

Q. A coaxial lens system placed in air has two lenses of focal length $3F$ and F separated by a distance $2F$. Find the position of the cardinal points.

$$f_1 = 3F, \quad f_2 = F, \quad d = 2F$$

$$\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2} - \frac{d}{f_1 f_2}$$

$$\frac{1}{f} = \frac{f_2 + f_1 - d}{f_1 f_2}$$

$$f = \frac{f_1 f_2}{f_1 + f_2 - d}$$

$$f = \frac{3F \times F}{4F - 2F} = \frac{3F^2}{2F}$$

$$f = \frac{3}{2} F$$

$$\alpha_1 = \frac{df}{f_2}$$

$$\alpha_1 = \frac{2F}{F} \times \frac{3}{2} F$$

$$\alpha_1 = 3F$$

$$\alpha_2 = -\frac{df}{f_1}$$

$$\alpha_2 = -\frac{2F}{3F} \times \frac{3}{2} F$$

$$\alpha_2 = -F$$

Focus points

$$B_1 = -f \left(1 - \frac{d}{f_2}\right)$$

$$B_1 = -\frac{3}{2} F \left(1 - \frac{2F}{F}\right)$$

$$B_1 = -\frac{3}{2} F (1-2)$$

$$B_1 = \frac{3}{2} F$$

$$B_2 = f \left(1 - \frac{d}{f_1}\right)$$

$$B_2 = \frac{3}{2} F \left(1 - \frac{2F}{3F}\right)$$

$$B_2 = \frac{3}{2} F \left(1 - \frac{2}{3}\right)$$

$$B_2 = \frac{3}{2} F \left(\frac{1}{3}\right)$$

$$B_2 = \frac{F}{2}$$