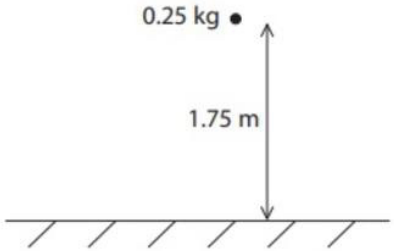
A ball has a mass of **0.25 Kg.** A student holds the ball at **1.75 m** above the ground.

a. State the equation linking the potential energy, mass and height.
b. Calculate the potential energy of the ball
c. The student let the ball fall. Calculate the K.E of the ball just before it hits the ground.
d. Another ball with the same mass has different K.E = 3.1 J. State the equation linking K.E, mass and Speed and calculate the speed of this ball.

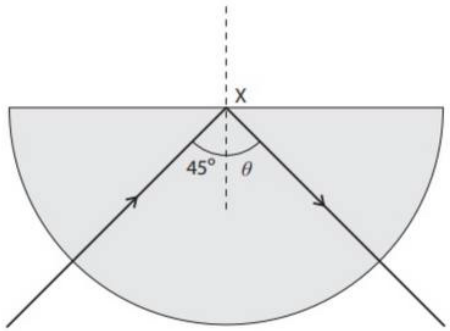


AL NOJOUM ACADEMY

حرشلا ةدهاشملا

The following diagram shows a light ray passing through the semicircular glass slab.

a. State the name of the **dotted line "X'** shown on the surface.
b. When the light ray hits the surface as shown in the figure, all of it reflected back inside. **What is the name of this process?**
c. **What is the angle labelled Θ?**

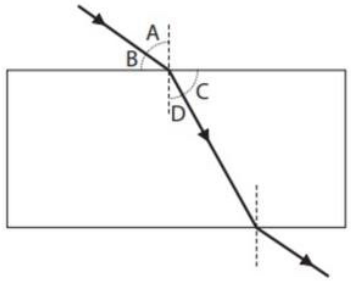


AL NOJOUM ACADEMY

حرشلا ةدهاشملا

A student plans to measures the refractive index of glass. He traces a ray light through the glass block as shown in the figure below.

a. Which letter represents the angle of refraction?
b. Explain how a student can use the glass block to find an accurate value for the refractive index of the glass block.



AL NOJOUM ACADEMY

Identify the row that contains two scalars and one vector quantity.

A	distance	acceleration	velocity
B	speed	mass	acceleration
C	distance	weight	force
D	speed	weight	acceleration
E	velocity	force	mass

- ○ A.
- ○ C.
- ○ B.
- ○ D.

AL NOJOUM ACADEMY

Chapter 2

REFLECTION AND REFRACTION OF LIGHT

Problems

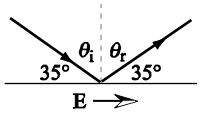
6.

Light rays from the Sun, which is at an angle of 35° above the western horizon, strike the still surface of a pond. (a) What is the angle of incidence of the Sun's rays on the pond? (b) What is the angle of reflection of the rays that leave the pond surface? (c) In what direction and at what angle from the pond surface are the reflected rays traveling?

Strategy The normal is perpendicular to the surface of the pond. Use the laws of reflection.

Solution

(a) The angle of incidence is $\theta_i = 90° - 35° = \boxed{55°}$.

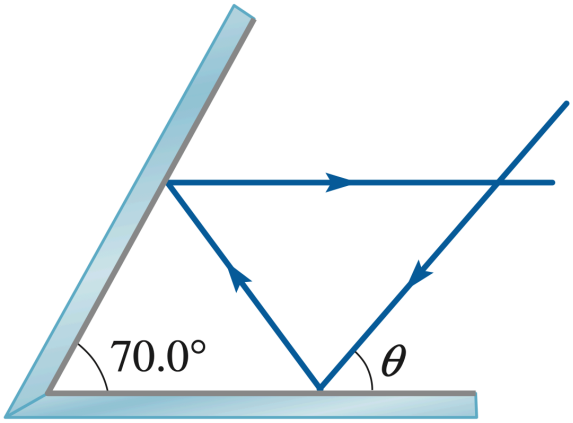


(b) The angle of reflection is $\theta_r = \theta_i = \boxed{55°}$.

