Riverside Community College

Physics 4-C

LABORATORY REPORT 6

Do Lenses do the thing?

Author: Marlon Lopez

Lab Partner: Chris Stark

Professor

Dr. Russel

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1 Introduction

This lab's goal will be to test the Thin lens law which will result with a focal point for the corresponding lens, as well as making sure the magnification equation for a thin lens holds true.

2 Methodology

We will use three different lenses to test the Thin lens law as well as checking if the Magnification equation is indeed true. The process should be the same for your three different lenses

2.1 Setup

1. We utilized a PASCO metallic rail 1.6 meters in length where the measurements are marked on the rail. A light source from PASCO and a plastic board from PASCO .
2. Measure the height of the Image on the PASCO light source, h_o. We measured from the two tips of the arrows, I'll refer to this as my points of reference.
3. Position a lens on the track so that it starts at 20 cm. [1]

2.2 Procedure

What lens you use should not change the procedure as it is identical for all three lenses you will use in this lab. The lenses are labeled; Red, Green, Blue.

1. Start the experiment by placing the plastic board on the track.
2. Move the board on the track until you find a position that will allow the object image focus on the board.
3. Log the displacement of the lens, call that d_o. As well as the distance of the image, d_i.[2]
4. Measure and log the points of reference on the projected image.
5. Repeat 9 more times, incrementing the light by 5 cm.

[1]We found that anything less won't have enough space on the track to focus the image.

[2]An easy way to get this is by measuring the distance to the board, x_i) and subtracting that from d_o).

3 Data

Tabulating our displacement of the lens as well as the white board

do (cm)	xi (cm)	1/do (1/cm	hi (cm)	di (cm)	1/di 1/(cm	hi/ho	negative di/
20	112	0.05	9	92	0.01087	-4.5	-4.6
25	72	0.04	3.75	47	0.021277	-1.875	-1.88
30	66.1	0.033333	2.4	36.1	0.027701	-1.2	-1.20333
35	66	0.028571	1.7	31	0.032258	-0.85	-0.88571
40	68	0.025	1.4	28	0.035714	-0.7	-0.7
45	71	0.022222	1.1	26	0.038462	-0.55	-0.57778
50	74.5	0.02	1	24.5	0.040816	-0.5	-0.49
55	78.3	0.018182	0.9	23.3	0.042918	-0.45	-0.42364
60	82.7	0.016667	0.7	22.7	0.044053	-0.35	-0.37833
65	87	0.015385	0.65	22	0.045455	-0.325	-0.33846

Figure 1: Green lens

BLUE							
do (cm)	xi (cm)	1/do (1/cm	hi (cm)	di (cm)	1/di 1/(cm	hi/ho	negative di/do
30	95	0.033333	4.25	65	0.015385	-2.125	-2.16667
35	86	0.028571	2.85	51	0.019608	-1.425	-1.45714
40	82.4	0.025	2.1	42.4	0.023585	-1.05	-1.06
45	83	0.022222	1.7	38	0.026316	-0.85	-0.84444
50	85	0.02	1.4	35	0.028571	-0.7	-0.7
55	88.1	0.018182	1.2	33.1	0.030211	-0.6	-0.60182
60	91.6	0.016667	1.1	31.6	0.031646	-0.55	-0.52667
65	95.3	0.015385	0.95	30.3	0.033003	-0.475	-0.46615
70	99.3	0.014286	0.8	29.3	0.03413	-0.4	-0.41857
75	103.7	0.013333	0.75	28.7	0.034843	-0.375	-0.38267

Figure 2: Blue lens

RED							
do (cm)	xi (cm)	1/do (1/cm	hi (cm)	di (cm)	1/di 1/(cm	hi/ho	negative di/do
20	40	0.05	1.975	20	0.05	-0.9875	-1
25	42.1	0.04	1.35	17.1	0.05848	-0.675	-0.684
30	45.1	0.033333	1	15.1	0.066225	-0.5	-0.50333
35	49	0.028571	0.775	14	0.071429	-0.3875	-0.4
40	53.3	0.025	0.65	13.3	0.075188	-0.325	-0.3325
45	57.8	0.022222	0.55	12.8	0.078125	-0.275	-0.28444
50	62.7	0.02	0.5	12.7	0.07874	-0.25	-0.254
55	67.1	0.018182	0.45	12.1	0.082645	-0.225	-0.22
60	72.1	0.016667	0.4	12.1	0.082645	-0.2	-0.20167
65	77	0.015385	0.35	12	0.083333	-0.175	-0.18462

