5-7) The following combination of thin lenses in air is in a telephoto configuration:

$f_1 = 75\,mm$, $f_2 = -60\,mm$, spacing $= 35\,mm$

Use Gaussian reduction to determine the focal length of the system, and the locations of the rear principal plane and the rear focal point.

Focal length $f = \frac{1}{\phi}$

$\phi = \phi_1 + \phi_2 - \phi_1\phi_2\tau \qquad \tau = \frac{t}{n_2} = \overset{\text{spacing}}{t}$ since we are in air

$\phi = \frac{1}{f_1} + \frac{1}{f_2} - \frac{1}{f_1}\left(\frac{1}{f_2}\right)t = \frac{1}{75\,mm} + \frac{1}{-60\,mm} - \left(\frac{1}{75}\right)\left(\frac{-1}{60}\right)35\,mm$

$$\phi = \frac{1}{225\,mm}$$

$\boxed{f = \frac{1}{\phi} = 225\,mm}$

$f_R = f = 225\,mm$

d' tells us the location of the rear principal plane

$d'/n' = -\frac{\phi_1}{\phi}\tau \Rightarrow d' = -\frac{f}{f_1}t = -\frac{225\,mm}{75\,mm}(35\,mm) = -105\,mm$

$\boxed{d' = -105\,mm}$ from the rear principal plane of the second system

$\boxed{BFD = f + d' = 120\,mm}$ BFD is the distance from the vertex of the second optical surface to the rear focal point