Experiment 6: Dispersion and Total Internal Reflection

EQUIPMENT NEEDED:

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

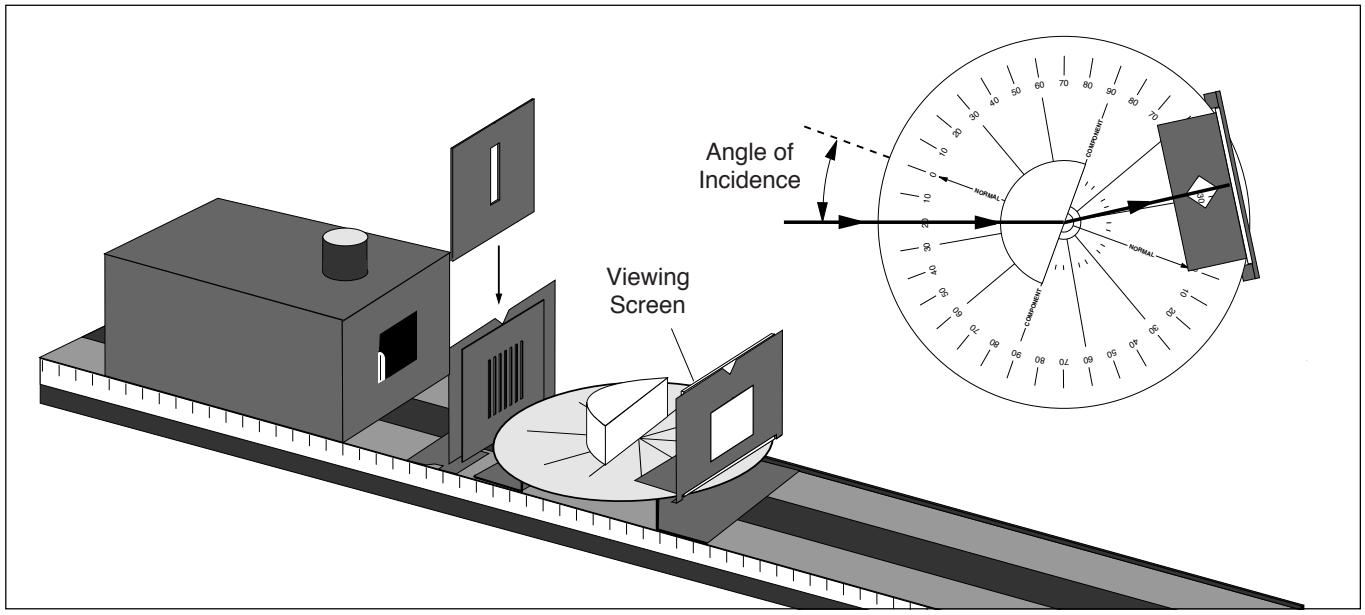

Figure 6.1 Equipment Setup

Introduction

In this experiment you will look at two phenomena related to refraction: Dispersion and Total Internal Reflection. Dispersion introduces a complication to the Law of Refraction, which is that most materials have different indexes of refraction for different colors of light. In Total Internal Reflection, it is found that in certain circumstances, light striking an interface between two transparent media can not pass through the interface.

Procedure

Set up the equipment as shown in Figure 6.1, so a single light ray is incident on the curved surface of the Cylindrical Lens.

Dispersion

Set the Ray Table so the angle of incidence of the ray striking the flat surface of the lens (from inside the lens) is zero-degrees. Adjust the Ray Table Component Holder so the refracted ray is visible on the Viewing Screen.

Slowly increase the angle of incidence. As you do, watch the refracted ray on the Viewing Screen.

① At what angle of refraction do you begin to notice color separation in the refracted ray?

② At what angle of refraction is the color separation a maximum? _____

_____.

③ What colors are present in the refracted ray? (Write them in the order of minimum to maximum angle of refraction.) _____

_____.

④ Measure the index of refraction of acrylic for red and blue light ($n_{acrylic} \sin \theta_{acrylic} = n_{air} \sin \theta_{air}$).

> ➤**NOTE:** In Experiment 4 we said that the index of refraction of a given material is a constant. That statement was almost accurate, but not quite. As you can see, different colors of light refract to slightly different angles, and therefore have slightly different indexes of refraction.

n_{red} = _____.

n_{blue} = _____.

Total Internal Reflection

Without moving the Ray Table or the Cylindrical Lens, notice that not all of the light in the incident ray is refracted. Part of the light is also reflected.

① From which surface of the lens does reflection primarily occur? _____

_____.

② Is there a reflected ray for all angles of incidence? (Use the Viewing Screen to detect faint rays.) _____

_____.

③ Are the angles for the reflected ray consistent with the Law of Reflection? _____

_____.

④ Is there a refracted ray for all angles of incidence? _____

_____.

⑤ How do the intensity of the reflected and refracted rays vary with the angle of incidence?

_____.

incidence

⑥ At what angle of ~~refraction~~ is all the light reflected (no refracted ray)? _____

_____.