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Experiment No - 1
Newton's Rings.

Aim -

The aim of the experiment is to determine wavelength of light using Newton's Rings experiment

Formulae Used -

$$\Delta x = \frac{\lambda}{2\pi}(\Delta\phi)$$

where Δx = Path difference
$\Delta\phi$ = Phase difference
λ = Wavelength.

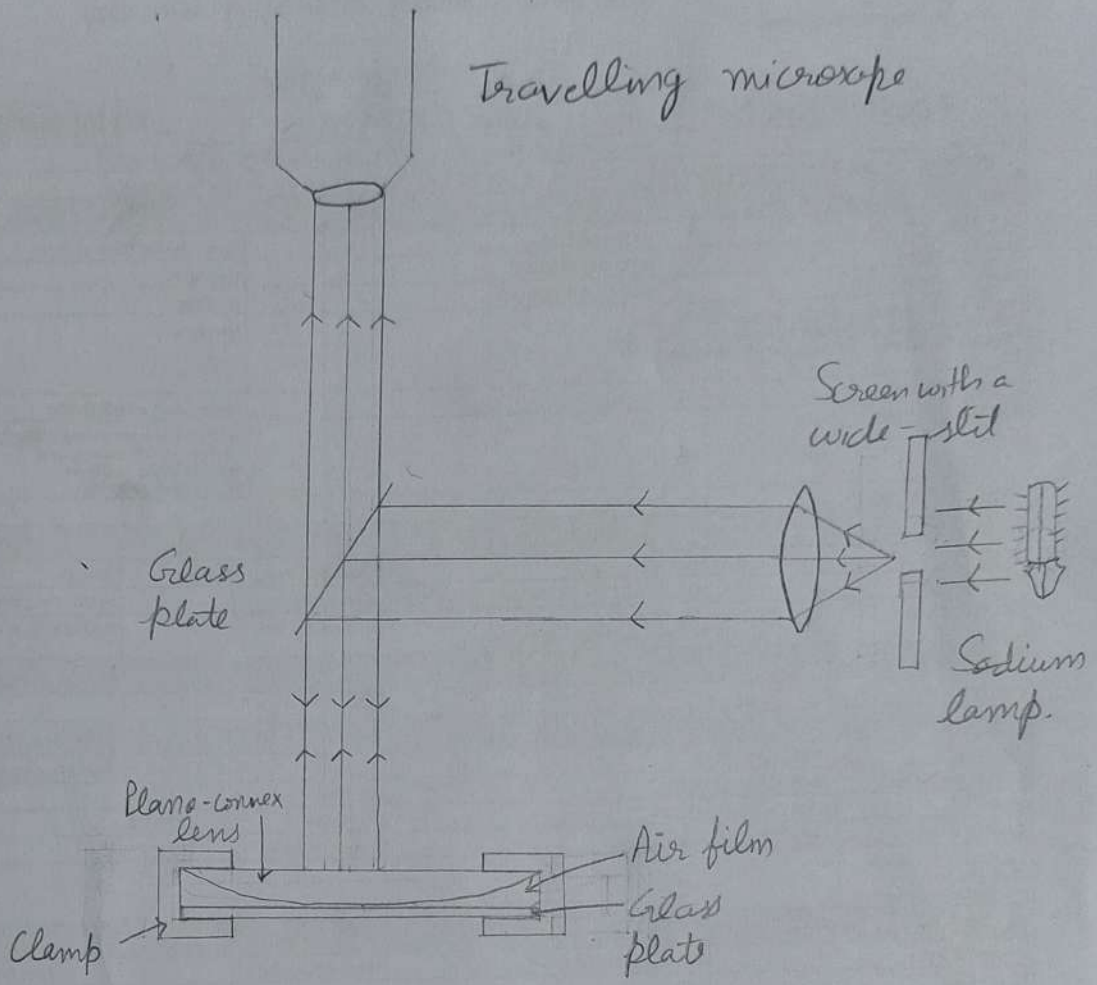
$$m = 4R\lambda \Rightarrow \lambda = \frac{m}{4R}$$

where m = Slope of D_n^2 vs n graph
R = Radius of curvature of lens.

