Concave-Convex Lens with Embedded Stop

a) Entrance Pupil

Front Surface: $\phi_1 = (1.5 - 1.0)/R_1$ $\phi_1 = -0.005/mm$

EP: Image the stop into object space.
Light going from Right to Left.

$$\frac{n'}{z'_{EP}} = \frac{n}{z_{STOP}} + \phi_1$$

$z_{STOP} = t_1 = 10\ mm$

$n = -1.5$ $n' = -1.0$
- For EP imaging

$$\frac{-1}{z'_{EP}} = \frac{-1.5}{10} - 0.005$$

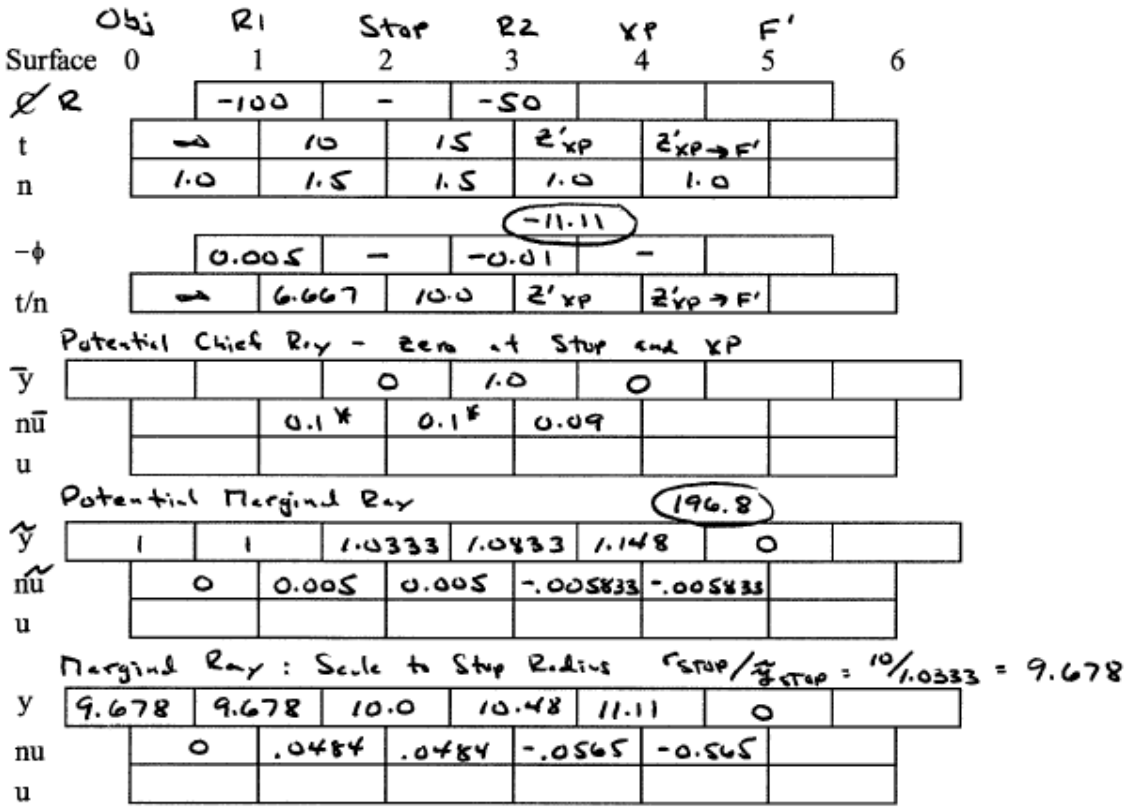
$z'_{EP} = 6.45\ mm$
to the Right of V_1

$$m_{EP} = \frac{z'_{EP}/n'}{z_{STOP}/n} = \frac{-6.45}{10/-1.5}$$

$m_{EP} = 0.968$ $D_{EP} = m_{EP} D_{STOP} = 19.35\ mm$

b) Focal Length and Exit Pupil

A potential chief ray must be traced from the stop to the XP.



$z'_{xp} = -11.11$ $\qquad z'_{xp\to F'} = 196.8$

$n'u' = -0.565$ $\qquad y_1 = 9.678$

$n'\tilde{u}' = -.005833$ $\qquad \tilde{y}_1 = 1.0$

$y_{xp} = 11.11$

$$\phi = -\frac{n'u'}{y_1} = -\frac{n'\tilde{u}'}{\tilde{y}_1} = .005833/mm$$

$$f = 1/\phi = 171.4\ mm$$

$$BFD = z'_{XP \to F'} + z'_{XP} = 196.8\ mm - 11.11\ mm$$

$$BFD = 185.7\ mm$$

XP: $z'_{XP} = -11.11$ (to the left of V_2)

$$r_{XP} = y_{XP} = 11.11\ mm$$

$$D_{XP} = 2\,r_{XP} = 22.22\ mm$$