

O P JINDAL SCHOOL, SAVITRINAGAR

CLASS NOTES

CLASS XII PHYSICS PRACTICAL (EXPERIMENT-05)

DATE : 15/05/20

Aim

To determine angle of minimum deviation for a given prism by plotting a graph between angle of incidence and angle of deviation.

Materials Required

- A drawing board
- A white sheet of paper
- A prism
- Drawing pins
- Pencil
- A half-metre scale
- Office pins
- Protractor
- Graph paper

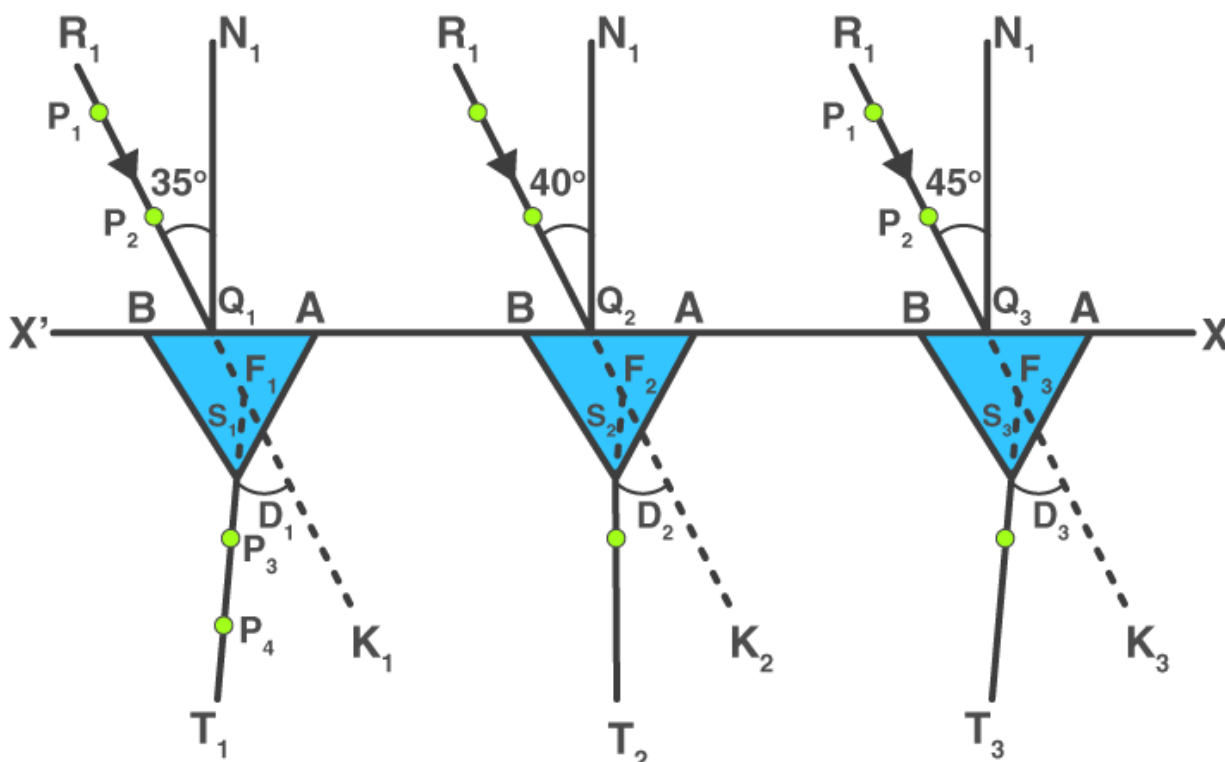
Theory

Refraction takes place when a light ray travels from one medium to another resulting in deviation of the emergent ray from that of the incident ray. Following is the refractive index of the material used in the prism:

$$\mu = \frac{\sin(A + D_m)}{\sin A}$$

Where D_m is the angle of minimum deviation and A is the angle of the prism.

