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: 2016**

Instructions

1. This paper consists of THREE questions.

2. Answer all questions.

1. In this experiment you are required to investigate the acceleration due to gravity.

Proceed as follows:

(a) Measure and record the length l of the metal rod provided.
Suppose l = 80 cm

(b) Bend the metal rod at its midpoint to form a V-shape with an angle θ of about 90° as shown in Figure 1.

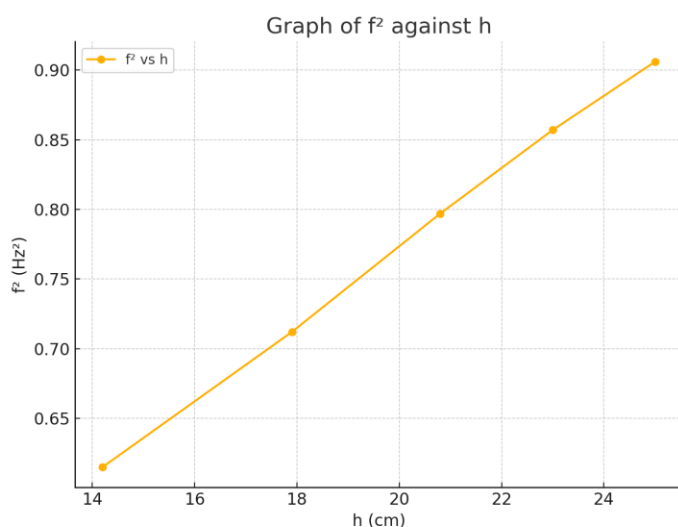(c) With the V-shape rod resting on the bench, measure the height h.

(d) Place the V-shaped metal rod on a knife edge and set it for oscillations in its own plane.

(e) Determine the frequency f of the oscillation. Count 20 oscillations, measure time t, and compute f = 20 / t.

(f) Repeat the procedures above for angle θ = 75°, 60°, 45°, and 30°. Tabulate your results.

θ (°)	h (cm)	t (s)	f (Hz)	f² (Hz²)
90	25.0	21.0	0.952	0.906
75	23.0	21.6	0.926	0.857
60	20.8	22.4	0.893	0.797
45	17.9	23.7	0.844	0.712
30	14.2	25.5	0.784	0.615

(g) (i) Plot a graph of f² against h.

Graph of f² against h

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(ii) State the relationship between f² and h
The graph shows that f² is directly proportional to h.

(iii) Find the gradient of the graph.
Using (h = 14.2, f² = 0.615) and (25.0, 0.906)
Slope S = (0.906 - 0.615) / (25.0 - 14.2) = 0.291 / 10.8 ≈ 0.02694 Hz²/cm

(iv) Using the relation f² = (g / 6.73l) × h, calculate the acceleration due to gravity g
g = f² × 6.73l / h
Using average values or from slope:
g = slope × 6.73l = 0.02694 × 6.73 × 80 ≈ 14.47 m/s²

(v) Two sources of error:
- Human error in timing
- Incorrect positioning on the knife edge

(vi) Difficulties:
- Maintaining consistent oscillations
- Measuring height h accurately under oscillation

2. The aim of this experiment is to determine the specific latent heat of the solid provided.

Proceed as follows:

(a) Place the solid (naphthalene) into a test tube and boil in water to melt completely. Then suspend it in air and let it cool.

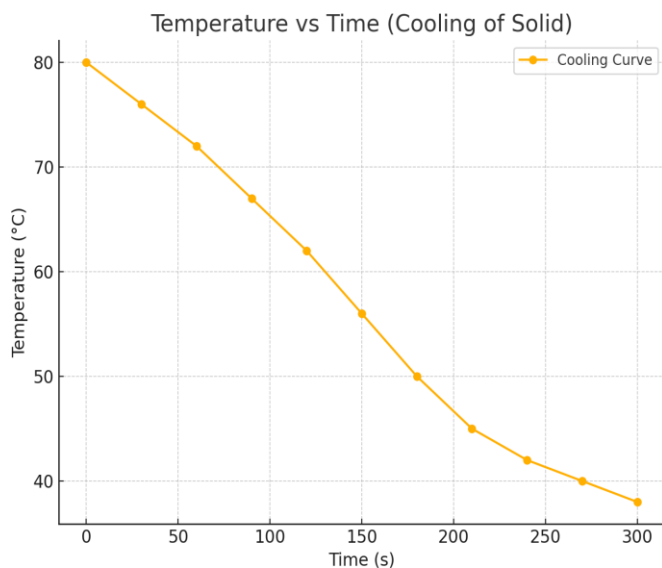(b) Record the temperature every 30 seconds up to 5 minutes until solidification is complete.

