Experiment 10: Polarization

EQUIPMENT NEEDED:

-Optical Bench
-Polarizers (2)
-Ray Table and Base
-Cylindrical Lens
-Slit Plate
-Light Source
-Component Holders (3)
-Ray Table Component Holder
-Crossed Arrow Target
-Slit Mask.

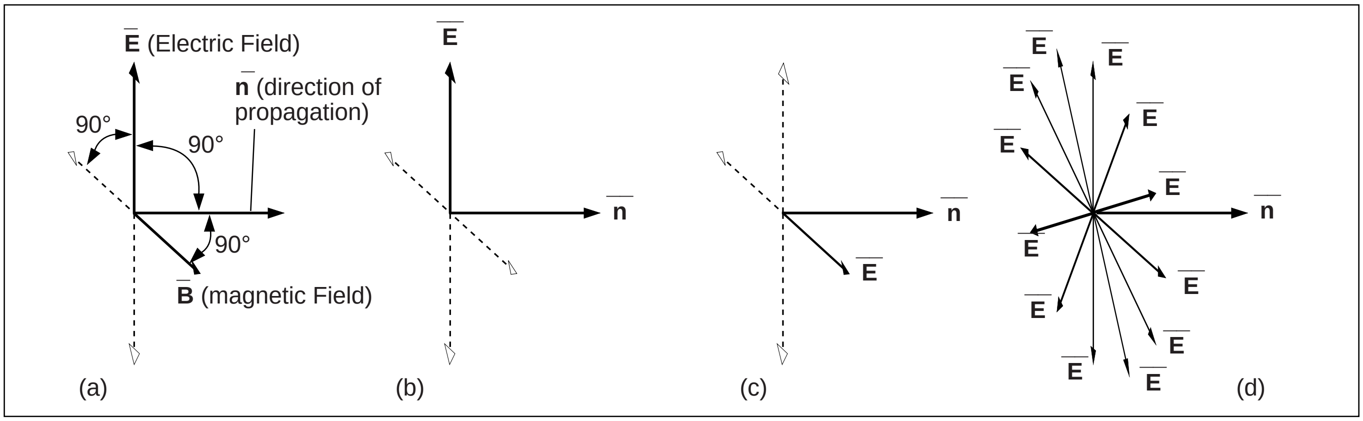

Figure 10.1 Polarization of Light

Introduction

Light is a transverse wave; that is, the electromagnetic disturbances that compose light occur in a direction perpendicular to the direction of propagation (see Figure 10.1a). Polarization, for light, refers to the orientation of the electric field in the electromagnetic disturbance. The magnetic field is always perpendicular to the electric field. Figure 10.1b and 10.1c show vertical and horizontal polarization, respectively. Figure 10.1d depicts random polarization, which occurs when the direction of polarization changes rapidly with time, as it does in the light from most incandescent light sources.

Your optics equipment includes two Polarizers, which transmit only light that is plane polarized along the plane defined by the 0 and 180 degree marks on the Polarizer scales. Light that is polarized along any other plane is absorbed by the polaroid material. Therefore, if randomly polarized light enters the Polarizer, the light that passes through is plane polarized. In this experiment, you will use the Polarizers to investigate the phenomena of polarized light.

