

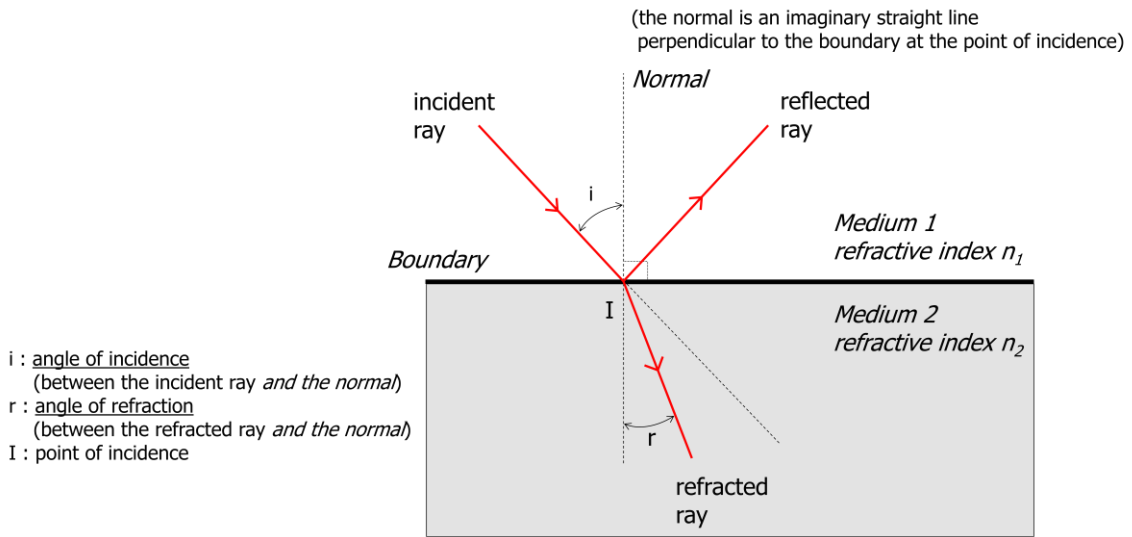
**LAB WORK 3 REFRACTION OF LIGHT**

**1. The refraction phenomenon**

see experiments from Lab Work 2 Dispersion of light (laser light passing from the air into the water of a fish tank or a coin in an opaque container becoming visible as water is poured in the container):

**Refraction is the abrupt change in direction of light as it crosses the boundary between two transparent media.**

**2. Diagram and vocabulary**



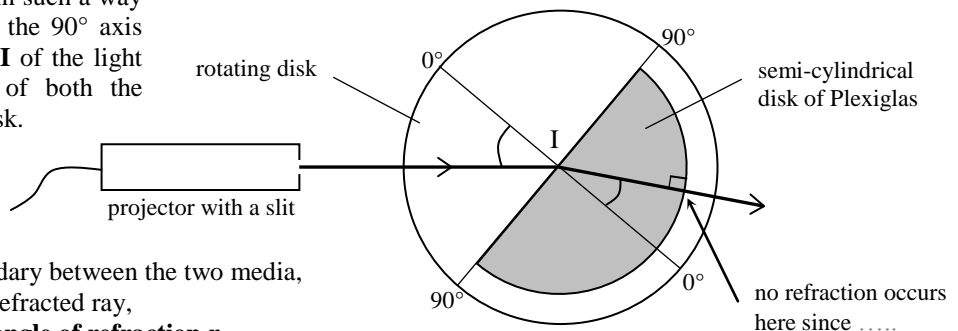
**3. Law of refraction**

**3.1. Aim**

The aim of that part is to find a relationship (called law of refraction) between the **angle of incidence  $i$**  and the **angle of refraction  $r$** .

**3.2. Experimental setup**

Place the semi-disk of Plexiglas in such a way that its flat side is aligned with the  $90^\circ$  axis and that the **point of incidence I** of the light beam meets the exact centre of both the rotating disk and the Plexiglas disk.



