

## Aim

To trace the path of a ray of light passing through a rectangular glass slab for different angles of incidence. Measure the angle of incidence, angle of refraction, angle of emergence, and interpret the result.

## Theory

### What are laws of refraction?

Following are the laws of refraction:

- The incident ray, the normal ray, and the refracted ray, all lie in the same plane.
- Snell's law: The law states that the ratio of the sine of an angle of incidence to the sine of the angle of refraction is constant.

$$\sin i / \sin r = \text{constant}$$

### What is refraction of light?

The refraction of light is a property of light in which the light changes its path when it passes from one medium to the other.

### What is lateral displacement?

Lateral displacement is defined as the perpendicular shift in the path of light when it emerges out from the refracting medium.

## Materials Required

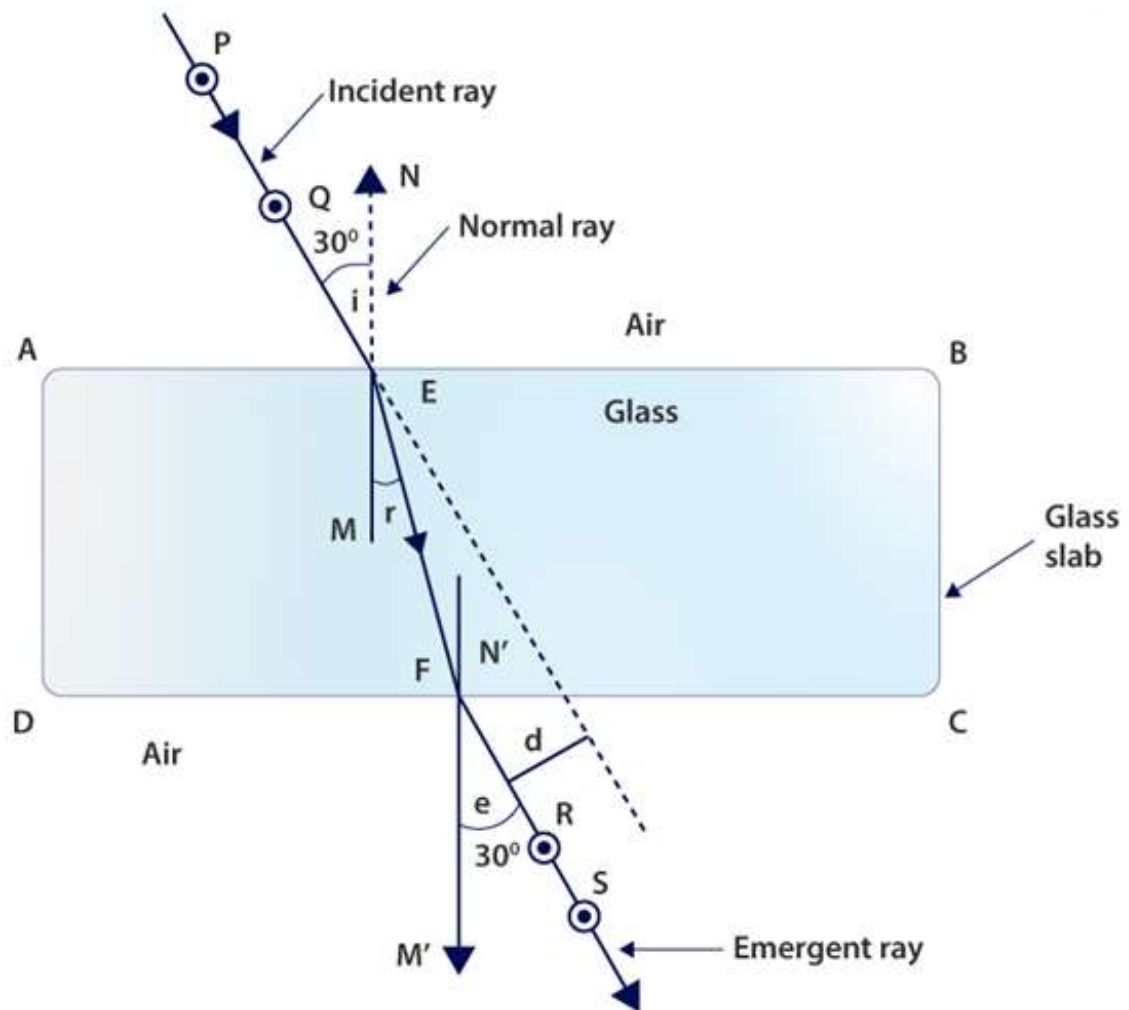
1. A drawing board
2. 4-6 all pins
3. White sheet of paper
4. Rectangular glass slab
5. A protractor
6. A scale
7. A pencil
8. Thumb pins

## Procedure

1. Fix a white sheet on the soft drawing board using thumb pins.
2. Using a sharp pencil, draw the outline boundary of the glass slab, place it at the of the white paper.
3. Let ABCD be the rectangular figure obtained by drawing.
4. Mark point E on AB and draw a perpendicular EN and label it as a normal ray.
5. Draw one angle of 30° with the help of protractor with EN. Fix pins at P and Q at 4-5 cm on the ray that is obtained by the angle.
6. Place the glass slab on the rectangular figure ABCD.
7. To fix R and S, see through the glass slab of side CD, such that when seen through the glass slab, all the pins P, Q, R, and S should lie in a straight line.

8. Draw a small circle around the pins P, Q, R, and S and remove the pins.
9. Remove the glass slab.
10. Join points R and S such that it meets CD at point F. Draw a perpendicular  $N'M'$  to CD at point F.
11. Using a pencil, join the points E and F.
12. Measure the angles formed at AB and CD, i.e, the incident angle, refracted angle, and emergent angle.
13. The lateral displacement is obtained by extending the ray PQ in a dotted line which is parallel ray to FRS.
14. Measure the lateral displacement.
15. Repeat the same procedure for angle  $45^\circ$  and  $60^\circ$ .

## Ray Diagram



Refraction of light through a rectangular glass slab

## Observation Table

Sl.no	Angle of incidence $\angle i = \angle PEN$	Angle of refraction $\angle r = \angle MEF$	Angle of emergence $\angle e = \angle SFM'$	$\angle i - \angle e$ $\angle PEN - \angle SFM'$
1	30°	28°	30°	0°
2	45°	43°	44.8°	0.2°
3	60°	56°	59.8°	0.2°

Due to human error the value of  $\angle i - \angle e$  may not be equal to zero.

## Conclusion

1. The angle of incidence and the angle of emergence are almost equal.
2. As the light is traveling from rarer to denser optical medium, the angle of refraction will be lesser than the angle of incidence.
3. For different angles of incidence, the lateral displacement will remain the same.
4. The light will bend towards the normal when it travels from an optically rarer medium to an optically denser medium.

## Precautions

1. The rectangular glass slab used should have perfectly smooth faces.
2. The drawing board should be soft so that pins can be easily fixed on it.
3. The angle of incidence should lie between 30° and 60°.
4. All pins base should be in a straight line.
5. The distance between the pins P and Q or the pins R and S, a minimum 5 cm gap should be maintained.
6. Using a sharp pencil, draw thin lines.
7. The quality of the protractor should be good.
8. The placement of the protractor should be correct to get correct measurements.
9. The perpendiculars should be drawn with care.

## Sources of Error

1. There shouldn't be any air bubbles in the glass slab.
2. The measurements done by the protractor should be accurate.