Convex Mirrors

PROBLEM

An upright pencil is placed in front of a convex spherical mirror with a focal length of 8.00 cm. An erect image 2.50 cm tall is formed 4.44 cm behind the mirror. Find the position of the object, the magnification of the image, and the height of the pencil.
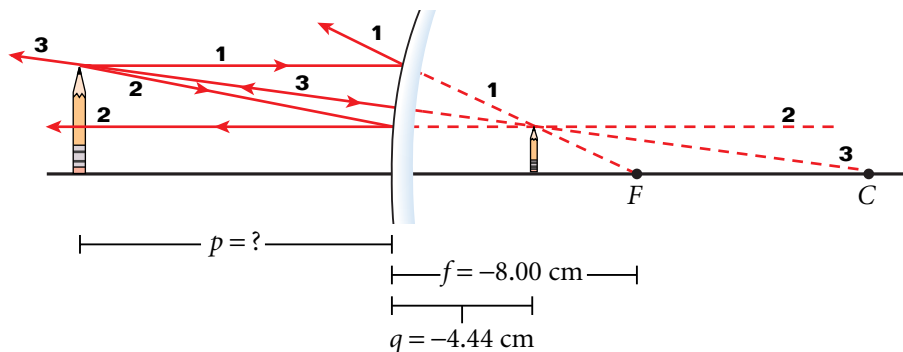
SOLUTION

1. DEFINE   **Given:** $f = -8.00$ cm $q = -4.44$ cm $h' = 2.50$ cm

Because the mirror is convex, the focal length is negative.
The image is behind the mirror, so q is also negative.

Unknown: $p = ?$ $h = ?$ $M = ?$

Diagram: Construct a ray diagram.

2. PLAN

Choose an equation or situation: Use the mirror equation.

$$\frac{1}{p} + \frac{1}{q} = \frac{1}{f}$$

Use the magnification formula.

$$M = \frac{h'}{h} = -\frac{q}{p}$$

Rearrange the equation to isolate the unknown:

$$\frac{1}{p} = \frac{1}{f} - \frac{1}{q} \quad \text{and} \quad h = -\frac{p}{q}h'$$

3. CALCULATE   **Substitute the values into the equation and solve:**

$$\frac{1}{p} = \frac{1}{-8.00 \text{ cm}} - \frac{1}{-4.44 \text{ cm}}$$

$$\frac{1}{p} = \frac{-0.125}{1 \text{ cm}} - \frac{-0.225}{1 \text{ cm}} = \frac{0.100}{1 \text{ cm}}$$

$$\boxed{p = 10.0 \text{ cm}}$$