ASHOKA
Date:
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Experiment - 4

Refractive index & Cauchy's constants

Aim -

Determination of the refractive index μ of glass for different wavelengths λ, and Cauchy's constants a, b with the help of a prism.

Formula Used -

$$\mu = \frac{\sin\left(\frac{A+\delta_{min}}{2}\right)}{\sin\left(\frac{A}{2}\right)}$$ where, { μ = Refractive index, A = Angle of prism, δ_{min} = Angle of minimum deviation }

$$\delta_{min} = 2(\theta_i - \theta_r)$$ where { δ_{min} - Angle of minimum deviation, θ_i - Angle of incidence, θ_r - Angle of refraction }

$$\mu = a + \frac{b}{\lambda^2} + \frac{c}{\lambda^4} + \cdots$$

Two term form of Cauchy's equation to describe variation of μ with wavelength (λ)

$$\mu = a + \frac{b}{\lambda^2}$$ where { a, b - Constants, μ - Refractive index, λ - Wavelength }

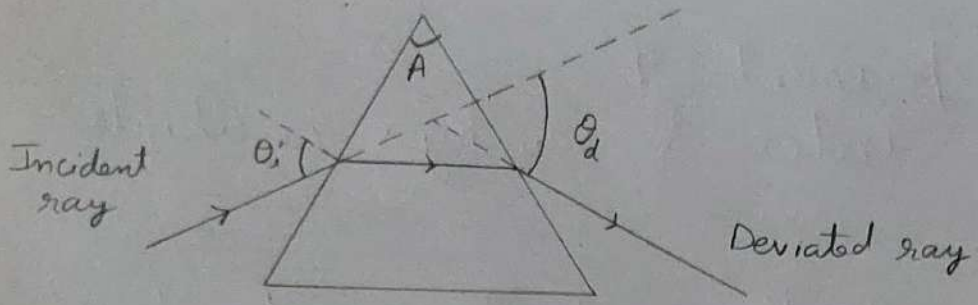


Fig. 1 Refraction of light through the prism.

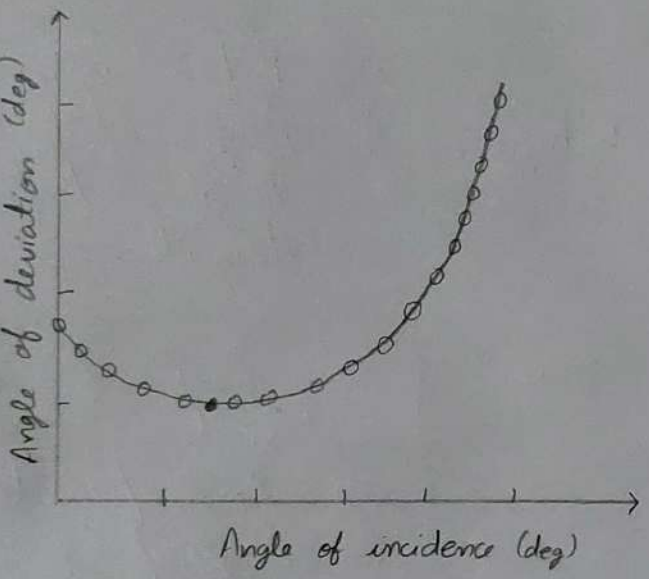
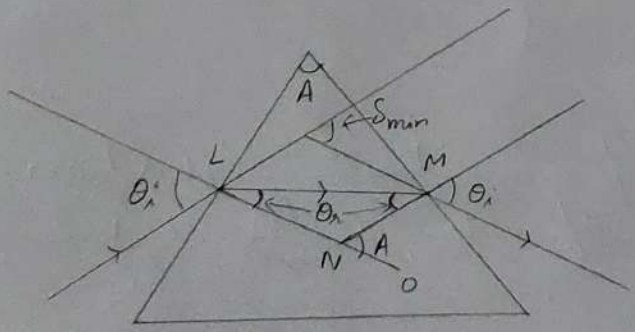


Fig 2 Graph between angle of deviation as a function of angle of incidence.



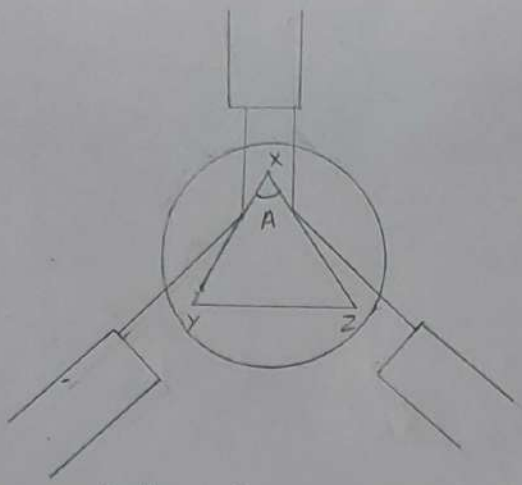


Fig3. Schematic setup to measure angle of prism.

