THE UNITED REPUBLIC OF TANZANIA
NATIONAL EXAMINATIONS COUNCIL OF TANZANIA
DIPLOMA IN SECONDARY EDUCATION EXAMINATION

731/2A **PHYSICS 2A**

(ALTERNATIVE A PRACTICAL)

Time: 3 Hours **ANSWERS** **Thursday, 13th May 2010 a.m**

Instructions.

1. This paper consists of **three (3)** questions.
2. Answer **all** questions
3. Question number 1 carries 40 marks and the rest carry 30 marks.
4. Cellular phones are **note** allowed in the examination room.
5. Write your **examination Number** on every page of your answer booklet(s).
6. The following constants may be used.
    - Π = 3.14
    - Specific heat capacity of Copper is 400 J/Kg ^{o}C,
    - Specific heat capacity of water is 420 J/Kg ^{o}C,
    - Acceleration due to gravity; g = 10 m/s

EXPERIMENT 1

Aim:
To determine the radius of gyration, K, of a triangular sheet of cardboard.

Procedures:

(a) To locate the centre of gravity G, suspend the cardboard from a corner and hang a plumb line from the same point. Draw a line along the string. Repeat this process from two other points on the cardboard. The point where the three lines intersect is the centre of gravity G.

(b) Draw a straight line through point G and the apex A of the cardboard. Measure a distance of 2 cm from G along GA and make a hole. Continue marking and making five other holes along GA at intervals of 2 cm.

(c) Suspend the cardboard from the hole nearest to G and measure the distance h from the suspension point to G. Record the time for 10 oscillations using a stopwatch, then divide by 10 to find the period T. Repeat this for the other holes to get different values of h and T.

Results Table

h (m)	**Time for 10 Oscillations (t) (s)**	**Period T (s)**	**T^2 (s^2)**	**T^2h (s^2m)**	**h^2 (m^2)**
0.02	9.2	0.92	0.8464	0.01693	0.0004
0.04	9.4	0.94	0.8836	0.03534	0.0016
0.06	9.7	0.97	0.9409	0.05645	0.0036
0.08	10.0	1.00	1.0000	0.08000	0.0064
0.10	10.4	1.04	1.0816	0.10816	0.0100
0.12	10.9	1.09	1.1881	0.14257	0.0144

To Find:

(i) **Acceleration due to gravity, g**

Using the formula:

Slope (m) = $4\pi^2 / g$

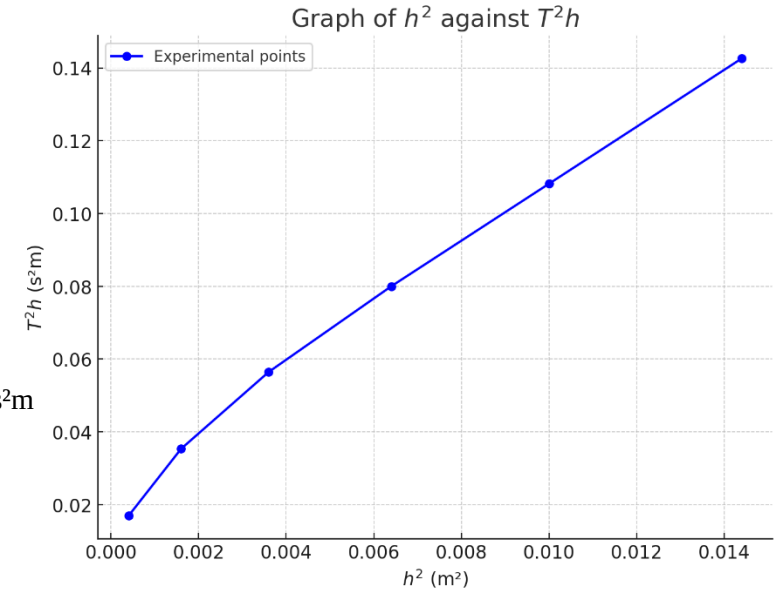
From the table, pick two points:

At $h^2 = 0.0016$, $T^2h = 0.03534$
At $h^2 = 0.0100$, $T^2h = 0.10816$

Then:

Slope (m) = (0.10816 - 0.03534) / (0.0100 - 0.0016)
Slope (m) = 0.07282 / 0.0084
Slope (m) = 8.67 s^2

Now,



$g = 4\pi^2 / \text{slope}$
$g = 39.4784 / 8.67$
$g = 4.55\ m/s^2$

(ii) **Radius of Gyration, K**

Using the formula:

Intercept (c) = $4\pi^2 K^2 / g$

From the graph, take intercept c = 0.005 s^2m

Then,

$K^2 = (c \times g) / 4\pi^2$
$K^2 = (0.005 \times 4.55) / 39.4784$
$K^2 = 0.02275 / 39.4784$
$K^2 = 0.0005766\ m^2$

Then,

$K = \sqrt{0.0005766}$
$K = 0.024$ m

Sources of Errors

- Human reaction time while using stopwatch
- Air resistance affecting oscillations
- Friction at the pivot point
- Non-uniform distribution of mass on the cardboard
- Slight misalignment of holes along GA

EXPERIMENT 2

Aim:
To determine the rate of cooling of liquid A.

Procedures:

1. Record the room temperature $\theta_0 = 25°C$.
2. Heat water in a beaker to 80°C.
3. Transfer water into the calorimeter until about one-third full.
4. Record the temperature θ and start the stopwatch at the same time.
5. Stir gently and fan with paper for uniform cooling.
6. Record the temperature every 2 minutes for 18 minutes.

