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

731/2A **PHYSICS 2A**

(ACTUAL PRACTICAL A)

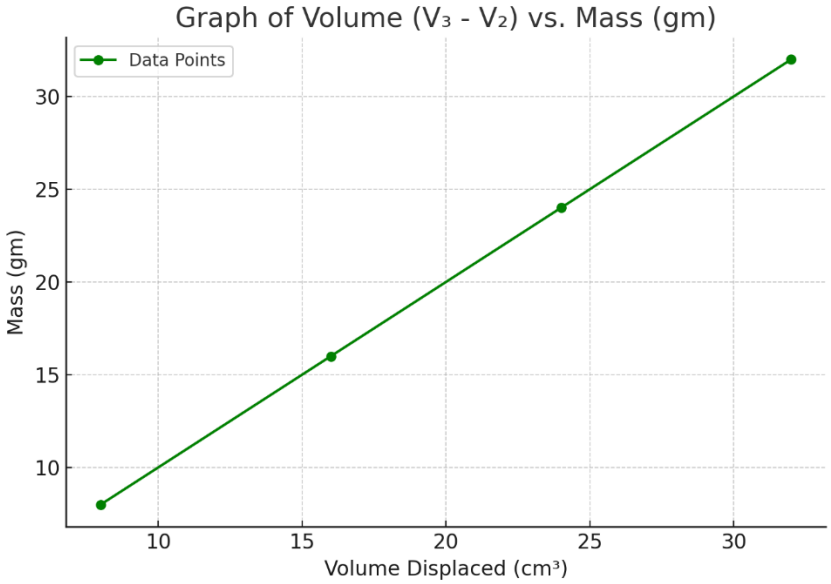
Time: 3 Hours **ANSWERS** **Thursday, 08th May 2014 a.m**

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).

1. The aim of this experiment is to determine the density of softwood (pine tree wood)

(a) Plot the graph of volume against mass



(b) Find the slope from your graph.

Answer:
Using two points from the graph:
Point 1: (8 cm^3, 8 gm)
Point 2: (32 cm^3, 32 gm)

Slope = (32 − 8) / (32 − 8)
Slope = 24 / 24 = 1.0 gm/cm^3

(c) Use the slope obtained in (b) to find the density of wood provided.

Answer:
Density = Mass / Volume = slope of the graph
So, density = **1.0 gm/cm^3**

(d) State two sources of errors in this experiment and suggest ways of eliminating them.

Answer:

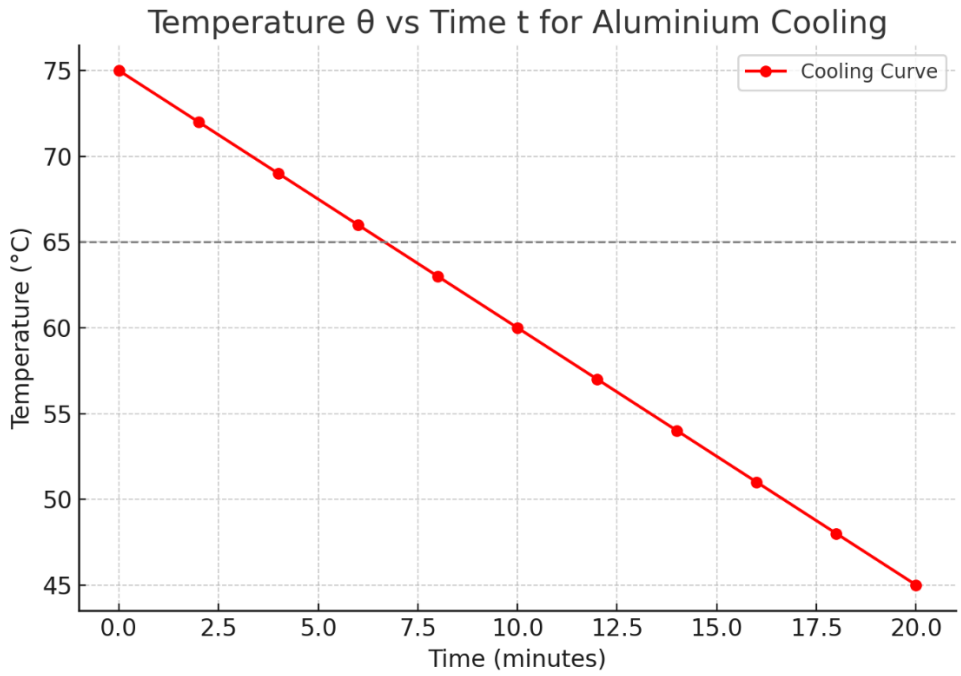
1. **Air bubbles sticking to wood or bob during immersion**
    - Eliminate by tapping gently or immersing slowly.
2. **Parallax error when reading the measuring cylinder**
    - Avoid by reading at eye level.