(c) 55° from the normal is equivalent to 35° above the horizontal. The sun is above the western horizon. So, the reflected rays are traveling at an angle $\boxed{35° \text{ above the surface of the pond to the east}}$.

8.

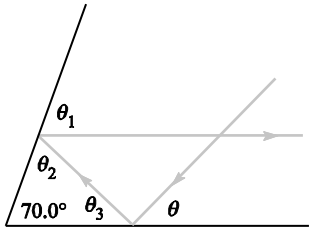
Two plane mirrors form a 70.0° angle as shown. For what angle θ is the final ray horizontal?



Strategy Redraw the figure, including any necessary angles. Use the laws of reflection.

Solution The final ray must be parallel to the base mirror, so θ_1 and the 70.0° angle are equal (corresponding angles). A consequence of the laws of reflection is that the base angles in a reflection must be equal, so $\theta_2 = \theta_1 = 70.0°$. Since the angles of a triangle add to 180°, we have $\theta_2 + \theta_3 + 70.0° = 70.0° + \theta_3 + 70.0° = 180°$, so $\theta_3 = 40.0°$.

Again, the base angles in a reflection must be equal, so $\theta = \theta_3 = \boxed{40.0°}$.



11.

Sunlight strikes the surface of a lake. A diver sees the Sun at an angle of 42.0° with respect to the vertical. What angle do the Sun's rays in air make with the vertical?

Strategy Use Snell's law, Eq. (23-4).

Solution Find the angle the Sun's rays in air make with the vertical.

$$n_i \sin\theta_i = n_t \sin\theta_t, \text{ so } \theta_i = \sin^{-1}\left(\frac{n_t}{n_i}\sin\theta_t\right) = \sin^{-1}\left(\frac{1.333}{1.000}\sin 42.0°\right) = \boxed{63.1°}.$$

16.

A glass lens has a scratch-resistant plastic coating on it. The speed of light in the glass is $0.67c$, and the speed of light in the coating is $0.80c$. A ray of light in the coating is incident on the plastic-glass boundary at an angle of 12.0° with respect to the normal. At what angle with respect to the normal is the ray transmitted into the glass?

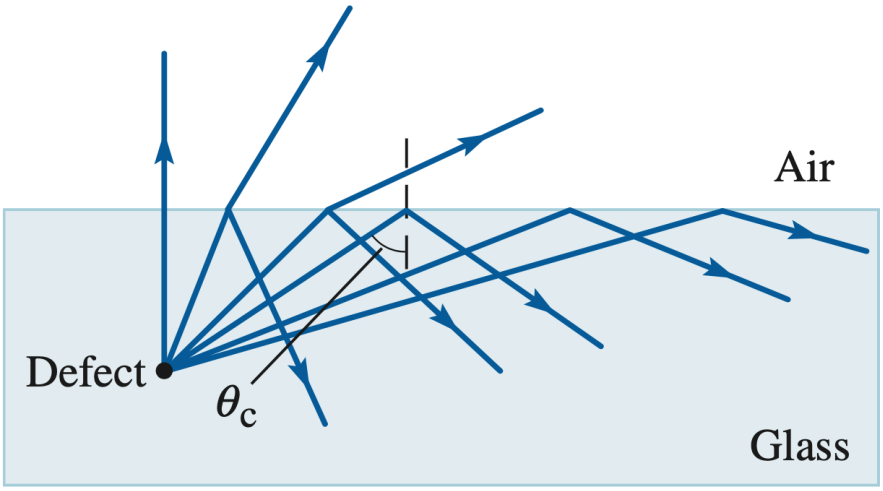
Strategy Use Snell's law. Let $\theta_2 = \theta_t$.

Solution Find the angle of the transmitted ray.

$$n_1 \sin\theta_1 = n_2 \sin\theta_2, \text{ so } \sin\theta_2 = \frac{n_1}{n_2}\sin\theta_1 = \frac{c/v_1}{c/v_2}\sin\theta_1 = \frac{v_2}{v_1}\sin\theta_1 \text{ and } \theta_2 = \sin^{-1}\left[\frac{0.67c}{0.80c}\sin 12.0°\right] = \boxed{10°}.$$

25.

The figure shows some light rays reflected from a small defect in the glass toward the surface of the glass. (a) If $\theta_c = 40.00°$, what is the index of refraction of the glass? (b) Is there any point above the glass at which a viewer would not be able to see the defect? Explain.



