

1- A light ray initially in water enters a transparent substance at an angle of incidence of 37.0° , and the transmitted ray is refracted at an angle of 25.0° . Calculate the speed of light in the transparent substance.

2- A concave spherical mirror has a radius of curvature of 20.0 cm. Find the location of the image for object distances of (a) 40.0 cm, (b) 20.0 cm, and (c) 10.0 cm. For each case, state whether the image is real or virtual and upright or inverted. Find the magnification in each case.

① $\theta_1 = 37^\circ, \theta_2 = 25^\circ$
 n_1 For water = 1.33 $v = ?$
 $n_1 \sin \theta_1 = n_2 \sin \theta_2$
 $1.33 \sin(37^\circ) = n_2 \sin(25^\circ)$
 $n_2 = \frac{1.33 \sin(37^\circ)}{\sin(25^\circ)} = 1.89$
 $n_2 = \frac{c}{v} \rightarrow v = \frac{c}{n_2} = \frac{3 \times 10^8}{1.89} = 1.58 \times 10^8 \text{ m/s}$

② $R = 20 \text{ cm} \rightarrow f = \frac{R}{2} = \frac{20}{2} = 10 \text{ cm}, s'$

$$\frac{1}{s} + \frac{1}{s'} = \frac{1}{f} \rightarrow \frac{1}{s'} = \frac{1}{f} - \frac{1}{s}$$

a) $s = 40 \text{ cm}$

$$\frac{1}{s'} = \frac{1}{10} - \frac{1}{40} = \frac{3}{40}$$

$$s' = \frac{40}{3} = 13.3 \text{ cm}$$

$$M = -\frac{s'}{s} = -\frac{13.3}{40} = -0.33$$

(Real, inverted)

b) $s = 20 \text{ cm}$

$$\frac{1}{s'} = \frac{1}{10} - \frac{1}{20} = \frac{1}{20}$$

$$s' = 20 \text{ cm}$$

$$M = -\frac{20}{20} = -1$$

(Real, inverted)

c) $s = 10 \text{ cm}$

$$\frac{1}{s'} = \frac{1}{10} - \frac{1}{10} = \text{Zero}$$

$$s' = \frac{1}{\text{Zero}} = \infty$$

No image created (rays parallel)

$$M = -\frac{s'}{s} = \infty$$

$$f = +20 \text{ cm} \quad (\text{Converging})$$

3-. A converging lens has a focal length of 20.0 cm. Locate the image for object distances of (a) 40.0 cm, (b) 20.0 cm, and (c) 10.0 cm. For each case, state whether the image is real or virtual and upright or inverted. Find the magnification in each case.

$$\text{a) } s = 40 \text{ cm}$$

$$\frac{1}{s'} = \frac{1}{f} - \frac{1}{s} = \frac{1}{20} - \frac{1}{40} = \frac{1}{40}$$
$$s' = \boxed{40 \text{ cm}}$$

$$M = -\frac{s'}{s} = -\frac{40}{40} = \boxed{-1}$$

((Real , inverted))

$$\text{b) } 20 \text{ cm}$$

$$\frac{1}{s'} = \frac{1}{20} - \frac{1}{20} = 0$$

$$s' = \frac{1}{0} = \boxed{\infty}$$

$$M = \boxed{\infty}$$

No image is created

$$\text{c) } s = 10 \text{ cm}$$

$$\frac{1}{s'} = \frac{1}{20} - \frac{1}{10} = \frac{-1}{20}$$

$$s' = \boxed{-20 \text{ cm}}$$

$$M = \frac{-(-20)}{10} = \boxed{+2}$$

((virtual , upward))