1. PSE6 36.P.005. [318010] A person walks into a room with two flat mirrors on opposite walls, which produce multiple images. When the person is located 6.00 ft from the mirror on the left wall and 8.0 ft from the mirror on the right wall, find the distance from the person to the first three images seen in the mirror on the left.

distance to first image

[12] ft

distance to second image

[28] ft

distance to third image

[40] ft

Soll:

![Diagram]

(a) 1st image: \( \overline{O_0} = 6 + 6 = 12 \text{ (ft)} \) (0 \( \rightarrow \) \( O_1 \))

(b) \( O_0 \xrightarrow{\text{Mirror 1}} O_1 \xrightarrow{\text{Mirror 2}} O_{1''} \Rightarrow \overline{O_{1''}} = 6 + 34 = 40 \text{ (ft)} \) (3rd image)

\( O_0 \xrightarrow{\text{Mirror 1}} O_1 \xrightarrow{\text{Mirror 2}} O_{1''} \Rightarrow \overline{O_{1''}} = 6 + 22 = 28 \text{ (ft)} \) (2nd image)
2. **PSE6 36.P.008. [318115]** At an intersection of hospital hallways, a convex mirror is mounted high on a wall to help people avoid collisions. The mirror has a radius of curvature of 0.510 m. What is the image distance for a patient 10.1 m from the mirror? (Use the correct sign conventions.)

[-0.249] m (from the mirror)

Determine the magnification.

[0.0246]x

Describe the image:

- [x] diminished
- [x] upright
- [x] behind the mirror
- [ ] inverted
- [ ] real
- [ ] enlarged
- [x] virtual

**Sol:**

(a) \[ \frac{1}{s} + \frac{1}{s'} = \frac{1}{f} = \frac{2}{R} \Rightarrow \frac{1}{10.1} + \frac{1}{s'} = -\frac{2}{0.510} \]

\[ s' = -0.249 \text{ m} \]

(b) \[ M = -\frac{s'}{s} = \frac{0.249}{10.1} = 0.0246 \]

(c) : S' < 0 ⇒ behind the mirror & virtual

: M < 1 ⇒ diminished & M > 0 ⇒ image is upright.
3. PSE6 36.P.018. [318004] A dedicated sports-car enthusiast polishes the inside and outside surfaces of a hubcap that is a section of a sphere. When she looks into one side of the hubcap, she sees an image of her face 36.0 cm in back of the hubcap. She then flips the hubcap over and sees another image of her face 10.0 cm in back of the hubcap.

(a) How far is her face from the hubcap?

[15.7] cm

(b) What is the radius of curvature of the hubcap?

[55.4] cm

Sol:

(a) \(-\frac{1}{s} - \frac{1}{36} = -\frac{1}{5} + \frac{1}{10}\) \(\Rightarrow \frac{2}{s} = \frac{1}{36} + \frac{1}{10}\) \(\Rightarrow s = 15.652\) \(\Rightarrow 15.7\) (cm)

(b) \(\frac{1}{15.652} - \frac{1}{36} = \frac{1}{f}\) \(\Rightarrow f = 27.692\)

Hence \(R = 2f = 55.4\) (cm)
4. PSE6 36.P.023. [318093] A glass sphere \( n = 1.50 \) with a radius of 20.0 cm has a tiny air bubble located 6.00 cm above its center. The sphere is viewed looking down along the extended radius containing the bubble. What is the apparent depth of the bubble below the surface of the sphere?

\[ 12.2 \text{ cm} \]

\[ \text{Sol.} \]

Use \( \frac{n_1}{S} + \frac{n_2}{S'} = \frac{n_2 - n_1}{R} \)

where \( n_1 = 1, n_2 = 1.50, R = 20 \text{ (cm)} \)

\[ S = 20 - 6 = 14 \text{ (cm)} \]

\[ \Rightarrow \quad \frac{1}{8} + \frac{1.50}{14} = \frac{1.50 - 1}{20} \]

\[ \Rightarrow \quad S' = -12.2 \quad \Rightarrow \quad \text{Apparent depth} = 12.2 \text{ (cm)} \]
5. PSE6 36.P.022. [318105] A flint glass plate \((n = 1.66)\) rests on the bottom of an aquarium tank. The plate is 7.00 cm thick (vertical dimension) and is covered with a layer of water \((n = 1.33)\) 10.0 cm deep. Calculate the apparent thickness of the plate as viewed from straight above the water. (Assume nearly normal incidence.)

\[
\text{[4.22] cm}
\]

\[
\text{Solution:}
\]

\[
\text{(a)}
\]

\[
\frac{1}{s_1} + \frac{1.33}{10} = 0 \Rightarrow s_1 = -7.519
\]

\[
\text{(b)}
\]

For \(q \rightarrow q'\):

\[
\frac{1.33}{s_2} = \frac{4}{s_3} \Rightarrow s_2 = -5.608
\]

For \(q' \rightarrow q''\):

\[
\frac{1.33}{10 + 5.608} = \frac{4}{s_3} \Rightarrow s_3 = -11.735
\]

\[
\Rightarrow \text{Apparent thickness} = 11.735 - 7.519 = 4.22 \text{ (cm)}
\]
6. PSE6 36.P.028. [318018] A contact lens is made of plastic with an index of refraction of 1.50. The lens has an outer radius of curvature of +2.05 cm and an inner radius of curvature of +2.45 cm. What is the focal length of the lens?

\[ f = 25.1 \text{ cm} \]

**Solution:**

\[
\frac{1}{f} = (n-1) \left( \frac{1}{R_1} - \frac{1}{R_2} \right) \\
= (1.50-1) \left( \frac{1}{2.05} - \frac{1}{2.45} \right)
\Rightarrow f = 25.1 \text{ cm}
\]