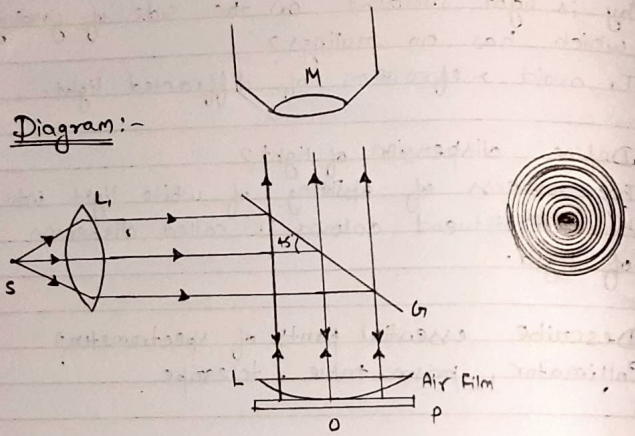
Diagram:-



Newton's ring

Date 02/11/2024
Page No. 27.

Z-Class

Experiment-

Object:- To determine the wavelength of Sodium light by Newton's Ring experiment.

Apparatus:- A plano convex lens of large radius of curvature, traveling microscope, optical arrangement for Newton's ring, sodium lamp and a spherometer.

Theory and Formula:- When a plano-convex lens with its convex surface is placed on a plane glass plate, an air film of gradually increasing thickness is formed between the two. If monochromatic light is allowed to fall normally and viewed as shown in fig, then alternate dark and bright circular fringes are observed. These rings are called Newton's Ring.

The mean wavelength of D_1 and D_2 lines of sodium light is given by the formula:

$$\lambda = \frac{D_{n+p}^2 - D_n^2}{4pR}$$

where,

D_{n+p} = diameter of the $(n+p)^{th}$ Ring

Teacher's Signature :

Teacher's Signature :

Calculations:-

l = cm , h = cm , R = 100 cm

(i) mean of $D^2_{n+p} - D^2_n$ = $\frac{0.411}{5}$ cm^2 = 0.0822×10^{-4} m^2

(for $n=p=6$)

(ii) R = 100 cm

(iii) $\lambda = \frac{D^2_{n+p} - D^2_n}{4PR} = \frac{0.0822 \times 10^{-4} m^2}{4 \times 6 \times 100 \times 10^{-2} m} = 3.425 \times 10^{-7}$ m

$\lambda = 3425 Å$

(iv) Percentage error = $\frac{[\text{Standard value} - \text{calculated value}]}{\text{Standard value}}$

% error = $\frac{(5893 - 3425)}{5893} \times 100$ = 41.8 %

Teacher's Signature :

Date / /

Page No. 28

D_n = diameter of the n^{th} Ring

n & p are the integer number.

R = radius of curvature of the curved surface of the lens.

Again $R = (l^2/6h) + (h/2)$

where, l = distance between the two legs of the spherometer.

h = difference of the reading of the spherometer of on plane surface and curved surface of the lens.

Observations:- (a) table for determination of the diameter of Newton's ring.

Least count = 0.1/100 cm = 0.001 cm

S.No.	No. of rings	Microscope reading: One end MS	CS	TR (a)	Other end MS	CS	TR (b)	Diameter D (a-b)	$(D)^2$ cm^2	$(D^2_{n+p} - D^2_n)$ cm^2
1.	16	4.7	0	4.700	5.1	19	5.119	0.419	0.175	
2.	14	4.7	38	4.738	5.1	12	5.112	0.374	0.139	
3.	12	4.7	46	4.746	5.1	4	5.104	0.358	0.128	
4.	10	4.7	58	4.758	5.0	87	5.087	0.329	0.108	0.067
5.	8	4.8	56	4.856	5.0	69	5.069	0.213	0.045	0.094
6.	6	4.8	88	4.888	5.0	36	5.036	0.148	0.021	0.107
7.	4	4.9	40	4.940	5.0	21	5.021	0.081	0.006	0.102
8.	2	4.9	73	4.973	4.9	94	4.994	0.021	0.004	0.041

Mean value of $D^2_{n+p} - D^2_n$ =

(for p = 8 or 6)

Result:-

Mean wavelength of sodium light = 3425 Å

Standard value is 5893Å

percentage error = ±1.8 % Å

Precautions:-

(i) The cross wire should be focused tangentially on the bright rings.

(ii) The microscope must be moved in uni-direction while taking readings.

Industrial Application:-

(1) Using the method of Newton's rings, the wavelength of a given monochromatic source of light can be determined.

(2) Using Newton's rings, the refractive index of a liquid can calculated.

Teacher's Signature :

Date / /
Page No. 50.

Viva Questions with Answers:-

Q1 What are Newton's Rings?

Ans Alternate dark and bright rings formed due to presence of air film when plano convex lens is placed on glass plate is called newtons rings.

Q2 How are Newtons rings formed?

Ans They are formed as a ~~newtons~~ result of interference between light waves reflected from the upper and lower surface of the air film developed between the convex-surface of plano convex lens and glass plate.

Q3 Why are they circular?

Ans This is so because the air film formed is wedge shaped and loci of points of equal thickness are circles concentric with point of contact.

Q4 What is the function of the 45° inclined glass plate?

Ans It turns the light rays coming from an extended source to ninety degrees so the rays fall normally on the plano convex glass.

Teacher's Signature :

Q5 Why do rings get closer as their order increases?

Ans The diameter of dark rings is proportional to the square root of natural numbers while bright rings are proportional to the square root of odd natural numbers hence they don't increase at the same rate.

Q6 Why is the center of the ring dark?

Ans At the point of contact the path difference is zero but one of the rays is reflected so the effective path difference becomes $\lambda/2$ thus the condition of minimum intensity is created hence it is a dark spot.

Q7 What if the glass plate is replaced with plane mirror?

Ans Then we will not get interference fringe because the intensity of light reflected from mirror will be so great that it won't be visible and we will get uniform illumination.

Teacher's Signature :

Q8 What if sodium light is replaced with white light?

Ans Few coloured fringes will be observed near the center.

Q9 What will happen if we replace the lens with plane glass?

Ans The interference will take place but the shape of the rings will be irregular.

Q10 What will happen if few drops of liquid is introduced between the lens and glass?

Ans The diameter of the rings will decrease because the diameter of the rings is inversely proportional to the refractive index.

Teacher's Signature :