☆ Experiment No :→ 03

1.) Aim :→ To determine the dispersive power of prism.
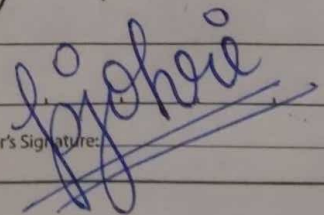
2.) Apparatus Required :→ Spectrometer, A Glass Prism, Mercury Vapour Lamp, Magnifying Glass.

3.) Formula Used :→

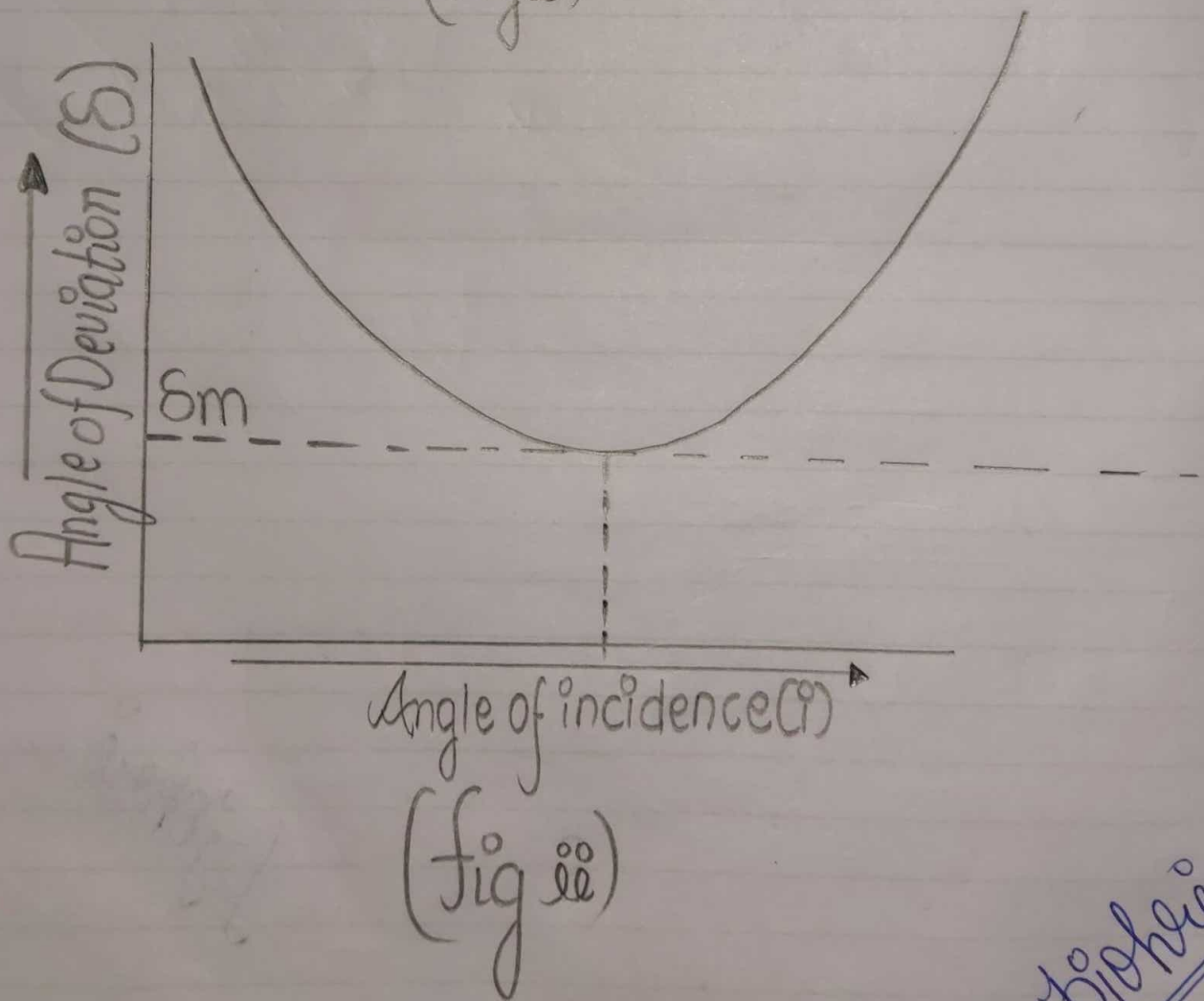$$\mu = \left[\frac{\sin\left(\frac{A + \delta m}{2}\right)}{\sin\left(\frac{A}{2}\right)} \right] ; -(i)$$
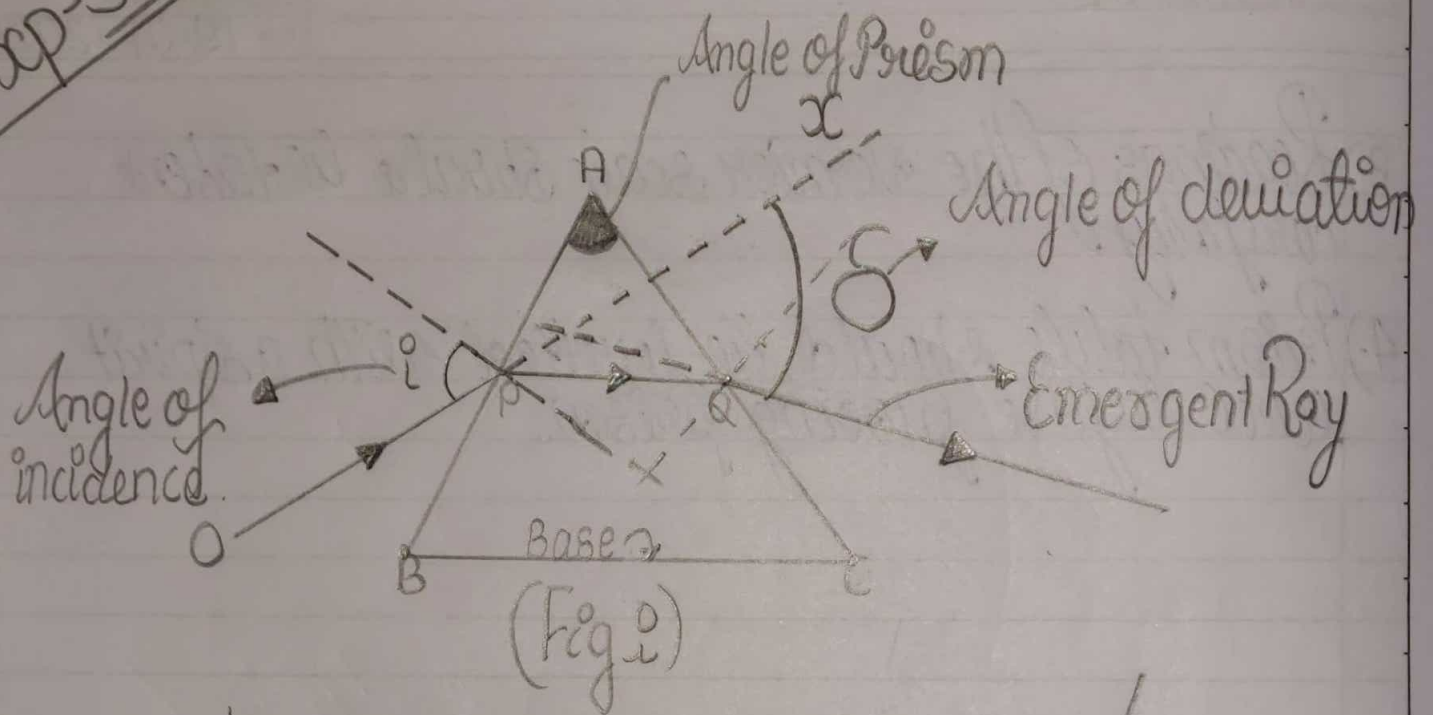
The refractive index of material of prism μ is given by the formula :→(i)

where A = Angle of Prism
δm = Angle of minimum deviation for particular Line of Spectrum