Indicate on the diagram the boundary between the two media, the normal, the incident ray, the refracted ray, the **angle of incidence  $i$**  and the **angle of refraction  $r$** .

In which medium does the incident ray travel? .....  
 In which medium does the refracted ray travel? .....  
 How does the ray of light travel in each medium? .....

Draw on the diagram the ray of light travelling through the Plexiglas in the case where **the incident ray is perpendicular to the boundary**.  
 What is the value of  $i$ ? ..... What is the value of  $r$ ? .....

Conclusion:

**3.3. Measurements**

For each value of  $i$ , measure the corresponding angle  $r$  and record its value in the table.

$i$ ( $^\circ$ )	0	10.0	20.0	30.0	40.0	50.0	60.0	70.0	80.0
$r$ ( $^\circ$ )									
$\sin i$									
$\sin r$									
$\frac{\sin i}{\sin r}$									

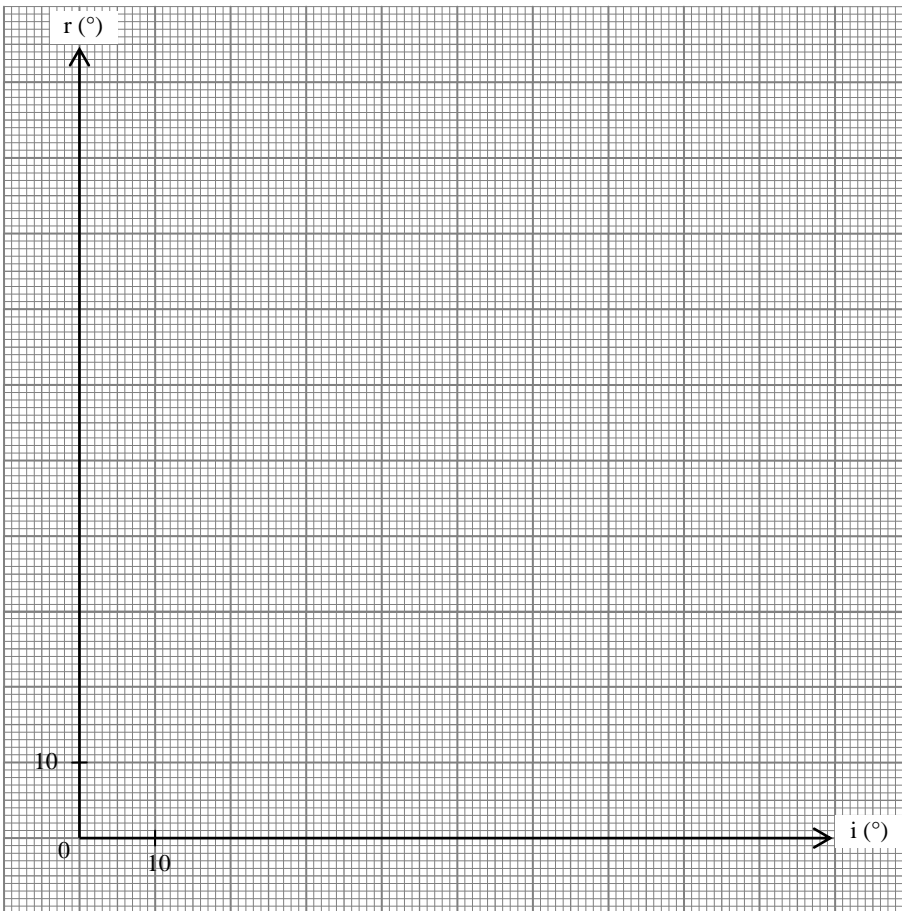
**3.4. Investigating the law of refraction**

Plot a graph of  $r$  (y-axis) against  $i$  (x-axis).  
What kind of graph do you obtain?

Can you say that the angle of incidence and the angle of refraction are proportional? Why?



**Johannes Kepler**  
(German physicist, 1571-1630) suggested that the angle of refraction is proportional to the angle of incidence for small angles.  
What do you think of that?



