PHYSICS LAB (PHY F110)

PHYSICS ASSIGNMENT

Exp 7 : Diffraction Grating

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Observations

Table 1: Calibration of diffraction grating
Least Count = 1′ = $\frac{1}{60}^{\circ}$

Spectral lines (Hg)	Wavelength (Å)	Position of Telescope: Left side θ_L (°′) Main	Vernier	Total	Right side θ_R (°′) Main	Vernier	Total	$\theta = \frac{\lvert\theta_L \sim \theta_R\rvert}{2}$	$\sin\theta$
Violet I	4047	230	6	230·1	260	58	261·0	15·43	0·266
Violet II	4078	229	19	229·3	260	23	260·4	15·53	0·268
Blue (prominent)	4358	227	21	227·4	262	55	262·9	17·78	0·305
Bluish-Green (weak)	4916	225	20	225·3	262·5	15	262·8	18·71	0·321
Green (Prominent)	5461	224·5	38	225·1	264·5	15	264·8	19·81	0·339
Yellow I	5770	224	45	224·8	265·5	20	265·8	20·54	0·351
Yellow II	5791	224	5	224·1	265·5	59	266·5	21·20	0·362

Let wavelength (λ) be x, $\sin\theta$ be y
$\therefore \bar{x} = 4917.286 \quad \bar{y} = 0.3159$

$(x-\bar{x})$	$(x-\bar{x})^2$	$(x-\bar{x}) \times y$
−870·286	757397·2	−231·598
−839·286	704400·5	−224·760
−559·286	312800·5	−170·816
−1·286	1·6531	−0·412
543·714	295625·2	184·251
852·714	727121·7	299·208
873·714	763376·7	315·957

$$m = \frac{\sum (x_i - \bar{x})y}{\sum (x_i - \bar{x})^2}$$
$$= 4.8257 \times 10^{-5}$$
$$c = \bar{y} - m\bar{x}$$
$$= 0.0786$$
$$\therefore d = \frac{1}{m}$$
$$= 20722.473 \text{Å}$$

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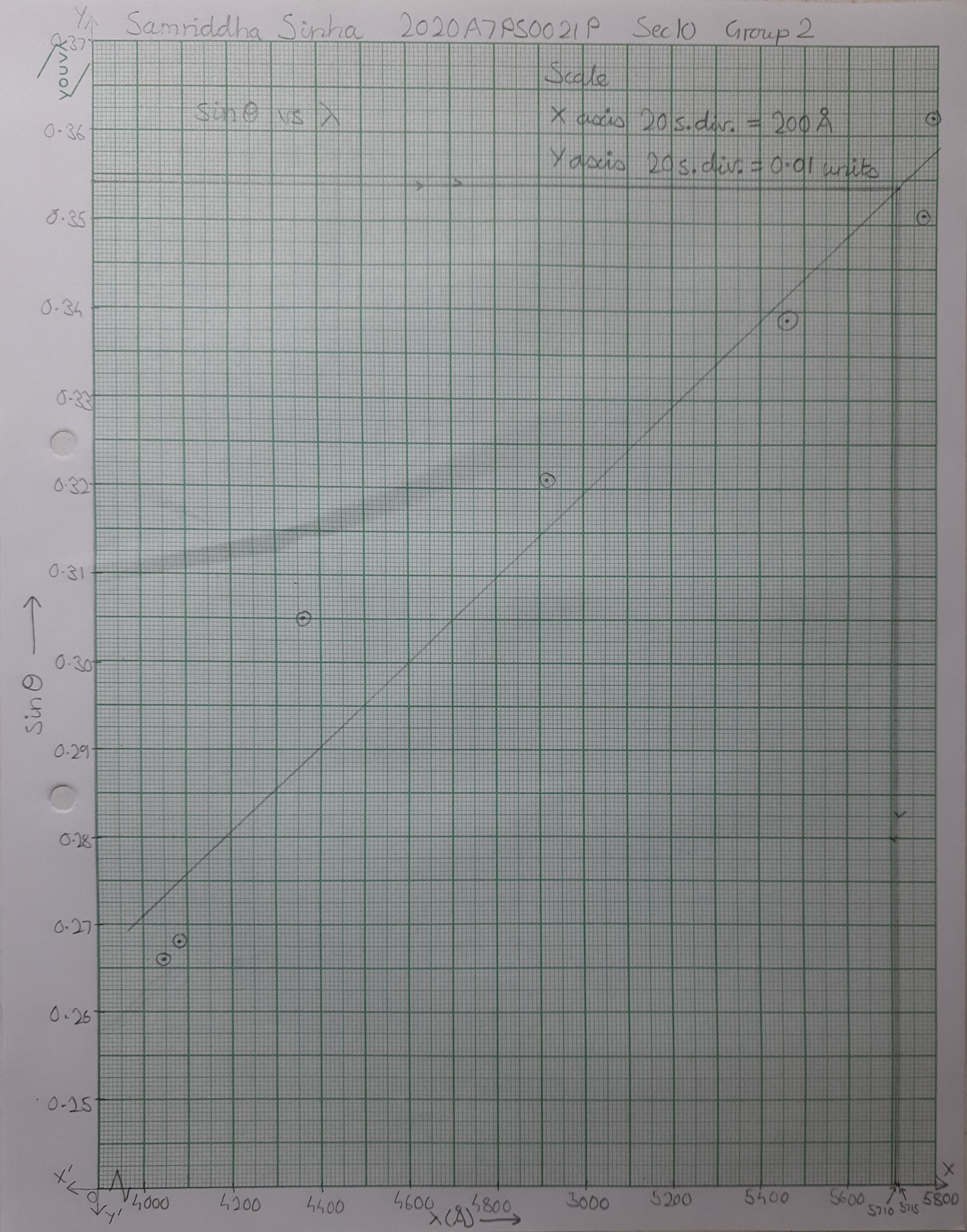

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Table 2:

Spectral line (Na)	Wavelength (Å)	Position of Telescope						$\theta = \lvert\theta_L - \theta_R\rvert/2$	$\frac{\sin\theta}{2}$
		Left side θ_L (°′)			Right side (°′)				
		Main	Vernier	Total	Main	Vernier	Total		
Yellow I	5890	199	8	199.1	290	45	290.8	45.81	0.3585
Yellow II	5896	199	29	199.5	290	60	291	45.76	0.3582

θ of Yellow I in second order = 45.8083°
$\Delta\theta$ between 2 yellow lines of second order = 0.05°

From graph, $\Delta\lambda = 5$ Å
But the lines are too close, so possibility of error arises
∴ To find $\Delta\lambda$ from graph reliably, we may use the equation obtained by best fit line

$$\sin\theta = m\lambda + c$$

$$\therefore \lambda = \frac{\sin\theta - c}{m}$$

$$\therefore \Delta\lambda = \frac{\sin\theta_1 - \sin\theta_2}{m}$$

$$= 6.3056 \text{ Å}$$

Using formula,

$$\Delta\lambda = \tfrac{1}{2}\, d \cos\theta\, \Delta\theta$$

$$= \tfrac{1}{2} \times (20722.473) \times (\cos(45.8083°)) \times (0.05 \times \tfrac{\pi}{180})$$

$$= 6.3027 \text{ Å}$$

Results

1. $d = 20722.473$ Å
2. λ of sodium lines are 5890 Å and 5896 Å
3. $\Delta\lambda$ (from graph) = 6.3056 Å
4. $\Delta\lambda$ (from formula) = 6.3027 Å