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Experiment No. 2
Newton's rings

Aim :

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

formulas used :

Determination of wavelength :

$$D_n^2 = \frac{4nR\lambda}{\mu}$$

where,

D_n = diameter of the n^{th} fringe
R = Radius of curvature of lens
λ = wavelength to be calculated
μ = Refractive index

plot between D_n^2 and r will be linear with slope(m)

$$m = 4R\lambda \qquad (\mu = 1 \text{ for air})$$
$$\Rightarrow \lambda = \frac{m}{4R}$$

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observations

Table 1

Sodium light

Ring No.	Microscope reading						Diameter $D_n = \lvert a-b \rvert$ (cm)	D_n^2 (cm^2)
	Left side (a)			Right side (b)				
	Main	Vernier	total	Main	Vernier	total		
12	2.20	0.009	2.209	2.70	0.015	2.715	0.506	0.256
11	2.24	0	2.240	2.70	0.013	2.713	0.473	0.223
10	2.23	0.004	2.234	2.70	0	2.7	0.466	0.217
9	2.25	0.016	2.410	2.65	0.029	2.679	0.269	0.072
8	2.30	0	2.300	2.65	0.016	2.666	0.366	0.134
7	2.40	0.002	2.402	2.65	0.011	2.661	0.259	0.067
6	2.35	0.005	2.355	2.65	0	2.650	0.295	0.087
5	2.24	0.007	2.247	2.60	0.007	2.607	0.36	0.130
4	2.18	0	2.180	2.60	0.002	2.602	0.422	0.178
3	2.21	0.003	2.213	2.55	0.029	2.579	0.306	0.093
2	2.21	0.005	2.215	2.55	0.021	2.571	0.356	0.126
1	2.35	0.013	2.363	2.50	0.014	2.514	0.151	0.022

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Table 2 (Neon light)

Ring No.	Microscope reading						Diameter $D_n = \lvert a-b \rvert$ (in cm)	D_n^2 (in cm^2)
	Left side (a)			Right side (b)				
	Main	Vernier	total	Main	Vernier	total		
12	2.23	0.03	2.233	2.71	0.011	2.721	0.488	0.238
11	2.22	0.029	2.249	2.72	0.025	2.745	0.496	0.246
10	2.26	0.04	2.3	2.7	0.026	2.726	0.426	0.181
9	2.25	0.003	2.258	2.69	0	2.69	0.432	0.186
8	2.25	0.016	2.266	2.69	0.015	2.705	0.439	0.192
7	2.31	0	2.31	2.5	0.003	2.503	0.193	0.037
6	2.3	0.025	2.325	2.55	0.010	2.56	0.235	0.055
5	2.3	0.011	2.311	2.71	0.024	2.734	0.423	0.179
4	2.35	0.15	2.5	2.72	0.021	2.741	0.241	0.058
3	2.40	0.015	2.415	2.42	0.017	2.419	0.004	0
2	2.35	0.025	2.375	2.5	0.026	2.526	0.151	0.022
1	2.45	0.025	2.475	2.55	0.017	2.567	0.092	0

Calculations –

Table 1 – Slope $m = \dfrac{0.223 - 0.087}{11 - 6} = 0.0272$

$\lambda = \dfrac{m}{4R} = \dfrac{0.0272}{4 \times 80} = 8.5 \times 10^{-5} = 850\,nm$

Actual $\lambda = 589.3\,nm$

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$$\%\text{ error} = \frac{850 - 589.3}{850} = 30.6\%$$

Table 2 - slope $m = \frac{0.192 - 0.179}{8 - 5} = 4.33 \times 10^{-3}$

$$\lambda = \frac{m}{4R} = 732\text{nm} \qquad \text{actual } \lambda = 718\text{nm}$$

$$\%\text{ error} = \frac{732 - 718}{732} = 19.1\%$$

Sources of error -

1. defective software of ~~online~~ online lab
2. can't measure exact number of rings ~~to~~ due to such a small size
3. cannot accurately take measurement from vernier caliper.

Comments - I accidentally took neon light for table 2 instead of Red light. Please allow this time.

