

ANGLE OF MINIMUM DEVIATION

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

Apparatus: Drawing board, prism, drawing pins, and white paper.

Principle:

A ray of light incident on one of the refracting surface of prism of angle A and refractive index n , it will deviate while passing through prism as shown in figure-1. The deviation is given by

$$d = (i_1 + i_2) - A \quad \text{where } i_1 \text{ and } i_2 \text{ are angle of incident and angle of emergence.}$$

As the angle of incidence is gradually increased, the angle of deviation first decreases reaches a minimum value (d_m) and then increases as shown in graph. When the angle of incidence is equal to the angle of emergence, the deviation is minimum.

Procedure:

1. A straight line XY is drawn on the sheet of white paper fixed on the drawing board.
2. The points $O_1, O_2, O_3 \dots$ are marked on line XY .
3. A normal N_1O_1 is drawn to XY at O_1 and straight line D_1O_1 is drawn to represent ray of incidence which makes an angle 45° with N_1O_1 .
4. The prism ABC is placed on the paper as shown in the figure and its boundary is drawn.
5. Two pins P_1 and Q_1 are vertically fixed about 5cm apart on the ray of incidence D_1O_1 .
6. While seeing the images of the pins P_1 and Q_1 through the other refracting surface BC of the prism, two more pins R_1 and S_1 are fixed on the side of AC so that R_1, S_1 and the images of the pins P_1 and Q_1 will be collinear.
7. Pins are removed and their pricks are marked. A straight line is drawn through the pin pricks of R_1 and S_1 to obtain the ray of emergence.
8. The ray of incidence and emergence are extended as shown in the figure – 2 to find the angle of deviation (d).
9. The experiment is repeated for different value of angle of incidence and to find the corresponding angle of deviation.
10. A graph of angle of incidence (i) versus angle of deviation (d) is drawn and angle of minimum deviation d_m is found from the graph.

Diagram:

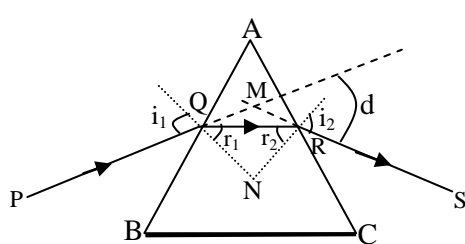


Figure - 1

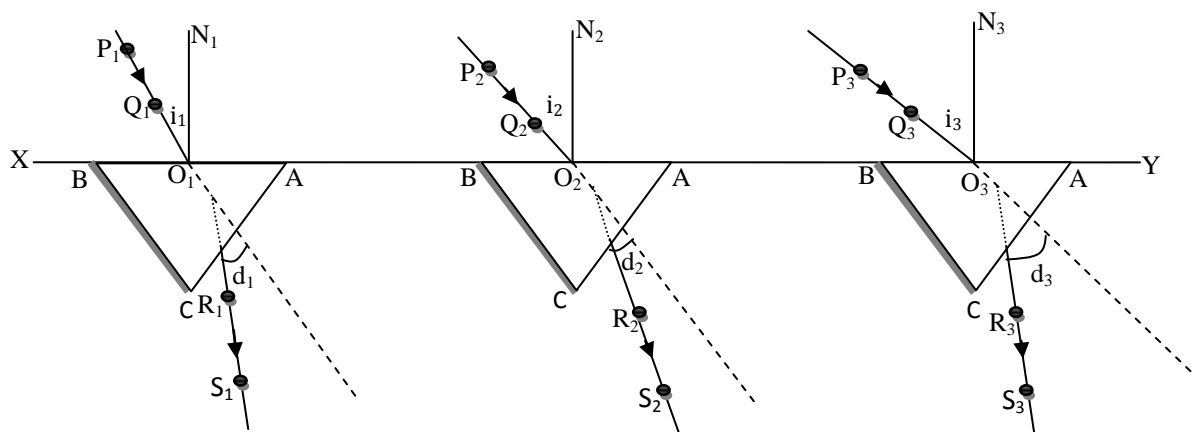
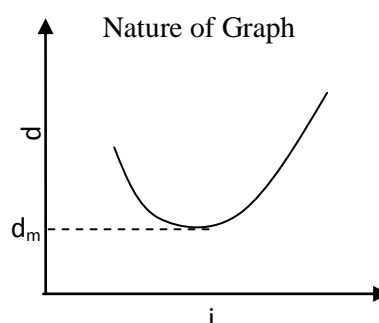


Figure – 2

Where:

ABC – Prism,

P₁Q₁R₁S₁, P₂Q₂R₂S₂... - pins,

i₁i₂&i₃ – different angle of incidence,

d₁d₂&d₃ –angle of deviation

Observations:

S.N o	Angle of incidence i	Angle of deviation d
1		
2		
3		
4		
5		
6		
7		

$$\mu = \frac{\sin\left(\frac{A + D_m}{2}\right)}{\sin\left(\frac{A}{2}\right)}$$

Calculations:

From graph

Angle of minimum deviation d_m =

Result: The angle of minimum deviation, d_m =

Precautions:

1. The angle of incidence should lie between 35° – 60°
2. The pins should be fixed vertically
3. The distance between the two pins should not be less than 10mm.
4. Arrow heads should be marked to represent incident and emergent rays.
5. The same angle of prism should be used for all observations.

Sources of error:

1. Pin pricks may be thick.
2. Measurement of angles may be wrong.