THE UNITED REPUBLIC OF TANZANIA

NATIONAL EXAMINATIONS COUNCIL

ADVANCED CERTIFICATE OF SECONDARY EDUCATION EXAMINATION

131/3C   **PHYSICS 3C**

(For Both School and Private Candidates)

Time: 3 Hours   **ANSWERS**   **Year: 1999**

Instructions

1. This paper consists of THREE questions.

2. Answer all questions.

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1. The aim of this experiment is to determine the radius of gyration, k, of the given wooden bar of length 1 m.

(a) Suspend the wooden bar horizontally and balance it at its center of mass G. Measure its length L.

(b) Suspend the bar using a pin at a distance d from the center of mass G, allowing it to swing vertically. Measure d and time for 20 oscillations.

(c) Repeat with four different values of d.

No.	d (m)	Time for 20 Oscillations (sec)	Period T (sec)	T² (sec²)	d² (m²)
1	0.05	18.2	0.91	0.8281	0.0025
2	0.07	18.7	0.935	0.8742	0.0049
3	0.09	19.2	0.96	0.9216	0.0081
4	0.11	20.0	1.00	1.0000	0.0121
5	0.13	21.0	1.05	1.1025	0.0169

(d) Plot a graph of d² (y-axis) against T² (x-axis)

d² vs T² for Radius of Gyration
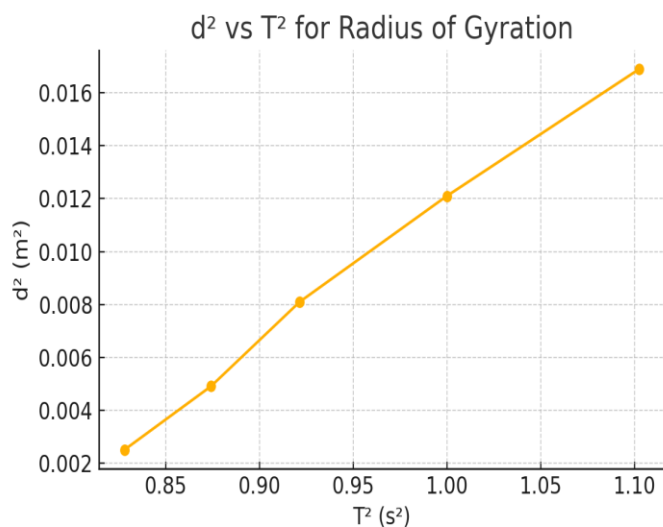
(e) Given that $d^2 = k^2(T^2g/4\pi^2 - 1)$, rearranged as:
$d^2 = mT^2 + c$ (linear form)

From the slope $m = gk^2 / 4\pi^2$
Let slope from graph be m = 0.015

Then $k^2 = (4\pi^2 \times m) / g = (39.48 \times 0.015)/9.81 = 0.0604$
$k = \sqrt{0.0604} = 0.2458$ m

Compare with value of $k = L/\sqrt{12} = 1/\sqrt{12} \approx 0.2887$ m
So experimental $k \approx 0.2458$ m vs theoretical ≈ 0.2887 m

(f) Errors:
– Air resistance affecting oscillation period
– Inaccurate timing due to human reaction

2. The aim of this experiment is to determine the boiling points of liquids A and B and their rate of cooling at 70°C.

Procedure:
(i) Boil 200 cm³ of liquid A and measure boiling temperature:
Let $T_a = 99°C$

(ii) Quickly place on wooden block, start stopwatch

(iii) Stir and record temp at 2-minute intervals

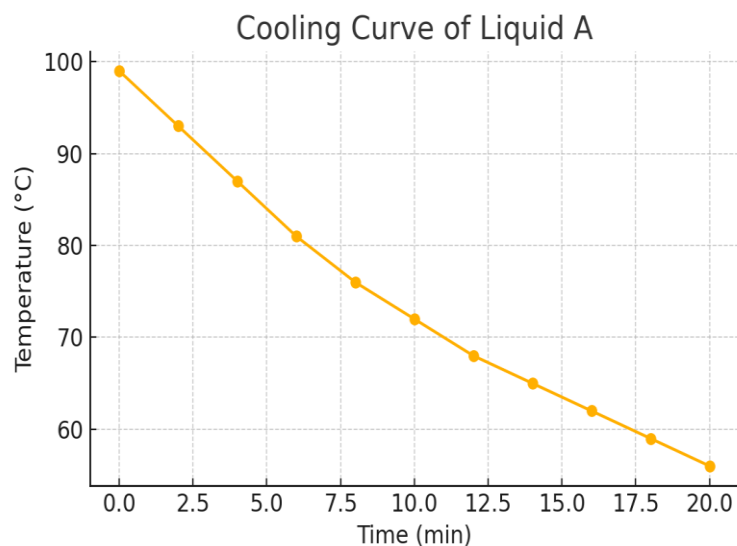| Time t (min)	Temp (°C)
0	99
2	93
4	87
6	81
8	76
10	72
12	68
14	65
16	62
18	59
20	56

Plot T vs t, determine cooling rate at 75°C

Cooling Curve of Liquid A

Repeat for B, let B boil at 78°C, and cool faster

(vi) Liquid A is water, Liquid B is likely ethanol

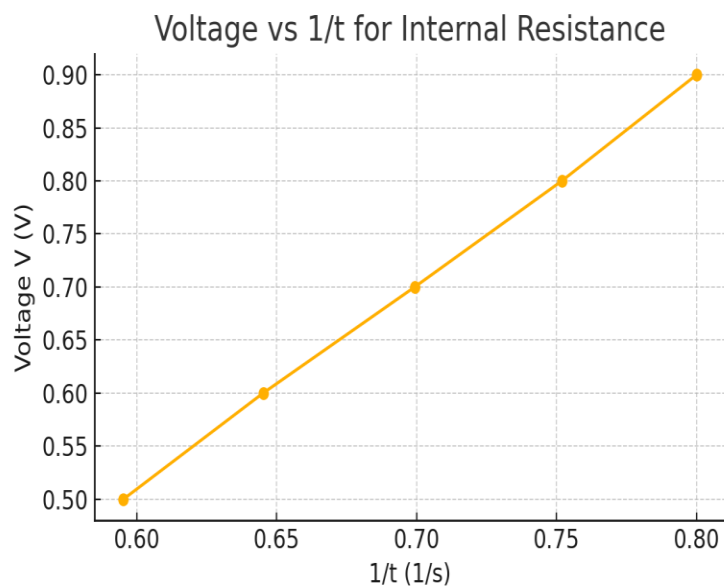3. The aim of this experiment is to determine the internal resistance of a voltmeter.

Procedure:
(i) Connect circuit as in Fig 3.
(ii) Set V to various values (0.9, 0.8, 0.7 …), record balance length ℓ and t.

V (volts)	ℓ (cm)	t (s)
0.9	45	1.25
0.8	40	1.33
0.7	35	1.43
0.6	30	1.55
0.5	25	1.68

Plot a graph of V (vertical) against 1/t (horizontal)

Voltage vs 1/t for Internal Resistance

(iv) From slope S and formula:

V = IR

R = V/I = V × t

Use slope S to find R_v average

Errors:

– Fluctuation in voltmeter readings

– Loose connections in potentiometer