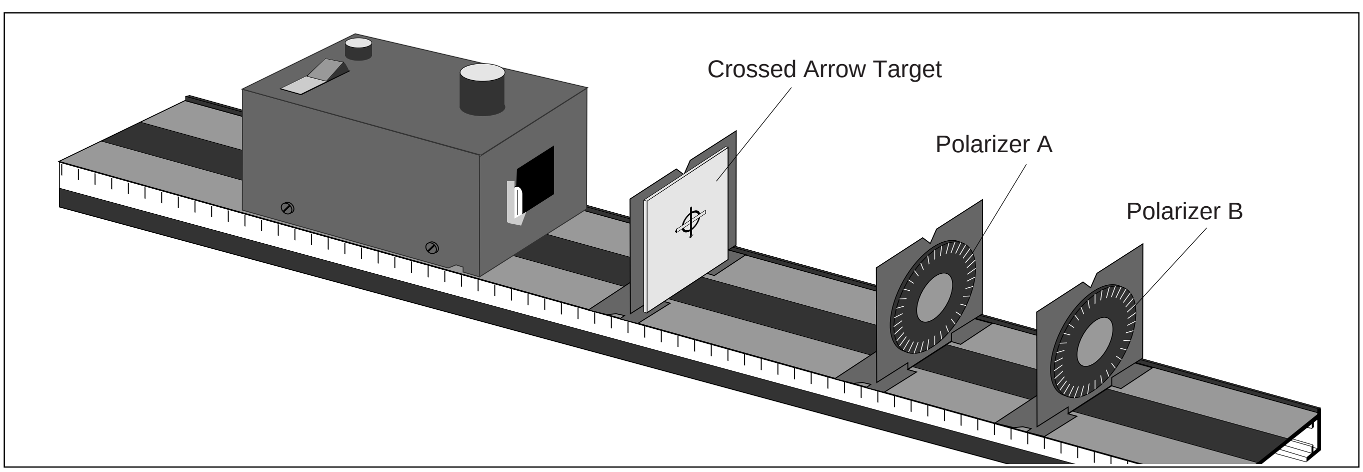

Figure 10.2 Equipment Setup

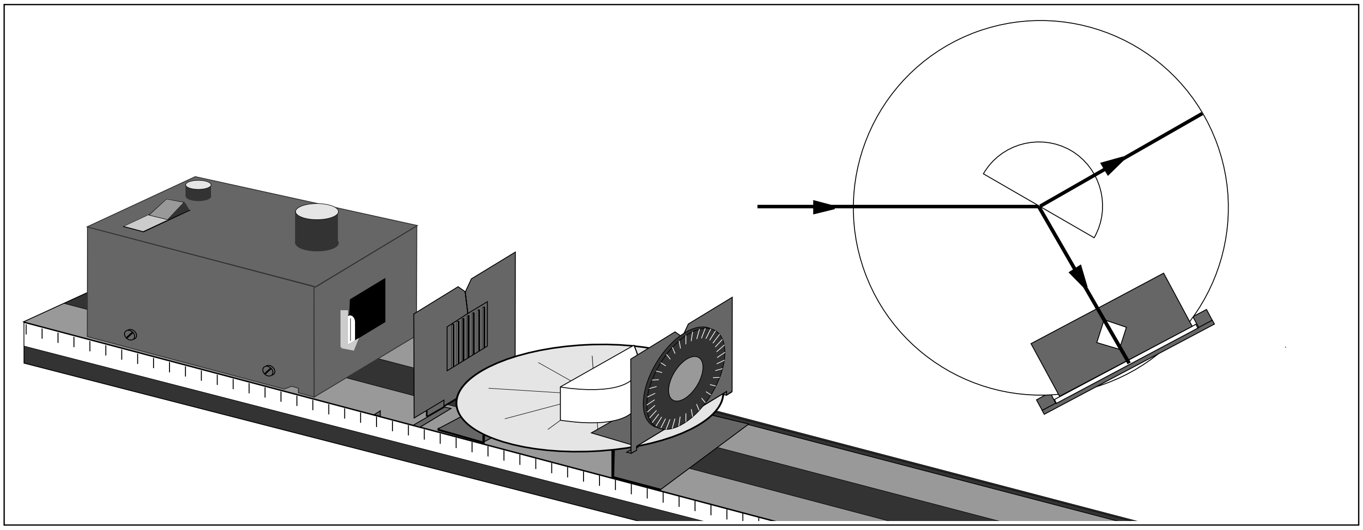

Figure 10.3 Equipment Setup

Procedure

Set up the equipment as shown in Figure 10.2. Turn the Light Source on and view the Crossed Arrow Target with both Polarizers removed. Replace Polarizer A on the Component Holder. Rotate the Polarizer while viewing the target.

① Does the target seem as bright when looking through the Polarizer as when looking directly at the target? Why? ____

____.

② Is the light from the Light Source plane polarized? How can you tell?__________________

____.

Align Polarizer A so it transmits only vertically polarized light. Replace Polarizer B on the other Component Holder. Looking through both polarizers, rotate Polarizer B.

③ For what angles of Polarizer B is a maximum of light transmitted? For what angles is a minimum of light transmitted?____

____.

Polarization by Reflection: Brewster's Angle

Set up the equipment as shown in Figure 10.3. Adjust the components so a single ray of light passes through the center of the Ray Table. Notice the rays that are produced as the incident ray is reflected and refracted at the flat surface of the Cylindrical Lens. (The room must be reasonably dark to see the reflected ray.)

Rotate the Ray Table until the angle between the reflected and refracted rays is 90°. Arrange the Ray Table Component Holder so it is in line with the reflected ray. Look through the Polarizer at the filament of the light source (as seen reflected from the Cylindrical Lens), and rotate the Polarizer slowly through all angles.

① Is the reflected light plane polarized? If so, at what angle from the vertical is the plane of polarization? ____

____.

Observe the reflected image for other angles of reflection.

② Is the light plane polarized when the reflected ray is not at an angle of 90° with respect to the refracted ray? Explain. ____

____.