

SAMPLE PROBLEM B

STRATEGY Imaging with Concave Mirrors

PROBLEM

A concave spherical mirror has a focal length of 10.0 cm. Locate the image of a pencil that is placed upright 30.0 cm from the mirror. Find the magnification of the image. Draw a ray diagram to confirm your answer.

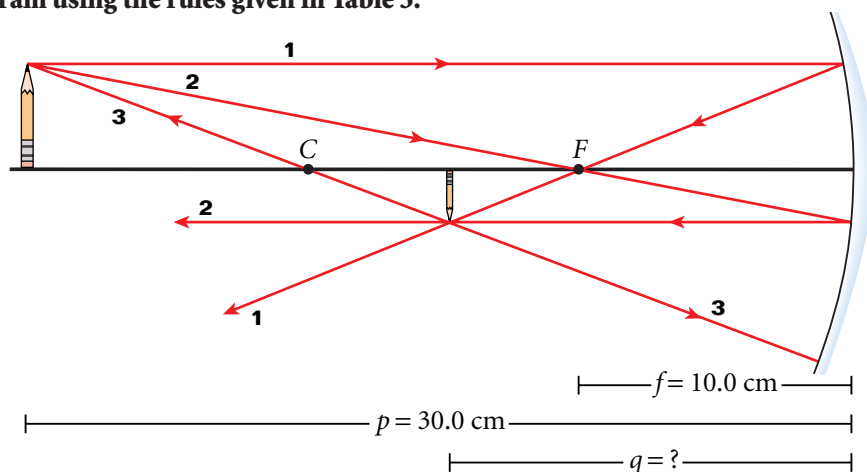
SOLUTION

1. Determine the sign and magnitude of the focal length and object size.

$$f = +10.0 \text{ cm} \quad p = +30.0 \text{ cm}$$

The mirror is concave, so f is positive. The object is in front of the mirror, so p is positive.

2. Draw a ray diagram using the rules given in Table 3.



3. Use the mirror equation to relate the object and image distances to the focal length.

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

4. Use the magnification equation in terms of object and image distances.

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

5. Rearrange the equation to isolate the image distance, and calculate.

Subtract the reciprocal of the object distance from the reciprocal of the focal length to obtain an expression for the unknown image distance.

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

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