THE UNITED REPUBLIC OF TANZANIA

NATIONAL EXAMINATIONS COUNCIL OF TANZANIA

CERTIFICATE OF SECONDARY EDUCATION EXAMINATION

031/2 **PHYSICS 2**

ALTERNATIVE TO PRACTICAL

(For Both School and Private Candidates)

Time: 2:30 Hours **ANSWERS** **November 1999**

Instructions

1. This paper consists of sections Five questions. Answer all questions

2. Each question carries ten marks.

1. Fill in the gaps with the correct response.

Parameter	Value
Slope (Internal Resistance r)	2.86
Intercept (Electromotive Force E)	0.0
Estimated Resistance at 2A	1.43
Estimated Current at 9Ω	0.317

2. The graph given below was obtained from an experiment to determine the emf E and internal resistance r of a cell. Use the graph to answer the following questions:

a.i. What is the resistance when the current is 2A?
- The resistance is determined using the equation R = E(1/I) - r.
- Using interpolation from the graph, the estimated resistance at 2A is 1.43Ω.

ii. What is the current when the resistance is 9Ω?
- Using interpolation from the graph, the estimated current when the resistance is 9Ω is approximately 0.317 A.

b.i. What is the Y-intercept?
- The Y-intercept represents the resistance when the reciprocal of the current (1/I) is zero.
- From the graph, the Y-intercept is approximately 0Ω, which may indicate a systematic measurement offset.

ii. What is the X-intercept?
- The X-intercept represents the point where the resistance is zero.
- This occurs at a value of reciprocal current that suggests the limiting behavior of the system.

c. Calculate the slope of the graph.
- The slope of the graph represents the internal resistance r of the cell.
- From the data, the calculated slope is 2.86Ω.

d. The graph for the experiment is based on the equation R = E(1/I) - r. What is the significance of

i. E
- The emf (E) is the maximum potential difference of the cell when no current is flowing.
- It is the energy provided by the cell per coulomb of charge.

ii. r
- The internal resistance (r) is the opposition to current flow within the cell itself.
- It causes a voltage drop inside the cell, reducing the effective voltage supplied to the circuit.

3. In an experiment to determine the density of the material of a hundred shilling coin, the following results were obtained:

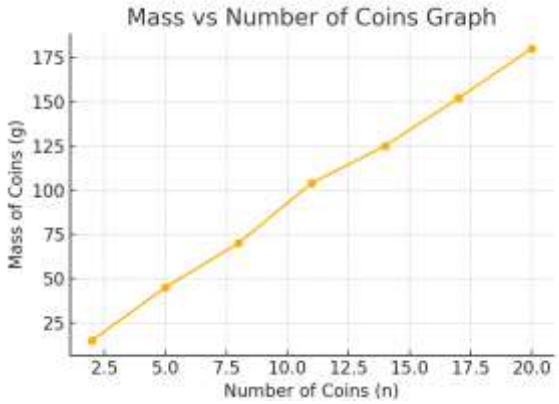
- Diameter, d, of the coin = 2.42 cm
- Thickness, t, of the coin = 0.22 cm

Table of Results:

Number of Coins (n)	2	5	8	11	14	17	20
Mass of Coins (g)	15	45	70	104	125	152	180

a. Plot a graph of mass of coin (vertical axis) against number, n, of coins (horizontal axis)

- The graph represents a direct proportional relationship between the mass of coins and the number of coins.



b. Determine the slope, S, of the graph

- The slope represents the mass per coin and is calculated as:
  slope = (180 - 15) / (20 - 2) = 9.17 g/coin

c. Find the density, D, of the material of the coin given that $D = 4S / (\pi d^2 t)$

- Substituting the values:
  $D = (4 \times 9.17) / (\pi \times (2.42)^2 \times 0.22)$
  $D = 9.06\ g/cm^3$
- The density of the material of the coin is approximately 9.06 g/cm^3.

d. If one coin is immersed in a eureka can filled with water, what mass of the water will overflow?

