An erect object of height 3 cm is 40 cm to the left of a lens of focal length +20 cm. A second lens of focal length -10 cm is 50 cm to the right of the first lens.

(a) If the second lens were not in the system, where would the image from the first lens be?

\[ \frac{1}{i} + \frac{1}{p} = \frac{1}{f}, \quad \frac{1}{u} = \frac{1}{20} - \frac{1}{40} = \frac{1}{40} \Rightarrow i_1 = +40 \text{ cm} \]

(b) How large would this image be? Is it erect or inverted?

\[ m_1 = \frac{v}{p} = \frac{-40}{40} = -1 \]
\[ s_{1 \text{HE}} = (3 \text{ cm})(-1) = -3 \text{ cm} \quad \text{inverted} \]

(c) For the whole optical system (both lenses), where is the final image relative to the second lens?

\[ \frac{1}{i_2} + \frac{1}{p_2} = \frac{1}{f_2} \quad \frac{1}{u_2} = \frac{1}{-10 \text{ cm}} - \frac{1}{10 \text{ cm}} = -\frac{1}{5} \Rightarrow i_2 = -5 \text{ cm} \]

5 cm to left of second lens

(d) How large would this image be? Is it erect or inverted relative to the original? Is it real or virtual?

\[ m_2 = \frac{v_2}{p_2} = -\frac{-5 \text{ cm}}{-10 \text{ cm}} = \frac{1}{2} \]
\[ m = m_1 m_2 = (-1) \left( \frac{1}{2} \right) = -\frac{1}{2} \]
\[ s_{2 \text{HE}} = (3 \text{ cm})(-\frac{1}{2}) = -1.5 \text{ cm} \quad \text{inverted} \]
\[ \text{Virtual} \]