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Experiment No. 6
Refractive Index and Cauchy's constants

Aim:

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

Apparatus Required:

A white light source (Mercury Vapor lamp)
Prism
Spectrometer

formulas used:

$$\delta_{min} = 2(\theta_i - \theta_r)$$

θ_i = ∠ of incidence
θ_r = ∠ of refraction

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

δ_{min} = min. ∠ of deviation

A = angle of prism

μ = refractive index

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

Teacher's Signature

Table 1 : Measurement of angle of prism (A)

Position 1 θ_1 in deg	Position 2 θ_2 in deg	$2A = \theta_2 - \theta_1$ in deg.	Prism angle A (in deg)
120°	240°	120°	60°

Table 2 : Measurement of angle of minimum deviation (δ_{min})

[Angle of undeviated ray (θ') = 0°]

S.No	Color	Angle of deviated ray (θ)	$\delta_{min} = \theta - \theta'$ (in deg)	Refractive index (μ)	λ (in nm)	$1/\lambda^2$ (nm^{-2})
1	Indigo	40.4	40.4	1.536	453.88	5.26×10^{-6}
2	Blue	40.1	40.1	1.533	491.66	4.13×10^{-6}
3	green	39.6	39.6	1.527	546.07	3.35×10^{-6}
4	Yellow	39.4	39.4	1.525	578.0	2.99×10^{-6}
5	orange	39.1	39.1	1.522	615.2	2.64×10^{-6}
6	Red	39	39	1.521	690.75	2.09×10^{-6}

Calculations :

μ for Indigo = $\dfrac{\sin\left(\frac{A+\delta_{min}}{2}\right)}{\sin\left(\frac{A}{2}\right)}$

$= \dfrac{\sin\left(\frac{60+40.4}{2}\right)}{\sin\left(\frac{60}{2}\right)^{30}} = \sin(50.2)\times 2$

