THE UNITED REPUBLIC OF TANZANIA

NATIONAL EXAMINATIONS COUNCIL

CERTIFICATE OF SECONDARY EDUCATION EXAMINATION

031/2C **PHYSICS 2C**

ACTUAL PRACTICAL C

(For Both School and Private Candidates)

Time: 2:30 Hours **ANSWERS** **Year: 2012**

Instructions

1. This paper consists of two questions.

2. Answer all questions.

1. You are provided with a metre rule with a hole drilled at 50 cm mark, steel knitting needle, unknown mass M of a dry cell size D, known mass W (100 g), two weighing pans or two pieces of threads, retort stand and clamp. Proceed as follows:

(a) Locate and record the centre of gravity, C of the metre rule by balancing the ruler on the clamped knitting needle and ensure that the ruler balances in a horizontal position.
This is done by placing the knitting needle at various points until the ruler balances horizontally. The point at which this occurs is the center of gravity C, and its position is recorded.

(b) Suspend unknown weight M at 10 cm mark and adjust the position of W on the other side of O so that the ruler balances in a horizontal position.
This creates a moment balance, where the moment (torque) due to M on one side of the pivot is balanced by the moment due to W on the other side. The principle of moments is used here.

(c) Measure the distances of M and W from O as x and y respectively.
The distances from the pivot point O (center of gravity) to the suspended weights M and W are measured and labeled as x and y. These distances are used to compute the moments.

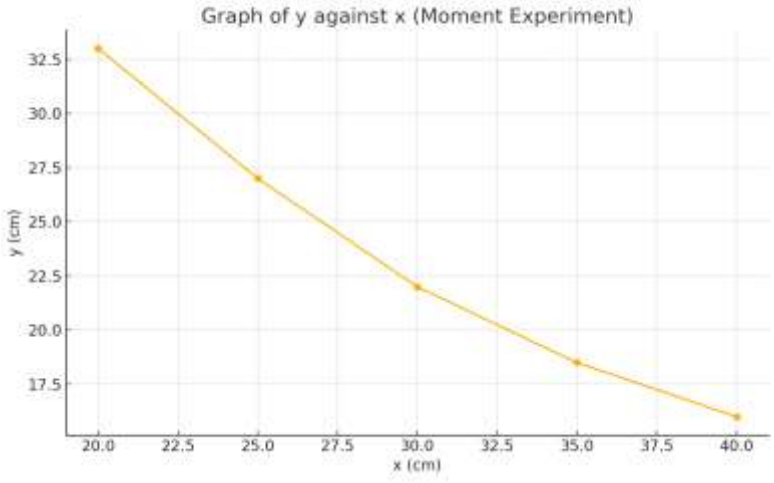
(d) Draw the diagram for this experiment.
The diagram shows a horizontal metre rule with a hole at 50 cm mounted on a stand. Mass M hangs at one side (e.g., 10 cm) and mass W hangs on the other side with adjustable position y to balance the rule.

(e) Repeat procedures (b) and (c) above with M suspended from 15 cm, 20 cm, 25 cm and 30 cm marks.
This involves shifting M to different points and adjusting W accordingly to maintain balance each time, then recording new x and y values.

(f) Tabulate your results.

x (cm)	y (cm)
40	16
35	18.5
30	22
25	27
20	33

(g) Plot a graph of y against x.



(h) State the nature of the graph.
The graph is a straight line indicating a linear relationship between y and x.

(i) Read and record the value of y when x = 17.5 cm.
From the graph, the corresponding y value can be found when x = 17.5 cm. Assume y ≈ 39 cm based on extension of the trend.

(j) Calculate the slope G of the graph.
Using two points from the table:
G = (33 - 16) ÷ (20 - 40) = 17 ÷ (-20) = -0.85
Since y increases as x decreases, slope is negative, but magnitude is used for mass comparison.

(k) Find the value of M given that the equation representing the graph is M = G x W, where G is given.
M = G x W = 0.85 x 100 = 85 g

(l) Mention and state the principle governing this experiment.
The principle of moments: For a system in equilibrium, the sum of clockwise moments equals the sum of anticlockwise moments about a pivot.

(m) State a possible source of error in this experiment.
A possible error is incorrect reading of the position of W, especially if the ruler is not completely horizontal when considered "balanced".

(n) What is the aim of the experiment?
The aim is to determine the unknown mass M using the principle of moments.

