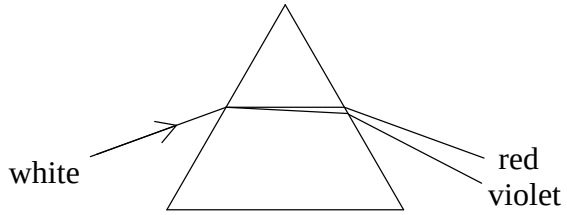
Phys 531 Assignment 5 Due October 14

1. Consider two positive thin lenses L_1 and L_2, separated by 60 cm. Their diameters are 6 and 4 cm respectively, and their focal lengths are 90 and 30 cm respectively. A diaphragm with a hole 4 cm in diameter is located between them, 20 cm from L_2. For an object point located 120 cm in front of L_1, find
(a) the aperture stop
(b) the location and size of the entrance pupil
(c) the location and size of the exit pupil

2. A beam of white light is incident on an equilateral prism as shown. Suppose the prism is made of BK7 glass, with $n = 1.53$ at $\lambda = 400$ nm and $n = 1.51$ at $\lambda = 750$ nm. Assume that that the angle of incidence is such that the red rays in the prism are parallel to the bottom face. What is the angle between the transmitted red and violet beams?

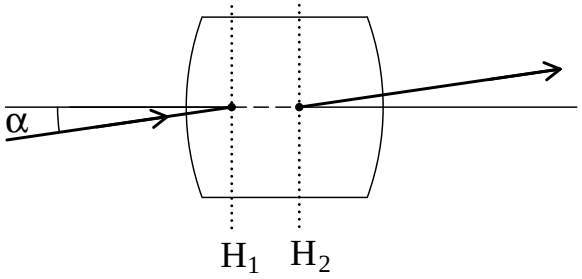


3. Calculate the front and back focal lengths of a glass hemisphere of radius R and index n. Take the front surface to be the curved one.

4. Consider an arbitrary optical system having a vertex-vertex ray matrix

$$\mathcal{M}_v = \begin{bmatrix} a & b \\ c & d \end{bmatrix}.$$

Consider a ray entering this system aimed at the front principle point. Show that the output ray has the same inclination angle α, and appears to come from the back principle point.



5. An optometrist finds that a farsighted person has a near point at 125 cm. What prescription (in diopters) will be required for contact lenses if they are to move that point inward to 25 cm?

6. The Plössl eyepiece is often used in microscopes and telescopes. Suppose it is constructed as shown below, with the second doublet identical to the first (but with reversed orientation). The indices of refraction are $n_1 = 1.5189$ and $n_2 = 1.6771$ at $\lambda = 550$ nm.
(a) Compute the vertex-to-vertex system matrix.
(b) Find the principle planes of the system and the focal length.
(c) If the eyepiece is to be used in a microscope, what is its magnifying power?
(d) With reference to Hecht Fig. 5.99, if the microscope objective provides an aperture stop 1 cm in diameter located 176 mm in front of the field stop, find the size of the exit pupil and its distance from the rear vertex.