■ PROCEDURE:

(1) Fix an mm graph on the screen and draw a straight line on it.

(2) Taken an optical bench and place the screen at one end and He – Ne laser source at a distance around 1 m from it in the optical bench, so that the spot lies on the centre of the straight line in the screen.

(3) Place the given grating in front of the laser source.

(4) Observe a large number of bright diffraction spots symmetrically on both sides of the central spot.

(5) Mark the portion of the central bright spot with a pencil. Measure the separation between the grating and the screen. From the optical bench and measure the distance between the central bright spot and each dark spots.

(6) Repeat the experiment replacing the grating by a thin wire or hair.

(7) Plot a graph between n and sin θ_n in both case.

■ OBSERVATION:

(a) Determination of wave length

(a + b) of the grating = 1.27×10^{-3}

Table 1: Determination of λ

S.N.	No. of Order (n)	Separation Between Grating and Screen (D)	Distance Between Bright Spots (Y) About Central	Distance $X = \frac{Y}{2}$
1.	1	25	2.8	1.4
2.	2	25	5.5	2.75
3.	3	25	8.5	4.25
4.	4	25	11.5	5.75
5.	5	25	14.6	7.3
6.	1	35	3.7	1.85
7.	2	35	7.4	3.7
8.	3	35	11.2	5.6
9.	4	35	15	7.5
10	5	35	17.1	8.55

Table 2: Determination of thickness of wire or hair:

S.N.	No. of Order (n)	Separation Between Grating and Screen (D)	Distance Between Bright Spots (Y) About Central	Distance $X = \frac{Y}{2}$
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10				

■ DATE ANALYSIS:

(a) Calculation of λ

S.N.	$\tan\theta = X / D$	$\sin\theta_n$	$\lambda = (a+b)\sin\theta_n / n$	$\bar{\lambda}$	$\delta\lambda_i = \lambda_i - \bar{\lambda}$	$\delta\lambda_i^2$	σ_λ
1.	0.056	0.0559	7.0993×10^{-5}	6.793685×10^{-5}	3.05615×10^{-6}	9.34×10^{-12}	1.0909×10^{-6}
2.	0.11	0.109	6.9215×10^{-5}		1.27815×10^{-6}	1.63×10^{-12}	
3.	0.17	0.167	7.069×10^{-5}		2.75315×10^{-6}	7.57×10^{-12}	
4.	0.23	0.224	7.112×10^{-5}		3.18315×10^{-6}	1.01×10^{-11}	
5.	0.292	0.280	7.112×10^{-5}		3.18315×10^{-6}	1.01×10^{-11}	
6.	0.0528	0.0527	6.6929×10^{-5}		-1.00785×10^{-6}	1.015×10^{-12}	
7.	0.105	0.1044	6.6294×10^{-5}		-1.64285×10^{-6}	2.69×10^{-12}	
8.	0.16	0.157	6.646×10^{-5}		-1.47685×10^{-6}	2.18×10^{-12}	
9.	0.214	0.209	6.63575×10^{-5}		-1.57935×10^{-6}	2.49×10^{-12}	
10	0.2442	0.287	6.019×10^{-5}		-7.74685×10^{-6}	6.001×10^{-11}	

