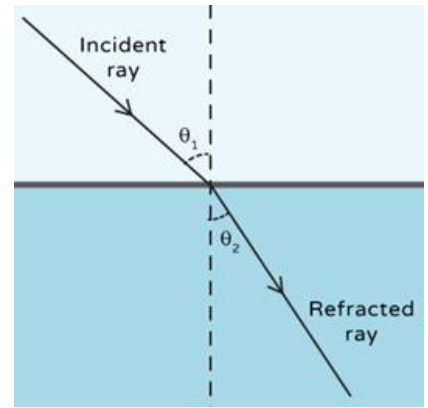


## Snell's Law & Refraction

$$n = \frac{c}{v} \quad n_1 \sin \theta_1 = n_2 \sin \theta_2$$



- 1) The refractive index of water is 1.33. Calculate the speed of light in water.
- 2) The refractive index of a mystery substance is measured to be 1.50. What is the speed of light in this substance?
- 3) The speed of light in quartz is  $2.05 \times 10^8$  m/s, while the speed of light in sapphire is  $1.69 \times 10^8$  m/s. Calculate the refractive indices of both quartz and sapphire and state which material bends light more?
- 4) Light travels from air into an unknown liquid and slows down to  $1.95 \times 10^8$  m/s. The refracted light then enters a block of glass ( $n=1.52$ ). Determine the refractive index of the unknown liquid and then calculate the speed of light in the glass.
- 5) Light travels from air ( $n=1.00$ ) into water ( $n=1.33$ ) at an angle of incidence of  $30^\circ$ . Draw a picture, then find the angle of refraction in the water.
- 6) A light ray in air strikes a block of acrylic ( $n=1.49$ ) at an angle of incidence of  $40^\circ$ . Draw a picture, then find the angle of refraction inside the acrylic.
- 7) A laser in water ( $n=1.33$ ) enters glass ( $n=1.50$ ) with a refracted angle of  $25^\circ$ . Find the angle of incidence in water.
- 8) Light enters an unknown material from air ( $n=1.00$ ) at  $35^\circ$  and refracts at  $21^\circ$ . Find the refractive index of the unknown material.
- 9) A light ray enters a glass prism ( $n=1.52$ ) at  $45^\circ$  from air ( $n=1.00$ ). Calculate the angle of refraction inside the prism.
- 10) A light beam moves from one medium into another. The angle of incidence is  $50^\circ$ , and the angle of refraction is  $30^\circ$ . If the first medium is air ( $n=1.00$ ), find the refractive index of the second medium.
- 11) A light ray passes from air into water ( $n=1.33$ ), then into a glass block ( $n=1.50$ ). If the initial angle in air is  $45^\circ$ , find the final angle in the glass.
- 12) The **critical angle** is the angle of incidence,  $\theta_1$ , beyond which light is completely reflected back into a medium rather than refracted into another medium. This occurs when light travels from a **denser** medium (higher refractive index) to a **less dense** medium (lower refractive index) and the refracted angle,  $\theta_2 = 90^\circ$ . What is the critical angle for light traveling from water ( $n=1.33$ ) to air ( $n=1.00$ )?
- 13) A laser beam inside a glass block ( $n=1.50$ ) is incident at an angle of  $42^\circ$  at the glass-air interface. What is the refracted angle? Will total internal reflection occur?

# Snell's Law & Refraction Lab

## Objective

To experimentally determine the **refractive index** of glass using **Snell's Law** and then calculate the **speed of light in glass**.

## Materials

- Laser pointer
- Rectangular glass block
- Protractor

## Procedure

1. Place the glass block on a sheet of paper and trace its outline.
2. Shine the **laser** at an **angle** into one side of the glass block.
3. Mark the **incoming** and **refracted** laser beam paths on the paper.
4. Use a **protractor** to measure:
  - $\theta_1$  = angle of incidence in **air**
  - $\theta_2$  = angle of refraction in **glass**
5. Record at least **three** different sets of angles and calculate the refractive index using **Snell's Law**.
6. Calculate the **average refractive index** of glass.

## Data Table

	$\theta_1$	$\theta_2$	$n_2 = \frac{\sin \theta_1}{\sin \theta_2}$
<b>Trial 1</b>			
<b>Trial 2</b>			
<b>Trial 3</b>			
<b>Experimental Average:</b>			

7. Calculate the **speed of light in glass** using  $n = \frac{c}{v}$
8. The theoretical value of the refractive index is 1.50. Calculate the percentage error  $\frac{\text{Theoretical} - \text{Experimental}}{\text{Theoretical}} \cdot 100\%$ . How does your result compare with the theoretical value?