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: 2010**

Instructions

1. This paper consists of THREE questions.

2. Answer all questions.

1. The aim of this experiment is to determine the radius of gyration k of the rectangular cardboard and the acceleration due to gravity g.

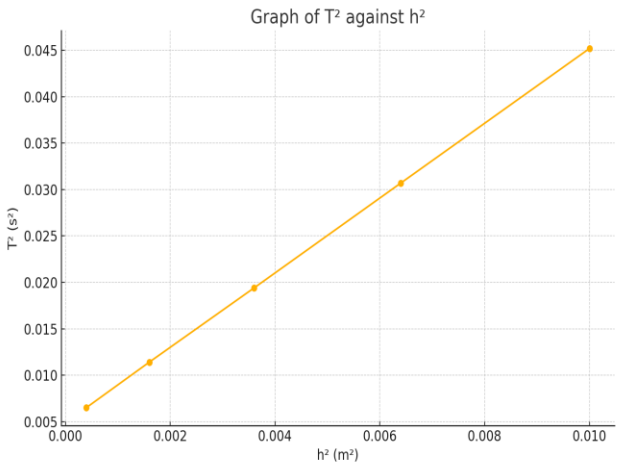
(a) You find the centre of gravity G by suspending the cardboard from two different corners and drawing vertical plumb lines. Their intersection is point G.

(b) Suspend the cardboard from holes at different distances h from G and record the time for 10 oscillations. Calculate the period T.

(c) Tabulated data:

h (m)	h^2 (m^2)	T (s)	T^2 (s^2)
0.02	0.0004	0.0809	0.0065
0.04	0.0016	0.1066	0.0114
0.06	0.0036	0.1393	0.0194
0.08	0.0064	0.1752	0.0307
0.10	0.0100	0.2125	0.0452

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



The relation is: $T = 2\pi\sqrt{((k^2 + h^2)/gh)}$
Squaring gives: $T^2 = (4\pi^2/g)(k^2 + h^2) = (4\pi^2/g)h^2 + (4\pi^2k^2/g)$

So:
Slope = $4\pi^2/g \rightarrow g = 4\pi^2$ / slope
Intercept = $(4\pi^2k^2)/g \rightarrow k = \sqrt{(\text{intercept} \times g / 4\pi^2)}$

Choose two points: (0.0004, 0.0065) and (0.0100, 0.0452)
Slope = (0.0452 − 0.0065) / (0.0100 − 0.0004) = 0.0387 / 0.0096 = 4.031

Thus:
$g = 39.48 / 4.031 = 9.80\ m/s^2$
Use intercept ≈ 0.005
$k^2 = (\text{intercept} \times g) / 4\pi^2 = (0.005 \times 9.80) / 39.48 = 0.049 / 39.48 = 0.00124$
$k = \sqrt{0.00124} = 0.035\ m$

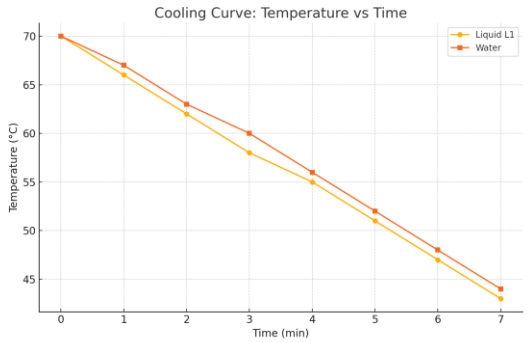
(e) Two sources of error:
Error in measuring h from G.
Timing error due to reaction time.

2. You are required to investigate the specific heat capacity of a liquid L by the method of cooling.

(a) Recorded data:

Time (min)	Temperature L1 (°C)	Temperature Water (°C)
0	70	70
1	66	67
2	62	63
3	58	60
4	55	56
5	51	52
6	47	48
7	43	44

(b) Plot both cooling curves on same axes.



(i) Time taken for cooling from 55°C to 45°C:
L1: From 4 to 6 mins = 2 mins
Water: From 4 to approx 5.5 mins = 1.5 mins

(ii) Use:
$(M_c + M_L C_L)\Delta\theta = (M_c + M_W C_W)\Delta\theta \rightarrow$ use rates

Let:
$M_c = 0.15$ kg
$C_c = 4200$ J/kg°C
$M_L = M_W = 0.1$ kg
$C_W = 4200$ J/kg°C
Time for L1 = 120 s
Time for W = 90 s

Let $Q_L = (M_c C_c + M_L C_L) \times 10 / 120$
$Q_W = (M_c C_c + M_W C_W) \times 10 / 90$

Equating rates:
$[(0.15 \times 4200) + 0.1 \times C_L] / 120 = [(0.15 \times 4200) + (0.1 \times 4200)] / 90$
$[630 + 0.1 C_L] / 120 = [630 + 420] / 90 = 1050 / 90 = 11.67$
Cross-multiplied:
$630 + 0.1 C_L = 11.67 \times 120 = 1400.4$
$0.1 C_L = 770.4$
$C_L = 7704$ J/kg°C

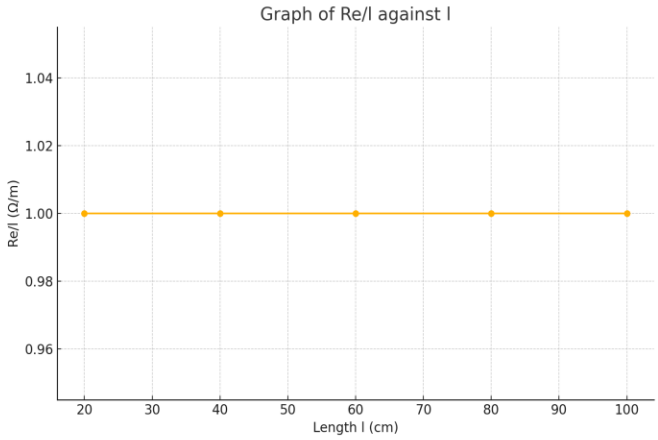
So, specific heat capacity of L1 = 7704 J/kg°C

3.

(a) The table of observations:

l (cm)	l (m)	Re (Ω)	Re/l (Ω/m)
20	0.20	0.20	1.0
40	0.40	0.40	1.0
60	0.60	0.60	1.0
80	0.80	0.80	1.0
100	1.00	1.00	1.0

(b)(i) The graph of Re/l (y-axis) against l (x-axis) is a straight horizontal line at Re/l = 1.0.



(ii) From the graph, the average value of Re/l is Q = 1.0 Ω/m.

(iii) To calculate resistivity:

Let the measured diameter of the wire be d = 0.50 mm = 0.0005 m.
Radius r = 0.00025 m
Cross-sectional area $A = \pi r^2 = 3.142 \times (0.00025)^2 = 1.963 \times 10^{-7}$ m²

Resistivity $\rho = Q \times A = 1.0 \times 1.963 \times 10^{-7} = 1.96 \times 10^{-7}$ Ωm