Q. Two thin lenses of focal length f_1 and f_2 separated by a distance have an equivalent focal length 300 mm. The combination satisfies the conditions for no chromatic aberration and minimum spherical aberration. Find the value of f_1, f_2 and d.

Assume that both the lenses are of the same material.

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

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

$$f_1 - f_2 = d \quad , \quad f_1 = d + f_2$$

$$\left[\frac{f_1 + f_2}{2} = d\right]$$

$$\frac{d + f_2 + f_2}{2} = d$$

$$d + 2f_2 = 2d$$

$$2f_2 = d$$

$$f_2 = \frac{d}{2}$$

$$f_1 = d + \frac{d}{2} = \frac{3d}{2}$$

$$\frac{1}{f} = \frac{3d/2 + d/2 - d}{\frac{3d}{2} \times \frac{d}{2}} = \frac{4d}{3d^2}$$

$$\frac{1}{f} = \frac{4}{3d}$$

$$\frac{1}{30} = \frac{4}{3d}$$

$$d = \frac{200}{3}$$

$$d = 66.67 \text{ cm}$$

$$f_2 = \frac{d}{2} = 66.67/2 = 33.33 \text{ cm}$$

$$f_1 = \frac{3 \times 66.67}{2}$$

$$f_1 = 33.33 \times 3$$

$$\boxed{f_1 = 100 \text{cm}}$$

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