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: 2013**

Instructions

1. This paper consists of two questions.

2. Answer all questions.

1. You are provided with a metre rule, a knife edge, two strings of length 100 cm each and two weights W_1 and W_2 of masses 50 g and 100 g respectively. Proceed as follows:

(a) Balance a metre rule on a knife edge, put a mark and write G at the balancing point using a piece of chalk or a pencil. Measure and record the length l, width w and thickness t of a metre rule using a vernier calliper.

Let l = 100 cm, w = 2.6 cm, t = 0.5 cm

(b) Place the metre rule on a knife edge so that the knife edge is at 60 cm of your metre rule (see Figure 1(a)). Suspend weight W_2 of 100 g on the right hand side of the knife edge. Adjust W_2 until the metre rule balances horizontally. Read and record lengths 'b' and 'c' as seen in Figure 1(a).

Suppose G is at 48 cm and W_2 balances at 78 cm
Then: b = 78 − 60 = 18 cm, c = 60 − 48 = 12 cm

(i) Suspend weight W_1 of 50 g on the left hand side of the knife edge at the position 47 cm and adjust weight W_2 until the metre rule balances horizontally as seen in Figure 1(b). Read and record the lengths 'a' and 'b'.

If W_2 is placed at 70 cm:
a = 60 − 47 = 13 cm, b = 70 − 60 = 10 cm

(ii) Repeat the procedures in (b)(i) by adjusting the position of W_1 to the left at the interval of 3 cm to obtain other four (4) readings.

Tabulate your results as shown in Table 1.

a (cm)	b (cm)
13	10
16	12
19	14
22	16
25	18

(d) Plot a graph of "b" against "a".

Graph provided separately

(e) What is the nature of the graph?

A straight line, indicating direct proportionality between a and b

(f) Calculate the slope S of the graph.

$S = \Delta b / \Delta a = (18 - 10) / (25 - 13) = 8 / 12 = 0.667$

(g) (i) Read the b-intercept, given that $b = Sa + (W/W_2) \times c$

From graph, intercept ≈ 2.0 cm
$(W/W_2) \times c = 2.0$
Therefore, $W/W_2 = 2 / 12 = 0.167$
So, $W = 0.167 \times 100 = 16.7$ g

(ii) What does $(W/W_2) \times c$ represent in your graph?

It represents the intercept value, showing the effect of the ruler's own mass as it contributes to moment balance

(iii) Calculate the value of W using the relation $W_2 = Wc / 9.5$ cm. What does W represent?

$W = (W_2 \times 9.5) / c = (100 \times 9.5) / 12 = 950 / 12 \approx 79.2$ g
W represents the mass of the metre rule

(h) (i) Find the value of the ratio $P = (l \times w \times t) / m$

m = 79.2 g = 0.0792 kg
l = 1.00 m, w = 0.026 m, t = 0.005 m
$P = (1.00 \times 0.026 \times 0.005) / 0.0792 = 0.00013 / 0.0792 \approx 0.00164$ m²/kg

(ii) What is the physical meaning of the value of P?

The specific cross-sectional volume per unit mass — it reflects the density and geometry of the ruler

(i) State a possible source of error in this experiment.

Parallax error while reading scale or ruler not horizontal

(j) How can you minimize error in 1(i)?

Ensure your eye is level with the readings and check horizontal balance with spirit level or pointer alignment

(k) State the aim of this experiment.

To determine the mass of a metre rule and verify the principle of moments

2. You are provided with a Plane mirror, a Ruler, Protract, Drawing board, Optical pins, Office pins and Plain papers. Proceed as follows:

(a) On the plain paper provided, draw a line 13 cm from the top of the paper and call it M_1M_2. Pin your paper on the board provided and place the reflecting surface of the mirror along the line M_1M_2 as seen in Figure 2.

(Procedure initiated by setup.)

(b) Insert pin O as an object at 4.0 cm in front of the mirror. Place pins P_1 and P_2 so as to appear in one straight line with the image of object O seen in the plane mirror.

(Proceed as described.)

(c) Remove pins P_1 and P_2, using other pins, place pins P_3 and P_4 so as to appear in a straight line with the image of object O in the other side (see Figure 2).

(Proceed as described.)

(d) Remove the mirror and pins. Draw lines joining P_1 and P_2 on one side and the other joining P_3 and P_4 on the other side of object O, extend both lines to meet at I on the other side of line M_1M_2.

(Intersection at I gives the image point.)

(e) Join OI, a line cutting the reflecting surface at N.

(f) Repeat this procedure for the distance of an object being 6, 8, 10 and 12 cm.

(g) On all the diagrams drawn:
(i) Measure the distance ON and NI.

Sample table:

Object Distance ON (cm)	Image Distance NI (cm)
4	4
6	6
8	8
10	10
12	12

(ii) Comment on the distances obtained in 2(g)(i).

The object and image distances from the mirror are equal, i.e., ON = NI.

(iii) What is the nature of the image? Give reasons for your answer.

The image is virtual, upright, laterally inverted, same size and located behind the mirror.

(iv) State four characteristics of the image you obtained.

- Upright
- Virtual
- Same size as the object
- Laterally inverted

(v) What is the aim of this experiment?

To verify that the distance of the image from the mirror equals the distance of the object from the mirror.

(vi) Mention and state the law governing the experiment.

Law of reflection: The angle of incidence equals the angle of reflection, and the image formed by a plane mirror appears as far behind the mirror as the object is in front of it.

(vii) Explain a source of error in this experiment.

Parallax error when aligning pins with image.

(viii) How can you minimize the error in (vii) above?

Ensure your eye is directly in line with the pins while viewing and take multiple confirmations of alignment.