**Optics Lab**

**Experiment No. (1)**

**Determination of the Refractive Index of Glass Using Snell's Law**

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## Purpose of the Experiment:

1. Measure the refractive index of glass.

2. Understand the relationship between the angles of incidence and refraction according to Snell's Law.

3. Study the behavior of light as it transitions between media with different optical densities.

## Apparatus Used:

1. Protractor for measuring angles.
2. Laser light source or monochromatic light beam.
3. Glass piece (glass plate or prism).
4. White paper to trace the light beam’s path.
5. Light beam stabilizer or holder.
6. Pencil and ruler for drawing and measuring paths.

## Theory (Detailed Explanation):

### Refraction Phenomenon:

When light travels from one transparent medium to another (e.g., air to glass), its speed changes due to the difference in optical density, causing the light to bend at the interface between the two media. This bending of light is called refraction.

### Snell's Law:

Snell's Law mathematically describes the relationship between the angles of incidence and refraction and the refractive indices of the two media:

n1 sin(θ1) = n2 sin(θ2)

Where:
- n1: Refractive index of the first medium (air, typically n1 = 1).
- n2: Refractive index of the second medium (glass).
- θ1: Angle of incidence, measured between the incident ray and the normal to the surface.
- θ2: Angle of refraction, measured between the refracted ray and the normal.

### Refractive Index:

The refractive index n is defined as the ratio of the speed of light in a vacuum (c) to its speed in a given medium (v):
n = c/v
The greater the refractive index, the slower the light travels in the medium and the greater the bending of light at the interface.

### Practical Application:

By measuring the angles of incidence (θ1) and refraction (θ2) for light passing through the glass, the refractive index of the glass can be calculated using:
n2 = sin(θ1) / sin(θ2)

### Factors Affecting Refraction:

1. Wavelength of Light: Red light bends less than blue light due to its longer wavelength.
2. Temperature: Changes in temperature can alter the density of glass and its refractive index.
3. Material Purity: Impurities or irregularities in the glass can slightly affect its refractive index.

## Procedure:

1. Setup:
- Place the glass piece on a sheet of white paper on a flat surface.
- Stabilize the light source to produce a precise beam.

2. Measure the Angle of Incidence:
- Direct the light beam onto the glass surface at a specific angle (θ1) measured using the protractor.
- Mark the point of incidence and draw the incident ray’s path on the paper.

3. Measure the Angle of Refraction:
- Observe the refracted beam inside the glass and mark its exit point.
- Draw the refracted ray’s path and measure the angle of refraction (θ2) using the protractor.

4. Record the results in the table as show below
5.Calculate the Refractive Index:
- Repeat the experiment for different angles of incidence

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Sin θ2** | **Sin θ1** | **θ2** | **θ1** |  |
|  |  |  | **10** | **1** |
|  |  |  | **20** | **2** |
|  |  |  | **30** | **3** |
|  |  |  | **40** | **4** |
|  |  |  | **50** | **5** |
|  |  |  | **60** | **6** |

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5. Analyze the results graphically to find the refractive index from the slope.

**Sin θ2**

**Sin θ1**

\* n2 = $\frac{1}{Slope}$

## Observations:

1. Ensure the glass surface is clean and free of scratches.
2. Use a precise light source (e.g., laser) for accurate beam tracing.
3. Measure all angles carefully to minimize errors.

## Results:

1. A table recording the angles of incidence (θ1), angles of refraction (θ2), and the calculated refractive indices.
2. A consistent refractive index value for the glass, along with an analysis of any deviations.

## Discussion Questions:

1. What is the importance of Snell’s Law in understanding refraction?
2. How does the wavelength of light affect the refractive index?
3. Why does the frequency of light remain constant during refraction?
4. What could cause errors in calculating the refractive index?
5. How can the accuracy of the measurements in this experiment be improved?
6. What are the practical applications of Snell's Law in everyday life?
7. How does a change in temperature affect the refractive index of glass?