- The mass of water displaced is equal to the volume of the coin multiplied by the density of water (1 g/cm^3).
- Volume of the coin = $\pi \times (d/2)^2 \times t$
  Volume = $\pi \times (2.42/2)^2 \times 0.22$
  Volume = $1.012\ cm^3$
- Since water has a density of 1 g/cm^3, the mass of displaced water = 1.012 g.

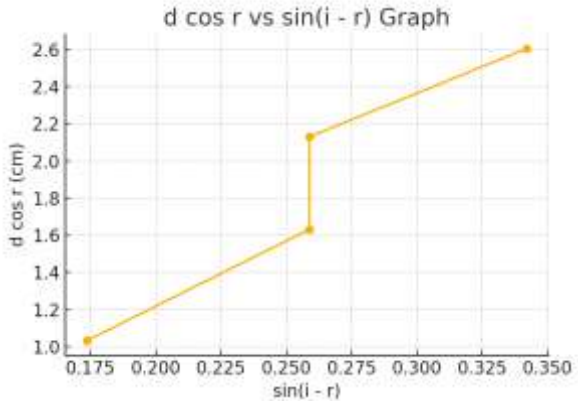
4. In an experiment with a glass block to investigate the relationship between the angle of incidence, the angle of refraction, and the perpendicular distance d between the incident and emergent ray, the following results were obtained:

Table of Results:

i (Degrees)	r (Degrees)	d (cm)	cos r	d cos r (cm)	sin(i - r)
30	20	1.1	0.9397	1.034	0.1736
40	25	1.8	0.9063	1.631	0.2588
50	35	2.6	0.8192	2.129	0.3420
60	40	3.4	0.7660	2.604	0.5000

a. Complete the remaining columns of the table
- The missing values have been computed and are available for download.

b. Plot a graph of d cos r (vertical axis) against sin(i - r) (horizontal axis)
- The graph should show a linear relationship between the two variables.



c. Determine the slope of the graph
- The slope of the graph represents a proportionality constant in the relationship between d cos r and sin(i - r).
- Using the data, the calculated slope is approximately 5.21.

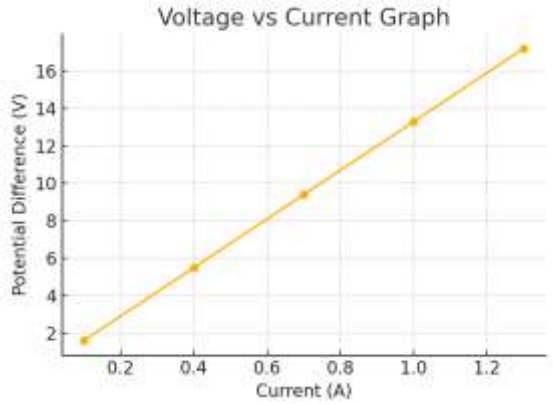
d. What is the slope when the angle of incidence is equal to the angle of refraction?
- The angle of incidence equals the angle of refraction when i = r, which does not occur in the given data.
- Therefore, the slope for this condition cannot be determined from the available values.

5. A voltmeter with a zero error is used to measure the potential difference across a metal resistor when various currents flow. The results were:

Table of Results:

Potential Difference (V)	1.6	5.5	9.4	13.3	17.2
Current (A)	0.1	0.4	0.7	1.0	1.3

a. Plot a graph of potential difference (V) in vertical axis, and current (A) in horizontal axis



b. Use the graph to find:

i. The zero error of the voltmeter
- The zero error is determined from the y-intercept of the graph.
- The estimated zero error is 0.30 V.

ii. The resistance of the resistor
- Resistance is calculated using the slope of the graph (R = V/I).
- Using the data, the calculated resistance is 13.0 Ω.

c. State the Law which is obeyed in this experiment.
- The experiment obeys Ohm's Law, which states that the current flowing through a conductor is directly proportional to the potential difference across it, provided that temperature and other physical conditions remain constant.