Phys 532/822 Assignment 1 Due February 4

1. **Ray Matrices** (a) Use Snell's Law to derive the ray transfer matrix for a spherical dielectric surface, Saleh and Teich Eq.(1.4-5)
   (b) Use ray matrices to calculate the focal length of a thin lens constructed of a material having index of refraction n. The radius of curvature of the first surface is R_1, and the second surface is R_2. (Note that Eq.(1.2-12) gives the correct answer, but in this problem, drive it using the matrix technique.)

2. **White Cell** A White cell is an optical cavity consisting of two mirrors, one of which has a small hole through which light can pass unimpeded. It is possible to introduce a laser beam through the hole such that it bounces back and forth between the two mirrors many times before exiting. This is often used for spectroscopic applications to give an increased interaction length. The condition for multiple bounces to occur involves the same considerations as the stability analysis of a closed optical cavity. (Note that the two transverse directions can be treated independently in the paraxial limit.)
   If a White cell is constructed with identical mirrors separated by a distance $d = 20$ cm, find all possible values for the radius of curvature R of the mirrors such that the ray trajectory is periodic and the beam hits each mirror ten times before exiting.