Strategy Total internal reflection occurs when the angle of incidence is greater than or equal to the critical angle. Use Eqs. (23-5).

Solution

(a) Find the index of refraction of the glass.

$$\theta_c = \sin^{-1}\frac{n_t}{n_i},\ \text{so}\ \sin\theta_c = \frac{n_t}{n_i}\ \text{and}\ n_i = \frac{1.000}{\sin 40.00°} = \boxed{1.556}.$$

(b) No; rays from the defect could reach all points above the glass since $\boxed{\text{for } 0 \le \theta_i \le \theta_c,\ 0 \le \theta_t \le 90°}$.

40.

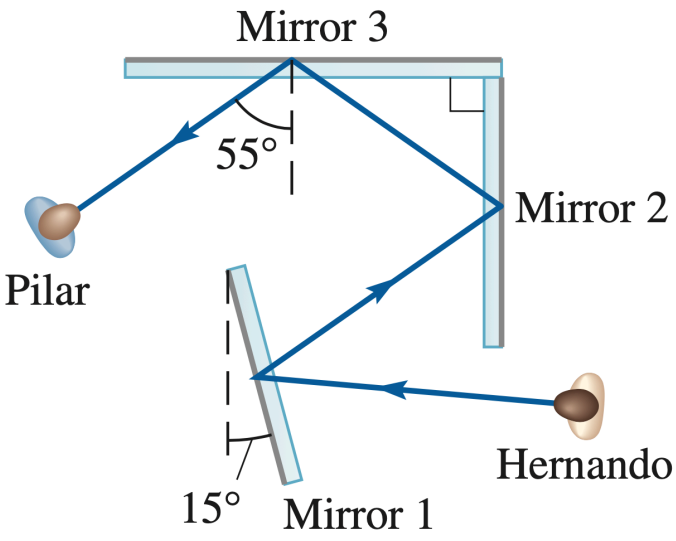
A rose in a vase is placed 0.250 m in front of a plane mirror. Nagar looks into the mirror from 2.00 m in front of it. How far away from Nagar is the image of the rose?

Strategy For a plane mirror, a point source and its image are at the same distance from the mirror (on opposite sides) and both lie on the same normal line.

Solution Since the rose is 0.250 m in front of the mirror, the image will be 0.250 m behind the mirror. If Nagar is looking straight into the mirror, the distance to the image will be the distance from Nagar to the mirror plus the distance from the mirror to the image. The distance from Nagar to the image is $2.00\text{ m} + 0.250\text{ m} = \boxed{2.25\text{ m}}$.

42.

In an amusement park maze with all the walls covered with mirrors, Pilar sees Hernando's reflection from a series of three mirrors. If the reflected angle from mirror 3 is 55° for the mirror arrangement shown in the figure, what is the angle of incidence on mirror 1?



Strategy The angle of incidence is equal to the angle of reflection. Work backward from the angle of reflection from Mirror 3.

Solution Find the angle of incidence on Mirror 1.
$\theta_{r3} = 55° = \theta_{i3}$ and Mirror 2 is perpendicular to Mirror 3, so $\theta_{r2} = 90° - 55° = 35° = \theta_{i2}$. Were Mirror 1 parallel to Mirror 2, the angles for Mirror 1 would be the same as those of Mirror 2, but Mirror 1 is 15° from being parallel to Mirror 2, so $\theta_{r1} = 35° - 15° = 20° = \theta_{i1}$. Thus, the angle of incidence on Mirror 1 is $\boxed{20°}$.

48.

In her job as a dental hygienist, Kathryn uses a concave mirror to see the back of her patient's teeth. When the mirror is 1.20 cm from a tooth, the image is upright and 3.00 times as large as the tooth. What are the focal length and radius of curvature of the mirror?

Strategy The object distance is $p = 1.20$ cm and the magnification is $m = 3.00$. Use the magnification and mirror equations. The focal length is half of the radius of curvature.

Solution Use the magnification equation to find the image distance.

$m = -\frac{q}{p}$, so $q = -mp$.

Find the focal length.

$$f = \left(\frac{1}{p} + \frac{1}{q}\right)^{-1} = \left(\frac{1}{p} + \frac{1}{-mp}\right)^{-1} = p\left(1 - \frac{1}{m}\right)^{-1} = (1.20 \text{ cm})\left(1 - \frac{1}{3.00}\right)^{-1} = \boxed{1.80 \text{ cm}}.$$

Compute the radius of curvature.

