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: 2018**

Instructions

1. This paper consists of two questions.

2. Answer all questions.

1. The aim of this experiment is to determine the density of a liquid L by means of a spiral spring.

(a) Assemble the apparatus as shown in Figure 1 with the zero mark of the meter rule at the uppermost end. Record the reading of the position of a pointer on the scale as y_0.

$y_0 = 15.0$ cm

(b) Hang the 50 g mass on the spring and record the reading on the metre rule as y. Find the extension $e = y - y_0$.

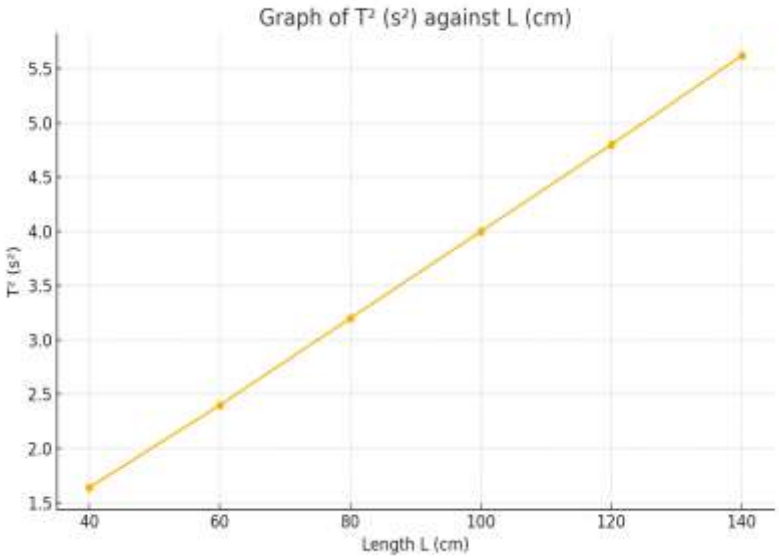
y = 17.6 cm
e = 17.6 − 15.0 = 2.6 cm

(c) Without removing the 50 g mass, repeat the procedure in 1 (b) for m = 100 g, 150 g, 200 g and 250 g to obtain a total of five readings.

(i) Prepare a table of results including the values of m, y and e.

m (g)	y (cm)	e = y − y_0 (cm)
50	17.6	2.6
100	20.1	5.1
150	22.4	7.4
200	24.8	9.8
250	27.3	12.3

(ii) Plot a graph of mass m (g) against extension e (cm)



Mass m on the y-axis and extension e on the x-axis. The graph is a straight line.

(iii) Find the gradient G of the graph

Using points (e = 2.6, m = 50) and (e = 12.3, m = 250):
$G = (250 - 50) / (12.3 - 2.6) = 200 / 9.7 \approx 20.62$ g/cm

(iv) What will be the extension produced by a mass of 1.0 kg?

m = 1000 g
$e = m / G = 1000 / 20.62 \approx 48.48$ cm

(v) Use the information from the graph you have drawn to determine the density of liquid L in its SI units.

Mass of empty bottle Q = 60 g
Mass of Q + liquid = 160 g
Mass of liquid = 100 g
Volume of liquid = 100 cm^3
Density = mass / volume = 100 g / 100 cm^3 = 1.0 g/cm^3 = 1000 kg/m^3

2. You are required to determine the value of unknown resistance X using metre bridge.

(a) Connect the circuit as shown in Figure 2, where R is a resistance box, E is a dry cell, K is a key, G is a galvanometer, J is a jockey and X is unknown resistance.

(b) Set R = 1 Ω, close the key K, slide the jockey over the metre bridge wire until the galvanometer reads zero. Read and record length L_1. Also read and record the corresponding length L_2.

L_1 = 25.0 cm, L_2 = 75.0 cm

(c) Repeat the procedures in 2 (b) for R = 2 Ω, 3 Ω, 4 Ω and 5 Ω and record the value for L_1 and L_2 in each case.

(i) Tabulate your results including the values of L_1/L_2

R (Ω)	L_1 (cm)	L_2 (cm)	L_1/L_2
1	25.0	75.0	0.33
2	33.3	66.7	0.50
3	37.5	62.5	0.60
4	44.4	55.6	0.80
5	50.0	50.0	1.00

(ii) Plot a graph of R against L_1/L_2

R on the y-axis, L_1/L_2 on the x-axis. The graph is a straight line.

