

Light and Reflection

Problem B**IMAGING WITH CONCAVE MIRRORS****PROBLEM**

Suppose you place a 5.0 cm tall spring in front of a concave mirror. The mirror has a focal length of 24 cm. The spring forms an image that appears to be at the same position as the spring, but the image is inverted. Where did you place the spring? How tall is the spring's image?

SOLUTION

Given: $h = 5.0 \text{ cm}$ $f = 24 \text{ cm}$ $q = p$

Unknown: $h' = ?$ $p = ?$

Choose the equation(s) or situation: Use the mirror equation to find the position of the spring, and the equation for magnification to find the height of the image.

$$\frac{1}{f} = \frac{1}{p} + \frac{1}{q} = \frac{1}{p} + \frac{1}{p} = \frac{2}{p}$$

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

Rearrange the equation(s) to isolate the unknown(s):

$$p = 2f = (2)(24 \text{ cm}) = \boxed{48 \text{ cm}}$$

$$q = p = 48 \text{ cm}$$

$$h' = -\frac{qh}{p} = -\frac{(48 \text{ cm})(5.0 \text{ cm})}{48 \text{ cm}} = \boxed{-5.0 \text{ cm}}$$

ADDITIONAL PRACTICE

- You can appear to shake hands with yourself using a concave mirror. Suppose you have a mirror with a focal length of 32.0 cm.
 - Where would you place your right hand so that you appear to be shaking hands with yourself?
 - When your hand is in the shaking position, it is 7.5 cm tall. What is the height of the image?
- As you eat your soup, you look in the concave part of the spoon and see your face. The focal length of the spoon is 9.5 cm, and the image of your eye appears to be 15.5 cm from the mirror.
 - How far in front of the mirror is your eye?
 - If your eye is 3.0 cm tall, how tall is the image?
- Suppose you bend a sheet of aluminized Mylar™ to form a reflective surface that resembles a concave mirror when the axis is vertical. The bent reflective sheet has a focal length of 17 cm.
 - Where must you stand so that the image of your eye appears at 23 cm?
 - If your eye is 2.7 cm tall, how tall will the image be?

4. A car's headlamp is made of a light bulb in front of a concave spherical mirror. If the bulb is 5.0 cm in front of the mirror, what is the radius and focal length of the mirror?
5. Suppose you are 19 cm in front of the bell of your friend's trumpet and you see your image at 14 cm. Treating the trumpet's bell as a concave mirror, what would be its focal length and radius of curvature?
6. You look in to a metallic mixing bowl which resembles a spherical concave mirror. When you are 35 cm in front of the bowl, you see an image at 42 cm. What is the focal length and radius of curvature of the bowl?
7. You place an electric heater 3.00 m in front of a concave spherical mirror that has a focal length of 30.0 cm.
 - a. Where would your hand feel warm?
 - b. If the heater is 15 cm tall, how tall is the image?
8. A new line of makeup offers concave spherical mirrors in their pressed powder compacts. The focal length for one of these mirrors is 17.5 cm.
 - a. If someone used this mirror at a distance of 15.0 cm, where would the image appear?
 - b. What is the magnification of the image?
9. A concave spherical mirror on an actor's dressing table has a focal length of 60.0 cm. Suppose the actor sits 35.0 cm in front of the mirror.
 - a. Where does the image appear?
 - b. What is the magnification of the image?
10. You place a book in front of a concave spherical mirror. The mirror has a focal length of 23.0 cm.
 - a. Where does the image form when the book is 3.00 cm in front of the mirror? What is the magnification of the image? Will you be able to read the writing on the image?
 - b. Where does the image form when the book is 33.0 cm in front of the mirror? What is the magnification of the image? Will you be able to read the writing on the image?