1

To determine the refractive Index of the material of a Prism.

Theory:- If A be the angle of the Prism and δ_m that of minimum deviation which light of a given Colour undergoes by refraction index of the material of the Prism for light of the given color wavelength is given by the relation

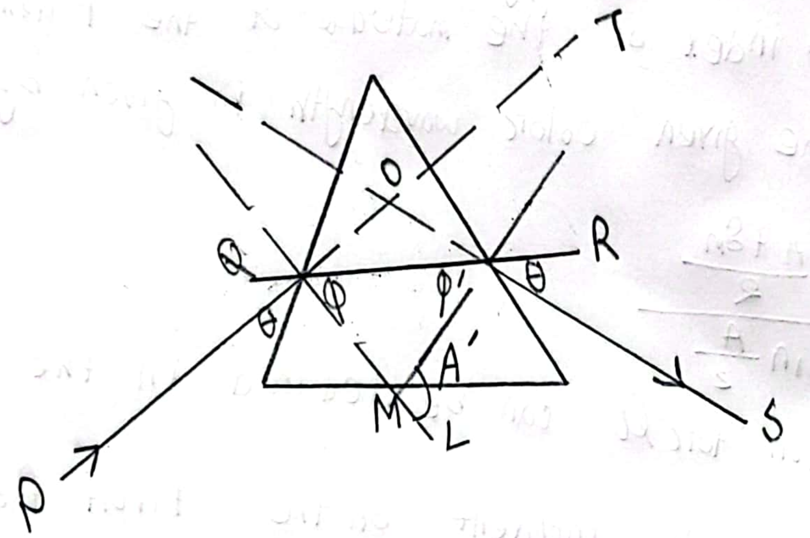
$$\mu = \frac{\sin \frac{A+\delta_m}{2}}{\sin \frac{A}{2}}$$

The expression for μ can be deduced in the following manner.

Let a ray PQ be incident on the first face of a Prism and after Passing through the principal plane of the prism, finally emerge out through the other face in the direction RS. Let θ and ϕ be the respective angles of incidence and refraction at the first face of the prism and ϕ' and θ' the corresponding quantities for the second face. Now the deviation of the ray, given by the angle SOT, is equal to $(\theta-\phi)+(\theta'-\phi')$. But in the position of minimum deviation, the ray passes symmetrically through the prism so that $\theta=\theta'$ and $\phi=\phi'$. Therefore the angle of minimum deviation,

$$\delta_m = 2(\theta-\phi) \quad \text{——— (1)}$$

From the figure, it can be shown that the angle $\angle LMR$ (between the two normals at the two faces) is equal to the angle.



(A) of the prism. But $\angle LMR$ is also equal to $(\phi + \phi')$

Therefore, $\angle LMR = \angle A = \phi + \phi' = 2\phi$ —— (2)

$(\phi = \frac{A}{2})$

From (1) and (2) $\theta = \frac{A + \delta m}{2}$ —— (3)

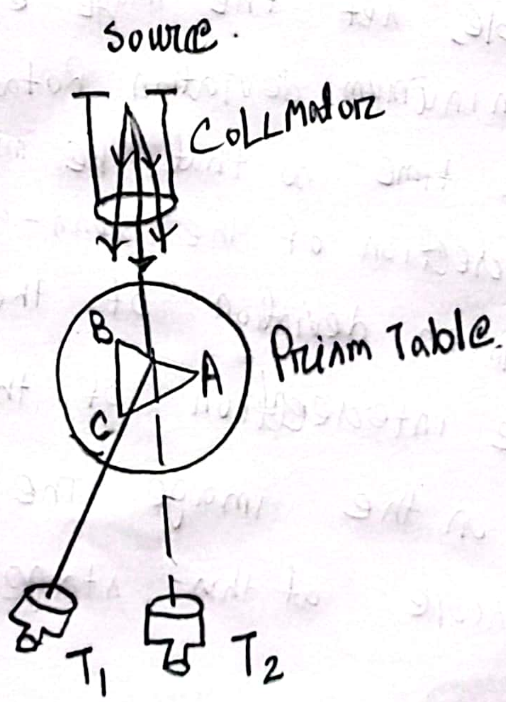
Hence $\mu = \frac{\sin\theta}{\sin\phi} = \frac{\sin \frac{A + \delta m}{2}}{\sin \frac{A}{2}}$

Apparatus: spectrometer, sodium lamp, prism, spirit level, reading lens etc.

