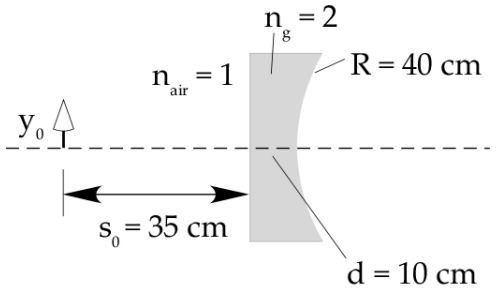
Physics 108 Midterm Exam (Spring of 2010)

1. *Thick lens*

A *thick* plano-concave lens in the air is used to image an object placed at a distance s_0 = 35 cm in front of the first surface of the lens.



(1) (20 points) Treating the lens as two spherical refraction surfaces, find the location of the image after refraction at the second surface, by *using* repeatedly *the refraction equation* $n_1/s_0 + n_2/s' = (n_2 - n_1)/r$;

(2) (20 points) Find the ABCD matrix for this *thick* lens;

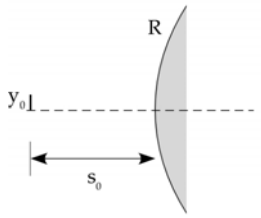
(3) (10 points) Using the ABCD matrix, find the location of the image after refraction at the second surface.

2. *Curved mirror*

A 0.5-m high object y_0 is placed at s_0 = 10 m in front of a spherical mirror with a radius of curvature of R = + 20 m.

(1) (10 points) Find the location and the linear size of the image;

(2) (10 points) If you are 2 m in front the mirror and look into the mirror, what is the angular size of the image?



3. *Interference*

A beam of white light with a continuous spectrum from λ = 400 nm to λ = 700 nm is incident from air at an angle of 60° on two *parallel* glass plates separated by an air gap of d = 5 μm = 5000 nm. The reflected light is analyzed by a spectroscope.

(1) (10 points) What is the angle of refraction when the beam enters the air gap from the top glass plate?

(2) (10 points) How many dark "lines" (i.e., values of λ) do you expect to observe across the spectrum of white light?

(3) (10 points) Now you increase the air gap to d' = 5005 nm (by 5 nm), find the wavelengths of the new dark lines across the spectrum of the white light. How much do they shift from the dark "lines" in Part (a)?