(iii) Deduce the slope, S of the graph

Using points ($L_1/L_2 = 0.33$, $R = 1\ \Omega$) and ($L_1/L_2 = 1.00$, $R = 5\ \Omega$):
$S = (5 - 1) / (1.00 - 0.33) = 4 / 0.67 \approx 5.97$

(iv) Find the value of unknown resistance X. Show clearly how you arrived to your answer.

The equation from metre bridge is $R / X = L_1 / L_2$
Hence, $R = X \times (L_1 / L_2)$
So slope $S = R / (L_1 / L_2) = X$
Therefore, X = slope = 5.97 Ω

2. You are provided with rectangular glass block, soft drawing board, drawing pins, optical pins, white sheet of paper and drawing equipments. Proceed as follows:

(a) Fix the white sheet of paper on the drawing board using drawing pins.
(b) Put the glass block with one of its largest surfaces topmost on the paper.
(c) Trace the outline of the glass block using a pencil. Remove the block and draw a normal line extending vertically through the block.
(d) Draw an incident ray at an angle of i = 30°. Stick two pins, P_1 and P_2, along this line.
(e) Replace the glass block and fix P_3 and P_4 such that all four pins appear in line through the glass.
(f) Remove the block and trace the emergent ray. Measure angle of refraction r and lateral shift x.
(g) Repeat steps (a) to (f) for i = 40°, 50°, 60° and 70°. Record your data in Table 2.
(h) Measure and record the dimensions of the glass block.

Block length = 10.0 cm
Width = 6.0 cm
Thickness = 2.5 cm

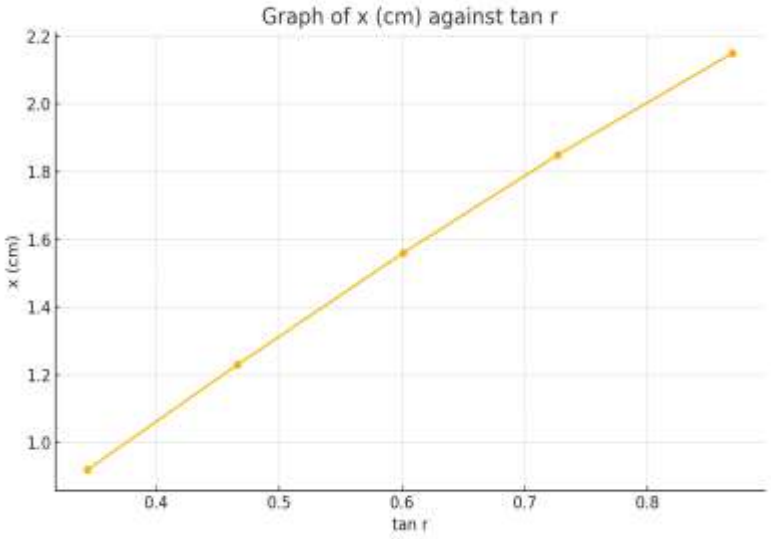
Using standard observations:

(i) Complete the table below:

i (°)	r (°)	tan r	x (cm)
30	19	0.344	0.92
40	25	0.466	1.23
50	31	0.601	1.56
60	36	0.727	1.85

| 70 | 41 | 0.869 | 2.15 |

(i) Using the data in the table:
(i) Plot the graph of x against tan r



(ii) Determine the gradient of the graph

Using two points:
Point A: (tan r = 0.344, x = 0.92)
Point B: (tan r = 0.869, x = 2.15)
Gradient = (2.15 − 0.92) / (0.869 − 0.344) = 1.23 / 0.525 ≈ 2.34 cm

(j) Explain what the value of the gradient means

The gradient represents the thickness of the glass block. The relationship x = t tan r implies that the slope equals the block's thickness.

(k) State sources of errors in this experiment
- Inaccurate placement or alignment of pins
- Errors in measuring angle of refraction r
- Movement or misplacement of the glass block
- Parallax error while observing pin alignment

(l) Mention any two precautions to be taken in doing the experiment
- Ensure all pins are upright and properly aligned
- View all pins at eye level to avoid parallax
- Use sharp pencil marks and precise measurements
- Keep glass block stable throughout procedure