$= 1.536$

μ for Blue = $\left(\sin\dfrac{60.1}{2}\right)2 = \sin(50.05)\times 2$

$= 1.533$

Calculation of a and b

$\Delta y = 0.010$

$\Delta x = 1.5\times 10^{-6}$

$\dfrac{\Delta y}{\Delta x} = 0.00667 \times 10^{6}$

$\Rightarrow \boxed{b = 6.67 \times 10^{3}\ nm^{2}}$

$1.521 = a + \left[6.67\times 10^{3} \times 2.09 \times 10^{-6}\right]$

$1.521 = a + 0.01384 \Rightarrow \boxed{a = 1.507}$

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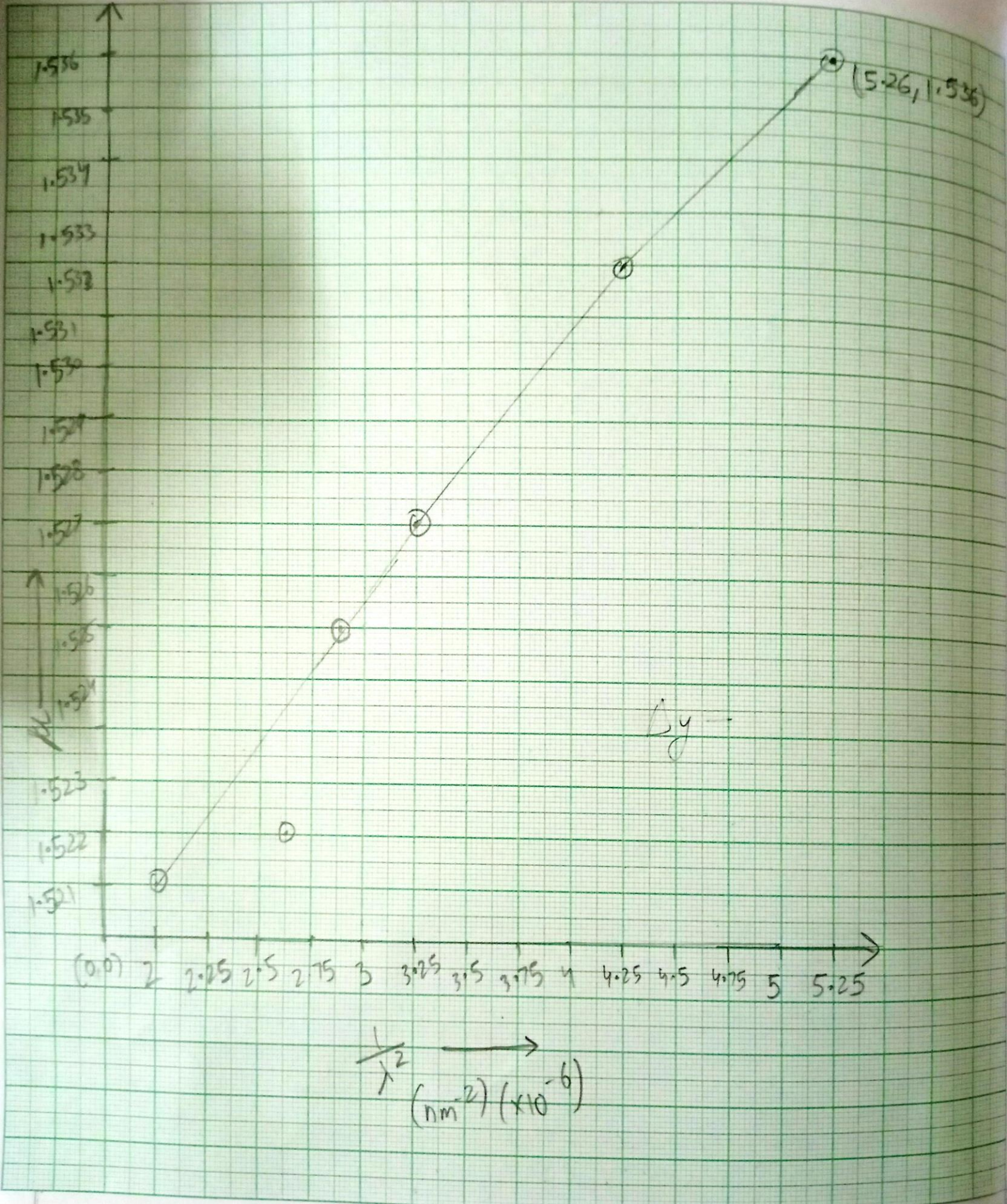
1.536
1.535
1.534
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1.531
1.530
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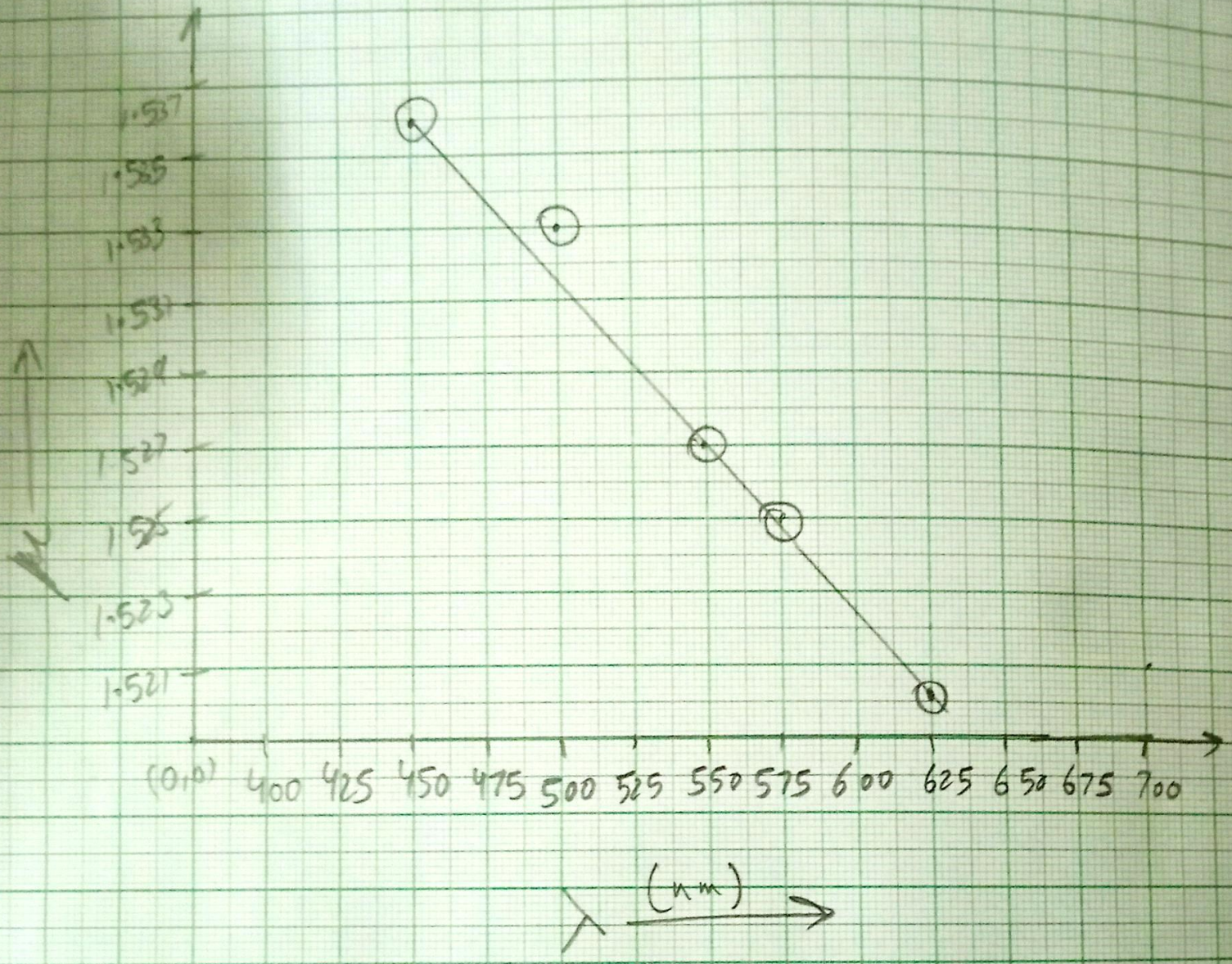
1.526
1.525
1.524
1.523
1.522
1.521
(5.26, 1.536)
(0,0)
2
2.25
2.5
2.75
3
3.25
3.5
3.75
4
4.25
4.5
4.75
5
5.25
$\frac{1}{\lambda^2}$
$(nm^{-2})(\times 10^{-6})$


1.537
1.535
1.533
1.531
1.529
1.527
1.525
1.523
1.521
(0,0)
400 425 450 475 500 525 550 575 600 625 650 675 700
(nm)

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Result and conclusion

We have found out the refractive indexes and the cauchy constants with the help of a prism