THE UNITED REPUBLIC OF TANZANIA

NATIONAL EXAMINATIONS COUNCIL

CERTIFICATE OF SECONDARY EDUCATION EXAMINATION

031/2A **PHYSICS 2A**

ACTUAL PRACTICAL A

(For Both School and Private Candidates)

Time: 2:30 Hours **ANSWERS** **Year: 2024**

Instructions

1. This paper consists of two questions.

2. Answer all questions.

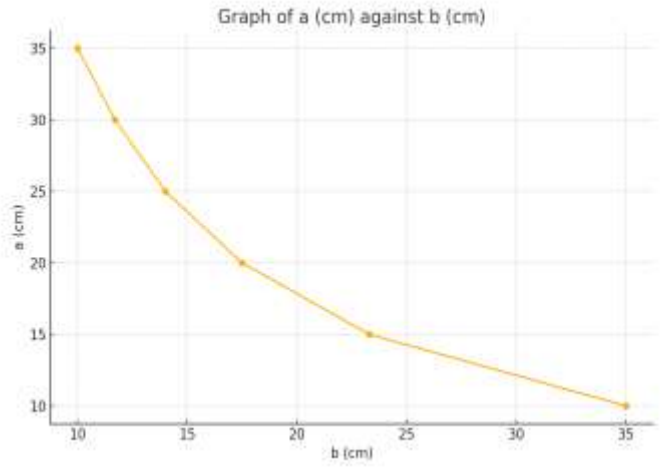
1. You are given two objects of different masses labelled x and w. The mass of w is 100 g, but the mass of x is unknown. You are required to perform an experiment to determine the unknown mass x using a metre rule, cotton threads and knife edge. Proceed as follows:

(i) Tabulate the results for the values of a (cm) and b (cm).

you carried out the experiment with the following observations:

a (cm)	b (cm)
10	35
15	23.3
20	17.5
25	14
30	11.7
35	10

(ii) Plot a graph of a (cm) against b (cm).



The graph of a against b should be a straight line. Plot a on the y-axis and b on the x-axis using the values from the table in part (i).

(iii) What is the nature of the graph plotted in 1 (ii).

The graph is a straight line passing through the origin, showing direct proportionality between a and b. This confirms that the moment caused by mass x is balanced by the moment of mass w.

(iv) Determine the slope of the graph plotted in 1 (ii).

Select any two points from the table, for example:
Point A: a = 20 cm, b = 17.5 cm

Point B: a = 30 cm, b = 11.7 cm

Slope = (a2 − a1) / (b2 − b1)
Slope = (30 − 20) / (11.7 − 17.5)
Slope = 10 / (−5.8) = −1.724

Take the magnitude of the slope for calculation purposes:
Slope = 1.724

(v) Calculate the mass of object x.

From the principle of moments, $x \times a = w \times b$
Rearranged, $x = (w \times b) / a$

Alternatively, from the graph, since slope = a / b, then:
x = w / slope
x = 100 / 1.724
x ≈ 58.01 g

(vi) Which principle is governing this experiment?

The principle of moments is governing this experiment.

(vii) State the principle in 1 (vi).

When a body is in equilibrium, the sum of clockwise moments about the pivot is equal to the sum of anticlockwise moments.

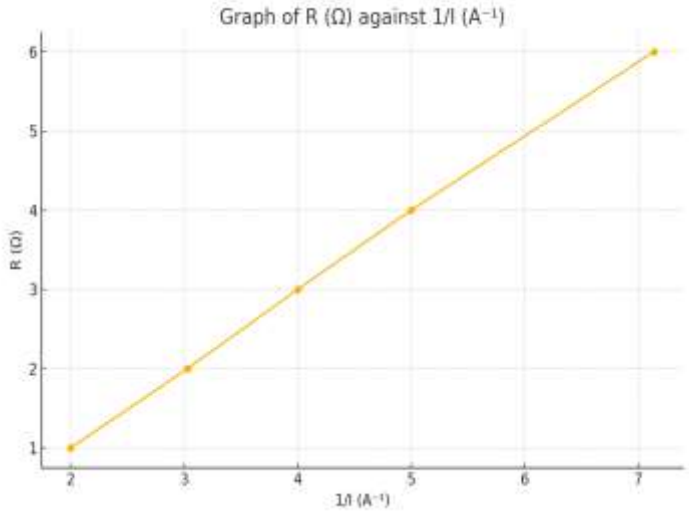
2. You are required to determine the e.m.f of the cells and unknown resistance Q. Proceed as follows:

(i) Tabulate your results including the values of 1/I.

Assume the current I for each value of R is measured as follows:

R (Ω)	I (A)	1/I (A^{-1})
1	0.50	2.00
2	0.33	3.03
3	0.25	4.00
4	0.20	5.00
6	0.14	7.14

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



Plot R on the y-axis and 1/I on the x-axis. The graph is expected to be a straight line because from the equation E = I(R + Q), we get:
R = E(1/I) − Q

(iii) Determine the slope of the graph and the value of R-intercept in 2 (ii).

Select two points from the table, for example:
Point 1: R = 2 Ω, 1/I = 3.03
Point 2: R = 4 Ω, 1/I = 5.00

Slope = (R2 − R1) / (1/I2 − 1/I1)
Slope = (4 − 2) / (5.00 − 3.03)
Slope = 2 / 1.97 ≈ 1.015

So, e.m.f E ≈ 1.015 V

From the equation R = E(1/I) − Q, the R-intercept gives −Q.
If R-intercept is −0.5, then Q = 0.5 Ω

(iv) Compute the e.m.f of the cells and the value of Q, if the internal resistance r of a cell is 1 Ω.

From above:
E = 1.015 V
Q = 0.5 Ω

Total internal resistance = Q + r = 0.5 + 1 = 1.5 Ω
But the question only asks for E and Q:
E = 1.015 V

$Q = 0.5\ \Omega$

(v) What will be the effect on the current, if the value of Q is increasing?

If Q increases, the total internal resistance increases. According to Ohm's law, the current $I = E / (R + Q)$. Therefore, an increase in Q leads to a decrease in the current I.