

## Experiment 4: Snell's Law

### Required Equipment from Basic Optics System

Light Source

Trapezoid from Ray Optics Kit

### Other Required Equipment

Protractor

White paper

### Purpose

The purpose of this experiment is to determine the index of refraction of the acrylic trapezoid. For rays entering the trapezoid, you will measure the angles of incidence and refraction and use Snell's Law to calculate the index of refraction.

### Theory

For light crossing the boundary between two transparent materials, Snell's Law states

$$n_1 \sin \theta_1 = n_2 \sin \theta_2$$

where  $\theta_1$  is the angle of incidence,  $\theta_2$  is the angle of refraction, and  $n_1$  and  $n_2$  are the respective indices of refraction of the materials (see Figure 4.1).

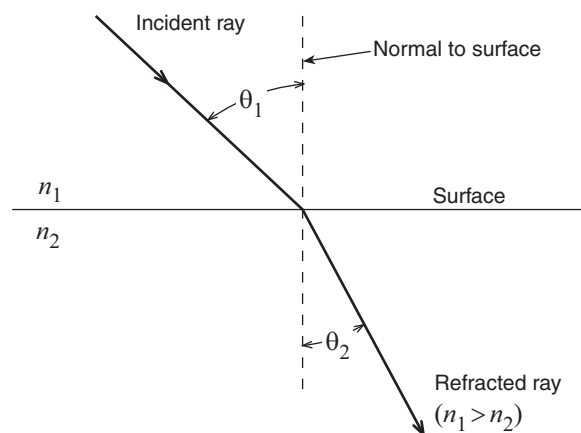


Figure 4.1

### Procedure

1. Place the light source in ray-box mode on a sheet of white paper. Turn the wheel to select a single ray.
2. Place the trapezoid on the paper and position it so the ray passes through the parallel sides as shown in Figure 4.2.
3. Mark the position of the parallel surfaces of the trapezoid and trace the incident and transmitted rays. Indicate the incoming and the outgoing rays with arrows in the appropriate directions. Carefully mark where the rays enter and leave the trapezoid.
4. Remove the trapezoid and draw a line on the paper connecting the points where the rays entered and left the trapezoid. This line represents the ray inside the trapezoid.
5. Choose either the point where the ray enters the trapezoid or the point where the ray leaves the trapezoid. At this point, draw the normal to the surface.
6. Measure the angle of incidence ( $\theta_1$ ) and the angle of refraction with a protractor. Both of these angles should be measured from the normal. Record the angles in the first row of Table 4.1.

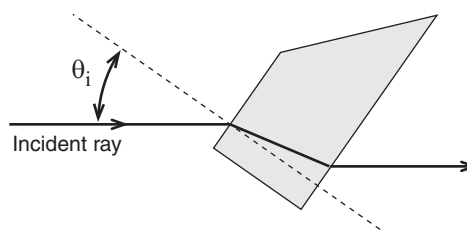


Figure 4.2

- On a new sheet of paper, repeat steps 2–6 with a different angle of incidence. Repeat these steps again with a third angle of incidence. The first two columns of Table 4.1 should now be filled.

Table 4.1: Data and Results

Angle of Incidence	Angle of Refraction	Calculated index of refraction of acrylic
		Average:

### Analysis

- For each row of Table 4.1, use Snell's Law to calculate the index of refraction, assuming the index of refraction of air is 1.0.
- Average the three values of the index of refraction. Compare the average to the accepted value ( $n = 1.5$ ) by calculating the percent difference.

### Question

What is the angle of the ray that leaves the trapezoid relative to the ray that enters it?