$f = \frac{1}{2}R$, so $R = 2f = 2(1.80 \text{ cm}) = \boxed{3.60 \text{ cm}}$.

57.

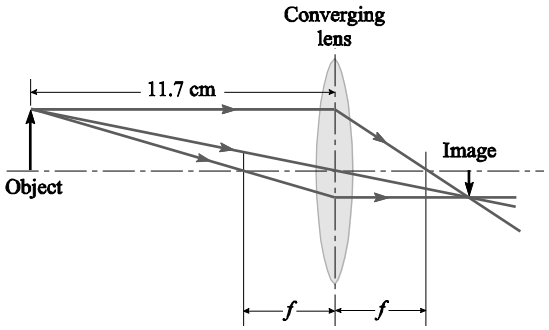
(a) For a converging lens with a focal length of 3.50 cm, find the object distance that will result in an inverted image with an image distance of 5.00 cm. Use a ray diagram to verify your calculations. (b) Is the image real or virtual? (c) What is the magnification?

(a)Strategy Use the thin lens equation to find the object distance. Then, draw the ray diagram.

Solution Find the object distance.

$\frac{1}{p}+\frac{1}{q}=\frac{1}{f}$, so $p=\frac{qf}{q-f}=\frac{(5.00\text{ cm})(3.50\text{ cm})}{5.00\text{ cm}-3.50\text{ cm}}=\boxed{11.7\text{ cm}}$.

The diagram is shown.



(b) Strategy and Solution Light rays actually pass through the image location, so the image is $\boxed{\text{real}}$.

(c) Strategy Use the magnification equation.

Solution Compute the magnification of the image.

$m=-\frac{q}{p}=-\frac{5.00\text{ cm}}{11.667\text{ cm}}=\boxed{-0.429}$

68.

In order to read his book, Stephen uses a pair of reading glasses. When he holds the book at a distance of 25 cm from his eyes, the glasses form an upright image a distance of 52 cm from his eyes. (a) Is this a converging or diverging lens? (b) What is the magnification of the lens? (c) What is the focal length of the lens?

(a)Strategy and Solution Light rays do not pass through the image location, since the image is on the same side of the lens as the object, so the image is virtual. The image is upright, as well. Therefore, the lens is a $\boxed{\text{converging}}$ lens.

(b) Strategy Since the image is virtual, the image position is negative. Use the magnification equation.

Solution Compute the magnification of the lens.

$m=-\frac{q}{p}=-\frac{-52\text{ cm}}{25\text{ cm}}=\boxed{2.1}$

(c) **Strategy** Use the thin lens equation.

Solution Find the focal length of the lens.

$$\frac{1}{p}+\frac{1}{q}=\frac{1}{f},\ \text{so}\ f=\left(\frac{1}{p}+\frac{1}{q}\right)^{-1}=\left(\frac{1}{25\ \text{cm}}+\frac{1}{-52\ \text{cm}}\right)^{-1}=\boxed{48\ \text{cm}}.$$

Which of these provides the best explanation for why the pencil appears broken?

1. The pencil absorbs the light rays that hit it.

2. Refraction of light (Light rays are bent by the water)

3. Water reflects light rays away from the pencil.

4. The surface of the water reflects the light rays.

PRACTICE # 5

LIGHT

- A light ray reflects from a surface. If the angle of incidence is 24°.

A. What is the angle between the reflected ray and the incident ray at the surface?

B. What is the angle that the reflected ray makes with the surface?

- A light ray in air strikes a glass surface with an agle of incidence of 30°. The angle of refraction in the glass is 20°.

A. What is the index of refraction of the glass?

B. What is the speed of light in the glass?

C. What is the angle between the reflected ray and the refracted ray?

- A light ray strikes the surface of sapphire (n=1.77) at angle of incidence of 40°.

What angle of refraction results?

- When a light ray in air enters glass with index of refraction 1.6, what is the greatest angle of refraction that can occur?

- What is the critical angle of diamond (n=2.42) in air?

- In a camera, the image focused on the film is:

A. Real and inverted

B. Real and upright

C. Virtual and inverted

D. Virtual and upright

- A convex mirror has a radius of 10 cm. what is its focal length?

