The object in the image is midway between the lens and the morror. The mirror's radius of curvature is 20.0cm and the lens has a focal length of -16.7 cm.

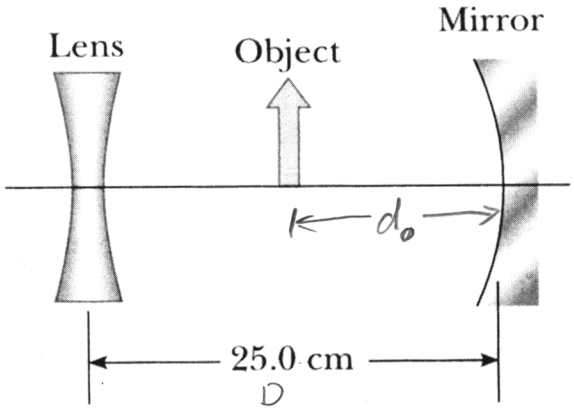
Considering only the light that leaves the object and travels first toward the mirror, locate the final image formed by this system. Is the image real or virtual, upright or inverted, and what is the overall magnification?

Given

$D = 25cm$

$R_m = 20.cm$

$f_l = -16.7cm$



1) Find image due to mirror

$f_{mirror} = 10.0cm, \quad P = 12.5cm$

object between focus and radius gives Real inverted image.

object and radius are positive.

$$\frac{1}{p} + \frac{1}{q} = \frac{2}{R} \Rightarrow \frac{1}{q} = \frac{2}{R} - \frac{1}{p} \Rightarrow \frac{1}{q} = \left(\frac{2p-R}{pR}\right) \Rightarrow q = \frac{pR}{2p-R}$$

$$\Rightarrow \boxed{q = \frac{(12.5)(20.0)}{2(12.5)-20.0} = 50cm} \text{ in Front of mirror}$$

$$M = -\frac{q}{p} = -\frac{50}{12.5} = \boxed{+4.0}$$

2) Find image due to lens. Concave lenses give virtual images.

object is beyond the focus on the left side of the lens.

continued

↓

Optics Set 3, P2 continued

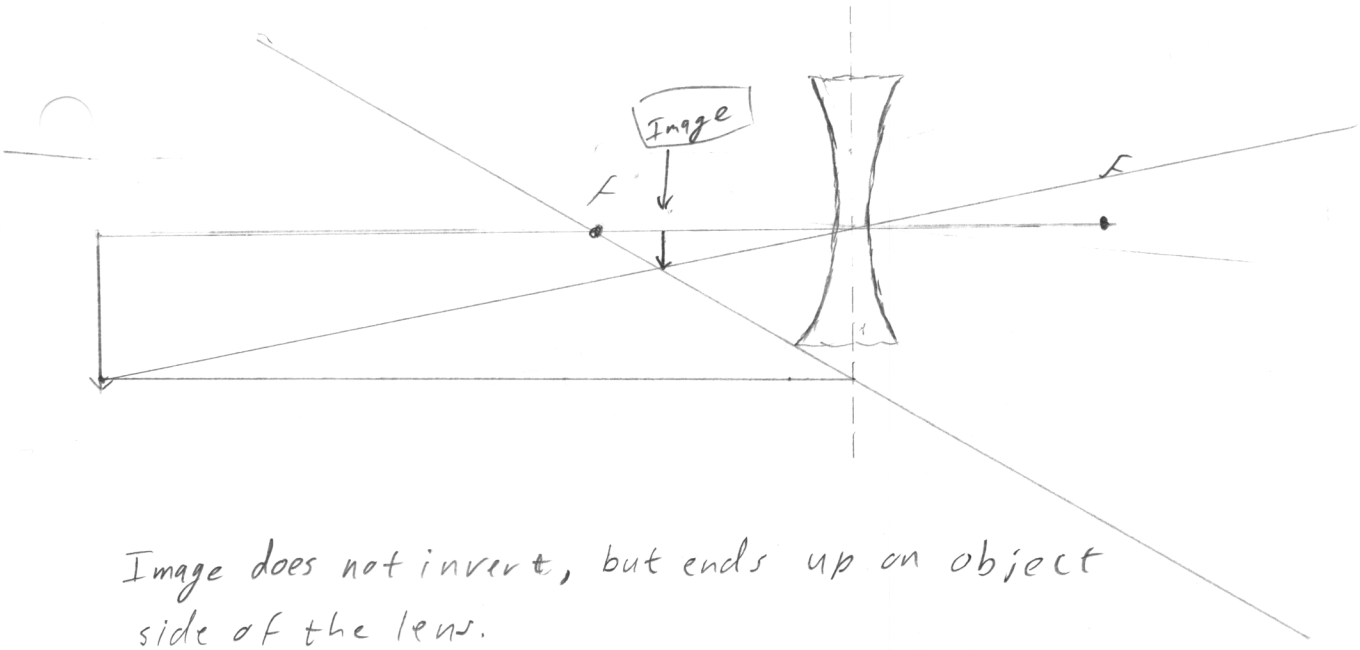


Image does not invert, but ends up on object side of the lens.

