Experiment Name / No.: 05

FRIDAY

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Date 05/02/2021

Experiment No:-> 05.

1) Aim:-> To determine the wavelength of Sodium Light by Newton's Ring

2) Apparatus:-> Monochromatic Light, Mount (At the bottom of which we place plane glass and lens, Light is directed to the lens by the reflector fixed on the top of it) Optical flat glass plate, Plano Convex Lens Travelling Microscope.

3) Theory:->

Newton's Ring:-> The phenomenon of Newton's Ring is named after the scientist Sir Issac. Newton, is an interference pattern caused by the reflection of light between two surfaces

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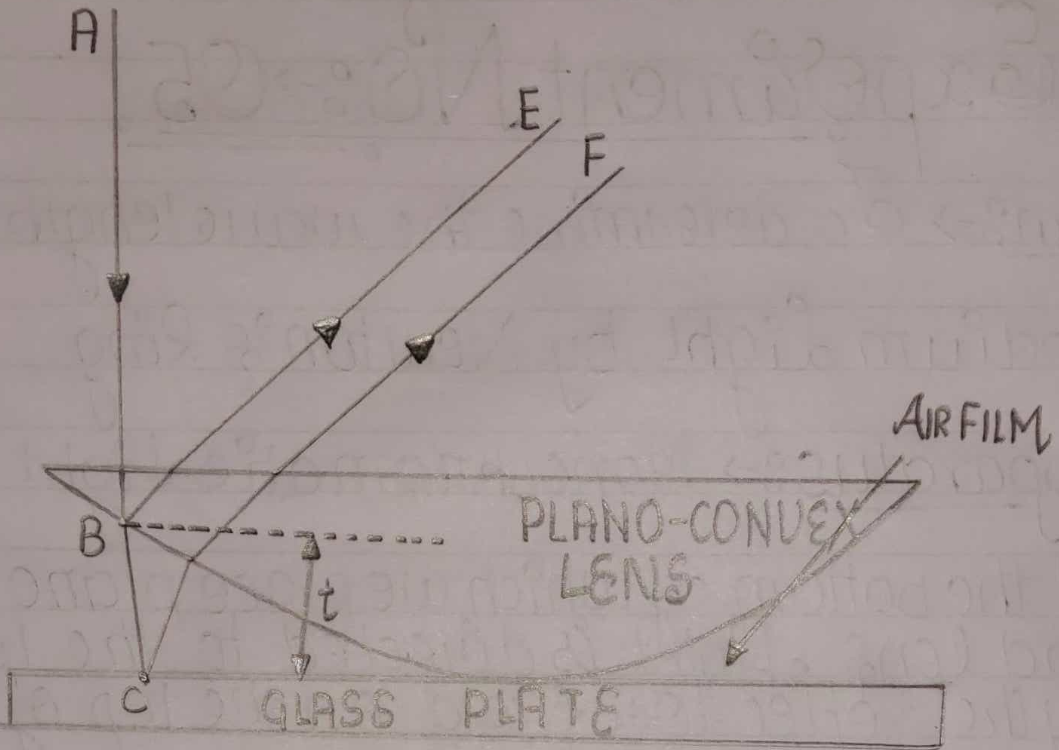
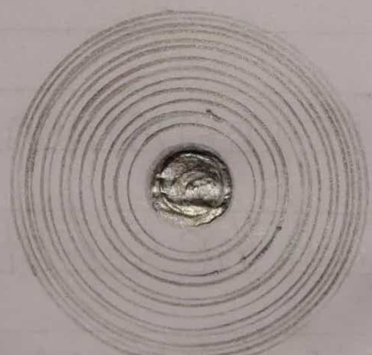


(a) Schematic diagram of light rays in Newton's Ring



(b) Newton's Ring

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→ A spherical surface

→ An adjacent flat surface.

When the beam of monochromatic light is incident normally (shown here as A) on a combination of plano-convex lens and a glass plate, a part of each incident ray is reflected from the lower surface of the lens (shown here as E) and a part after refraction (BC) through the air film between the lens and the plate is reflected back from the plane surface. (shown here as F) These two refracted rays, are coherent and as the lens is symmetric along its axis as well as the thickness is constant along the

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circumference of a ring of a given radius, hence will interfere and produce a system of alternate dark and bright circular rings.

