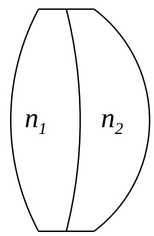
Physics 422 - Spring 2016 - Assignment #7, Due April 8st

1. Consider a doublet made of two lenses with different indices of refraction as shown below:



If the front surface has radius of curvature R_1, the interface between the two lenses has radius of curvature R_2 and the back surface has radius of curvature R_3, calculate the focal length of the assembly using the thin lens approximation.

2. For the doublet lens in question 1, suppose the material with index of refraction n_1 has thickness d_1 along the optical axis and the material with index of refraction n_2 has thickness d_2. Determine the position of the focal point measured with respect to the back surface of the lens for the following set of parameters:

$$\begin{aligned}
n_1 &= 1.5 \\
n_2 &= 2.0 \\
R_1 &= 10.0 \text{ cm} \\
R_2 &= -20.0 \text{ cm} \\
R_3 &= -10.0 \text{ cm} \\
d_1 &= 1.0 \text{ cm} \\
d_2 &= 1.0 \text{ cm}
\end{aligned}$$

Compare this focal length to the one obtained using the thin-lens approximation.

Note that this will not be the same as the focal length calculated using the thick-lens equation because that is defined with respect to the principle planes.

3. (a) Calculate the numerical values of the elements of the system matrix that describes the doublet lens system with the parameters shown in question 2.

(b) Calculate the position at which an incident ray, parallel to the optical axis, will intersect the optical axis after being refracted by the lens system. Compare this answer to the one obtained in question 2.