Ray Diagram



Procedure

1. Place the white sheet of paper on the drawing board and fix it with the help of drawing pins.
2. XX' is the straight line which is drawn parallel to the length of the paper such that it is in the middle of the paper.
3. Mark points Q_1, Q_2, Q_3, \dots on the straight line XX' at a distance of 5 cm each.
4. N_1Q_1, N_2Q_2, \dots are the normals that are drawn on the points Q_1, Q_2, \dots as shown in the ray diagram.
5. Make angles of $35^\circ, 40^\circ, \dots, 60^\circ$ by drawing straight lines R_1Q_1, R_2Q_2, \dots . With respect to the normals.
6. To take one edge of the prism for all the observation, mark any corner of the prism as A.
7. Place the prism with its refracting face AB on the line XX' and on the point Q_1 and also in the middle of AB.
8. Mark the boundary of the prism.
9. On the line, R_1Q_1 , fix office pins vertically and mark them as P_1 and P_2 . the distance between these pins should not be less than 10mm.
10. Through prism face, AC, look for the images of the points P_1 and P_2 .
11. Close your left eye and with the right eye open bring it in line with the two images.
12. Fix the other two office pins vertically and name them as P_3 and P_4 . These pins should be 10cm apart from each other. P_3 and P_4 should be in one straight with respect to the images of P_1 and P_2 .
13. Encircle the pricks of pins P_3 and P_4 .
14. For points, Q_2, Q_3, \dots for angle $40^\circ, 45^\circ, \dots, 60^\circ$, repeat the steps 7 to 13.

To measure D in a different case

1. To get emergent rays S_1T_1, S_2T_2, \dots draw straight lines through P_3 and P_4 .
2. Inward the boundary of the prism to produce T_1S_1, T_2S_2, \dots so that they meet incident rays R_1Q_1, R_2Q_2, \dots at points F_1, F_2, \dots
3. To obtain the angle of deviation D_1, D_2, \dots measure the angles $K_1F_1S_1, K_2F_2S_2, \dots$
4. Note these angles.

To measure angle A

1. To get angle A, measure the angle BAC in the boundary of the prism.
2. Record the observations.

Observations

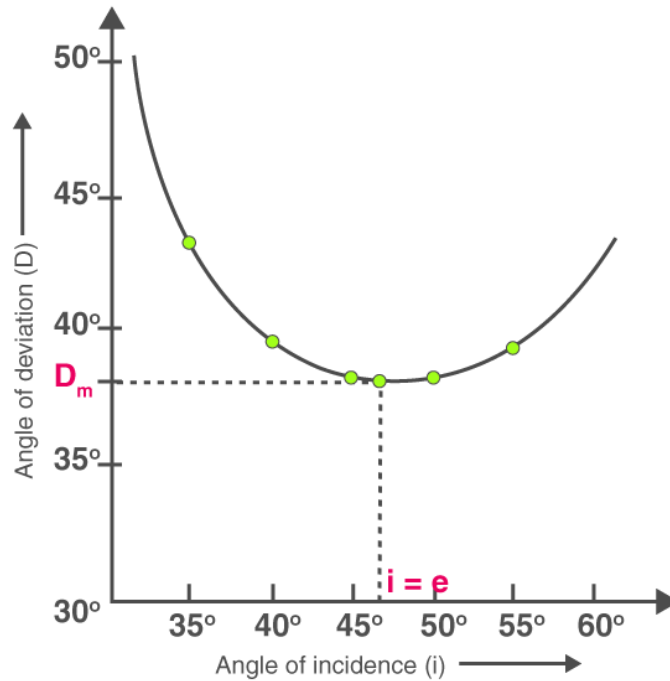
The angle of prism, $A = \dots$

| Serial no. | Angle of incidence $\angle i$ | Angle of deviation $\angle D$ |
|------------|-------------------------------|-------------------------------|
| 1 | 35° | |
| 2 | 40° | |
| 3 | 45° | |
| 4 | 50° | |
| 5 | 55° | |
| 6 | 60° | |

Calculations

To plot the graph between the angle of incidence $\angle i$ and the angle of deviation $\angle D$, take $\angle i$ along the x-axis and $\angle D$ along the y-axis. Minimum deviation D_m can be found from the graph which would be corresponding to the lowest point in the graph.

Graph between i and D



Let the value of angle of minimum deviation, $D_m = \dots$

Then, $n = \frac{\sin(A + D_m/2)}{\sin(A/2)}$

Result

- The angle of minimum deviation, $D_m = \dots$
- Refractive index of the material of the prism, $n = \dots$
- The graph indicates that the angle of incidence increases, the angle of deviation first decreases to attain the minimum value of D_m and then increases as the angle of incidence increases.

Precautions

- 35° - 60° is the angle of incidence that needs to be maintained.
- The placement of the pins must be vertical.
- The placement of two pins should be such that the distance is not more than 10mm.
- To represent incident and emergent rays, arrowheads must be marked.
- The angle of prism used should be the same for all the observations.

Sources of Error

- The pricks made by the pins might be thick.
- Angles might go wrong while measuring them.