Angle of Prism

x

Angle of deviation

δ

Angle of incidence.

i

Emergent Ray

A

P

Q

O

B

Base

C

(Fig i)

Angle of Deviation (δ)

δm

Angle of incidence(i)

(fig ii)

Dipika

The dispersive power (ω) of the material of a prism is given by :->

$$\omega = \left(\frac{b_V - b_R}{b_Y - 1} \right)$$

$b_V = R_0T_0$ for violet
$b_R = R_0I$ for Red
$b_Y = R_0I$ for Yellow

•> Total readings :-> MSR + (VSR × LC) in degrees
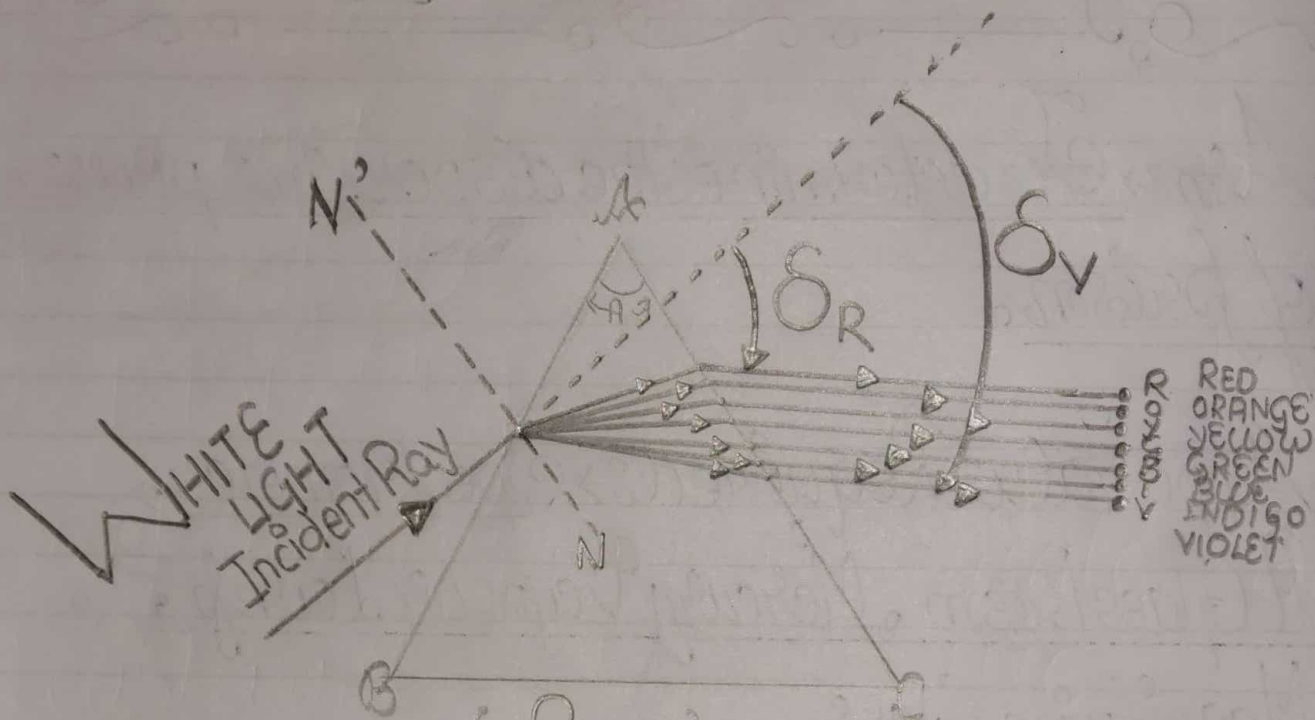
4) <u>Theory</u> :-> Dispersion of light through prism :->

Upon passage through the prism, the white light is separated into its component colors - red, orange, yellow, green, blue, indigo and violet.

The separation of visible light its different colors is known as Dispersion.

