Observations

Vernier constant for the horizontal scale of the microscope (Least Count) : 0.001 cm

Table 1

Measurements of the diameter of the ring

Ring No. (n)	Microscope readings (cm) on the										Diameter D_{n+m}= R_1-R_2 (cm)	D^2_{n+m} (cm^2)	m_1-m_2	$D^2_{n+m_1} - D^2_{n+m_2}$ (cm^2)
	Left (R_1)				Right (R_2)									
	Main Scale (cm)	Circular scale		Total (cm)	Main scale (cm)	(cm)	Circular scale		Total (cm)					
n+10	3.0	45	61	3.053	2.4	2.3	5	87	2.396		0.657	0.432	0	0
n+9	3.0	40	49	3.044	2.4	2.3	11	95	2.403		0.641	0.411	1	0.021
n+8	3.0	33	37	3.035	2.4	2.4	18	3	2.410		0.625	0.391	2	0.041
n+7	3.0	25	28	3.027	2.4	2.4	26	12	2.419		0.608	0.370	3	0.062
n+6	3.0	19	18	3.019	2.4	2.4	35	20	2.428		0.591	0.349	4	0.083
n+5	3.0	11	8	3.010	2.4	2.4	45	28	2.436		0.574	0.329	5	0.103
n+4	3.0	6	0	3.003	2.4	2.4	57	39	2.448		0.555	0.308	6	0.124
n+3	2.9	97	89	2.993	2.4	2.4	64	32	2.448		0.545	0.297	7	0.135
n+2	2.9	88	78	2.983	2.4	2.4	73	44	2.458		0.525	0.276	8	0.156
n+1	2.9	80	68	2.974	2.4	2.4	81	53	2.467		0.507	0.257	9	0.175

Calculation and Results

Plot a graph between $D^2_{n+m_1} - D^2_{n+m_2}$ vs m_1-m_2 using the method of least squares.

Table 2

Calculation of radius of curvature, R, from the graph

$D^2_{n+m_1} - D^2_{n+m_2}$ (cm^2) from graph	m_1-m_2	λ (cm) (5893×10^{-8})	$R = \frac{D^2_{n+m_1} - D^2_{n+m_2}}{4(m_1 - m_2)\lambda}$ (cm)
0.00284	0		-
0.022	1		93.33
0.042	2		89.09
0.061	3		86.26
0.080	4		84.85
0.0998	5		84.68
0.119	6		84.14
0.139	7		84.24
0.158	8		83.78
0.177	9		83.43

$R_{MEAN} = 85.98$ cm

RESULT : Radius of curvature = (85.98 ± 21.49) cm

R VALUE CALCULATIONS:

- $(m_1 - m_2) = 1$; $\lambda = 5893\times10^{-8}$ cm; $D^2_{n+m_1} - D^2_{n+m_2} = 0.022$ cm^2

$$R = \frac{0.022 \times 10^8}{4\times1 \times 5893} = 93.33 \text{ cm.}$$

- $(m_1 - m_2) = 2$; $\lambda = 5893\times10^{-8}$ cm ; $D^2_{n+m_1} - D^2_{n+m_2} = 0.042$ cm^2

$$R = \frac{0.042 \times 10^8}{4\times2\times5893} = 89.09 \text{ cm}$$

Estimate error in R

The radius of curvature is calculated from Equation (3), viz.

$$R = \frac{D^2_{n+m_1} - D^2_{n+m_2}}{4(m_1 - m_2)\lambda}$$

Since D_{n+m_1} and D_{n+m_2} are only measured, the maximum proportional error in R is given by

$$\frac{\delta R}{R} = \frac{\delta\left(D^2_{n+m_1} - D^2_{n+m_2}\right)}{D^2_{n+m_1} - D^2_{n+m_2}} = \frac{2(\delta D_{n+m_1})D_{n+m_1} + 2(\delta D_{n+m_2})D_{n+m_2}}{D^2_{n+m_1} - D^2_{n+m_2}}$$

Since D_{n+m_1} or D_{n+m_2} is measured by taking the difference between the two readings of a sc
provided with a vernier, the maximum error in measuring each of these quantities is twice the vern
constant i.e. $2v.c.$
Therefore, $\delta D_n = 2v.c$

$$\text{Hence, } \frac{\delta R}{R} = 4v.c\frac{(D_{n+m_1} + D_{n+m_2})}{D^2_{n+m_1} - D^2_{n+m_2}} = \frac{4v.c}{(D_{n+m_1} - D_{n+m_2})}$$

$$\frac{\delta R}{R} = \frac{4(v.c)}{D_{n+m_1} - D_{n+m_2}} = \frac{4(0.001)}{0.016} = 0.25$$

$$(\delta R) = (0.25)(85.98) \text{ cm}$$

$$= 21.49 \text{ cm.}$$

- ABSOLUTE ERROR → 21.49 cm
- RELATIVE ERROR → 0.25

EXPERIMENTAL ERROR (MAXIMUM)

$$(\delta R)_{max.} = 93.33 - R_{MEAN} = 93.33 - 85.98$$

$$= 7.35 \text{ cm}$$

$$\frac{(\delta R)_{max.}}{R_{MEAN}} = \frac{7.35}{85.98} = (0.08) < (0.25)$$

Thus, experimental error is within limits.

RESULT : Radius of curvature = (85.98 ± 21.49) cm.

DISCUSSION :

This experiment uses the concept of interference of the light from two coherent sources, which here are produced from the same source. Two reflections take place, one has a π change in phase due to reflection from rarer to denser medium. The wavefronts obtained are circular giving them a look like rings, with a central dark spot due to destructive interference at center.

