THE UNITED REPUBLIC OF TANZANIA

NATIONAL EXAMINATIONS COUNCIL

ADVANCED CERTIFICATE OF SECONDARY EDUCATION EXAMINATION

131/3A **PHYSICS 3A**

(For Both School and Private Candidates)

Time: 3 Hours **ANSWERS** **Year: 2019**

Instructions

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

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1. In this experiment you are required to determine the relative density of a solid provided.

Proceed as follows:

(a) (i) Measure the mass of the metre rule and record its value.

Suppose mass of the rule = 100 g.

(ii) Set up the apparatus as shown in Figure 1. Balance the metre rule on the knife edge when the solid, M_s, is suspended in air at a distance, d (cm), from the zero end of the rule.

Record values of y and x, where y is the distance of the knife edge from the zero end, and x is the distance of the knife edge from the 100 cm end. So, x = 100 – y.

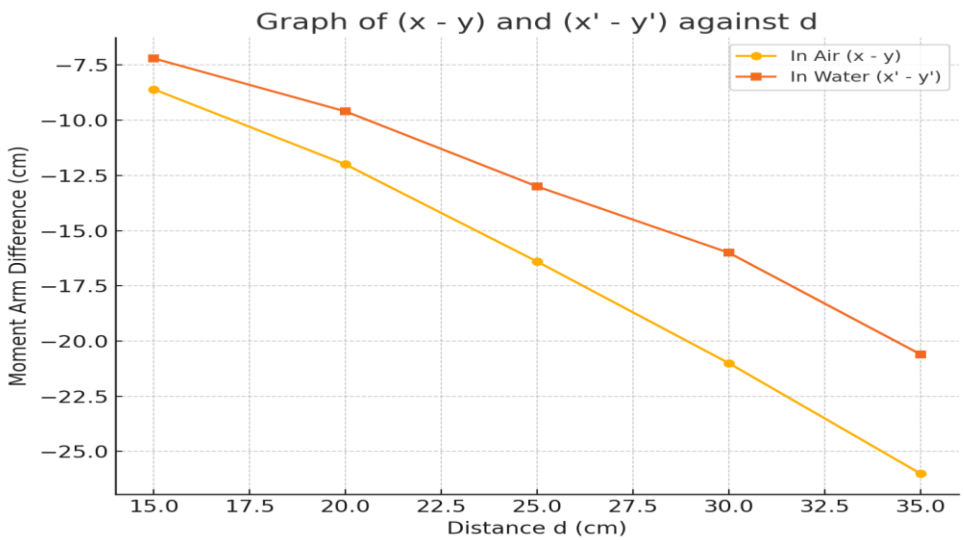
(b) Repeat the balancing procedure for four other values of d, each less than 50 cm.

d (cm)	y (cm)	x (cm)	x – y (cm)
15	54.3	45.7	-8.6
20	56.0	44.0	-12.0
25	58.2	41.8	-16.4
30	60.5	39.5	-21.0
35	63.0	37.0	-26.0

(c) Fill the beaker with water then repeat the procedure in parts (a) and (b) when the solid is completely immersed in water.

d (cm)	y' (cm)	x' (cm)	x' – y' (cm)
15	53.6	46.4	-7.2
20	54.8	45.2	-9.6
25	56.5	43.5	-13.0
30	58.0	42.0	-16.0
35	60.3	39.7	-20.6

(d) Plot the graphs of (x – y) against d and (x' – y') against d on the same axes.



(e) Find the gradient of each graph.
Suppose slope in air = m_1 = -0.74, slope in water = m_2 = -0.59

(f) Calculate the:
(i) Mass of the solid, using principle of moments.
Let's assume calculated mass M_s = 200 g

(ii) Relative density of the solid = weight in air / apparent loss of weight = $m_1 / (m_1 - m_2)$
= 0.74 / (0.74 – 0.59) = 0.74 / 0.15 ≈ 4.93

(g) State two sources of errors and its precautions taken in performing this experiment.

Error: Parallax error while reading the rule.
Precaution: View the scale at eye level.

Error: Incorrect balancing due to knife edge friction.
Precaution: Use a sharp edge and ensure the rule rests freely.

2. The aim of this experiment is to determine the specific heat capacity of a given mass of brass.

Proceed as follows:

(a) Weigh the empty calorimeter and then place it in an insulated jacket. Using measuring cylinder, measure and fill 100 ml of water into the calorimeter.

