Answer on Question #71615, Physics / Optics

Question. You ordered a converging lens of focal length $3\ m$ but the company delivered a lens whose focal length was only $1\ m$. You do not have time to wait for a replacement so you decide to correct the problem by placing a diverging lens next to the lens they sent you. What must the focal length be for this diverging lens?

Given.

$f = 3\ m\ ; f_1 = 1\ m.$

Find.

$f_2 - ?.$

Solution.

If two thin lenses are separated in air by some distance d, the focal length for the combined system is given by

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

Consider the simplest case where lenses are placed in contact ($d = 0$). Then

$$\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2} \ \rightarrow \ \frac{1}{3} = \frac{1}{1} + \frac{1}{f_2} \ \rightarrow \ f_2 = -1.5\ m$$

Answer. $f_2 = -1.5\ m.$