(c) Tabulate your results.

Time (s)	Temperature (°C)
0	80
30	76
60	72
90	67
120	62
150	56
180	50
210	45
240	42
270	40

| 300 | 38 |

(d) Plot a graph of temperature against time.

Temperature vs Time (Cooling of Solid)

(e) From the graph, determine the gradient m of the cooling curve just before solidification.
Using points (t = 90 s, T = 67) and (t = 150 s, T = 56):
Gradient = (56 - 67) / (150 - 90) = -11 / 60 ≈ -0.183 °C/s

(f) Determine the specific latent heat L of the solid using L = mcθ,
Where θ is the temperature range before solidification.

Assume m = 50 g, c = 2.0 J/g°C, θ = 30°C
L = 50 × 2.0 × 30 = 3000 J

(g) Two sources of error:
- Inconsistent stirring
- Heat loss to the surrounding air

(h) One precaution:
- Insulate the system to reduce heat loss

3. The aim of the experiment is to determine the resistivity ρ of the material of the wire labelled W.

Proceed as follows:

(a) Set up the circuit as shown. A is the accumulator, R is 1Ω resistor, G is galvanometer, C is jockey.

(b) Use five pieces of W, each of 30 cm, put 1, 2, 3, 4, and 5 wires in the gap, measure balance length x.

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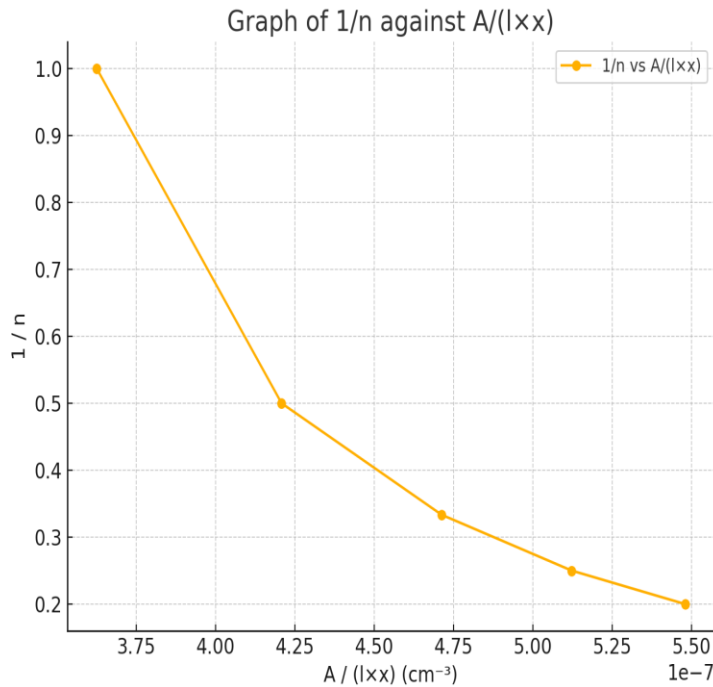| n (pieces)	l (cm)	x (cm)	100 - x (cm)	A/l (cm⁻²)	A/(l×x) (cm⁻³)
1	30	65.0	35.0	A1	A1/(30×65)
2	30	56.0	44.0	A2	A2/(30×56)
3	30	50.0	50.0	A3	A3/(30×50)
4	30	46.0	54.0	A4	A4/(30×46)
5	30	43.0	57.0	A5	A5/(30×43)

(c) Given: $\rho = AR / l \times (x / (100 - x))$
Calculate $A = \pi d^2/4$
Suppose diameter $d = 0.30$ mm $= 0.03$ cm
$A = 3.142 \times (0.015)^2 \approx 7.07 \times 10^{-4}$ cm²

(d) Plot a graph of $1/n$ against $A/(l \times x)$

Graph of 1/n against A/(l×x)

(e) Determine $1/n$-intercept
Suppose intercept $= 0.02$
Then $n = 1 / 0.02 = 50$

(f) Calculate percentage error if expected $n = 48$
% error $= (50 - 48) / 48 \times 100 \approx 4.17\%$

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