Least count of spectrometer :->

Least count of an instrument gives the minimum measurement that can be taken from

Teacher's Signature:

WHITE LIGHT Incident Ray

N'

N

δ_R

δ_V

RED
ORANGE
YELLOW
GREEN
BLUE
INDIGO
VIOLET

Fig (iii)

that instrument

Least count of spectrometer:-> $\left(\dfrac{1 MSD}{No\ of\ divisions\ on\ vernier\ scale}\right)$

As $20\,MSD = 10^{\circ}$

So, $1\,MSD = \dfrac{10^{\circ}}{20}$

No of divisions on vernier scale $= 30^{\circ}$

Least count $= \left(\dfrac{1}{60}\right)^{\circ} = 1$ minute.

Observations:→

1) Determination of the Least count of the Spectrometer

$$\text{Least count} = \left[\frac{1MSD}{\text{No of divisions on vernier scale}}\right]$$

As $20MSD = 10°$

So $1MSD = \left(\frac{10}{20}\right)°$

No of divisions on Vernier Scale :→ 30

$$\text{Least count} = \left(\frac{1}{60}\right)° = 1\text{ minute}$$

2) Angle of the prism $(\theta/2)$ is taken to be $60°$

3) Rays of Light are // (parallel) through a collimator

Dishou

Observation Table :→

S.No	Line	Vernier	Refracted Ray reading	Direct Reading	Difference (Minimum Deviation)	Mean (D)	n
1	Violet	V_1	67.26	108.23	40.97	40.63	1.539
		V_2	247.93	288.23	40.3		
2	Yellow	V_1	68.2	108.23	40.03	39.82	1.530
		V_2	248.5	288.23	39.73		
3	Red	V_1	69.46	108.23	38.77	38.785	1.518
		V_2	249.43	288.23	38.8		

Calculations :→ where

(A = Angle of Prism = 60°)

$$\mu_{violet} = \frac{\sin\left(\frac{A+D}{2}\right)}{\sin\left(\frac{A}{2}\right)}$$

$$\mu_{violet} = \frac{\sin\left(\frac{60+40.63}{2}\right)}{\sin\left(\frac{60}{2}\right)} \Rightarrow \frac{\sin\left(\frac{100.63}{2}\right)}{\sin(60/2)} \Rightarrow \frac{\sin(50.315)}{\sin(30)} = 1.539$$

$$\mu_{yellow} = \frac{\sin\left(\frac{60+39.82}{2}\right)}{\sin\left(\frac{60}{2}\right)} \Rightarrow \frac{\sin(99.82/2)}{\sin(30)} = \frac{\sin(49.91)}{\sin(30)} = 1.530$$

$$\mu_{Red} = \frac{\sin\left(\frac{60+38.7}{2}\right)}{\sin(60/2)} \Rightarrow \frac{\sin(98.785/2)}{\sin(30)} = \frac{\sin(49.3925)}{\sin(30)} = 1.518$$

Now using Dispersive power formula
we calculate :->

$$\omega = \left[\frac{\mu_V - \mu_R}{\mu_y - 1}\right] = \left(\frac{1.539 - 1.518}{1.530 - 1}\right)$$

$$\omega = \left(\frac{0.021}{0.530}\right)$$

$$\omega = 0.039622641$$

Result :-> The dispersive power of the prism using spectrometer comes out to be $\omega = 0.039622641$.
Ans

5) **Result :→** The dispersive power of the prism using Spectrometer comes out to be $\omega = 0.03962264$

Ans

6) **Percentage error :→**

→ $\%\text{Error} = \left(\dfrac{\text{Measured value} - \text{Exact value}}{\text{Exact Value}}\right) \times 100$

→ $= \left(\dfrac{0.03962264 - 0.030}{0.030}\right) \times 100\%$

$= 32.07547\%$

7) **Precautions and sources of error**

1) Light coming from the slit should be narrow & bright

2) Telescope must be focussed

3) Readings of the vernier scale should be taken

Teacher's Signature: *johi*

carefully

4) Prism table should be leveled with a spirit level before placing prism

pjdhoi