**Example from Geary chapter 5 HW**

**Two thick lenses, physical stop, then another lens. Find EP and XP.**

| | | ← | ← | ← | ← | ← | ← | ← | ← | ← | ← Rays | | | | Rays → | → | → | → | → | → |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | (EP) | | *Lens 1 Surface 1* | | *Lens 1 Surface 2* | | *Lens 2 Surface 1* | | *Lens 2 Surface 2* | | | STOP (r=10) | | | *Lens 3 Surface 1* | | *Lens 3 Surface 2* | | *(XP)* |
| | c | | | | 0.02443 | | 0 | | -0.01797 | | 0.02516 | | | | 0.0093 | | -0.02308 | | | |
| | t | | | -15.5914 | | 8.74 | | 11.05 | | 2.78 | | 2 | - | 5.63 | | 9.54 | | -14.0645 | | |
| | n | | | 1 | | 1.617 | | 1 | | 1.649 | | 1 | | 1 | | 1.617 | | 1 | | |
| | $-\phi$ | | | | 0.01507 | | 0 | | -0.01166 | | -0.01633 | | - | | -0.00574 | | -0.01424 | | | |
| | $\tau$ (t/n) | | | -15.5914 | | 5.40507 | | 11.05 | | 1.68587 | | 2 | | 5.63 | | 5.89981 | | -14.0645 | | |
| | | | | | | | | | | | | | - | | | | | | | |
| Ray 1 (Chief Ray): originates from center of sto | y | | | | 1.88518 | | 1.38521 | | 0.36308 | | 0.2 | | 0 | | 0.563 | | 1.13393 | | | |
| ***[This ray gives image (pupil) location]*** | $\omega$ (nu) | | | 0.12091 | | 0.0925 | | 0.0925 | | 0.09673 | | 0.1 | - | 0.1 | | 0.09677 | | 0.08062 | | |
| ***[Initial u arbitrary in both directions, $y_0$ = 0]*** | | | | | | | | | | | | | - | | | | | | | |
| | | | | | | | | | | | | | - | | | | | | | |
| Ray 2 (Marginal ray): originates from top of stc | y | | **8.2705** | | 7.05718 | | 8.05267 | | 10.0878 | | 10.2 | | 10 | | 10.563 | | 10.7955 | | **12.4033** | |
| ***[This ray gives image (pupil) height]*** | $\omega$ (nu) | | | -0.07782 | | -0.18418 | | -0.18418 | | -0.06653 | | 0.1 | - | 0.1 | | 0.03941 | | -0.11432 | | |
| ***[Initial u arbitrary in both directions $y_0$ = 10]*** | | | | | | | | | | | | | | | | | | | | |

EP 15.5914mm RIGHT of Lens 1 (virtual image), r=8.27mm

XP 14.06mm LEFT of Lens 3 (virtual image), r=12.4mm