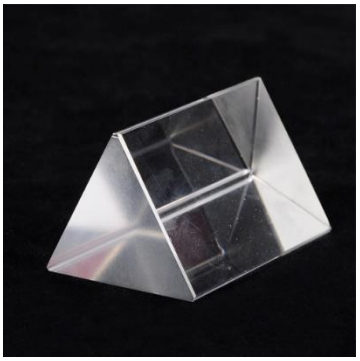
AIM

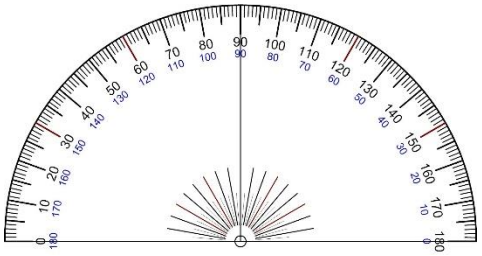
To determine angle of minimum deviation for a given prism by plotting a graph between angle of incidence and the angle of deviation.

APPARATUS AND MATERIAL REQUIRED

Drawing Board

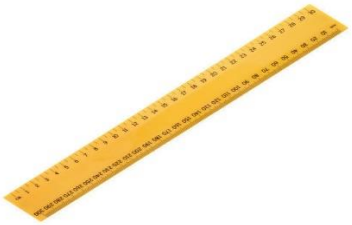


Triangular Glass Prism

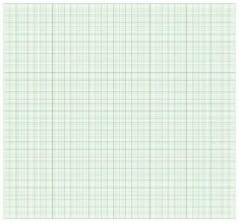


Protractor

Alpins And Drawing Pins



Metre Scale



Graph Paper And White Paper Sheets

THEORY

- A triangular prism has three rectangular lateral surfaces and two triangular bases.

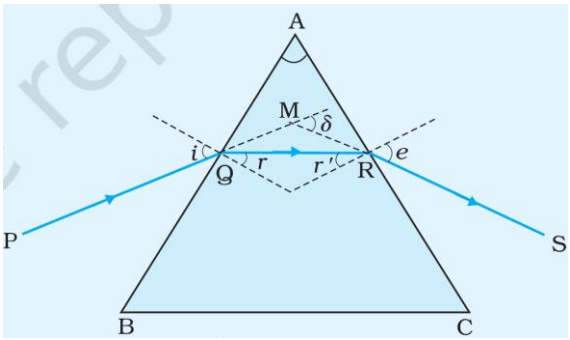
  PQ – incident ray

  QR – refracted ray

  RS – emergent ray

  i – angle of incidence r, r' – angle of refraction

  e – angle of emergence δ – angle of deviation



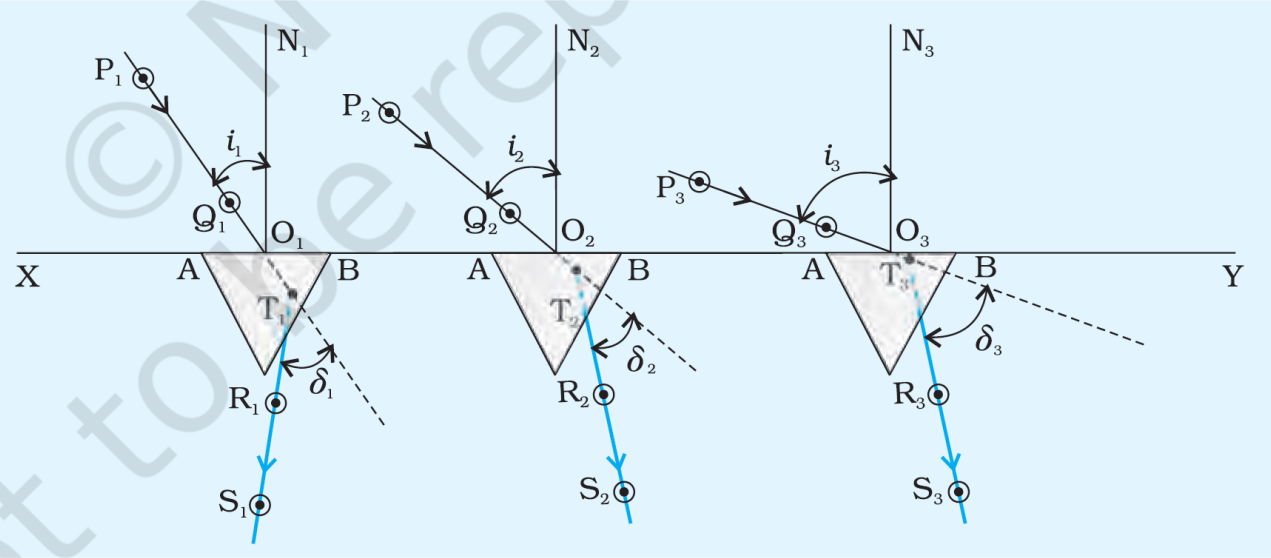
- $\delta = i + e - A$

  For $\delta = \delta_m$, $i = e$

NOTE: The advantage of putting the prism in minimum deviation position is that the image is brightest in this position.

PROCEDURE

1. Fix a white sheet of paper on a drawing board with the help of drawing pins.
2. Draw a straight line XY, using a sharp pencil nearly in the middle and parallel to the length of the paper.
3. Mark points O_1, O_2, O_3, ... on the straight line XY at suitable distances of about 8 to 10 cm and draw normals N_1O_1, N_2O_2, N_3O_3. . . . on these points.