Procedure: ① Make all the necessary adjustments of the spectrometer including focusing for parallel rays by Schuster's method in the usual manner as described in Art. Determine the vernier constants of both the verniers. Now place the prism on the prism table in such a way that the vertex of the prism coincides with the centre of the prism table.

(ii) Determine the angle of the prism in the manner described in previous experiment.

(iii) To determine the angle of minimum deviation, so place the prism on the prism table that the centre of the prism is on the centre of the table and one of its refracting faces say AB in figure is directed towards the collimator.



(iv) Looking toward the other face (AC) of the prism, determine the position of the refractive image of the slit with an unaided eye. Turn the prism table so that the deviation gradually decreases. At the same time follow the image. Gradually the image will approach as near to the direct course of the rays from the collimator as possible. On further turning the table in the same direction, the image will be found to move back. This point of turning back is the position of minimum deviation.

(v) The telescope is now brought approximately to the position of minimum deviation of the image. If the image is not already in the field of view, a slight adjustment this way or that way will bring it in the field of view. Next by turning the prism table, set the image exactly at its position of minimum deviation. Rotate the telescope at the same time so that the image always remains near the intersection of the cross-wires. Once the position of minimum deviation of the image is determined, the intersection of the cross-wires is focussed on the image. The fine adjustments of the telescope at this stage should always be done.

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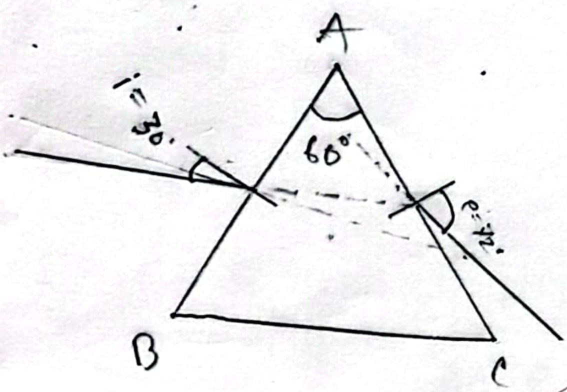

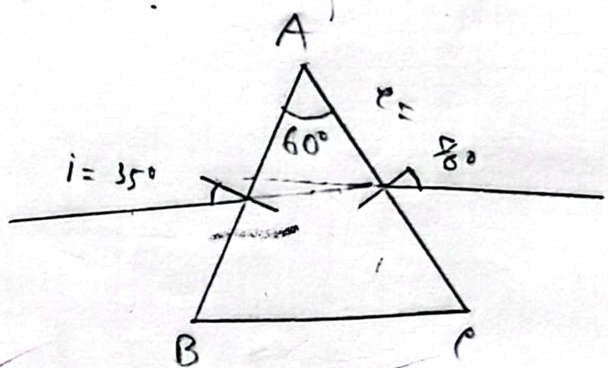

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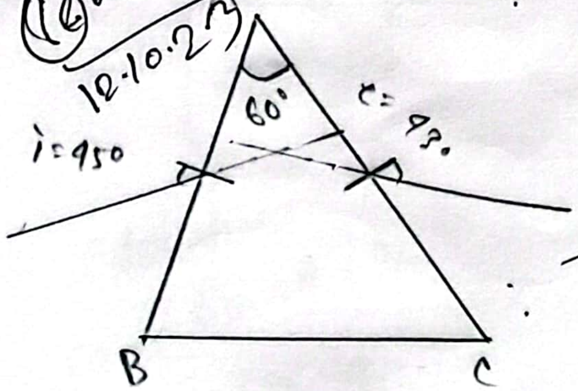