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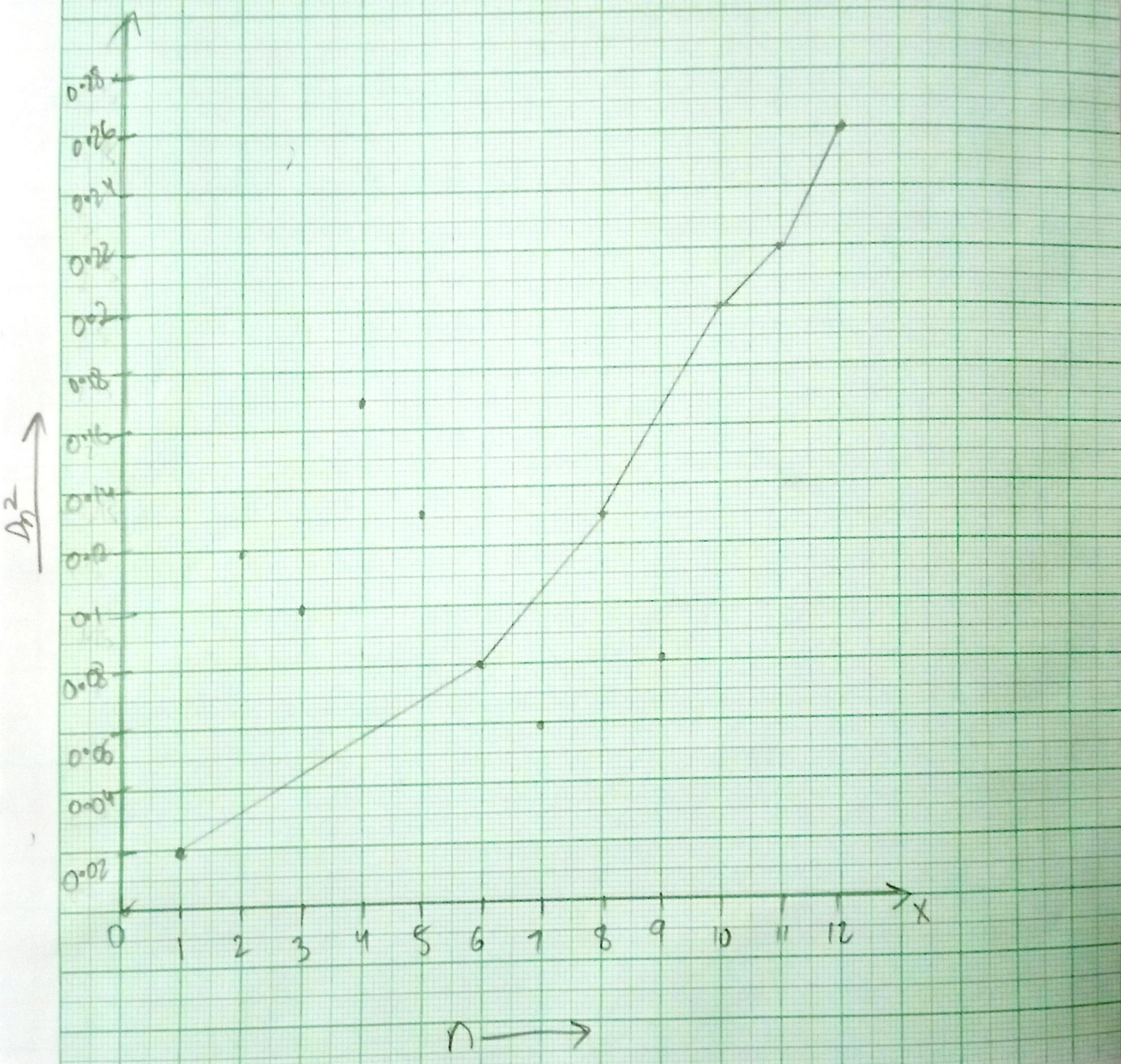
Result

The Newton's ring experiment is successful in calculating a wavelength of light with least possible errors.