Observations -

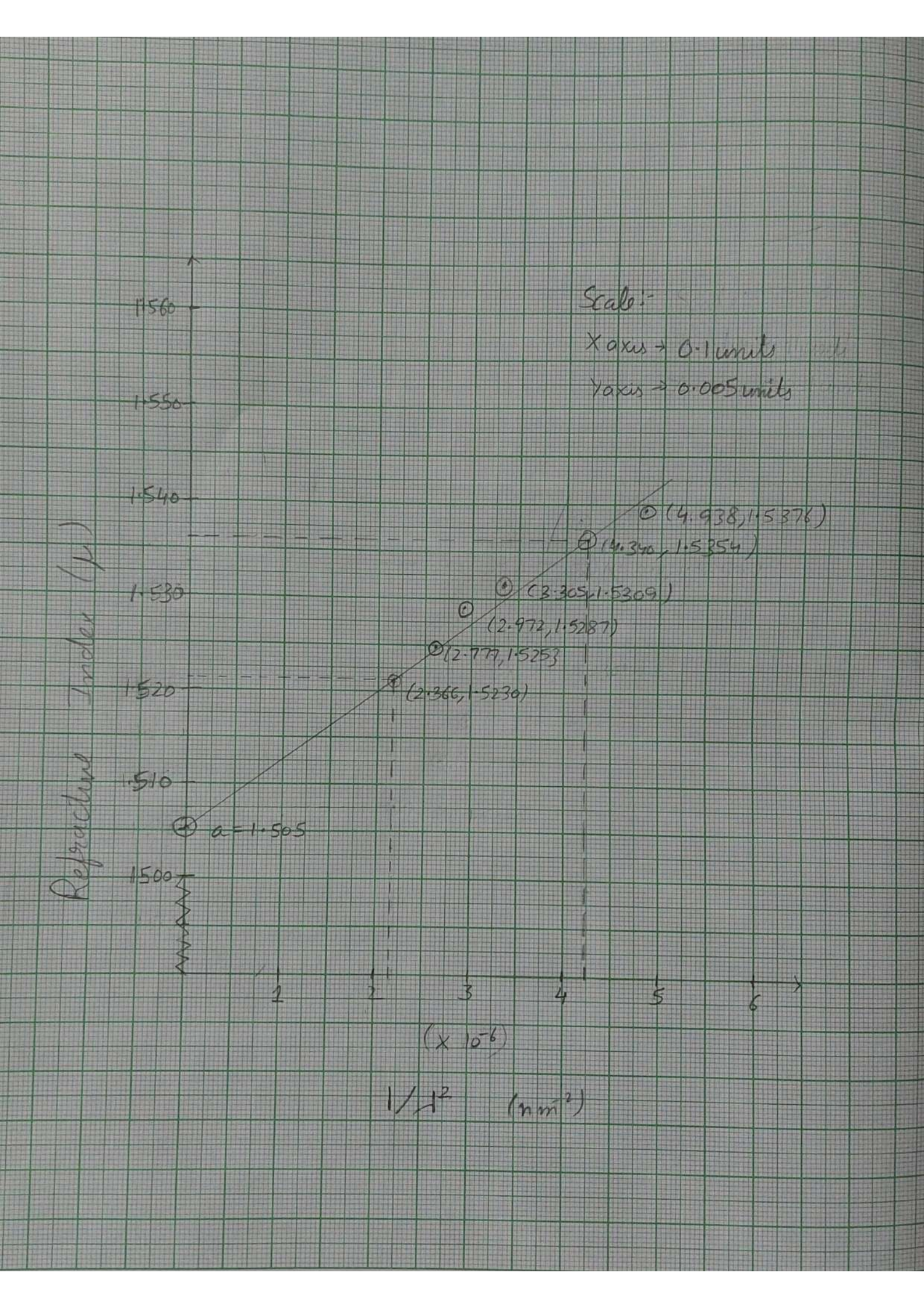
Table I - Measurement of angle of prism (A)

Position I (θ_1)	Position II (θ_2)	$2A = \theta_2 - \theta_1$	Prism Angle (A)
80°	−40°	120°	60°

Table II - Measurement of angle of minimum deviation (δ_{min})

Angle of undeviated (θ') = 0 in deg

SI	Color	Angle of deviated ray (θ)	$\delta_{min} = \theta - \theta'$	Refractive Index (μ)	λ (nm)	$1/\lambda^2$ (nm^{-2})
1	Indigo	40.5	40.5	1.5376	450	4.938×10^{-6}
2	Blue	40.3	40.3	1.5354	480	4.340×10^{-6}
3	Green	39.9	39.9	1.5309	550	3.305×10^{-6}
4	Yellow	39.7	39.7	1.5287	580	2.972×10^{-6}
5	Orange	39.4	39.4	1.5253	600	2.777×10^{-6}
6	Red	39.2	39.2	1.5230	650	2.366×10^{-6}


Scale:-
X axis → 0.1 units
Y axis → 0.005 units
1560
1550
1540
1530
1520
1510
1500
Refractive Index (μ)
a = 1.505
(2.366, 1.5230)
(2.777, 1.5253)
(2.972, 1.52871)
(3.305, 1.5309)
(4.340, 1.5354)
(4.938, 1.5376)
1
2
3
4
5
6
(× 10⁻⁶)
1/λ² (nm⁻²)

Calculations

$$\text{Slope} = \frac{1.5354 - 1.5230}{(4.340 - 2.366) \times 10^{-6}} = 6281$$

$$= 6.281 \times 10^{3}$$

$$\therefore b = 6.281 \times 10^{3}\ nm^{-2}$$

Intercept = $a = 1.505$

Result -

$a = 1.505$

$b = 6.281 \times 10^{3}\ nm^{-2}$