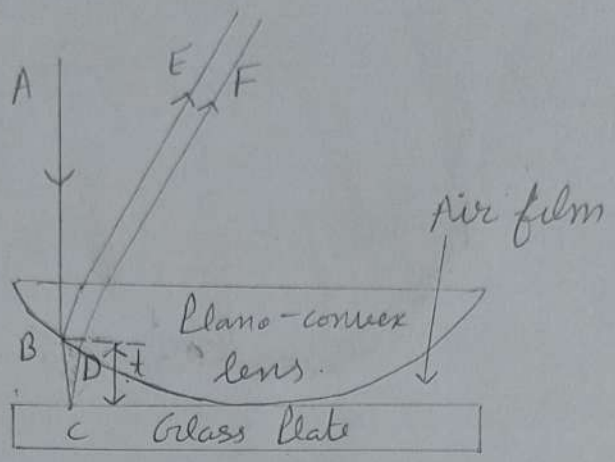
$$\left|\frac{\lambda - \lambda_0}{\lambda_0}\right| \times 100\%$$

Total reading = Main scale reading + (Vernier scale reading × least count)

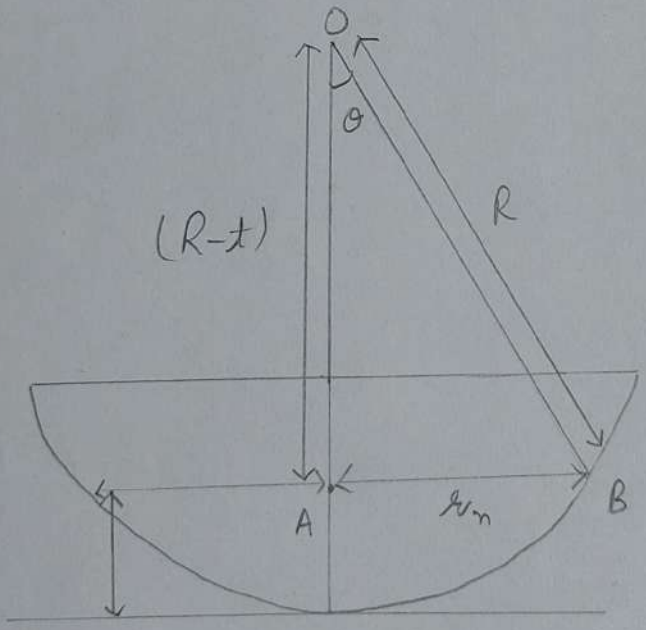
$$D_n = |a - b|$$



A schematic ray diagram to explain how Newton's rings are formed.



Interfering rays formed by upper & lower surfaces of air film



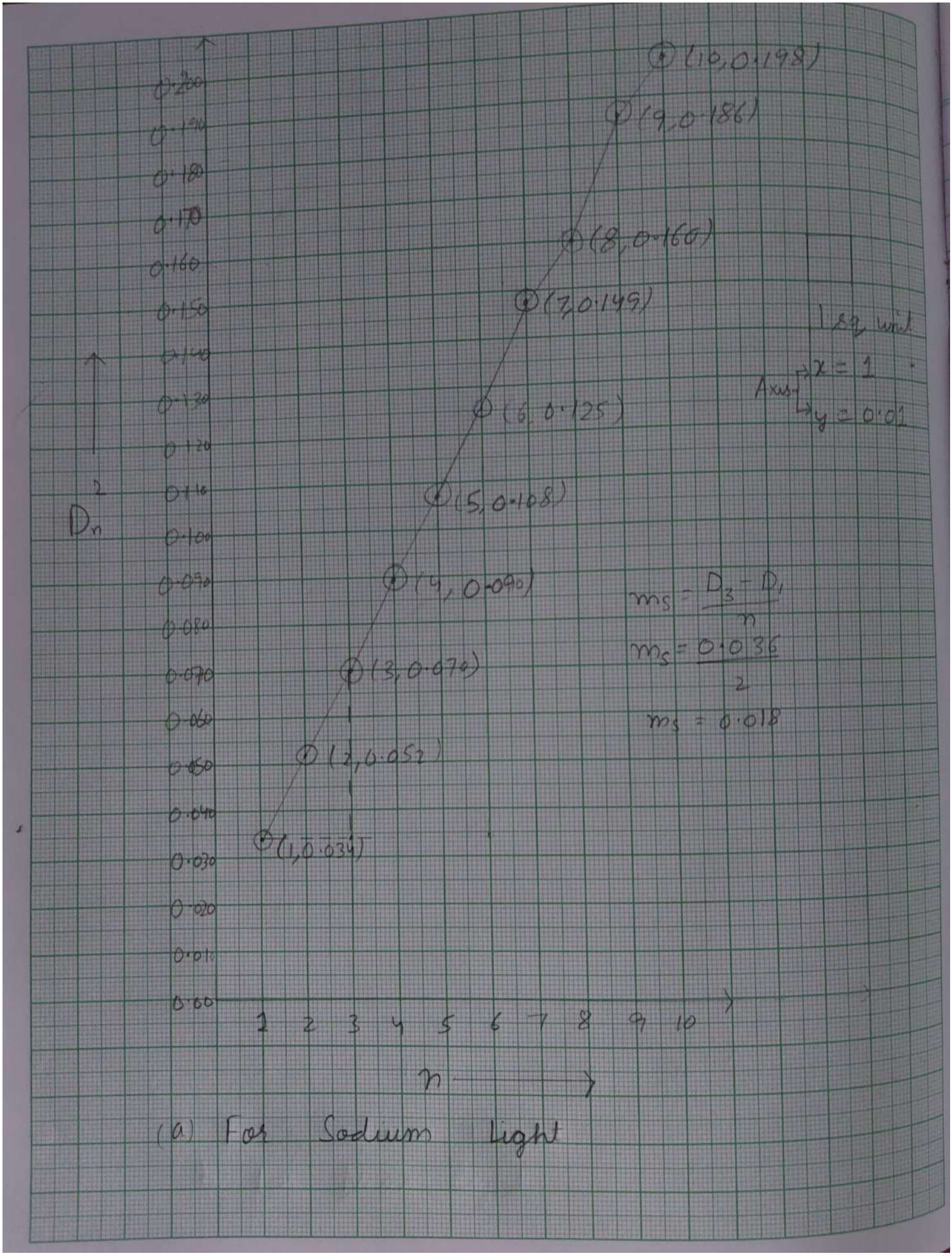
Geometry used to determine the thickness of the air film.

