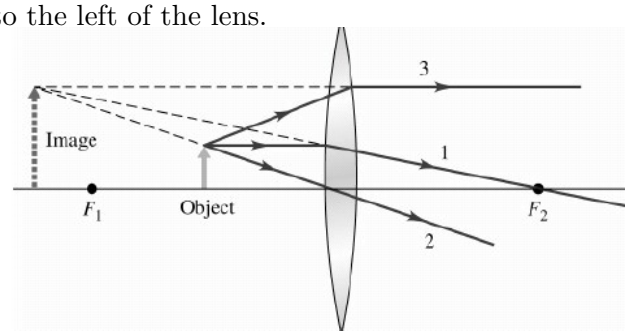
HW Solution 2

September 10, 2010

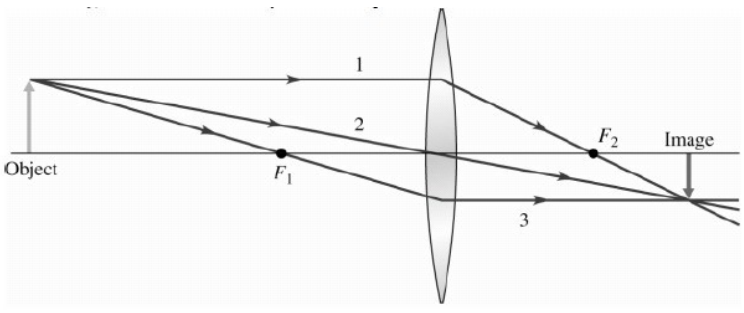
34.72.
(a) The ray is bent toward the optic axis by the lens so the lens is converging.
(b) The ray is parallel to the optic axis after it passes through the lens so it comes from the focal point. $f = 18.0cm$
(c) The principal ray diagram is drawn in Figure. The diagram shows that the image is 22.5 cm to the left of the lens.



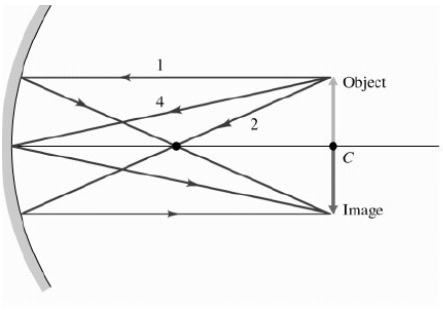
(d) $\frac{1}{s} + \frac{1}{s'} = \frac{1}{f} \rightarrow s' = \frac{sf}{s-f} = 22.5cm$ The calculated image position agrees with the principal ray diagram.

34.80.
(a) $\frac{1}{f} = \frac{s+s'}{ss'} \rightarrow f = \frac{ss'}{s+s'} = -4.8cm$ f is negative so the lens is diverging.
(b) $m = \frac{s'}{s} = 0.375$, $y' = my = 2.44mm$. $s' < 0$ $\rightarrow$ the image is virtual.

34.94.
(a) The principal-ray diagrams from the two images are sketched in Figures a. In Figure b, only the image formed by the mirror is shown. This image is at the location of the candle so the principal ray diagram that shows the image formation when the image of the mirror serves as the object for the lens is analogous to that in Figure a and is not drawn.



(a)



(b)

(b) Image formed by the light that passes directly through the lens: The candle is 85.0 cm to the left of the lens.
$s' = \frac{sf}{s-f} = 51.3cm.$ $m = -\frac{s'}{s} = -0.604.$
This image is 51.3 cm to the right of the lens. $s' > 0$ so the image is real. $m < 0$ so the image is inverted. Image formed by the light that first reflects off the mirror: First consider the image formed by the mirror. The candle is 20.0 cm to the right of the mirror, so $s = 20.0cm.$
$s' = \frac{sf}{s-f} = 20.0cm.$ $m_1 = -\frac{s'_1}{s_1} = -1.00.$
The image formed by the mirror is at the location of the candle, so $s_2 = 85.0cm$ and
$s' = 51.3cm.$ $m_2 = -0.604.$ $m_{tot} = m_1 m_2 = 0.604.$ The second image is 51.3 cm to the right of the lens. $s'_2 > 0$, so the final image is real. $m_{tot} > 0$, so the final image is erect.