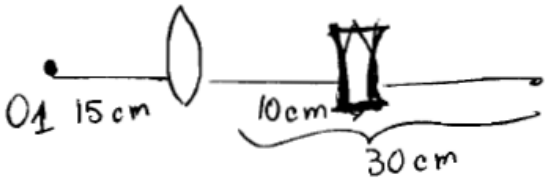
Answer on Question #52217-Physics-Optics

Object O1 is 15.0cm to the left of a converging lens with a 10.0cm focal length. A second lens is positioned 10.0cm to the right of the first lens and is observed to form a virtual image at the position of the original object O1. What is the focal length of the second lens? What is the overall magnification of this system? What is the nature of the final image?

Solution

$$\frac{1}{d_i}+\frac{1}{d_o}=\frac{1}{f}\rightarrow\frac{1}{d_i}=\frac{1}{15cm}+\frac{1}{10cm}\rightarrow d_i=30cm.$$



$$\frac{1}{d_{i2}}+\frac{1}{d_{o2}}=\frac{1}{f_2}\rightarrow\frac{1}{-20cm}+\frac{1}{-25cm}=\frac{1}{f_2}.$$

The focal length of the second lens is

$$f_2=-11.1cm.$$

The overall magnification of this system is

$$M_{tot}=m_1m_2=\left(-\frac{d_i}{d_0}\right)\left(-\frac{d_{i2}}{d_{02}}\right)=\left(-\frac{30}{15}\right)\left(-\frac{-25}{-20}\right)=2.5.$$

The final image is upright since M_{tot} is positive and virtual d_{i2} is negative and final image is made by a diverging lens.