Ring no.(n)	Microscope reading						Diameter $D_n = \|a-b\|$ (in cm)	D_n^2 (in cm^2)
	Left side (a in cm)			Right side (b in cm)				
	Main	Vernier	Total	Main	Vernier	Total		
10	2.20	33	2.233	2.55	0	2.550	0.445	0.198
9	2.20	42	2.242	2.55	20	2.570	0.432	0.186
8	2.25	10	2.260	2.55	41	2.591	0.400	0.160
7	2.25	13	2.263	2.60	8	2.608	0.387	0.149
6	2.25	29	2.279	2.60	21	2.621	0.354	0.125
5	2.25	41	2.291	2.60	33	2.633	0.330	0.108
4	2.30	7	2.307	2.65	0	2.650	0.301	0.090
3	2.30	25	2.325	2.65	10	2.660	0.266	0.070
2	2.30	41	2.341	2.65	19	2.674	0.229	0.052
1	2.35	13	2.363	2.65	28	2.678	0.187	0.034

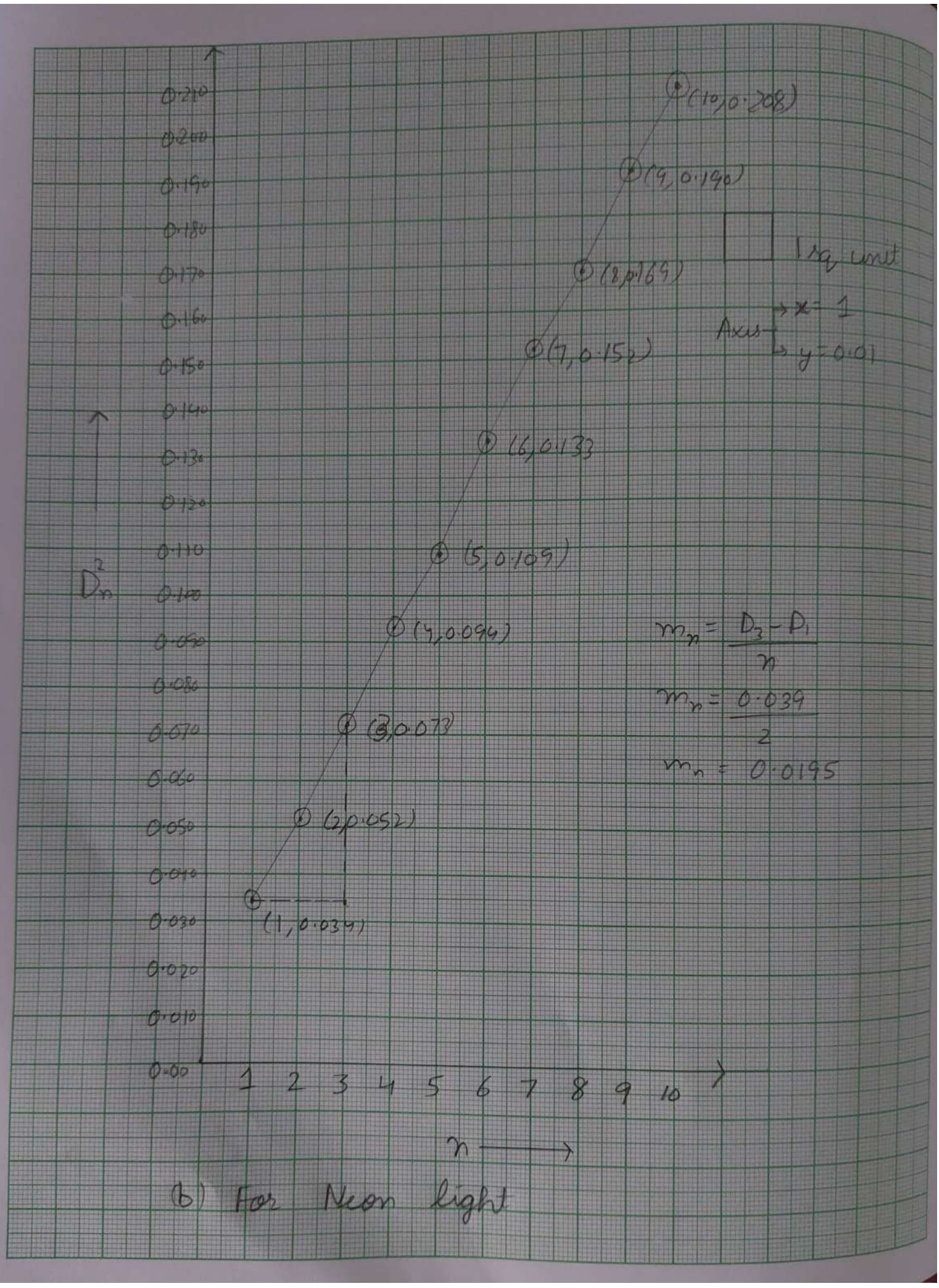
For Sodium Lamp.

