Experiment 5: Reversibility

Equipment Needed:

-Optics Bench
-Ray Table and Base
-Slit Plate
-Cylindrical Lens.
-Light Source
-Component Holder
-Slit Mask

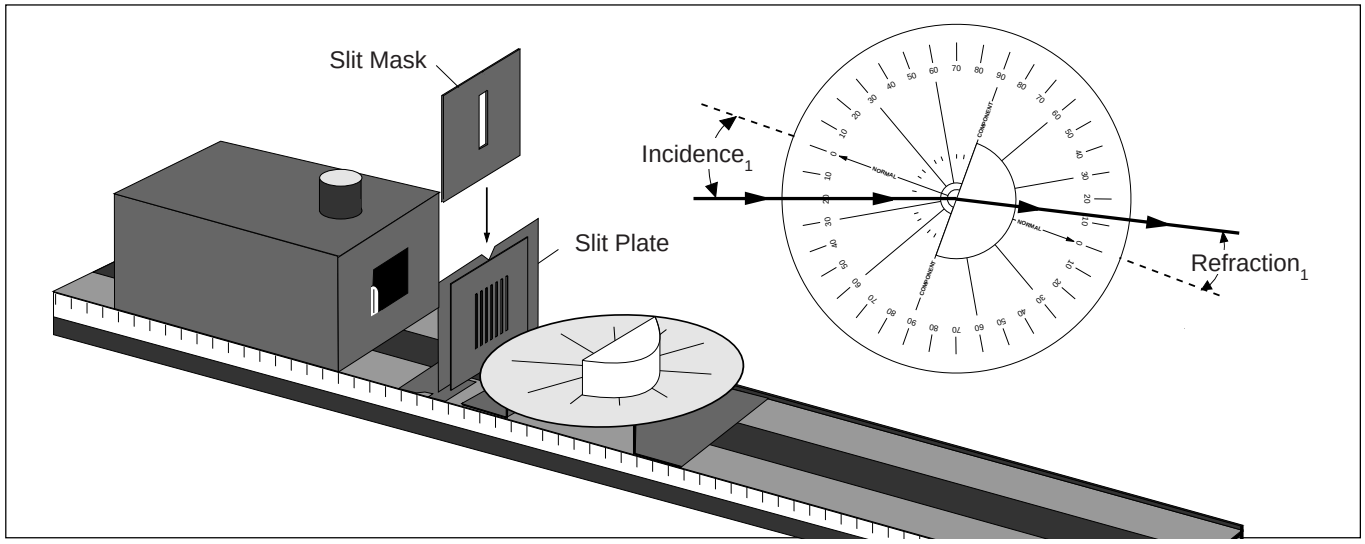

Figure 5.1 Equipment Setup

Introduction

In Experiment 4, you determined the relationship that exists between the angle of incidence and the angle of refraction for light passing from air into a more optically dense medium (the Cylindrical Lens). An important question remains. Does the same relationship hold between the angles of incidence and refraction for light passing out of a more optically dense medium back into air? That is to say, if the light is traveling in the opposite direction, is the law of refraction the same or different? In this experiment, you will find the answer to this question.

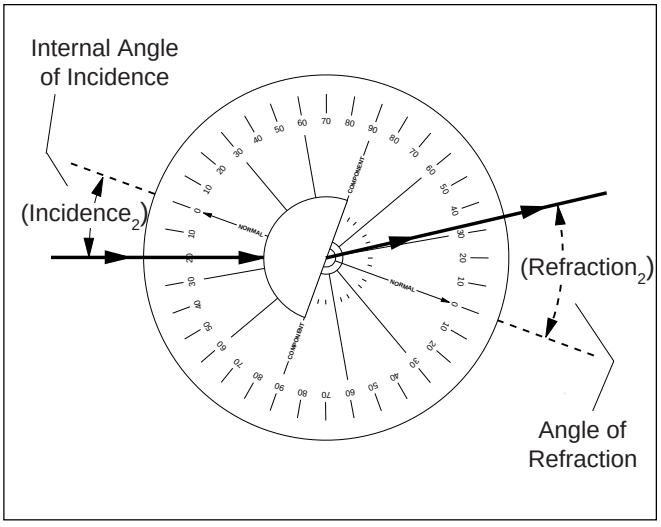

Figure 5.2 Internal Angle of Incidence

Procedure

Set up the equipment as shown in Figure 5.1. Adjust the components so a single ray of light passes directly through the center of the Ray Table Degree Scale. Align the flat surface of the Cylindrical Lens with the line labeled "Component". With the lens properly aligned, the radial lines extending from the center of the Degree Scale will all be perpendicular to the circular surface of the lens.

Without disturbing the alignment of the lens, rotate the Ray Table and set the angle of incidence to the values listed in Table 5.1 on the following page. Enter the corresponding angles of Refraction in the table in <u>two</u> columns: Refraction_1 <u>and</u> Incidence_2. (Let $\text{Incidence}_2 = \text{Refraction}_1$).

Table 5.1 Data

Ray Incident on:	**Flat Surface**		**Curved Surface**	
Angle of:	**Incidence$_1$**	**Refraction$_1$**	**Incidence$_2$**	**Refraction$_2$**
	0°			
	10°			
	20°			
	30°			
	40°			
	50°			
	60°			
	70°			
	80°			
	90°			

Now let the incident ray strike the curved surface of the lens. (Just rotate the Ray Table 180°.) The internal angle of incidence for the flat surface of the Cylindrical Lens is shown in Figure 5.2. Set this angle of incidence to the values you have already listed in the table (Incidence$_2$). Record the corresponding angles of refraction (Refraction$_2$).

① Using your collected values for Incidence$_1$ and Refraction$_1$, determine the index of refraction for the acrylic from which the Cylindrical Lens is made. (As in experiment 4, assume that the index of refraction for air is equal to 1.0.)

n_1 = _____.

② Using your collected values for Incidence$_2$ and Refraction$_2$, redetermine the index of refraction for the acrylic from which the Cylindrical Lens is made.

n_2 = _____.

③ Is the Law of Refraction the same for light rays going in either direction between the two media? _____.

④ On a separate sheet of paper, make a diagram showing a light ray passing into and out of the Cylindrical Lens. Show the correct angles of incidence and refraction at both surfaces traversed by the ray. Use arrow heads to indicate the direction of propagation of the ray. Now reverse the arrows on the light ray. Show that the new angles of incidence and refraction are still consistent with the Law of Refraction. This is the principle of optical reversibility.

⑤ Does the principle of optical reversibility hold for Reflection as well as Refraction? Explain.

_____.