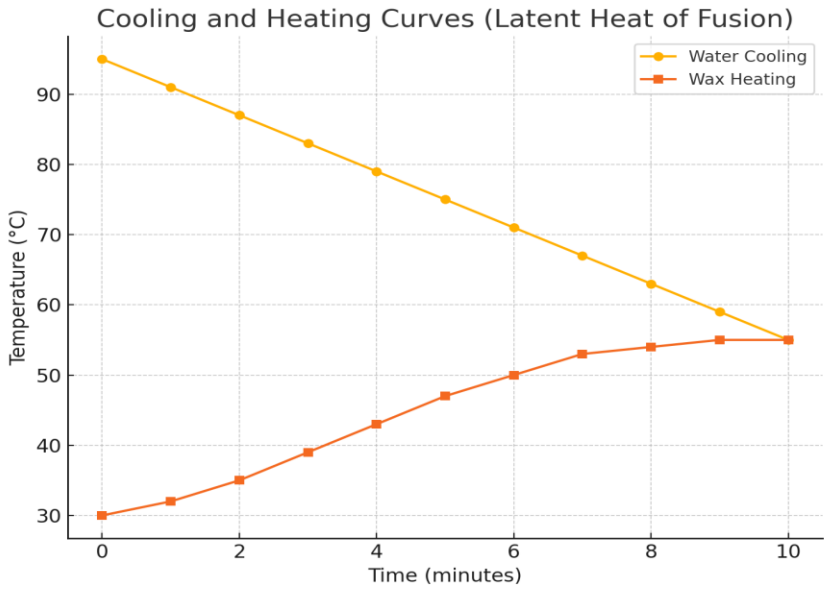
(c) Fill the calorimeter with cold water to about half of it and record the mass of water as m_3.

(d) Boil some water in a beaker to the boiling point. Heat the test tube with wax in boiling water until the wax is completely melted and the temp is about 95°C.

(e) Transfer the test tube into the calorimeter through the hole of the cover as shown in Figure 2.

(f) While stirring, record the temperature of the water every minute until it cools to about 36°C.

(g) Using the same axes, plot a cooling curve for wax and a heating curve for water.



(h) Determine the time interval over which the wax solidifies. Use water graph to determine the temperature rise $\theta_2 - \theta_1$ of the water.

(i) Using the equation:
$m_1L = (m_2C_1 + m_3C_2)(\theta_2 - \theta_1)$
Where C_1 = specific heat of calorimeter (copper), C_2 = of water.
Assume:
$m_1 = 20$ g, $m_2 = 50$ g, $m_3 = 150$ g,
$\theta_2 = 55°C$, $\theta_1 = 30°C$,
$C_1 = 0.39$, $C_2 = 4.18$

Then:
$L = [(50 \times 0.39 + 150 \times 4.18) \times 25] / 20$
$= (19.5 + 627) \times 25 / 20 = 646.5 \times 25 / 20 = 16162.5 / 20 =$ **808.13 J/g**

3. The aim of the experiment is to determine the resistance of each wire, S provided.

Proceed as follows:

(a) Connect two identical wires of S = 32 cm long in parallel on the right-hand gap of the metre bridge. Connect resistance R to the left-hand gap.

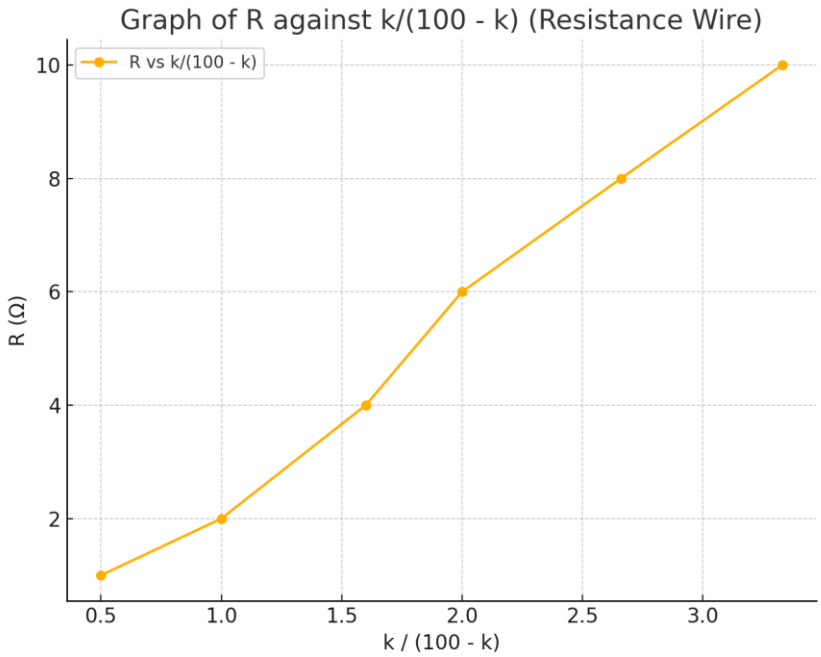
(b) Starting with R = 10 Ω, obtain the balance length l from left side.

(c) Repeat the procedure for R = 8Ω, 6Ω, 4Ω, 2Ω, and 1Ω.

R (Ω)	l (cm)	k = l	100 - l	R/S = k / (100 - k)
10	76.9	76.9	23.1	3.33
8	72.7	72.7	27.3	2.66
6	66.7	66.7	33.3	2.00
4	61.5	61.5	38.5	1.60
2	50.0	50.0	50.0	1.00
1	33.3	33.3	66.7	0.50

(d) Tabulate your results (above).

(e) Plot a graph of R against k / (100 - k)



(f) Determine the gradient of the graph.
Using (k/(100-k) = 0.5, R = 1) and (3.33, R = 10):
Slope = (10 - 1) / (3.33 - 0.50) = 9 / 2.83 ≈ 3.18

(g) What is the physical meaning of G?
The slope G represents the resistance of each wire S.

(h) Determine the resistance of each wire S:
S = slope = 3.18 Ω