2. You are provided with Beaker, Retort stand and Clamp, two optical pins, liquid (water), small sheet of white paper, plasticine, a rectangular block of wood, a metre rule and 30 cm transparent ruler. Proceed as follows:

(a) Put an optical pin O with a very small bob of plasticine to the bottom of a clean beaker and stand the beaker on a sheet of white paper as shown in Figure 1.
This creates a fixed point at the bottom of the beaker to represent the real depth of the object.

(b) Pour in a liquid carefully to about 11 cm depth and view the optical pin O through this liquid. Adjust the position of the clamped search pin S so as to eliminate parallax between its point and that of the image I of O.
This step helps to locate the apparent position of the object by aligning the search pin with the image of the pin at the bottom.

(c) Make ink marks on the beaker corresponding to the position of the surface and the position of image I.
This helps to record the real and apparent depths without relying solely on visual judgement.

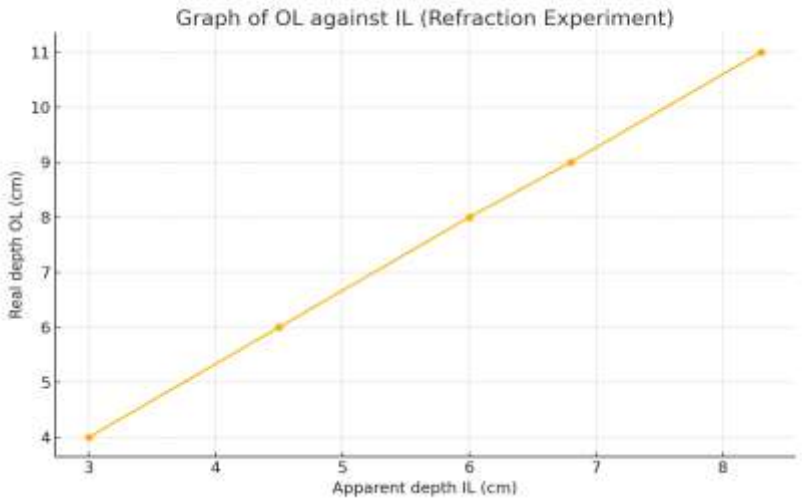
(d) Taking care not to remove the ink marks, measure the real depth OL and the apparent depth IL of the pin.
The measurements OL (from surface to real pin) and IL (from surface to image) are taken using a transparent ruler.

(e) Remove ink marks and repeat for the depth of liquid of 9 cm, 8 cm, 6 cm and 4 cm.
The same steps are repeated for different liquid heights to get corresponding apparent depths.

(f) Tabulate your results.

OL (cm)	IL (cm)
11	8.3
9	6.8
8	6.0
6	4.5
4	3.0

(g) Plot a graph of OL against IL.



(h) Using graph, find the real depth when apparent depth is 3 cm.
From the graph, when IL = 3 cm, corresponding OL = 4 cm.

(i) Why an object O looks less deep when looking down into it?
Due to refraction, light rays from the object bend away from the normal when moving from water to air, making the object appear closer to the surface than it actually is.

(j) From the graph find its slope.
Using two values: (OL_1 = 11 cm, IL_1 = 8.3 cm), (OL_2 = 4 cm, IL_2 = 3.0 cm)
Slope = (11 - 4) ÷ (8.3 - 3.0) = 7 ÷ 5.3 = 1.32

(k) What does the slope of the graph indicate?
The slope indicates the refractive index of the liquid.

(l) Find the reciprocal of the slope.
Reciprocal = 1 ÷ 1.32 ≈ 0.76

(m) Comment on the answer obtained in 2 (l).
This value is the ratio of apparent depth to real depth, showing how much the medium reduces the visual depth due to refraction. A value less than 1 is expected.

(n) Identify three possible sources of error in this experiment.
- Parallax error in aligning the search pin with the image.
- Inaccurate measurement of depth with the ruler.
- Beaker wall thickness may affect perceived position.

(o) State ways to minimize the errors in 2 (n).
- View pins directly from above to reduce parallax.
- Use precise, calibrated ruler for depth measurement.

- Use a beaker with thin, uniform walls.

(p) Identify the principle governing this experiment.
The principle of refraction: Light bends when it passes from a denser medium to a less dense medium, affecting the apparent position of submerged objects.