4. Draw straight lines, P_1O_1, P_2O_2, P_3O_3, . . . corresponding to the incident rays making angles of incidence at 35°, 40°, 45°, 50°, … 60° respectively with the normals, using a protractor. Write the values of the angles $\angle P_1O_1N_1$, $\angle P_2O_2N_2$, $\angle P_3O_3N_3$, … on the white paper sheet.
5. Place the prism with its refracting face AB on the line XY with point O_1 in the middle of AB as shown in the figure. Draw the boundary of the prism with a sharp pencil.
6. Fix two alpins P_1 and Q_1 with sharp tips vertically about 10 cm apart; on the incident ray line P_1Q_1 such that pin Q_1 is close to point O_1. Close one eye (say left) and looking through the prism, bring your right eye in line with the images of the pins P_1 and Q_1. Fix alpins R_1 and S_1 about 10 cm apart vertically on the white paper sheet with their tips in line with the tips of the images of pins P_1 and Q_1. In this way pins R_1 and S_1 will become collinear, with the images of pins P_1 and Q_1.
7. Remove the pins R_1 and S_1 and encircle their pin-pricks on the white paper sheet with the help of a sharp pencil. Remove the pins P_1 and Q_1 and encircle their pin pricks also.
8. Join the points (or pin pricks) R_1 and S_1 with the help of a sharp pencil and scale, to obtain the emergent ray R_1S_1. Produce it backwards to meet the incident ray P_1Q_1 (produced forward) at T_1. Draw arrowheads on P_1Q_1 and R_1S_1 to show the direction of the rays.
9. Measure the angle of deviation δ_l and the angle BAC (angle A) of the prism 1) with a protractor and write the values of these angles indicated in the diagram.

10. Repeat steps 5 to 9 for different values of angle of incidence (40°, 45°, 50°...) & measure corresponding angles of deviation with the protractor, and indicate them in the respective diagrams.
11. Record observations in tabular form with proper units and significant figures.

❖ https://youtu.be/UXp3GVtSTJA / https://youtu.be/AMjCrwoA77A

OBSERVATIONS

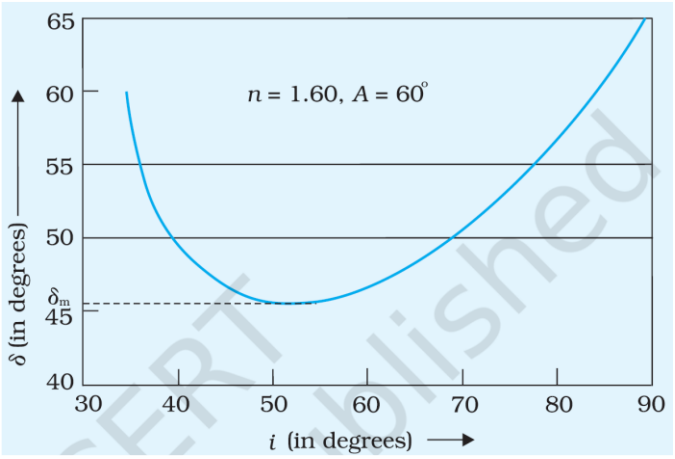
Least count of the protractor = ... (degree)

Angle of the prism, *A* = ... (degree)

S.No.	Angle of incidence *i (degree)*	Angle of deviation *δ (degree)*
1.		
2.		
3.		
4.		
5.		

Plotting the graph between i and d *for the prism*

- Take angle of incidence *i* along x-axis and angle of deviation d along y-axis, using the observed values from Table.
- Choose suitable scales on these axes and plot a graph between *i* and δ.
- Take care that you draw a free hand smooth curve passing practically through all the plotted points on the graph.



CALCULATIONS

Draw tangent on the lowest point of the graph parallel to x-axis, read the angle of minimum deviation δ_m on the y-axis of the graph. Express the result with proper significant figures.

RESULT

Angle of minimum deviation, $\delta_m = \ldots\ldots\ldots \pm \ldots\ldots$degree

PRECAUTIONS [TWO ONLY]

1. Alpins should be fixed vertically to the plane of paper.
2. Distance PQ & RS should be about 10 cm in order to locate incident & emergent rays with greater accuracy.
3. Same angle of prism should be used for all observations.
4. Position of the prism should not be disturbed for a given set of observations.

SOURCES OF ERROR

1. If the three angles of refraction between adjacent pairs of faces are not equal, then $A+\delta \neq i+e$.
2. There may be an error in measuring the values of the angles.

DISCUSSION

1. It is suggested that the value of angle of incidence be taken more than 35°. This is required for angles less than 35° as there is a possibility of total internal reflection inside the prism.
2. You must check your readings by applying the formula $i+e=A+\delta$
3. The $i-\delta$ curve that is obtained in this experiment is a non-linear curve. In such situations, more readings should be taken in the minimum deviation region to be able to obtain the value of angle of minimum deviation accurately. For example, if d readings are taken initially at 35°, 40°, 45° and 50° and if the $i-\delta$ data points are situated as shown in Fig. then a few more readings need to be taken for values of i in the range 45° to 55° say, at a difference of 1° or 2°. Taking more readings in this region will help in drawing a smooth curve. This will enable you to locate the position of the lowest point on the graph more accurately.
4. In the condition of minimum deviation, the refracted ray inside the prism becomes parallel to its base so as to satisfy the condition $r = r'$.
5. The graph does not show a sharp minimum. We have same deviation for a range of angle of incidence near minimum deviation. Therefore, extra care should be taken in drawing tangential line to the $i-\delta$ graph at minimum deviation.