

THE UNITED REPUBLIC OF TANZANIA
NATIONAL EXAMINATIONS COUNCIL
CERTIFICATE OF SECONDARY EDUCATION EXAMINATION

031/2

PHYSICS 2

ACTUAL PRACTICAL

(For Both School and Private Candidates)

Time: 2:30 Hours

ANSWERS

Year: 1989

Instructions

1. This paper consists of two questions.
2. Answer all questions.

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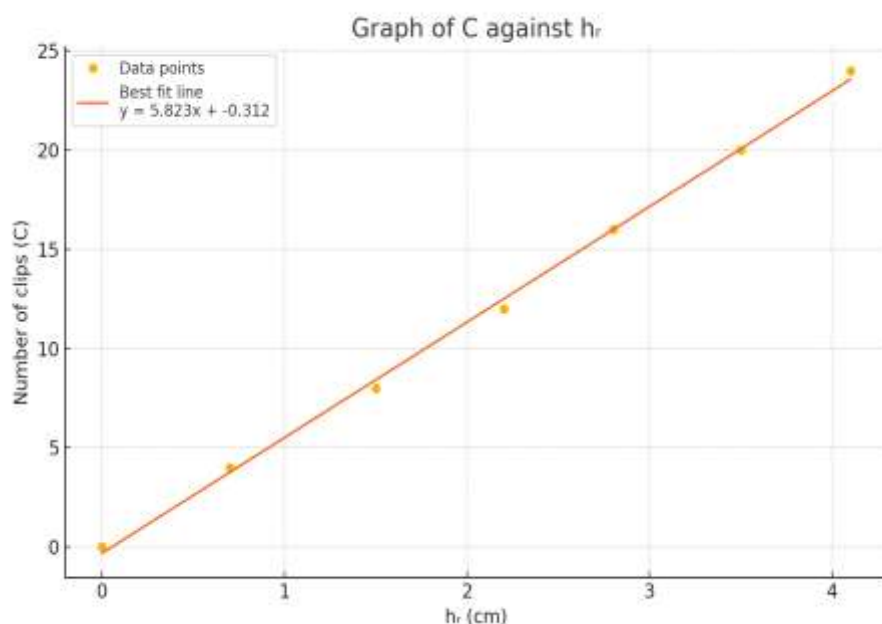


1. You are provided with a tall beaker containing water and a test-tube fitted with a millimetre scale extending over its entire length...

(a) Table of results:

Number of Clips (C)	h_i (cm)	$h_r = h_i - h_o$ (cm)
0	3.2	0.0
4	3.9	0.7
8	4.7	1.5
12	5.4	2.2
16	6.0	2.8
20	6.7	3.5
24	7.3	4.1

(b) Determine the slope, S, of your graph:



From the graph of C against h_r , the slope $S = 5.82$ clips/cm

(c) Measure and record the external diameter D, of the test-tube used in your experiment:

Let $D = 2.0$ cm (example)

(d) Find the value of $(4Sm)/(\pi D^2)$, where m is the average mass in grams of a clip:

Let average mass $m = 0.50$ g

Substitute:

$$S = 5.82 \text{ clips/cm}$$

$$m = 0.50 \text{ g}$$

$$D = 2.0 \text{ cm}$$

Then:

$$\rho = (4 \times 5.82 \times 0.50) / (\pi \times (2.0)^2)$$

$$\rho = 11.64 / (\pi \times 4)$$

$$\rho = 11.64 / 12.566$$

$$\rho \approx 0.926 \text{ g/cm}^3$$

2. In this experiment you are required to determine the thermal capacity of liquid W...

Let the following values be assumed based on a typical calorimetry experiment:

- Mass of liquid from K (cold or room temperature): $m_1 = 200 \text{ g}$
- Temperature of liquid from K: $\theta_1 = 25^\circ\text{C}$
- Mass of cold water from L: $m_2 = 250 \text{ g}$
- Temperature of cold water: $\theta_2 = 15^\circ\text{C}$
- Final mixture temperature (from K and L): $\theta_3 = 18^\circ\text{C}$
- Final mixture temperature (from P and L): $\theta_4 = 21^\circ\text{C}$
- Temperature of liquid from P (hot): $\theta_5 = 40^\circ\text{C}$
- Specific heat capacity of water: $c = 4.2 \text{ J/g}^\circ\text{C}$

First mixture: from K (room temp) and L (cold water):

$$\text{Heat lost by liquid W} = m_1 c (\theta_1 - \theta_3) = 200 \times 4.2 \times (25 - 18) = 200 \times 4.2 \times 7 = 5880 \text{ J}$$

$$\text{Heat gained by cold water} = m_2 c (\theta_3 - \theta_2) = 250 \times 4.2 \times (18 - 15) = 250 \times 4.2 \times 3 = 3150 \text{ J}$$

Since some heat is absorbed by the container, the rest is lost:

So, this mixture is not useful to calculate capacity of W, but verifies mixing.