P is positive, f is negative, M is positive

$$\frac{1}{p}+\frac{1}{q}=-\frac{1}{f} \Rightarrow \frac{1}{q}=-\frac{1}{f}-\frac{1}{p} \Rightarrow \frac{1}{q}=-\left(\frac{f+p}{fp}\right)$$

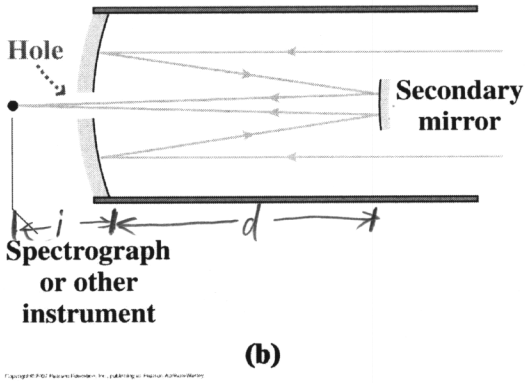
$$\Rightarrow q=-\frac{fp}{f+p}, \quad f=16.7\text{cm}, \quad p=25\text{cm}$$

$$q=-\frac{(16.7)(25)}{(16.7+25)}=\boxed{-10\text{cm}}, \quad M=\frac{q}{p}=\frac{10}{25}=0.4$$

So, Final image is

35cm in front of Mirror
Image is inverted,
overall mag. is: $M_T=-4\cdot 0.4=-1.6$

A Cassegrain telescope like that shown in the figure has a 1.0 m focal length, and the convex secondary mirror is located 0.85 m from the primary. What should be the focal length of the secondary in order to put the final image 0.12 m behind the front surface of the primary mirror?



(b)

Given

$f_1 = 1.0\,m$

$d = 0.85\,m$

$i = 0.12\,m$

1) Find image due to primary.

$p_1 = \infty$, so $q_1 = f_1$, which is $1\,m$

2) Secondary has a virtual object at $p_2 = q_1 - d \Rightarrow p_2 = -(f_1 - d)$

$\Rightarrow \boxed{p_2 = -0.15\,m}$

and $q_2 = d + i$, and q_2 is real

$\Rightarrow \boxed{q_2 = 0.7\,m}$

So: $\frac{1}{p_2} + \frac{1}{q_2} = \frac{1}{f_2} \Rightarrow f_2 = \left(\frac{1}{p_2} + \frac{1}{q_2}\right)^{-1}$

$\Rightarrow \boxed{f_2 = -0.19\,m}$

Name: _____ **Problems Solved __/ 3**

A real object is located at the zero end of a meter stick. A large concave mirror at the 100 cm end forms an image of the object at the 70.0 position. A small convex mirror placed at the 20.0cm position forms a final image at the 10.0 cm point.

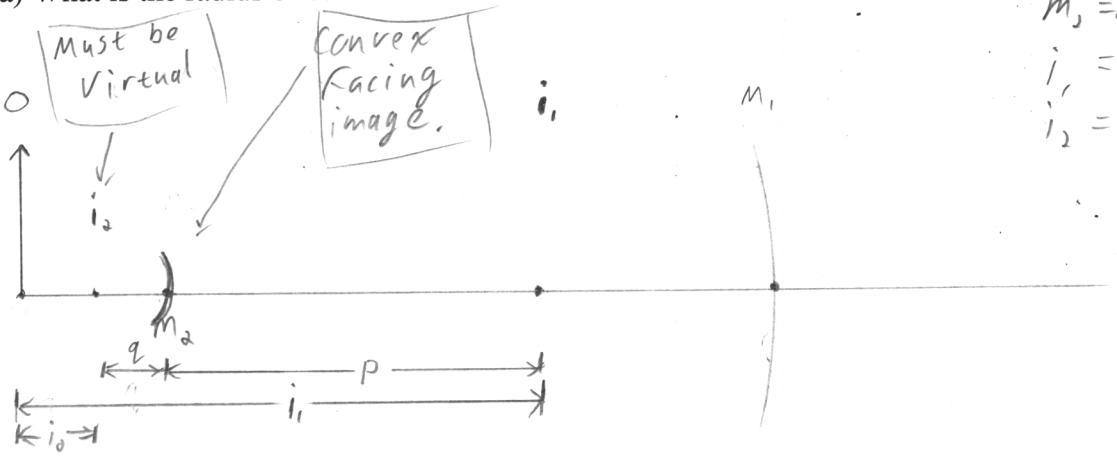
a) What is the radius of curvature of the convex mirror?

Given

$m_1 = 20.0\,cm$

$i_1 = 70.\,cm$

$i_2 = 10\,cm$



First mirror is irrelevant.

i_1 is in front of m_2, positive

i_2 is virtual, negative

R is negative

$$\frac{1}{p} + \frac{1}{q} = \frac{2}{R} \Rightarrow \quad \frac{1}{p} - \frac{1}{q} = -\frac{2}{R} \Rightarrow -\frac{1}{p} + \frac{1}{q} = \frac{2}{R}$$

$$\Rightarrow R = 2\left(\frac{qp}{p-q}\right), \quad p = i_1 - m_2 = 50\,cm$$

$$q = m_2 - i_2 = 10\,cm$$

$$R = 2\left(\frac{(50)(10)}{40}\right)$$

$$\boxed{R = -25\,cm}$$