Lab 6S

# Index Of Refraction of Solids and Liquids

(Physics 7, Experiment #6)

**Objective:**

To determine the index of refraction of some transparent solids and liquids.

**Foreword:**

A beam of light from a source changes its direction as it hits obliquely the surface of water or any transparent material. It bends at the point where it enters the air-water surface, the interface between the two media. This changing of direction as the beam passes from one medium into another is called refraction, and the beam is said to be refracted. The incoming or incident beam and the refracted beam lie in the same plane normal to the interface. It will be noted that the angle which the beam in air makes with this perpendicular line is greater than the angle which the beam in water makes with the same line. It will be observed too that changing the angle ($\theta_A$) in air automatically changes the angle ($\theta_W$) in water and that for $\theta_W$.

Snell and Descartes discovered that the ratio of the lines of the angle is constant for the passage of light between two given substances such as air and water, i.e.

$$n' = \text{Sin } \theta_A / \text{Sin } \theta_W = \text{constant}$$

Snell's law is generally written as

$$n' / n = \text{Sin } \theta / \text{Sin } \theta'$$

Where n' is the index of refraction of the first medium;
n is the index of refraction of the second medium;
$\theta$ is the angle which the beam in the first medium makes with the normal (angle of incident); and
$\theta'$ is the angle which the beam in the second medium makes with the normal(angle of refraction).

**Apparatus**

Glass block
Water
Bond paper
Pencil
Pins
Glycerin
Protractor
Semicircular dish

**Procedure**

**Step 1:** Place block of glass in the center of a sheet of unruled paper, mark around the glass with a pencil.

**Step 2:** Draw a line OA 45° with one edge of the glass. Set 2 pins $P_1$ and $P_2$ about 5 cm apart on this line. Look through the opposite side of the block and with a third pin; locate a position $P_3$ such that no. 1, no. 2, and no. 3 appear to be exactly in line. Find a fourth position P4 so that pin no. 4 appears to be aligned with the first three pins.

**Step 3:** Remove the block from the paper and draw straight lines joining the pin mark on

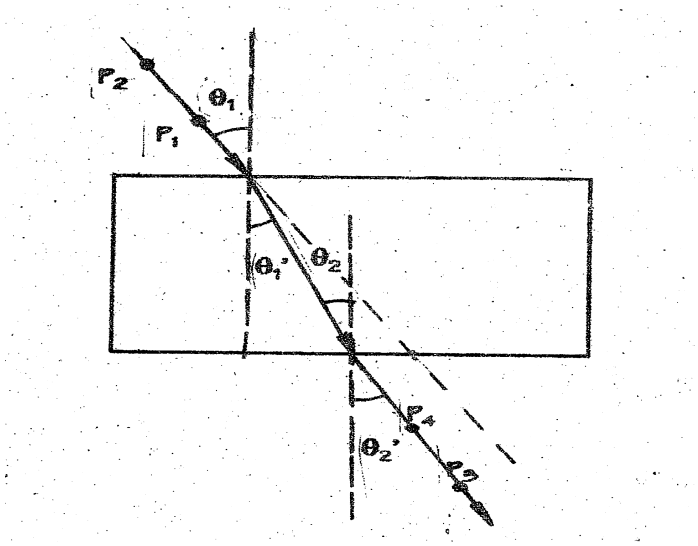
the paper. Draw also a line normal to the air-glass interface on either side of the block. Measure angle in air and θ' in glass at each interface.

**Step 4:** Repeat STEPS 1, 2, and 3 for two more trials.

**Step 5:** Repeat the procedure using semicircular dish with transparent liquid in it.

**Step 6:** Try STEP 5 using other kinds of liquid.

**Diagram:**




**Data:**

| Material | Glass Block | | Water (Semicircular Dish) | | Glycerin (Semicircular Dish) | |
|---|---|---|---|---|---|---|
| Trial | 1 | 2 | 1 | 2 | 1 | 2 |
| $\theta_1$ | | | | | | |
| $\theta_1$' | | | | | | |
| $\theta_2$ | | | | | | |
| $\theta_2$' | | | | | | |
| $n_1$ | | | | | | |
| $n_2$ | | | | | | |

Ave. $n_2$ = _____

**Name of Student:** _____

**Date Performed:** _____

**Instructor's Initial:** _____

**Question**

1) From the results, how does $\theta_1$ compare with $\theta_1$'? $\theta_2$ and $\theta_2$'? What conclusions can you draw regarding the direction of the incident ray upon the first surface and that of the refracted ray as it emerges from the second surface?