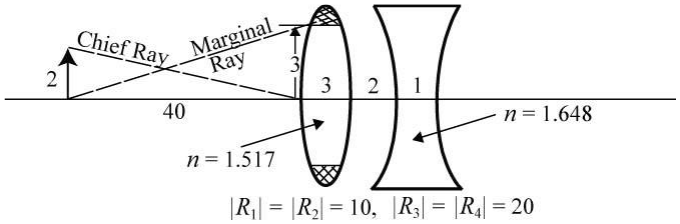
HW #2: Due Feb. 09, 2015

Note: Depending on the availability of CodeV, Pb.2b and Pb. 5, 6 can be submitted later. The due date of the problems will be announced in class.)

Problem 1 (10pt, 5pt each):

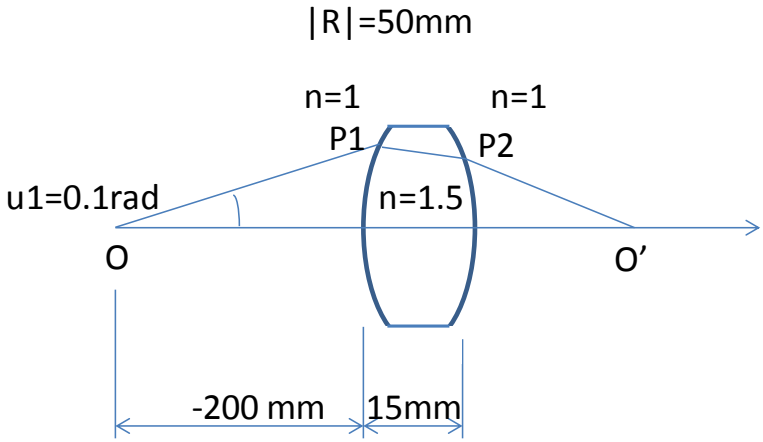
(D2 – 10.2) Paraxial ray trace the marginal and chief rays for the lens system below:



a. What is the Lagrange invariant?
b. What is the *BFD*?

Problem 2 (40pts, 20pts each):

a. Carry out exact ray trace for the following optical system. Find ray height at points P1, P2 and O'.
b. Compare the result from a) with the results from single ray trace by using CodeV. (Tip, use RSI or SIN command)



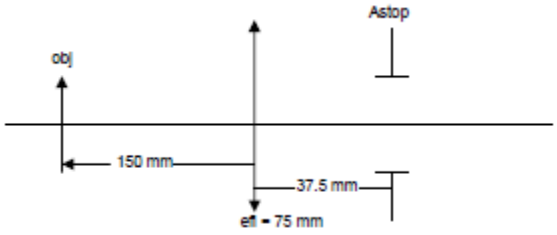
Problem 3 (15pts, 5pts each):

A CMOS array has a pixel size of 4μm, with 1024 x 1024 pixels, (assume 100% fill factor) used to record a visible image (400-700 nm wavelength). The objective lens is an F/2, 100 mm efl, used with magnification of −0.5 (M_T = −0.5).

a. What is the depth of field, or determine the near and far object distance.
b. If used for a distance object, what is the hyperfocal distance (M_T = 0)?
c. Where should the CMOS array be placed relative to the lens (BFD) for maximum depth of field (M_T=0)?

Problem 4 (10pts):

For the optical system shown in the figure, what is the radius of curvature of the reference sphere?



Problem 5 (10pts):

Why is the ray aberration not anti-symmetrical for the tangential plane ray fan for field angles of one (H=1)? Why are the sagittal (skew) ray fans anti-symmetric?

Problem 6 (15pts):

An **F/5** system has one wave of defocus ($W = W_{020}\,\rho^2$; λ = 500 nm; W_{020} = 1λ = 500 nm).
a. Plot the wavefront as a function of normalized x or y pupil coordinates.
b. Plot the ray aberration at paraxial focus versus normalized x or y.
c. Compare your results with CodeV's ones, by using Lens Module (MOD) option.