P26.7 For a concave mirror, both R and f are positive.

We also know that $$f = \frac{R}{2} = 10.0 \text{ cm}.$$

(a) $$\frac{1}{q} = \frac{1}{f} - \frac{1}{p} = \frac{1}{10.0 \text{ cm}} - \frac{1}{40.0 \text{ cm}} = \frac{3}{40.0 \text{ cm}}$$

and $$\boxed{q = 13.3 \text{ cm}}$$

$$M = \frac{q}{p} = -\frac{13.3 \text{ cm}}{40.0 \text{ cm}} = \boxed{-0.333}.$$

The image is 13.3 cm in front of the mirror, $\boxed{\text{real, and inverted}}$.

(b) $$\frac{1}{q} = \frac{1}{f} - \frac{1}{p} = \frac{1}{10.0 \text{ cm}} - \frac{1}{20.0 \text{ cm}} = \frac{1}{20.0 \text{ cm}}$$

and $$\boxed{q = 20.0 \text{ cm}}$$

$$M = \frac{q}{p} = -\frac{20.0 \text{ cm}}{20.0 \text{ cm}} = \boxed{-1.00}.$$

The image is 20.0 cm in front of the mirror, $\boxed{\text{real, and inverted}}$.

(c) $$\frac{1}{q} = \frac{1}{f} - \frac{1}{p} = \frac{1}{10.0 \text{ cm}} - \frac{1}{10.0 \text{ cm}} = 0$$

Thus, q = infinity.

$\boxed{\text{No image is formed}}$. The rays are reflected parallel to each other.

P26.9 (a) $$\frac{1}{p} + \frac{1}{q} = \frac{2}{R} \quad \text{gives} \quad \frac{1}{30.0 \text{ cm}} + \frac{1}{q} = \frac{2}{(-40.0 \text{ cm})}$$

$$\frac{1}{q} = -\frac{2}{40.0 \text{ cm}} - \frac{1}{30.0 \text{ cm}} = -0.0833 \text{ cm}^{-1} \quad \text{so} \quad q = \boxed{-12.0 \text{ cm}}$$

$$M = \frac{-q}{p} = -\frac{(-12.0 \text{ cm})}{30.0 \text{ cm}} = \boxed{0.400}.$$

(b) $$\frac{1}{p} + \frac{1}{q} = \frac{2}{R} \quad \text{gives} \quad \frac{1}{60.0 \text{ cm}} + \frac{1}{q} = \frac{2}{(-40.0 \text{ cm})}$$

$$\frac{1}{q} = -\frac{2}{40.0 \text{ cm}} - \frac{1}{60.0 \text{ cm}} = -0.0666 \text{ cm}^{-1} \quad \text{so} \quad q = \boxed{-15.0 \text{ cm}}$$

$$M = \frac{-q}{p} = -\frac{(-15.0 \text{ cm})}{60.0 \text{ cm}} = \boxed{0.250}.$$

(c) Since $M > 0$, the images are $\boxed{\text{upright}}$.

P26.15 $M=-\dfrac{q}{p}$

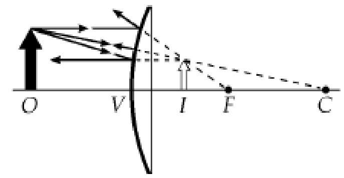


FIG. P26.15

$q=-Mp=-0.013(30\text{ cm})=-0.39\text{ cm}$

$\dfrac{1}{p}+\dfrac{1}{q}=\dfrac{1}{f}=\dfrac{2}{R}$

$\dfrac{1}{30\text{ cm}}+\dfrac{1}{-0.39\text{ cm}}=\dfrac{2}{R}$

$R=\dfrac{2}{-2.53\text{ m}^{-1}}=-0.790\text{ cm}$

The cornea is convex, with radius of curvature $\boxed{0.790\text{ cm}}$.

P26.30 For a converging lens, f is positive. We use $\dfrac{1}{p}+\dfrac{1}{q}=\dfrac{1}{f}$.