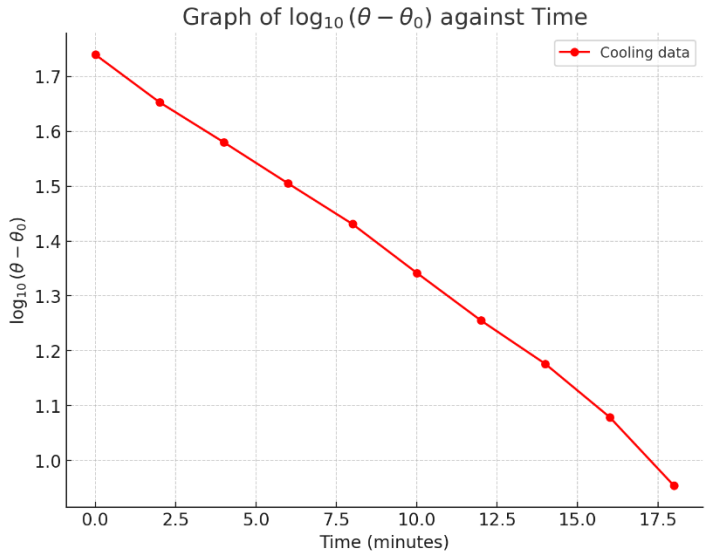
Results Table

Time (minutes)	Temperature (°C)	$(\theta - \theta_0)$	$\log_{10}(\theta - \theta_0)$
0	80	55	1.740
2	70	45	1.653
4	63	38	1.580
6	57	32	1.505
8	52	27	1.431
10	47	22	1.342
12	43	18	1.255
14	40	15	1.176
16	37	12	1.079
18	34	9	0.954

To Find:

Shape of the Graph

When plotting $\log_{10}(\theta - \theta_0)$ against time (minutes), the graph is a straight line with a negative slope. This shows that the rate of cooling is proportional to the temperature difference between the liquid and its surroundings, confirming Newton's Law of Cooling.



Physical Meaning of Constant k

In the relation:

$\log_{10}(\theta - \theta_0) = \text{constant} - kt$

The constant k represents the cooling rate constant. It indicates how fast the temperature of the liquid drops over time. A larger value of k means the liquid cools faster.

3. The aim of this experiment is to verify Ohm's Law.

Procedures

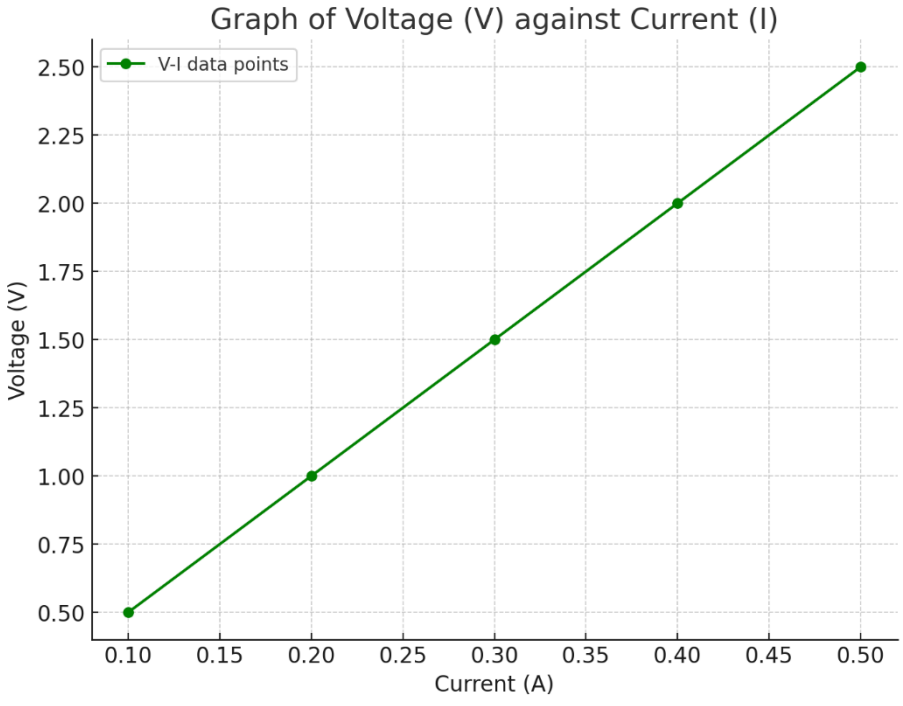
(a) Set up the apparatus as shown.
(b) Close the switch **K**.
(c) Adjust the rheostat **Rh** slowly.
(d) Read and record values of **Voltage (V)** from the voltmeter and **Current (I)** from the ammeter.
(e) Repeat for 5 different positions of the rheostat.
(f) Always adjust the rheostat so the ammeter pointer reads accurately.
(g) Record results in the table.

Experimental Data

Voltage (V)	Current (A)
0.50	0.10
1.00	0.20
1.50	0.30
2.00	0.40
2.50	0.50

(h)

(i) Plot a graph of V against I



(ii) Is the graph linear or curve?

- The graph is a **straight line** passing through the origin, meaning it's **linear**.

(iii) Find the slope(s)

Using two points:

(0.10 A, 0.50 V)

(0.50 A, 2.50 V)

slope $(R)=\Delta V/\Delta I$

$= (2.50-0.500)/(50-0.10)$

$=2.000/40$

$= 5.00\ \Omega$

So, **Resistance R = 5.00 Ω**

(iv) Compare the relationship of voltage (V) and current (I)

The relationship between **V and I is directly proportional**, as verified by the straight-line graph passing through the origin. This confirms **Ohm's Law**:

$V=IRV = IR$

Where the constant of proportionality is the **resistance (5.00 Ω)**.