

47. (a) (b) and (c) Our first step is to form the image from the first lens. With  $p_1 = 4$  cm and  $f_1 = -4$  cm, Eq. 35-9 leads to

$$\frac{1}{p_1} + \frac{1}{i_1} = \frac{1}{f_1} \implies i_1 = -2 \text{ cm} .$$

The corresponding magnification is  $m_1 = -i_1/p_1 = 1/2$ . This image serves the role of “object” for the second lens, with  $p_2 = 10 + 2 = 12$  cm, and  $f_2 = -4$  cm. Now, Eq. 35-9 leads to

$$\frac{1}{p_2} + \frac{1}{i_2} = \frac{1}{f_2} \implies i_2 = -3.00 \text{ cm}$$

with a corresponding magnification of  $m_2 = -i_2/p_2 = 1/4$ , resulting in a net magnification of  $m = m_1 m_2 = 1/8$ . The fact that  $m$  is positive means that the orientation of the final image is the same as the (original) object. The fact that  $i_2$  is negative means that the final image is virtual.