52. (a) First, the lens forms a real image of the object located at a distance

$$i_1 = \left(\frac{1}{f_1} - \frac{1}{p_1}\right)^{-1} = \left(\frac{1}{f_1} - \frac{1}{2f_1}\right)^{-1} = 2f_1$$

to the right of the lens, or at $p_2 = 2(f_1 + f_2) - 2f_1 = 2f_2$ in front of the mirror. The subsequent image formed by the mirror is located at a distance

$$i_2 = \left(\frac{1}{f_2} - \frac{1}{p_2}\right)^{-1} = \left(\frac{1}{f_2} - \frac{1}{2f_2}\right)^{-1} = 2f_2$$

to the left of the mirror, or at $p_1' = 2(f_1 + f_2) - 2f_2 = 2f_1$ to the right of the lens. The final image formed by the lens is that at a distance i_1' to the left of the lens, where

$$i_1' = \left(\frac{1}{f_1} - \frac{1}{p_1'}\right)^{-1} = \left(\frac{1}{f_1} - \frac{1}{2f_1}\right)^{-1} = 2f_1 \ .$$

This turns out to be the same as the location of the original object. The final image is real and inverted. The lateral magnification is

$$m = \left(-\frac{i_1}{p_1}\right)\left(-\frac{i_2}{p_2}\right)\left(-\frac{i_1'}{p_1'}\right) = \left(-\frac{2f_1}{2f_1}\right)\left(-\frac{2f_2}{2f_2}\right)\left(-\frac{2f_1}{2f_1}\right) = -1.0 \ .$$

(b) The ray diagram is shown below. We set the ratio $f_2/f_1 = 1/2$ for the purposes of this sketch. The intermediate images are not shown explicitly, but they are both located on the plane indicated by the dashed line.