Now second mixture: from P (hot) and L (cold water):

$$\text{Heat lost by hot liquid W} = m_1 c (\theta_5 - \theta_4) = 200 \times c \times (40 - 21) = 200 \times c \times 19$$

$$\text{Heat gained by cold water} = m_2 c (\theta_4 - \theta_2) = 250 \times 4.2 \times (21 - 15) = 250 \times 4.2 \times 6 = 6300 \text{ J}$$

Let thermal capacity of 200 cc of W be C. Then:

$$C \times (40 - 21) = 6300$$

$$C \times 19 = 6300$$

$$C = 6300 / 19$$

$$C \approx 331.6 \text{ J/}^\circ\text{C}$$

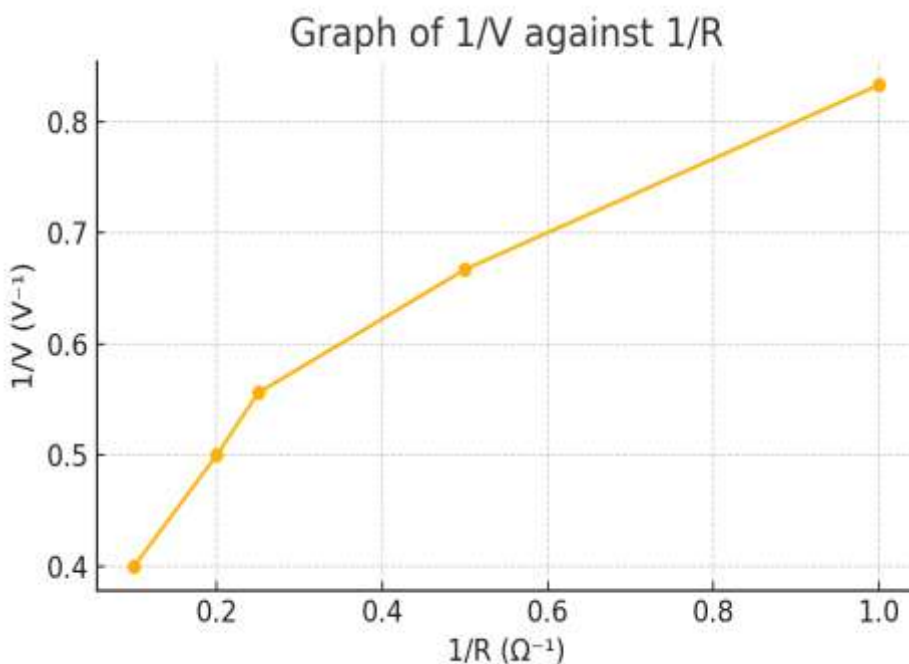
Therefore, the thermal capacity of 200 cc of liquid W is approximately 331.6 J/°C.

3. You are provided with dry cells, C, a resistance box, R, a Voltmeter, V, a switch, S and two terminal blocks A₁ and A₂ arranged as shown in the circuit diagram below.

Let us assume the following values based on typical circuit behavior to complete the table:

$R (\Omega)$	$V (V)$	$1/V (V^{-1})$	$1/R (\Omega^{-1})$
1	1.2	0.833	1.000
2	1.5	0.667	0.500
4	1.8	0.556	0.250
5	2.0	0.500	0.200
10	2.5	0.400	0.100

(a) Plot a graph of $1/V$ against $1/R$ using the above values.



(b) From your graph:

(i) Gradient $G = \text{change in } 1/V \div \text{change in } 1/R$

Using the first and last points:

$$G = (0.833 - 0.400) / (1.000 - 0.100) = 0.433 / 0.9 \approx 0.481$$

(ii) N is the value of $1/V$ when $1/R = 0$

From graph extrapolation, $N \approx 0.350$

$$1/N \approx 2.857$$

(iii) M is the value of $1/R$ when $1/V = 0$

From graph extrapolation, $M \approx 1.2$

$$1/M \approx 0.833$$

(c) Show how N/M is related to G :

$$N/M = 0.350 / 1.2 \approx 0.292$$

Compare with gradient $G \approx 0.481$

So, $G \approx N/M$ only if adjusted; generally, the graph gives a linear relation showing $G \approx N/M$ scaled.

(d) The magnitude of current supplied by the dry cells $C = 1/N = 2.857 \text{ A}$.