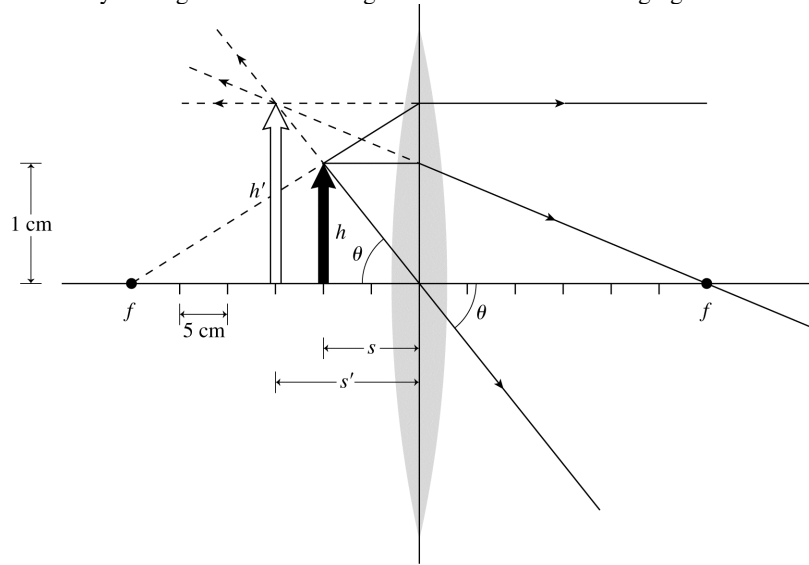


23.60. Model: Use ray tracing to locate the image. Assume that the converging lens is a thin lens.
Solve: (a)



The figure shows the ray-tracing diagram using the steps of Tactics Box 23.2. The three special rays that experience refraction do not converge at a point. Instead they appear to come from a point that is 15 cm on the same side as the object itself. Thus $s' = -15$ cm. The image is upright and has a height of $h' = 1.5$ cm.

(b) Using the thin-lens formula,

$$\frac{1}{s} + \frac{1}{s'} = \frac{1}{f} \Rightarrow \frac{1}{10 \text{ cm}} + \frac{1}{s'} = \frac{1}{30 \text{ cm}} \Rightarrow \frac{1}{s'} = -\frac{1}{15 \text{ cm}} \Rightarrow s' = -15 \text{ cm}$$

The image height is obtained from

$$M = -\frac{s'}{s} = -\frac{-15 \text{ cm}}{10 \text{ cm}} = +1.5$$

The image is upright and 1.5 times the object, that is, 1.5 cm high. These values agree with those obtained in part (a).