Table 1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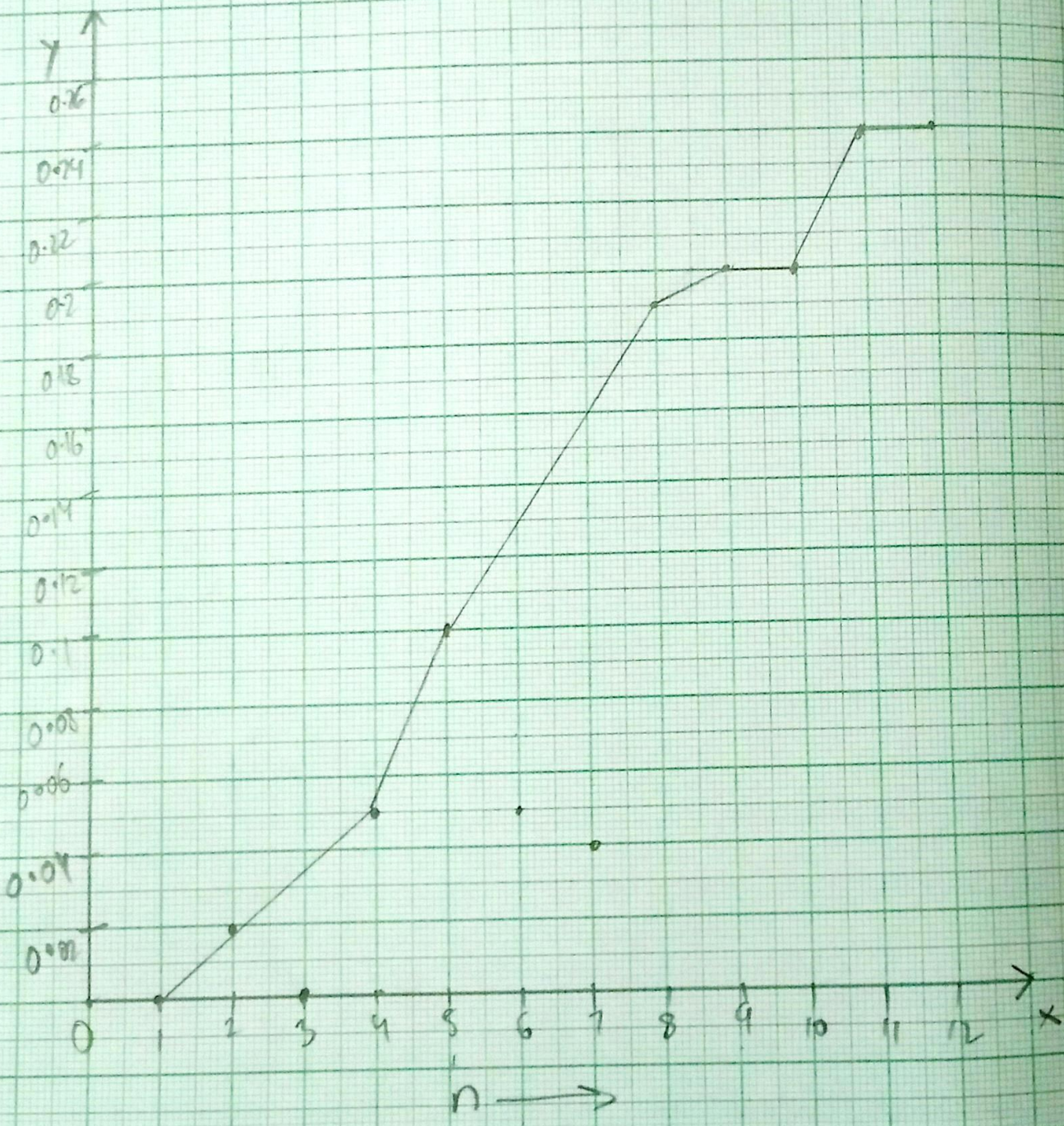
0.26
0.24
0.22
0.2
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
Δy^2
0
1
2
3
4
5
6
7
8
9
10
11
12
X
n

Table 2


y
0·16
0·14
0·12
0·1
0·08
0·06
0·04
0·02
0·18
0·16
0·14
0·12
0·1
0·08
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0·04
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0
1
2
3
4
5
6
7
8
9
10
11
12
x
n