Figure 3: Red lens

4 Analysis

4.1 Calculations

1. We will be verifying the Thin lens law by determining a linear relationship. $\frac{1}{d_o} + \frac{1}{d_i} = \frac{1}{f}$
2. You start off by subtracting $\frac{1}{d_o}$ to both sides of the equation. $\frac{1}{d_i} = -1(\frac{1}{d_o}) + \frac{1}{f}$
3. We notice that $\frac{1}{d_i}$ corresponds to the y axis, $\frac{1}{d_o}$ corresponding to the x axis, and $\frac{1}{f}$ to the y intercept.

4.2 Interpretation

Plotting out our $\frac{1}{d_i} vs \frac{1}{d_o}$, we should get a slope from our equation $\frac{1}{d_i} = -1(\frac{1}{d_o}) + \frac{1}{f}$. Where we said x is $\frac{1}{d_o}$ meaning that for our data to show that the thin lens law is true, our slope should be -1.

From this we can find the focus point for each lens by taking the reciprocal of the y intercept.

From our table.1, we can check the magnification law $\frac{h_i}{h_o} = -\frac{d_i}{d_o}$ by seeing if the corresponding columns are equal.

Finding the slope for the Green, Blue, and Red lenses:

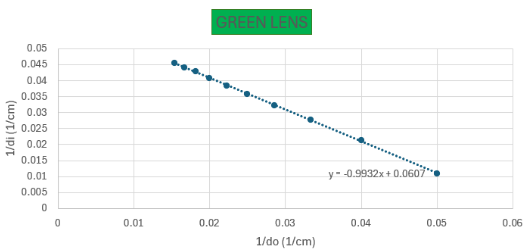

Figure 4: Green Lens

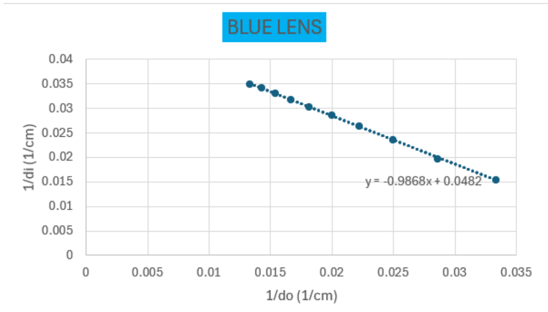

Figure 5: Blue Lens

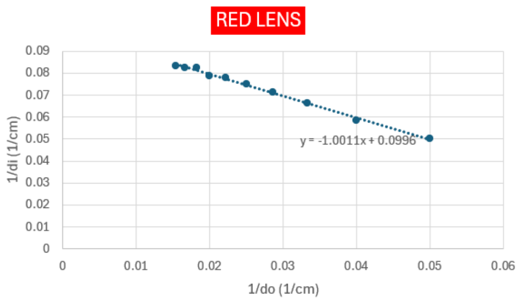

Figure 6: Red Lens

5 Result

The Green lens was found to have a focus of 16.4745 cm, Blue had a focus of 20.7469 cm, and Red having focus of 10.0402 cm. Our experimental values for $\frac{h_i}{h_o}$ and $-\frac{d_i}{d_o}$ showed that those values were approximately equal which indicates that the magnification equation is indeed true.

6 Conclusion

With this experiment we experimentally determined that the Thin lens law was indeed correct as well as seeing if the magnification of an image equation to be true.[3]

One thing to note with our data is that there might be slight discrepancy's as the projected image got smaller it was more difficult to accurately get a measurement.

7 References

[1] Dr. Russel's Lecture 4/15/24, Riverside Community College.

Special thanks to my Grandma for making me breakfast before this lab!

[3] For thin lenses