

State Examination Commission – Physics Higher Level, 2005

Question 3

In an experiment to verify Snell's law, a student measured the angle of incidence i and the angle of refraction r for a ray of light entering a substance. This was repeated for different values of the angle of incidence. The following data was recorded.

$i/\text{degrees}$	20	30	40	50	60	70
$r/\text{degrees}$	14	19	26	30	36	40

Describe, with the aid of a diagram, how the student obtained the angle of refraction. (9)

Draw a suitable graph on graph paper and explain how your graph verifies Snell's law. (18)

From your graph, calculate the refractive index of the substance. (9)

The smallest angle of incidence chosen was 20° . Why would smaller values lead to a less accurate result? (4)

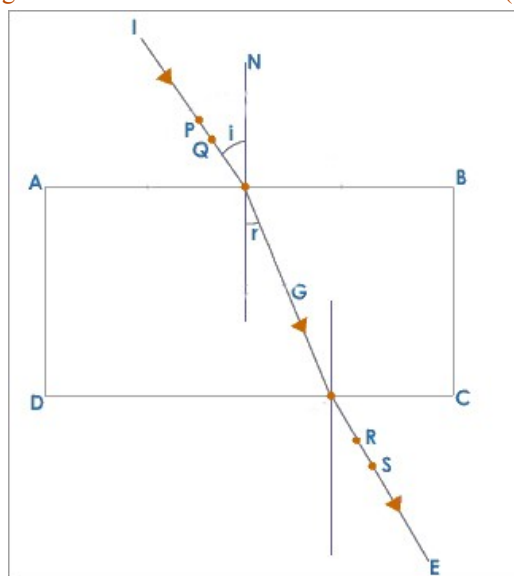
Describe, with the aid of a diagram, how the student obtained the angle of refraction. (9)

The apparatus was set up as shown in diagram. A glass block was placed on a sheet of paper and its outline ABCD drawn.

Two pins, P & Q were placed on one side of the block and two other pins, R & S were placed on the other side of the block so that they were in a straight line with pins P & Q, as seen viewed through the block.

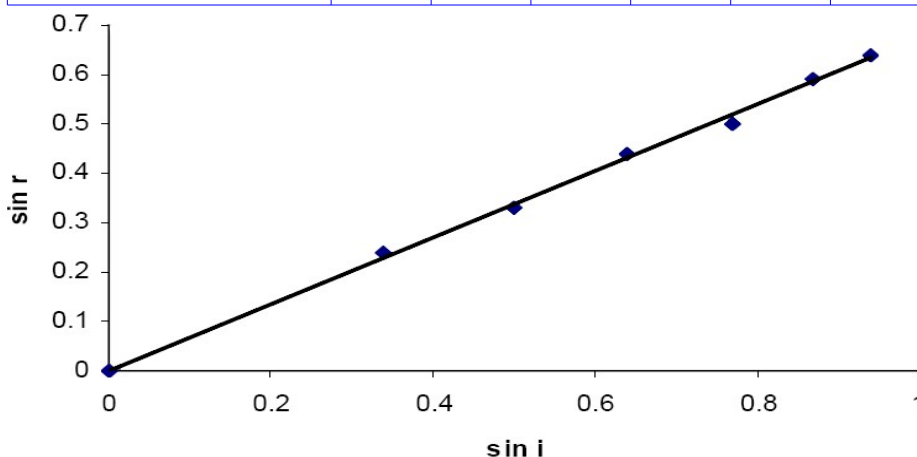
The block was then removed and the incident ray, I, the refracted ray, G and the emergent ray, E, as well as the normal N were drawn.

The angle of incidence, i and the angle of refraction, r are then measured using a protractor.



Draw a suitable graph on graph paper and explain how your graph verifies Snell's law. (18)

$i/\text{degrees}$	20	30	40	50	60	70
$r/\text{degrees}$	14	19	26	30	36	40
$\sin i$	0.34	0.50	0.64	0.77	0.87	0.94
$\sin r$	0.24	0.33	0.44	0.50	0.59	0.64



The graph of $\sin i$ against $\sin r$ is a straight line passing through the origin. Therefore $\sin i$ is proportional to $\sin r$ and Snell's law is thus verified.

From your graph, calculate the refractive index of the substance. (9)

Using points (0, 0) and (0.88, 0.60) from the graph we get a slope of 0.68.

The refractive index ($\sin i/\sin r$) is the reciprocal of this value, i.e., $n = 1.47$.

The smallest angle of incidence chosen was 20° . Why would smaller values lead to a less accurate result? (4)

Smaller readings always have greater possible percentage errors.