4) Formula used:->

The main scale has 20 divisions between 2cms and Vernier scale has 50 divisions.

Least count of the microscope:->

$$\left(\frac{1}{2}\right) \times 50 = 0.001 \text{ cm}$$

Take the reading of main scale (MSR) by reading just before zero of vernier scale.

For vernier scale reading, only one line of vernier scale coincide with the main scale (MSR)

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So, the total reading will be :->

=> MSR + CCSR x LC) = TSR

=> Plot the graph between (Diameter)^2 and No of rings.

Find out the slope of the graph between m^{th} and n^{th} rings and use the following formula to evaluate the wavelength (λ) of sodium lamp.

$$\lambda = \frac{D_m^2 - D_n^2}{m - n} \times \frac{1}{4R}$$

where, $\frac{D^2m - D^2n}{m-n}$ is the slope of the graph.

=> R is the radius of curvature of the plano convex lens.

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Least count of Microscope.

Main scale has 20 divisions between 2cms and Vernier scale has 50 divisions

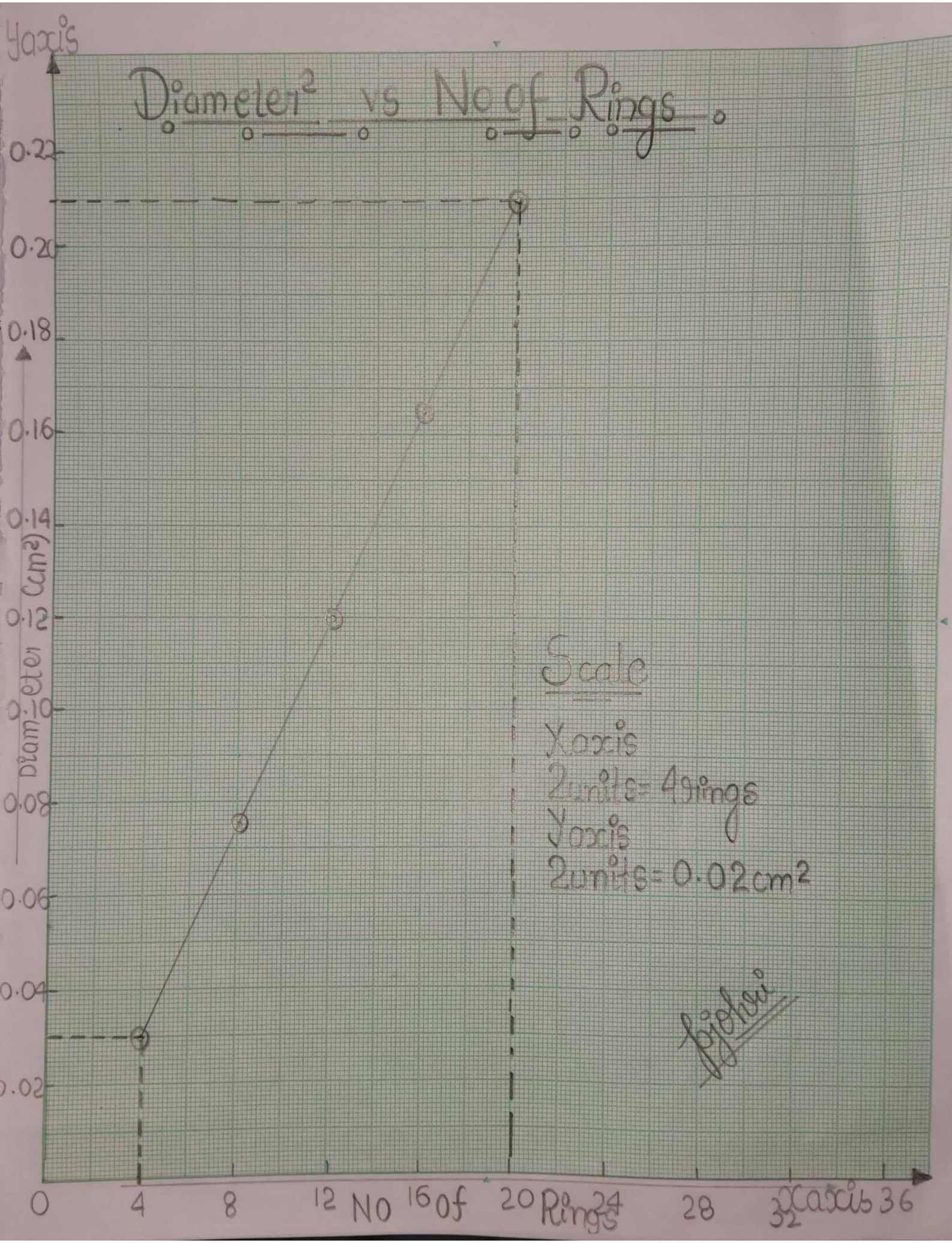
$\Rightarrow \left(\frac{1}{2} \div 50\right) = 0.001$ cms