$\Sigma\lambda_i^2 = 1.07125\times10^{-10}$

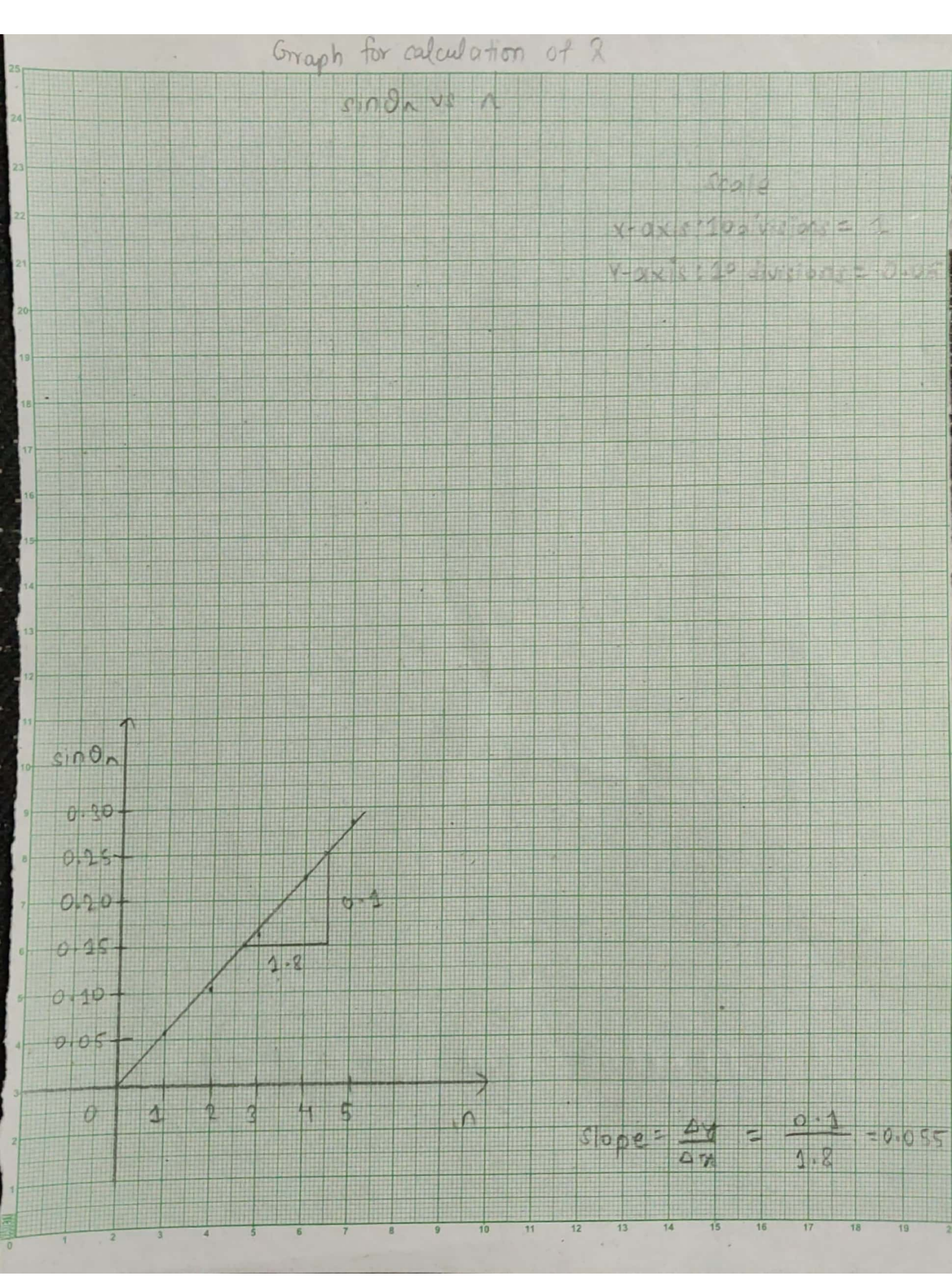
Graph for calculation of λ

$\sin\theta_n$ vs n

Scale

x-axis: 10 divisions = 1

y-axis: 1 division = 0.005



$$\text{Slope} = \frac{\Delta y}{\Delta x} = \frac{0.1}{1.8} = 0.055$$

Wave length of He – Ne laser from graph = 7055.556 Å

(a) Calculation of λ

S.N.	$\tan\theta = X / D$	$\sin\theta_n$	$\lambda = (a+b)\sin\theta_n / n$	$\bar{\lambda}$	$\delta\lambda_i = \lambda_i - \bar{\lambda}$	$\delta\lambda_i^2$	σ_λ
1.							
2.							
3.							
4.							
5.							
6.							
7.							
8.							
9.							
10							

RESULTS:

The wave length of He – Ne laser = $6793.6 \pm 1.09 \times 10^{-6}$ Å

Standard value of He – Ne laser = 6328 Å

Percentage error = 7.35 %

The thickness of hair from graph = ...

The thickness of wire (hair) = ... ± ... ...

DISCUSSION

In lab, we fixed a graph paper on the wall and He-Ne laser source was placed at distance 25 cm from the graph. Then a grating was placed between the source and the screen (paper). The diffraction pattern was observed and bright points were marked with pencil. Then distance between symmetrical points were measured. The same procedure was done by placing source at distance 35 cm from screen.

CONCLUSION:

From the data collected and with the help of graph, we were able to determine the wavelength of He–Ne laser.

PRECAUTIONS:

(I) The laser source should not be on for long period.

(II) The bright spots must be marked correctly.

(III) Separation of points must be measured correctly.

(IV) ... ...

ANSWER THE FOLLOWING QUESTIONS:

A. Before performing Experiment.

(1) Write working formula for λ Sinθn and d

The working formula for, $\lambda \sin\theta_n$ and d are;

$$d \sin\theta_n = n\lambda$$

(2) What do you mean by diffraction of light ? How does it differ from interference of light ?

Diffraction of light is the slight bending of light as it passes around the edge of an object

It differs from interference as diffraction is slight bending around a corner while interference is the collision of two waves with each other.

(3) What is diffraction grating ? How many types of grating do you known ?

Diffraction grating is an optical element that disperses light composed of different wavelengths into light components by wavelength.

Four types of gratings are known. They are ruled gratings, holographic gratings, transmission gratings and reflection gratings.

(4) Radio wave can be received inside a room but light cannot. Explain why ?

=> Radio wave can be received inside a room because radio wave is huge and their wavelength are much bigger than atoms of wall so they penetrate through. While light cannot be received as their wavelength is small and nearly equal to size of atoms so they cannot penetrate.

B: After Performing Experiment

(1) Explain how a grating produces dispersion ? Compare its action with a prism.

=> According to huygen's principle, each point on wave front act as a source of wavelets. In grating there are thousands of slits which gives rise to spherical wavelets - These wavelets give rise to dispersion.

whereas in prism light just deviates after diffraction but due to different wavelength, the diffraction causes dispersion.

(2) What is laser ? How laser is produced ?

=> Laser stands for light amplification by stimulated emission of radiation - It is a coherent, monochromatic highly intense beam of light.

Laser is produced by stimulated emission of radiation.

(3) Point out the difference between laser and normal light.

=> Laser is coherent and monochromatic source of light while normal light is mixture of seven colors of light and is not coherent.

4) Why did you take distance between bright spots in case of grating but distance between dark spots or minima in case of hair in your experiments ?

=> Because in case of grating the bright spots are much sharper and narrow.

(5) Point out the differences between spontaneous emission and stimulate emission.

=> The difference between spontaneous emission and stimulate emission is spontaneous emission occurs spontaneously without any external stimulation while stimulate emission occurs after providing some external energy to electron which it loses as emission of radiation.

(6) What parts are required to produced laser ?

The following are required to produce laser:

- source of atom
- emf source

Name of teacher: **Teacher's Signature**

Date:

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