Riverside Community College

Physics 4-C

LABORATORY REPORT 5

What the frac

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Professor

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1 Introduction

In this lab we experimentally find the index of refraction of acrylic and water.

2 Methodology

The process to achieve our experimental values of refraction will be identical for finding both the acrylic block's and the water's refraction respective indices.

2.1 Setup

1. You would need a wooden block with a circle of radius 25.25 cm drawn on with pen, a laser pointer, a acrylic semicircle block, and a a water in a plastic semicircle container[1]

2. Place either semicircle block right in the middle of the circle with the flat side facing the laser, we started with the acrylic block first.

3. the laser pointer should be slightly over the wooden block containing our circle.

2.2 Procedure

You could either start with the acrylic block or water in a plastic container, the process will be the same. For both materials we will record the displacement of the laser pointer to the right of the middle of the circle and record the displacement to the left side of the middle of the circle.

Repeat the procedure for both materials.

1. Start by displacing the laser pointer to the right side of the center of the circle.

2. For five different distances point the laser pointer to the center of the material and measure the distance from the center the circle to the displacement of the laser pointer x_1.

3. With this the laser should go through the material, so then you should measure the displacement of the exiting laser to the center of the circle x_2.

4. Repeat for the five different distances to the left of the middle of the circle.

2.3 Bonus experiment

If time permits make sure the law of reflection holds true! Keep the same set up but swap the material with a mirror. Measure five different displacements of the laser and the corresponding reflection's displacement from the center.

[1] The Plastic container should have a similar index of refraction to that of water.

3 Data

Tabulating our displacement of the laser as well as the sin(theta)[2] of both sides of the Acrylic and Water container:

Table 1: Acrylic Side 1

x1(cm)	x2(cm)	Sin(theta1)	Sin(theta2)
4.7	3.5	0.186139	0.138614
6.8	5.25	0.269307	0.207921
8.4	5.9	0.332673	0.233663
9.9	6.7	0.392079	0.265347
11.5	7.7	0.455446	0.304950

Table 2: Acrylic Side 2

x1(cm)	x2(cm)	Sin(theta1)	Sin(theta2)
3.3	1.9	0.130693	0.075248
5.2	3.3	0.205941	0.130693
7.4	4.8	0.293069	0.190099
9.2	6.25	0.364356	0.247525
10.6	7.5	0.419802	0.297030

Table 3: Water Side 1

x1(cm)	x2(cm)	Sin(theta1)	Sin(theta2)
3.45	1.15	0.136634	0.045545
6	3.9	0.237624	0.154455
8.15	5.6	0.322772	0.221782
10.4	7.3	0.411881	0.289109
13.7	9.2	0.542574	0.364356

Table 4: Water Side 2

x1(cm)	x2(cm)	Sin(theta1)	Sin(theta2)
1.85	2.9	0.073267	0.114851
5.2	4.5	0.205941	0.178218
7.7	6.35	0.304950	0.251485
9.8	8.05	0.388119	0.318812
12.2	10.5	0.483168	0.415842

Table 5: Bonus experiment: displacement from center

x1 (cm)	**x2 reflection(cm)**
7.4	7.3
9.2	9.4
12.4	12.3
14.5	14.3
15.4	15.0

[2]The sin(theta) is from the displacement over the radius.

4 Analysis

4.1 Calculations

1. To find our index of refraction for each material, we started with the law of refraction, $n_1 \times \sin\theta_1 = n_2 \times \sin\theta_2$.
2. The medium of the left hand side is air and the medium of the right hand side is that of our material.
3. Because we know the index of refraction of air is around 1 and we know both sin theta values we can rearrange this linear equation so that the slope will give us our index of refraction for our material.
4. $\frac{n_1}{n_2} \times \sin\theta_1 = \sin\theta_2$
5. where $n_1 = 1$
6. so $\frac{1}{n_2} \times \sin\theta_1 = \sin\theta_2$.

4.2 Interpretation

Plotting out our $\sin\theta_1 vs \sin\theta_2$, we get a slope of $\frac{1}{n_2}$ given from the equation $\frac{1}{n_2} \times \sin\theta_1 = \sin\theta_2$. So to get the index of refraction we just take the reciprocal of the slope given. We will use the average of both sides values to get a more accurate index of refraction.

Finding the slope for both sides of acrylic and water:

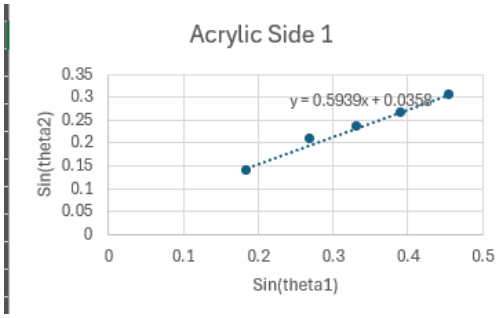

Figure 1: Side 1 of Acrylic block

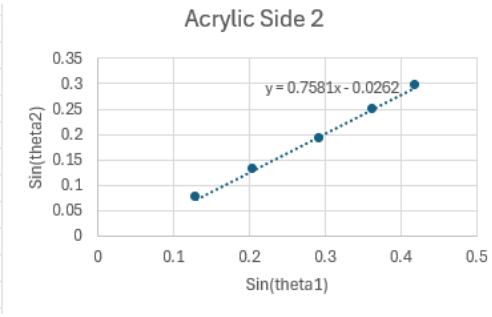

Figure 2: Side 2 of Acrylic block

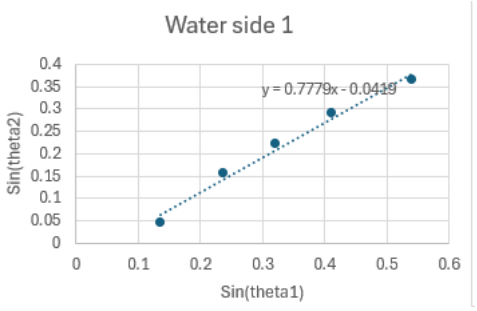

Figure 3: Side 1 of Water in container

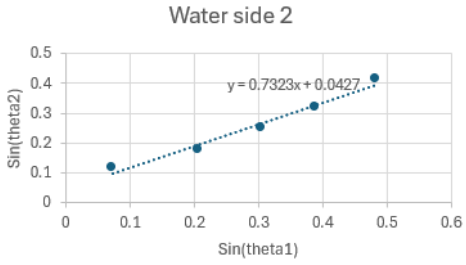

Figure 4: Side 2 of Water in container

5 Result

Our experimental index of refraction for acrylic would be 1.5. The experimental index of refraction for water would be 1.2.

6 Conclusion

With this experiment we experimentally determined the index of refraction of two different materials as well as observed the law of reflection to hold true.

One thing to note with our data is that there might be slight discrepancy's as our laser pointer's power cable had to be constantly held or placed back in as it was loose.

7 References

[1] Dr. Russel's Lecture 3/25/24, Riverside Community College.

Special thanks to the everything bagel I ate before lab!