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: 2015**

Instructions

1. This paper consists of THREE questions.

2. Answer all questions.

1. You are provided with standard masses, unknown mass labelled X, a retort stand with its accessories, and two cardboard discs, each with three small holes spaced at rectangular intervals near the edge. A disc has pieces of string threaded through the holes and also a known mass disc B.

Proceed as follows:

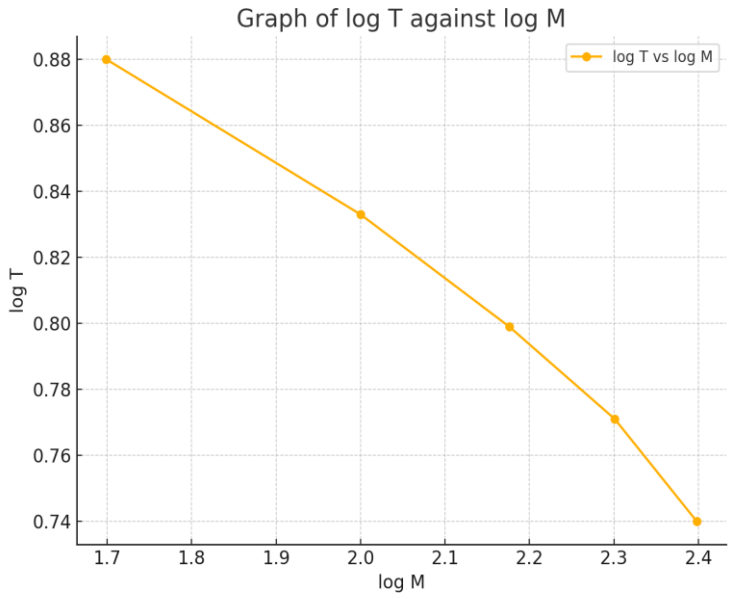
(a) Clamp disc A horizontally using two small blocks of wood. Suspend disc A vertically at the base using a string below the holes as shown. Place a 50g mass at the center of disc A and adjust the length of the string to 100 cm.

(b) Gently rotate disc A through a small angular displacement and release it to perform torsional oscillation. Measure the time t for 10 oscillations and calculate the period T.

(c) Repeat the procedure for M = 100 g, 150 g, 200 g, 250 g. Then replace the masses by an unknown mass X and repeat.

M (g)	T (s)	log M	log T
50	7.6	1.699	0.880
100	6.8	2.000	0.833
150	6.3	2.176	0.799
200	5.9	2.301	0.771
250	5.5	2.398	0.740
X	6.1	?	0.785

(d) Plot a graph of log T against log M.



(e) Use the relation $T = kM^n$, take logs to get $\log T = \log k + n \log M$.
From the slope of the graph, deduce values of n and k.
Using (1.699, 0.880) and (2.398, 0.740),
Slope = (0.740 - 0.880) / (2.398 - 1.699) = -0.140 / 0.699 ≈ -0.200

n = -0.200
From equation: $\log T = \log k + n \log M$
Using ($\log M = 2$, $\log T = 0.833$)
$0.833 = \log k - 0.200 \times 2$
$0.833 = \log k - 0.400 \rightarrow \log k = 1.233 \rightarrow k \approx 17.06$

(f) From $T = kM^n$, substitute $T = 6.1$, $k = 17.06$, $n = -0.200$
$6.1 = 17.06 \times M^{-0.2} \rightarrow M^{-0.2} = 6.1 / 17.06 \approx 0.3576$
$\log M^{-0.2} = \log 0.3576 = -0.447$
Then M = 10^(-0.447 / -0.2) ≈ 10^2.235 ≈ 171 g
So, mass of X = 171 g

2. The aim of this experiment is to determine the boiling point and the rate of cooling of liquid P at 65°C.

Proceed as follows:

