THE UNITED REPUBLIC OF TANZANIA

NATIONAL EXAMINATIONS COUNCIL

CERTIFICATE OF SECONDARY EDUCATION EXAMINATION

031/2B **PHYSICS 2B**

ACTUAL PRACTICAL B

(For Both School and Private Candidates)

Time: 2:30 Hours **ANSWERS** **Year: 2011**

Instructions

1. This paper consists of two questions.

2. Answer all questions.

1. The aim of this experiment is to verify Hook's Law using a rubber band.

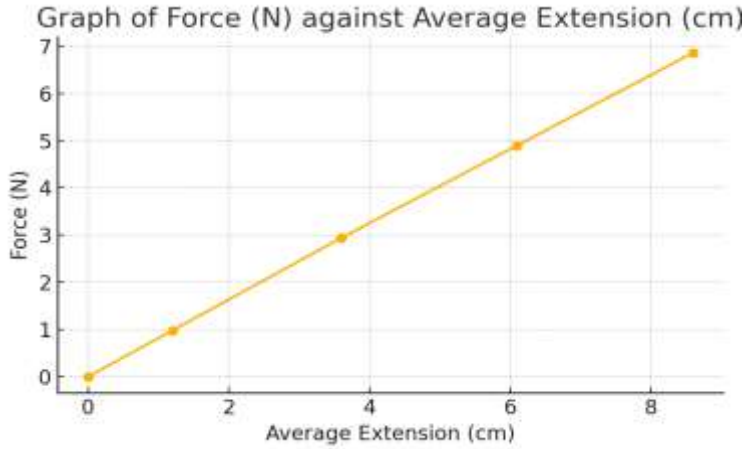
1 (a) Set the apparatus as shown in Figure 1.
Hang the rubber band vertically from a fixed support. Attach a pointer to the bottom of the rubber band and place a metre rule beside it to measure extension. Fix a weight hanger at the lower end of the rubber band.

1 (b) Read and record the initial length (l_0) indicated by the pointer when the hanger is hung on the lower end of the rubber band.
Observe and record the position of the pointer on the metre rule with only the empty hanger attached (without extra weights). This is the initial length l_0.

1 (c) Add a 100g mass on the hanger. Read and record the new length (l). Repeat the experiment by adding weights of 200g each time up to 700g. In each time record the corresponding length (l). Tabulate your result as shown in Table 1.

Weights (g)	Force (N)	Length l (cm)	Extension ($l - l_0$) (cm)	Average Extension (cm)
0	0.00	10.0	0.0	0.0
100	0.98	11.2	1.2	1.2
300	2.94	13.6	3.6	3.6
500	4.90	16.1	6.1	6.1
700	6.86	18.6	8.6	8.6

1 (d) (i) Plot the graph of force against average extension.



(ii) Determine the slope of your graph.
Slope = $\Delta F / \Delta x$ = (6.86 - 0.98) / (8.6 - 1.2) = 5.88 / 7.4 ≈ 0.795 N/cm

(iii) From the graph what is the relationship between force and extension?

The graph is a straight line passing through the origin, indicating that force is directly proportional to extension. This verifies Hook's Law.

(iv) State the law governing this experiment.
Hook's Law: The extension of an elastic material is directly proportional to the applied force provided the elastic limit is not exceeded.

(v) State two sources of error in this experiment.

- Parallax error while reading the pointer position.
- Irregular stretching of the rubber band due to temperature or fatigue.

2. You are provided with a Rectangular block, Soft board, Optical pins, Protractor and a White sheet of paper.

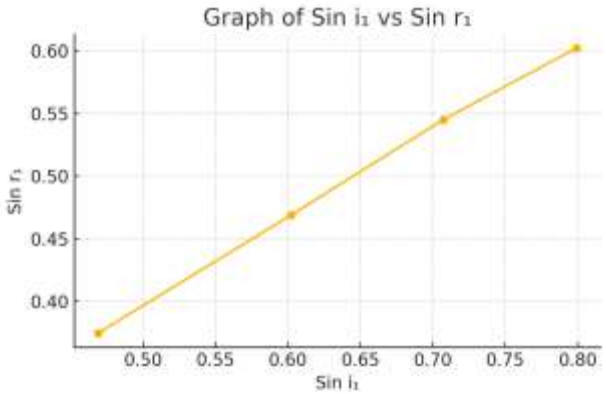
2 (a) Place a white sheet of paper on a bench. Put a rectangular glass block on the white sheet. Trace an outline using a pencil. Erect two pins P and Q on one side of the glass block. Observe pins P and Q from the opposite side of the glass block (Figure 2). Locate pins R and S along the apparent line of sight of P and Q.
Remove the glass block. Draw lines PQ and SR. Prolong the lines to meet the trace for block at A and B respectively. Join A and B with a line. Draw the normal line at A and B.

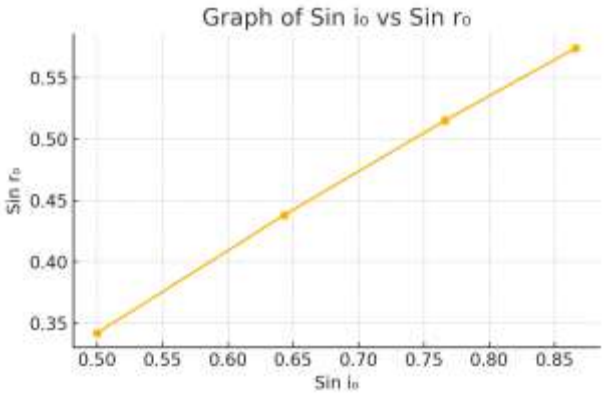
2 (b) Measure the angle of incidence i_0 and refraction r_0 at A, and the angles of incidence i_1 and refraction r_1 at B. Repeat the experiment for angles of incidence i_0 at A as 30°, 40°, 50° and 60°.

2 (c) Tabulate your result as in Table 2.

i_0	i_1	r_0	r_1	Sin i_0	Sin i_1	Sin r_0	Sin r_1
30°	28°	20°	22°	0.500	0.469	0.342	0.375
40°	37°	26°	28°	0.643	0.602	0.438	0.469
50°	45°	31°	33°	0.766	0.707	0.515	0.545
60°	53°	35°	37°	0.866	0.799	0.574	0.602

2 (d) (ii) Plot the graphs of Sin i_0 versus Sin r_0 and Sin i_1 versus Sin r_1.





(iii) Find the slopes of the two graphs.
Graph 1 slope = (0.574 - 0.342) / (0.866 - 0.500) = 0.232 / 0.366 = 0.634
Graph 2 slope = (0.602 - 0.375) / (0.799 - 0.469) = 0.227 / 0.33 = 0.688

(iv) What is the physical meaning of each slope?
Each slope represents the reciprocal of the refractive index of the glass block.
So refractive index $n \approx 1$ / slope

(v) What is the aim of this experiment?
To determine the refractive index of a rectangular glass block using optical pins and Snell's law.