(a) Plot a graph of θ against time t and use the graph to determine the slope Δθ / Δt at 65°C.

Answer:
From the graph:
At around 65°C (between 6 and 8 minutes):
θ drops from 66°C to 63°C between 6 and 8 min.

Δθ = 66 − 63 = 3°C
Δt = 8 − 6 = 2 min
Δθ / Δt = 3 / 2 = **1.5°C per minute** = 1.5 °C/min

Convert to SI units:
Δθ / Δt = 1.5 × (1 / 60) = 0.025 °C/s



(b) Calculate the rate of heat loss to the surroundings ΔH / Δt
Formula:
ΔH / Δt = [(M − m)Cw + mCc] × (Δθ / Δt)

Let:

- m = 0.150 kg (mass of empty calorimeter)
- M = 0.500 kg (mass with water)
- Cw = 4.2 × 10³ J/kg/K
- Cc = 4.0 × 10³ J/kg/K
- Δθ / Δt = 0.025 °C/s

Now calculate:

$\Delta H / \Delta t = [(0.500 - 0.150) \times 4200 + 0.150 \times 4000] \times 0.025$
$= [(0.350 \times 4200) + (0.150 \times 4000)] \times 0.025$
$= [1470 + 600] \times 0.025$
$= 2070 \times 0.025$
$=$ **51.75 W**

(c) Use the Newton's law of cooling to determine the value of K

Formula:
$\Delta H / \Delta t = K \times A \times (\theta - \theta_0)$

Let:

$\theta = 65°C$

$\theta_0 = 25°C$

A = external surface area = π r h + π $d^2/4$

Assume:

d = 8.0 cm = 0.08 m

h = 10.0 cm = 0.10 m
$\rightarrow$ r = 0.04 m

Then:
$A = \pi \times 0.04 \times 0.10 + (\pi \times 0.08^2)/4$
$A = \pi(0.004) + \pi(0.0064)/4$
$A = 0.01257 + 0.00502 =$ **0.0176 m^2**

Now use:
$K = \Delta H / \Delta t \div A(\theta - \theta_0)$
$= 51.75 \div (0.0176 \times 40)$
$= 51.75 \div 0.704$
$=$ **73.54 W/m^2K**

3. The aim of this experiment is to determine the electromotive force (E) and the internal resistance (r) of a cell.

Apparatus

An Ammeter A, a tapping key K, resistance box R, a dry cell E and connecting wires.

Procedures

(i) Tune R of 1Ω connected in series with circuit components of current I, read and record the value of I.

(ii) Repeat the process in (i) above for values of R equal to; 2Ω, 3Ω, 4Ω and 5Ω.

(iii) Tabulate the results obtained in (ii) above including the column for quantity 1/I in the same table.

Answer:

Resistance R(Ω)	Current I(A)	1/I (A^{-1})
1	0.70	1.429
2	0.57	1.754
3	0.47	2.128
4	0.39	2.564
5	0.33	3.030

Questions

(a) Plot the graph of R (Ω) against 1/I (A^{-1}).

Pick two points:

Point 1: (1.429, 1)
Point 2: (3.030, 5)

Slope (E) = (5 − 1) / (3.030 − 1.429)
Slope (E) = 4 / 1.601
Slope (E) ≈ 2.5 V

So, **E = 2.5 V**

(b) Find the electromotive force (E) and the internal resistance r of a cell.

Answer:
From the equation:
R = E × (1/I) − r

Intercept r is the point where the line crosses the R-axis when 1/I = 0.

Using point-slope form:
Let's use (1.429, 1)

1 = 2.5 × 1.429 − r
1 = 3.5725 − r
r = 3.5725 − 1
r = 2.5725 Ω

Approximate to **2.57 Ω**

(c) State any source of errors and precautions to minimize errors.

Answer:

Sources of error:

1. Internal heating of the cell during prolonged current flow, affecting readings.
2. Loose or corroded connections increasing contact resistance.

Precautions:

1. Take current readings quickly before temperature effects set in.
2. Use clean, tight connections and reliable wires.