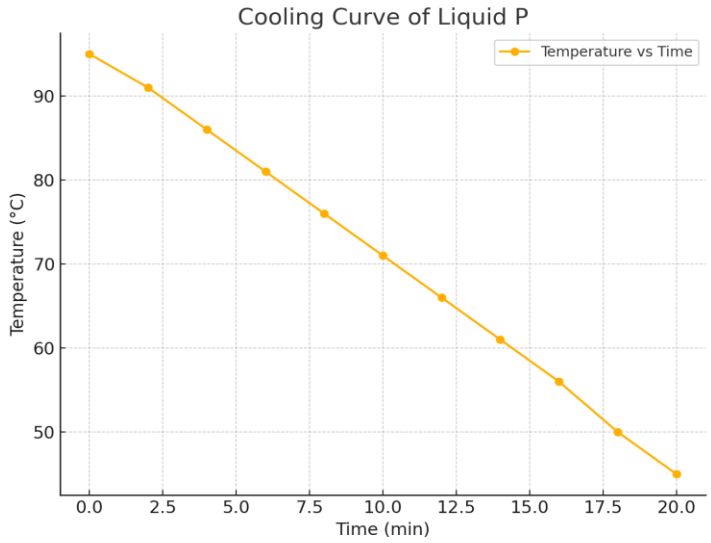
(a) Heat 200 cm^3 of liquid P until it boils and record its boiling temperature θ_0.
Suppose $\theta_0 = 95°C$

(b) Transfer to wooden block and begin timing while cooling.

(c) Stir the liquid and measure temperature at 2-minute intervals until it cools to 45°C.

Time (min)	Temp (°C)
0	95
2	91
4	86
6	81
8	76
10	71
12	66
14	61
16	56
18	50
20	45

(d) Plot graph of temperature vs time and determine slope at 65°C.



Using points (12 min, 66°C) and (14 min, 61°C):
Slope = (61 - 66) / (14 - 12) = -5 / 2 = -2.5°C/min

(e) From boiling point of 95°C and slope of cooling near 65°C, identify liquid:
If rapid cooling occurs, it could be alcohol-based.

(f) Boiling point of P is less than 100°C, not water → it's not expected if P was supposed to be water.

3. You are provided with a metre bridge, an accumulator, galvanometer, a switch, and two wires labelled X and Y.

Proceed as follows:

(a) Connect wire Y of 10 cm in right gap, wire X in left gap. Balance point found at 50 cm. Record x.

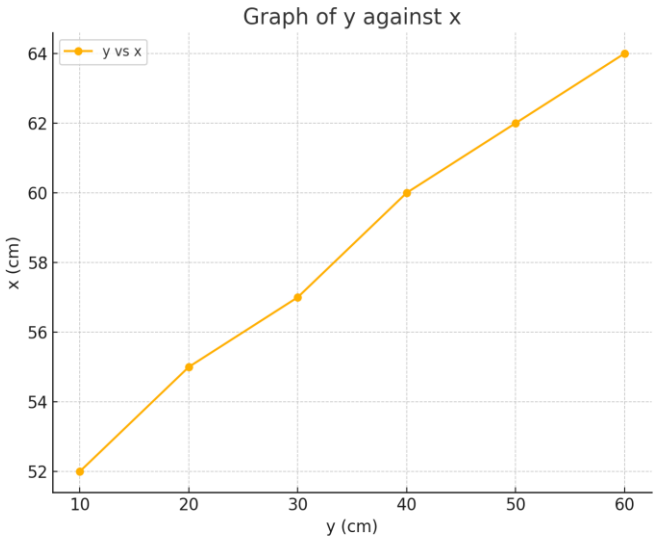
(b) Repeat for y = 20 cm, 30 cm, 40 cm, 50 cm, 60 cm and record x.

y (cm)	x (cm)
10	52
20	55
30	57
40	60
50	62
60	64

(c) Measure diameters: d_x = 0.30 mm = 0.03 cm, d_y = 0.40 mm = 0.04 cm

Calculate areas:
$A_x = \pi(0.015)^2 = 7.07\times10^{-4}$ cm²
$A_\gamma = \pi(0.020)^2 = 1.257\times10^{-3}$ cm²

(d) Plot graph of y against x.



(e) Determine slope. Using (10, 52) and (60, 64):
Slope = (64 - 52) / (60 - 10) = 12 / 50 = 0.24

(f) Use relation
$\rho_x = (\rho_\gamma A_\gamma / A_x) \times (x / y)$
At x/y = 0.24, and $\rho_\gamma = 49 \times 10^{-6}$ Ωcm
$\rho_x = (49 \times 10^{-6} \times 1.257\times10^{-3} / 7.07\times10^{-4}) \times 0.24$
$\rho_x \approx 1.25 \times 10^{-5}$ Ωcm

(g) Aim: to determine the resistivity of wire X using meter bridge comparison.