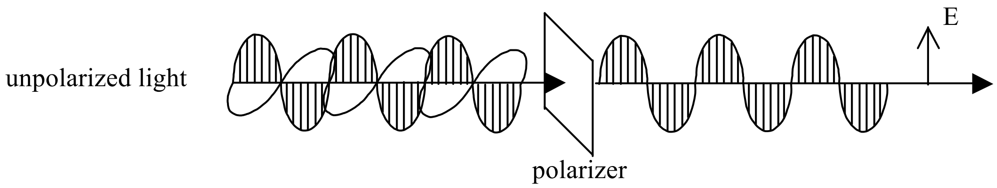
Polarized Light

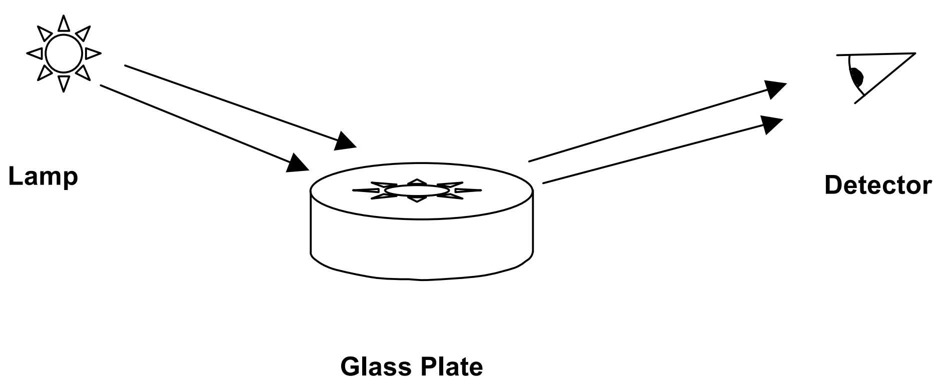
This lab is an introduction to experimental optics and the subject of optical polarization. The lab is divided into three parts, all of which employ polarizing sheets. You will have considerable freedom to decide how to carry out the experiments. Much of the data acquisition will be done visually; no photographs will be needed. However, you should take detailed notes as much of the data will be qualitative. The write-ups should explain how each part was performed. You may find it helpful to read the relevant sections of Chapter 8 in Hecht.



Procedure:

A. Determine the polarization properties of light reflected at grazing incidence from a glass plate (see figure below).

   Q1. For the reflected light, what is the polarization direction? Can you explain why?
   Q2. Instead of a glass plate, consider a road in the late afternoon sun. What orientation should your polarized sunglasses have?

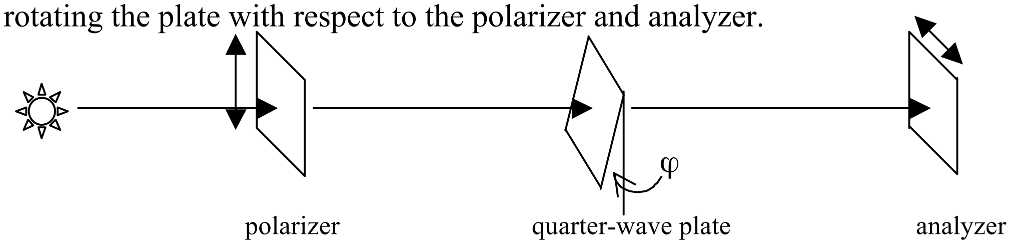


B. Using a beam of linearly polarized light from a diode laser, pass it through an analyzer (a second polarizing sheet). Using an optical power meter, measure the transmitted power as a function of angle of the analyzer. Plot the results using Kgraph and determine the trigonometric function that best describes the data (use a linear least-squares fit).

Q3. What is the average intensity of the transmitted beam (SI units)?

C. A quarter-wave plate is an optical element that introduces a relative phase shift of $\pi/2$ between orthogonal components of an incident wave. The reason this happens is that one component propagates through the plate more rapidly than the other. It should be apparent that linearly polarized light parallel to either principal axis will be phase-shifted but otherwise unaffected. If not aligned along a principal axis, a phase difference is developed between two orthogonal components. With the correct plate length, a ninety degree phase difference is obtained.

Using the following set-up, determine the optical axis of a quarter-wave plate by rotating the plate with respect to the polarizer and analyzer.



Q4. At what angle ϕ_0 do you expect to observe the least intensity?

Rotate the plate by 45° with respect to ϕ_0.

Q5. Do you expect this to be an intensity maximum? Why?

Q6. With the plate fixed at this orientation, what happens if you rotate the analyzer? Can you explain this effect?