- A mirror has a focal length -20 cm. If an object is placed 10 cm in front of the mirror, where will the image form?

- A 6 cm tall object is placed 20 cm in front of a convex mirror with focal length -100cm.

A. Where the image formed?

B. What is the size of the image formed?

- An object is placed 60 cm in front of a mirror and the image is upright and ¼ the size of the object.

What is the focal length of the mirror?

- A concave mirror has an object placed of 40 cm in front of it.

An image forms 60 cm in front of the mirror. What is the focal length of the mirror?

- A concave mirror has a 12 cm tall object placed 40 cm in front of the mirror. An image forms 60 cm in front of the mirror. What is the size and orientation of the image?

- Which of these statements is true for the image formed by a spherical mirror?

A. Real images are always inverted.

B. Virtual images of real objects are always in front of the mirror.

C. Virtual images of real objects are always upright.

D. Real images are always behind the mirror.

- Which of these statements is true for the image formed by an object placed in front of a thin lens?

A. Convex lenses never produce virtual images.

B. Real images are always enlarged.

C. Real images are always inverted.

D. Virtual images are always inverted.

- A thin lens of focal length −12.5 cm has a 5.0 cm tall object placed 10 cm in front of it. Where is the image located?

- Fiber optic cable is in the form of a cylindrical core of fiber with index of refraction 1.67 surrounded by a layer of cladding of index 1.45. What is the maximum angle for light rays inside the fiber core with respect to the cable's axis for which the light will be fully transmitted thanks to total internal reflection?

- An object placed closer to a converging lens than the focal point always produces an image that is

A. the same size as the object.

B. smaller than the object.

C. virtual.

D. inverted.

• The image of a real object formed by a diverging lens is always

A. real.

B. inverted.

C. larger than the object.

D. virtual.

Which of the following is demonstrated when light bounces off of mirrors or shiny surfaces?

1. reflection of light.
2. refraction of light.
3. interference of light
4. dispersion of light.

Curved mirrors with reflecing surface curved outwards are known as

1. convex mirrors
2. convave mirrors
3. plane mirrors
4. flate mirrors

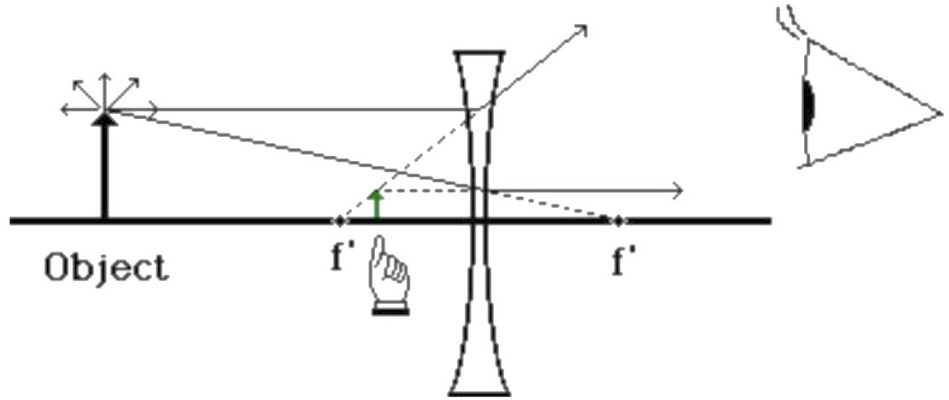
The distance between the centre of the mirror and focus is known as

1. focal length
2. principal axis
3. aperture
4. curvature

What type of lens is a Magnifying Glass ?

1. concave lens
2. convex lens
3. parabolic lens
4. plane lens

What type lens is this ?



1. convex lens
2. concave lens
3. parabolic lens
4. flat lens

Mirrors _____ light rays to make an image.

1. refract
2. diffuse
3. reflect
4. diffract

A convex mirror will always produce an image that is _____.

1. Virtual , upright , reduced
2. Real , upright , reduced
3. Virtual , upright , enlarged
4. Real , inverted , enlarged

If you are standing 4 feet from a flat mirror and looking into it , the image you see will be _____feet away from the mirror on the other side.

1. 8

2. 16

3. 2

4. 4

A flashlight and the lights in a car use a _____ mirror to creat a beam of light.

1. convex
2. Concave
3. high
4. flat