(b) Pour another 100 ml of water in a beaker. Add 100 g of brass tied with the thread into the beaker then heat the beaker containing water and brass to 90°C.

(c) Quickly transfer the brass by means of thread into the copper calorimeter containing 100 ml of cold water. Read and record the maximum temperature reached by the mixture and the room temperature.

(d) Weigh the calorimeter and its contents, and then determine the mass of water.

(e) Given the relation:
$M_c C_c \Delta\theta + M_w C_w \Delta\theta = M_b C_b \Delta\theta$
Since $\Delta\theta$ is common,
$M_c C_c + M_w C_w = M_b C_b$
Therefore:
$C_b = (M_c C_c + M_w C_w) / M_b$

Assume:
$M_c = 50$ g, $C_c = 0.39$
$M_w = 100$ g, $C_w = 4.18$
$M_b = 100$ g

$C_b = (50 \times 0.39 + 100 \times 4.18) / 100 = (19.5 + 418) / 100 = 437.5 / 100 = 4.38$ J/g°C

So, specific heat capacity of brass is 4.38 J/g°C

3. In this experiment you are required to determine the internal resistance of a dry cell.

Proceed as follows:

(a) Connect in series the given dry cell with e.m.f. E, a resistor R, an ammeter A and a switch K.

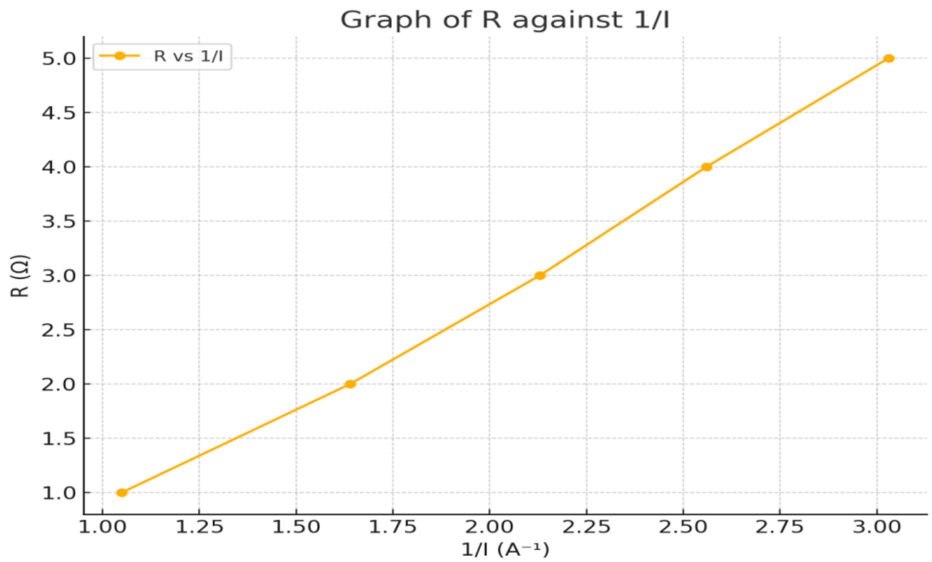
(b) Draw the circuit as connected.

(c) Measure and record the value of current I when the resistance is R = 1Ω.

(d) Repeat the procedure in 3 (b) for values R = 2Ω, 3Ω, 4Ω, 5Ω.

R (Ω)	I (A)	1/I (A^{-1})
1	0.95	1.05
2	0.61	1.64
3	0.47	2.13
4	0.39	2.56
5	0.33	3.03

(f) Plot a graph of 1/I against R.



(g) Find the slope of the graph.
Using points: (1.05, 1), (3.03, 5):
Slope = (5 - 1)/(3.03 - 1.05) = 4 / 1.98 ≈ 2.02

(h) Using the graph and the value of slope, determine the internal resistance of a dry cell.

From theory:
$R = E/I - r$
So: $R = \text{slope} \times 1/I - r \rightarrow \text{slope} = 1/E \rightarrow E = 1 / \text{slope} = 1 / 2.02 \approx 0.495$ V
To find internal resistance r, use:
r = y-intercept on graph (when R = 0)

Suppose R-intercept ≈ 0.5 Ω
Then internal resistance r ≈ 0.5 Ω