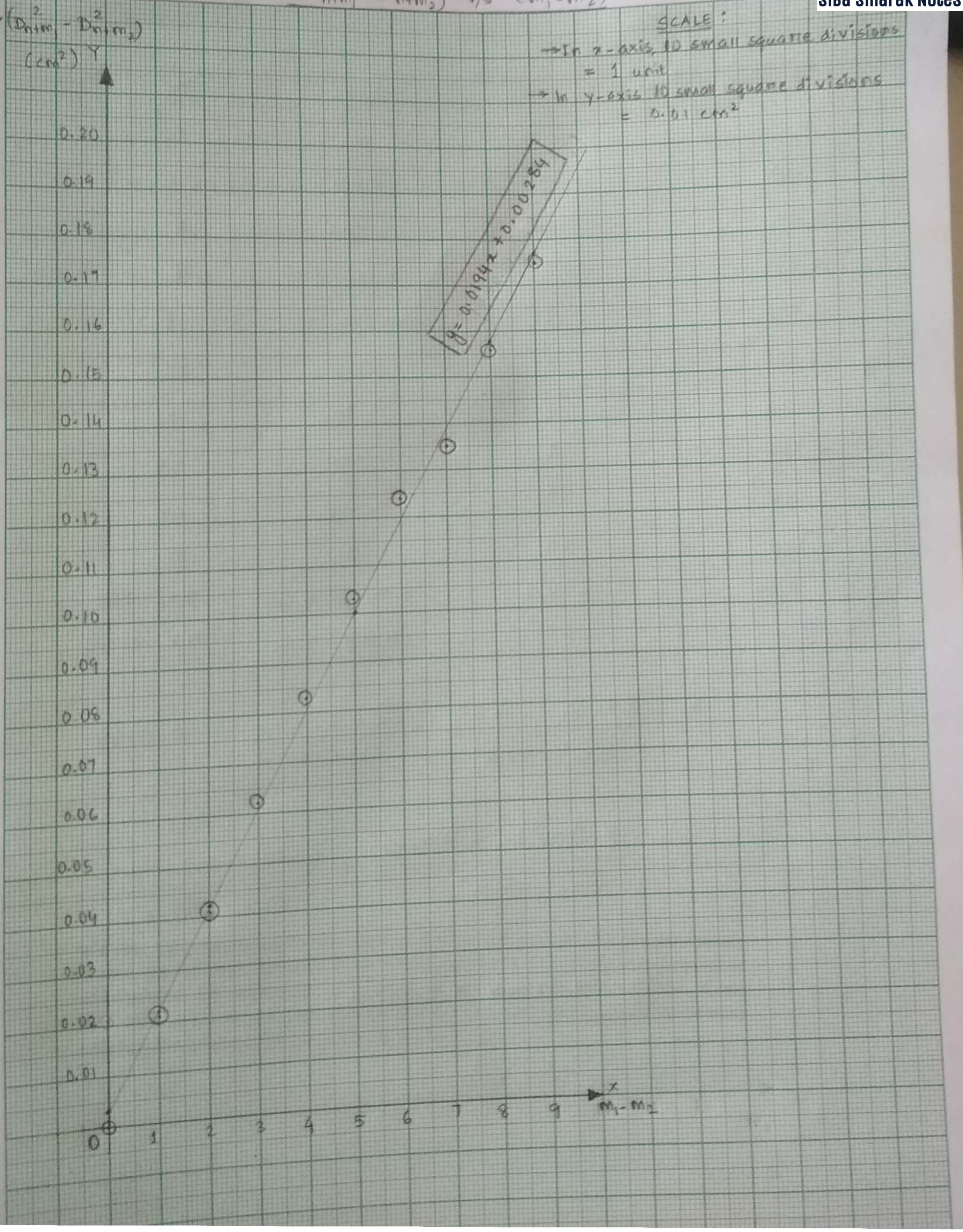
Discussion

(i) The Newton's ring experiment can be also used to find the wavelength of a monochromatic light. In this case, the radius of curvature of the convex surface of the given lens is supplied or is determined otherwise. By employing sodium light whose mean wavelength is 5893Å, R can be determined from Eqn.(3), as in the present experiment. Then the same equation can be used ... of any other given monochromatic light.

RESULT :

Radius of curvature : for ...

$(D^2_{n+m_1} - D^2_{n+m_2})$ v/s $(m_1 - m_2)$



$N = 10$

y_n $(D^2_{n+m_1} - D^2_{n+m_2})$	x_n	$x_n y_n$	x_n^2
0	0	0	0
0.021	1	0.021	1
0.041	2	0.082	4
0.062	3	0.186	9
0.083	4	0.332	16
0.103	5	0.515	25
0.124	6	0.744	36
0.135	7	0.945	49
0.156	8	1.248	64
0.175	9	1.575	81
$\bar{y} = 0.09$	$\bar{x} = 4.5$	$\Sigma x_n y_n = 5.648$	$\Sigma x_n^2 = 285$
		$N\bar{x}\bar{y} = 4.05$	$N\bar{x}^2 = 202.5$

$$a = \frac{\Sigma x_n y_n - N\bar{x}\bar{y}}{\Sigma x_n^2 - N\bar{x}^2} = \frac{5.648 - 4.05}{285 - 202.5} = 0.0194$$

$$b = \frac{\bar{y}(\Sigma x_n^2) - \bar{x}(\Sigma x_n y_n)}{\Sigma x_n^2 - N\bar{x}^2} = \frac{(0.09)(285) - (4.5)(5.648)}{285 - 202.5}$$

$$= 0.00284$$

$$\boxed{y = 0.0194x + 0.00284}$$