Observation Table:->

S.No.	Ring No.	LHS Total = MSR + (LC × VSR) MSR	VSR	TSR (a)	RHS Total = MSR + (LC × VSR) MSR	VSR	TSR (b)	Diameter (D) D = b - a.	D^2
1	20	2.24	29	2.269	2.7	27	2.727	0.458	0.209764
2	16	2.283	3	2.283	2.68	19	2.699	0.40620	0.165
3	12	2.28	20	2.30	2.64	6	2.6460	0.346410	0.12
4	8	2.30	4	2.304	2.58	5	~~2.585~~ 2.579	0.27568	0.076
5	4	2.30	45	2.345	2.5	16	2.516	0.171	0.0292

4.64

Sighu


Yaxis
Diameter² vs No of Rings
0.22
0.20
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
Diameter (cm²)
Scale
Xaxis
2units = 4rings
Yaxis
2units = 0.02cm²
fig 1
0
4
8
12
16
20
24
28
32
36
No of Rings
Xaxis

Calculations :→

Where,

$R = 50\text{cms}$

$$\lambda_i = \frac{D^2_m - D^2_n}{m-n} \times \left(\frac{1}{4R}\right)$$

$$\lambda_1 = \left(\frac{0.209764 - 0.165}{20 - 16}\right) \times \frac{1}{4\times 50} = 5595.5\ \text{Å}$$

$$\lambda_2 = \left(\frac{0.165 - 0.12}{16 - 12}\right) \times \frac{1}{4\times 50} = 5625\ \text{Å}$$

$$\lambda_3 = \left(\frac{0.076 - 0.029241}{8 - 4}\right) \frac{4}{\times 1} = 5844.8\ \text{Å}$$

$$\lambda_4 = \left(\frac{0.12 - 0.076}{12 - 8}\right) \times \frac{1}{200} = 5500\ \text{Å}$$

$$\lambda_{mean} = \left(\frac{5595.5 + 5625 + 5844.8}{4}\right) 5500$$

$$\lambda_{mean} = \left(\frac{22565.3}{4}\right) = 5641.325\ \text{Å}$$

Result :→ The wavelength of sodium light by Newton's Ring comes out to be 5641.325 Å

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5) Result :-> The wavelength of sodium light by Newton's Ring comes out to be 5641.325 Å Ans.

6) Percentage Error.

⇒ Percentage Error = $\left[\frac{\lambda r - \lambda s}{\lambda s}\right] \times 100\%$

where,

λr = Experimental wavelength = 5641.325 Å

λs = Standard Wavelength = 5890 Å

% error = $\left|\frac{5641.325 - 5890}{5890}\right| \times 100$

= 4.22%

7) Precautions and Sources of Error.

→ Glass Plate and Lens must be cleaned thoroughly

→ The Lens used should be of large radius of

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curvature

→ The source of light should be an extended one.

→ Before measuring the diameter of rings, the range of microscope should be adjusted properly

→ Cross wire should be focussed on a bright ring tangentially.

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