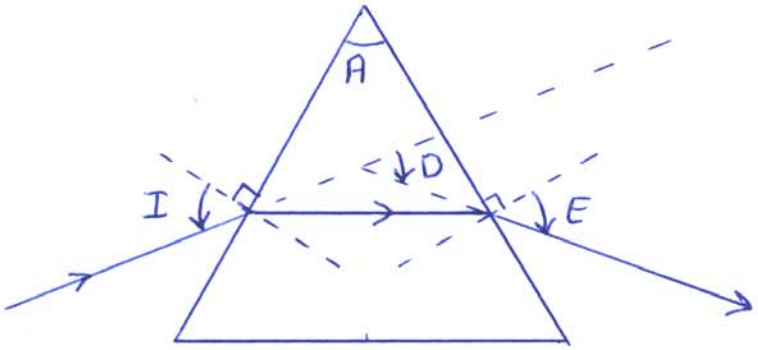
Assignment 3

1. Derive the 2 x 2 matrix describing light bouncing off a spherical mirror of radius R.

2. Consider a convex lens having a thickness d and whose sides have radii of curvature R_1 and R_2.
   a) Find the 2 x 2 matrix describing this lens.

   b) What is the change in focal length for the case where the two radii equal R and d = 0.1 R, compared to the case where the lens thickness is neglected?

3. Consider a refracting prism shown below. The face opposite the apex (top of prism) is called the base. The total angle by which light changes direction is called the angle of deviation D.



   a) Show that n_{prism} = sin (A+D)/2 / sin A/2 when light passes through the prism symmetrically such that angles of incidence (I) and emergence (E) are equal. (Assume A = 60°)

   b) Find the deviation angles for blue and red light having indices of refraction 1.652 and 1.618 respectively.

   c) Sketch what happens when white light is incident on the prism.

4. It can be shown that the radial distance of a light ray travelling along the z axis of an optical fiber is described by the following equation.

$$\frac{d^2r}{dz^2} = \frac{1}{n(r)} \frac{dn}{dr}$$

   For the case where the index of refraction $n(r) = n_o(1- Ar^2)$ and $Ar^2 << 1$ find a solution of the differential equation for r(z).

5. Explain how a rainbow is created. Hint: Look in some textbooks.