Ring no.(n)	Microscope Reading						Diameter $D_n = \|a-b\|$ (in cm)	D_n^2 (in cm^2)
	Left side (a in cm)			Right side (b in cm)				
	Main	Vernier	Total	Main	Vernier	Total		
10	2.20	27	2.227	2.65	34	2.684	0.457	0.208
9	2.20	37	2.237	2.65	24	2.674	0.437	0.190
8	2.25	0	2.250	2.65	12	2.662	0.412	0.169
7	2.25	9	2.259	2.65	0	2.650	0.391	0.152
6	2.25	22	2.272	2.60	38	2.638	0.366	0.133
5	2.25	40	2.290	2.60	21	2.621	0.331	0.109
4	2.30	0	2.300	2.60	7	2.607	0.307	0.094
3	2.30	20	2.320	2.55	41	2.591	0.271	0.073
2	2.30	40	2.340	2.55	20	2.570	0.230	0.052
1	2.35	10	2.365	2.55	0	2.550	0.185	0.034

For Neon Lamp.



(a) For Sodium Light



$$m_n = \frac{D_3 - D_1}{n}$$

$$m_n = \frac{0.039}{2}$$

$$m_n = 0.0195$$

(b) For Neon light

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Calculations:-

Least Count -

1 main scale division = 0.05 cm

50 vernier scale divisions = 49 main scale divisions

Vernier constant = (50 - 49)/50 × 0.05

= 0.001 cm

Slope -

$$m = \tan\theta = \frac{P}{B}$$

For Sodium lamp

$$m_S = \frac{D_3 - D_1}{n} = \frac{0.036}{2} = 0.018$$

For Neon lamp

$$m_N = \frac{D_3 - D_1}{n} = \frac{0.039}{2} = 0.0195$$

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Calculations -

(a) For Sodium light -

$\lambda = \frac{m}{4R}$ ∴ where R = Radius of curvature = 80 cm
m = Slope = 0.018

$\lambda = \frac{0.018}{4 \times 80}$

$\lambda = 0.00005625$ cm

$\boxed{\lambda = 562.5 \text{ nm}}$

(b) For Neon light -

$\lambda = \frac{m}{4R}$ R = 80cm

$\lambda = \frac{0.0195}{4 \times 80}$ m = 0.0195

$\lambda = 0.0000609$ cm

$\boxed{\lambda = 609 \text{ nm}}$

Errors -

(a) For Sodium light -

$\left| \frac{\lambda - \lambda_0}{\lambda_0} \right| \times 100$ $\lambda = 562.5$ nm
$\lambda_0 = 589.3$ nm

$= \left| \frac{562.5 - 589.3}{589.3} \right| \times 100$

For Sodium Lamp

$= 0.0454 \times 100$
$= 4.54\%$

(b) For Neon Lamp.

$$\left| \frac{\lambda - \lambda_0}{\lambda_0} \right| \times 100$$

$$= \left| \frac{609 - 632.8}{632.8} \right| \times 100$$

$= 0.0376$
$= 3.76\%$

Result-

Wavelength of Sodium light is experimentally found to be 562.5 nm with an error of 4.54%.

Wavelength of neon light is experimentally found to be 609 nm with an error of 3.76%.