(a) $\dfrac{1}{q}=\dfrac{1}{f}-\dfrac{1}{p}=\dfrac{1}{20.0\text{ cm}}-\dfrac{1}{40.0\text{ cm}}=\dfrac{1}{40.0\text{ cm}}$ $\boxed{q=40.0\text{ cm}}$

$M=-\dfrac{q}{p}=-\dfrac{40.0}{40.0}=\boxed{-1.00}$

The image is $\boxed{\text{real, inverted}}$, and located 40.0 cm past the lens.

(b) $\dfrac{1}{q}=\dfrac{1}{f}-\dfrac{1}{p}=\dfrac{1}{20.0\text{ cm}}-\dfrac{1}{20.0\text{ cm}}=0$ $\boxed{q=\text{infinity}}$

$\boxed{\text{No image}}$ is formed. The rays emerging from the lens are parallel to each other.

(c) $\dfrac{1}{q}=\dfrac{1}{f}-\dfrac{1}{p}=\dfrac{1}{20.0\text{ cm}}-\dfrac{1}{10.0\text{ cm}}=-\dfrac{1}{20.0\text{ cm}}$ $\boxed{q=-20.0\text{ cm}}$

$M=-\dfrac{q}{p}=-\dfrac{(-20.0)}{10.0}=\boxed{2.00}$

The image is $\boxed{\text{upright, virtual}}$ and 20.0 cm in front of the lens.

P26.35 (a) $\dfrac{1}{p}+\dfrac{1}{q}=\dfrac{1}{f}$ $\dfrac{1}{20.0\text{ cm}}+\dfrac{1}{q}=\dfrac{1}{(-32.0\text{ cm})}$

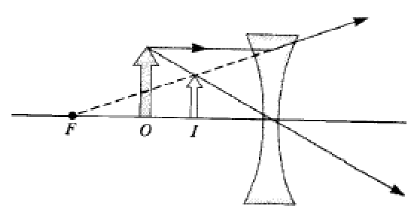


FIG. P26.35

so $q=-\left(\dfrac{1}{20.0}+\dfrac{1}{32.0}\right)^{-1}=\boxed{-12.3\text{ cm}}$

The image is 12.3 cm to the left of the lens.

(b) $M=-\dfrac{q}{p}=-\dfrac{(-12.3\text{ cm})}{20.0\text{ cm}}=\boxed{0.615}$

(c) See the ray diagram to the right.

P26.36 Comparing $\frac{1}{p}+\frac{1}{q}=\frac{1}{f}$ with $\frac{1}{p}+\frac{1}{-3.5p}=\frac{1}{7.5\text{ cm}}$ we see $q=-3.5p$ and $f=7.50$ cm for a converging lens.

(a) To solve, we add the fractions:

$$\frac{-3.5+1}{-3.5p}=\frac{1}{7.5\text{ cm}}$$

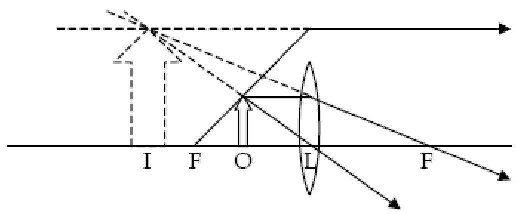
$$\frac{3.5p}{2.5}=7.5\text{ cm}$$

$$p=\boxed{5.36\text{ cm}}$$

(b) $q=-3.5(5.36\text{ cm})=\boxed{-18.8\text{ cm}}$

$M=-\frac{q}{p}=-\frac{-18.8\text{ cm}}{5.36\text{ cm}}=+3.50$

(c)



P26.36(c)

The image is $\boxed{\text{enlarged, upright, and virtual.}}$

(d) The lens is being used as a magnifying glass. Statement: A magnifying glass with focal length 7.50 cm is used to form an image of a stamp, enlarged 3.50 times. Find the object distance. Locate and describe the image.