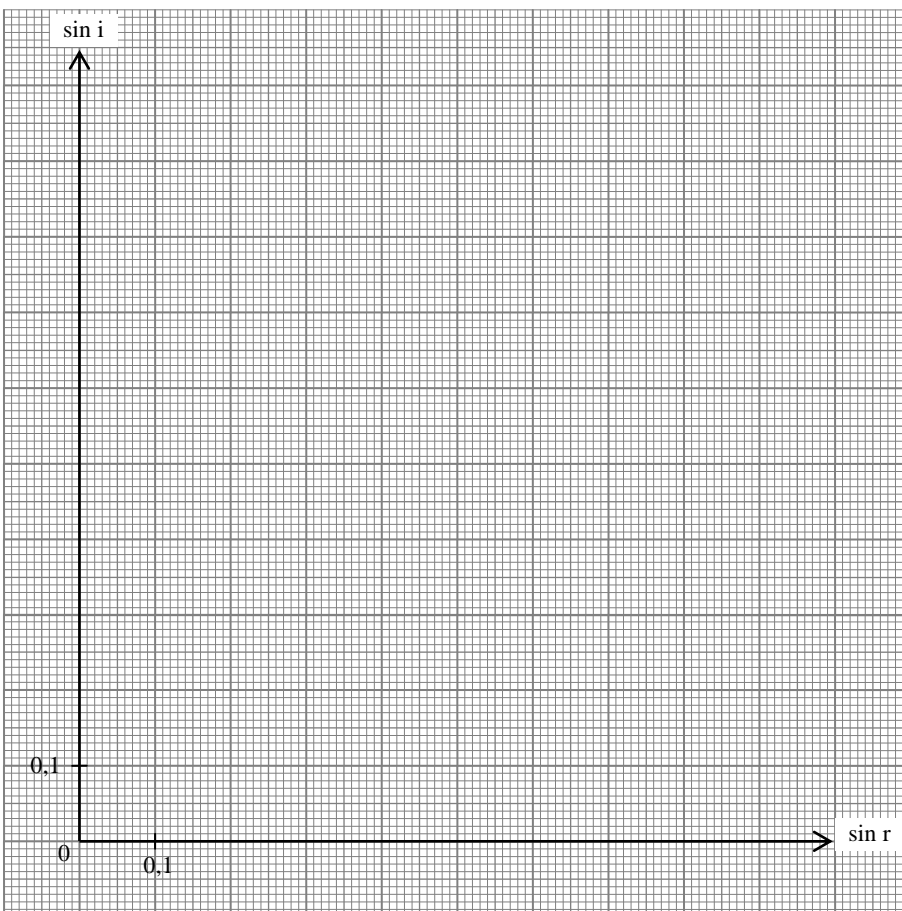
.....  
.....  
.....

Complete the table: calculate the sine of each angle of incidence, the sine of each angle of refraction and the ratio of  $\sin i$  to  $\sin r$  ( $\frac{\sin i}{\sin r}$ ).  
Give all the results rounded to 3 significant figures.



**René Descartes**  
(French philosopher, mathematician and physicist, 1596-1650) suggested that the ratio  $\frac{\sin i}{\sin r}$  is constant whatever the value of the angle  $i$ .  
What do you think of that?

Plot a graph of  $\sin i$  (y-axis) against  $\sin r$  (x-axis).  
What kind of graph do you obtain?  
What does it mean?



.....  
.....

According to Snell's law (or Descartes' law):  $n_1 \sin i = n_2 \sin r$  where  $n_1$  is the refractive index of the first medium and  $n_2$  of the second. Knowing that the refractive index of air is equal to 1, deduce a relationship between  $\sin i$ ,  $\sin r$  and the refractive index Plexiglas. ....

Is it in accordance with your graph of  $\sin i$  against  $\sin r$ ? Use your graph to determine the refractive index of Plexiglas.

**3.5. Conclusion:** what is the law of refraction?