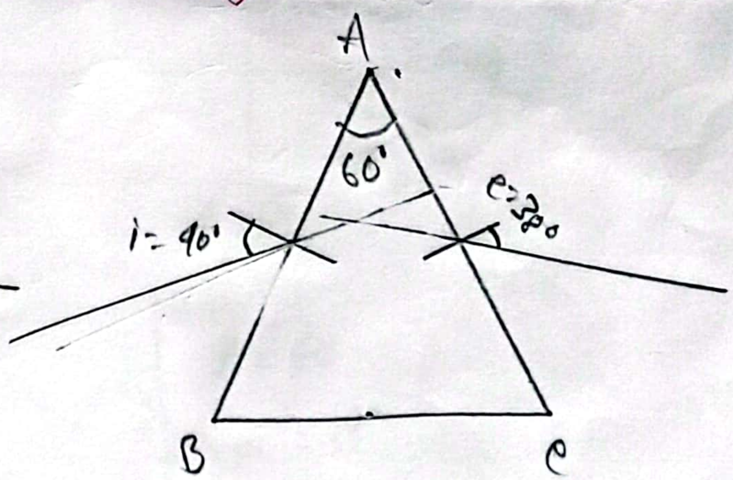

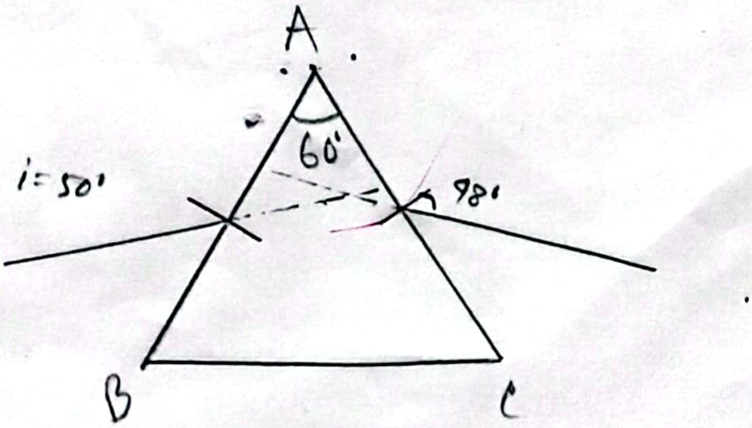

Calculation:

$$M = \frac{\sin \frac{A + \delta m}{2}}{\sin \frac{A}{2}}$$

Here,

$A = 60$

$\delta m = 38°$

$$= \frac{\sin \frac{60+38}{2}}{\sin \frac{60}{2}}$$

$= 1.509$

$\simeq 1.5$

ata table:-

serial	Angle of incedence	Deviation
1	30	42
2	35	40
3	40	38
4	45	43
5	50	48

Calculation:-

$$M = \frac{\sin \frac{A + \delta m}{2}}{\sin \frac{A}{2}}$$

$$= \frac{\sin \frac{60+38}{2}}{\sin \frac{60}{2}}$$

$$= 1.509$$

$$\simeq 1.5$$

Here,

$A = 60$

$\delta m = 38°$

(vi) Repeat the adjustment for minimum deviation at least three times. Note the readings and take the mean separately for both the vernier readings.

(vii) Remove the prism and receive the direct light by the telscope. In doing so the image should be focused on the intersection of the cross-wires. Note the readings on bothe the verniers. Repeat the operation three times and take the mean separately for both the verniers.

(viii) Determine separately the difference between the mean readings for the minimum deviated rays and direct rays for each vernier. This difference is the angle of minimum deviation (δ_m) Take the mean of the two vernier readings.

(ix) From known values of A and δ_m. calculate μ.

Result:

Here,

$A = 60^\circ$

$\delta_m = 38^\circ$

A is the angular of the Prism

δ_m is the minimum deviation of prism.

$$M = \frac{\sin \frac{A+\delta_m}{2}}{\sin \frac{A}{2}}$$

$$= \frac{\sin \frac{60+38}{2}}{\sin \frac{60}{2}}$$

$$= \frac{\sin 49}{\sin 30}$$

$$= 1.509.$$

Error calculation

$$\text{Error} = \frac{|\text{Experimental value} - \text{theoritical value}|}{\text{theoritical value}} \times 100\%.$$

$$= \frac{1.509 - 1.5}{1.5} \times 100\%.$$

$$= 0.6\%.$$

Actual value of refraction of index of glass is $\mu = 1.5$.

So the error percentage is 0.6%.

Discussion:-

(I) If an asbestos ring is used, it must be held in the non-luminous part of the bunsen flame; should be supplied with fresh solution of common salt from time to time.

(II) The width of the slit image should be as narrow as possible.

(III) In taking reading care should be taken to ascertain whether the zero of the main circular scale has been crossed in going from one position to the other.