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Phys111 Report

Experiment #6: Index of Refraction

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(1) Abstract:

- **Aim of the experiment:**

To find the index Refraction when light passes from one medium to another (Plastic).

- **The main result is:**

The index of refraction of the block is $\boldsymbol{\mu} = 1.32 \pm 0.07$

(2) Data:

	i		$\bar{\imath}$	$sin(\bar{\imath})$	r		$\bar{r}$	$sin(\bar{r})$
	i_1	i_2			r_1	r_2		
1	10º	10º	10º	0.17365	6 º	6 º	6 º	0.10453
2	20º	21º	20.5º	0.35020	11 º	10 º	10.5º	0.18223
3	30º	30º	30º	0.50000	18 º	18 º	18º	0.30902
4	40º	41º	40.5º	0.64945	26 º	26 º	26º	0.43837
5	50º	50º	50º	0.76604	32 º	31 º	31.5º	0.52250
6	60º	61º	60º	0.86602	36 º	36 º	36º	0.58778

(3) Calculations: 4.590580025

Let $x = sin(\bar{r}),\ \ y = sin(\bar{i})$

x_i	y_i	$x_i y_i$	x_i^2
0.10453	0.17365	0.01664	0.01815
0.18223	0.35020	0.06382	0.03321
0.30902	0.50000	0.15451	0.09550
0.43837	0.64945	0.28470	0.19217
0.52250	0.76604	0.40026	0.27030
0.58778	0.86602	0.50903	0.34585
$\sum x_i$ = 2.14443	$\sum y_i$ =3.30536	$\sum x_i y_i$ = 1.42896	$\sum x_i^2$ = 0.95518

$D = 6\left(\sum_{i=1}^{6} x_i^2\right) - \left(\sum_{i=1}^{6} x_i\right)^2$ = 6x(0.95518) – (2.14443)^2 = 1.12547

$\mu = \frac{6\left(\sum_{i=1}^{6} x_i y_i\right) - \left(\sum_{i=1}^{6} x_i\right)\left(\sum_{i=1}^{6} y_i\right)}{D} = \frac{[6x(1.42896)] - [(2.14443)(3.30536)]}{1.12547}$ = 1.31841 ➔ **1.32**

$b = \frac{\left(\sum_{i=1}^{6} x_i^2\right)\left(\sum_{i=1}^{6} y_i\right) - \left(\sum_{i=1}^{6} x_i\right)\left(\sum_{i=1}^{6} x_i y_i\right)}{D} = \frac{(0.95518)(3.30536) - (2.14443)(1.42896)}{1.12547}$ = 0.08334

$(y_i - mx_i - b)$	$(y_i - mx_i - b)^2$
0.17365 – 0.13797 – 0.08334 = **−0.04766**	0.0022751556
0.35020 – 0.24015 – 0.08334 = **0.02671**	0.0007145641
0.50000 – 0.40750 – 0.08334 = **0.00916**	0.0000839456
0.64945 – 0.57773 – 0.08334 = **−0.01162**	0.0001345444
0.76604 – 0.68987 – 0.08334 = **−0.00717**	0.0000514689
0.86602 – 0.77573 – 0.08334 = **0.00695**	0.0000483025
	$\sum (y_i - mx_i - b)^2$ = 0.0033089811

$\sigma_y^2 = \frac{1}{4}\sum_{i=1}^{N}(y - mx_i - b)^2 = \frac{1}{4}$ x 0.0033089811= 0.0008272453

$\Delta\mu = \Delta m = \sqrt{\frac{6\sigma_y^2}{D}} = \sqrt{\frac{6 \text{ x } 0.0008272453}{1.12547}}$ = 0.06634 ➔ **0.07**

(4) Results:

- The index of refraction of the block is μ = 1.32 ± 0.07

(5) Conclusions:

$\mu \pm \Delta\mu = 1.32 \pm 0.07$

After I did the readings and calculations ,I need to make the Discrepancy Test to check if the result is accepted or not :

***Discrepancy Test = |true value – exp. Value| ≤ 2 × error**

= | 1.46 – 1.32 | ≤ 2 x 0.07 ➔➔➔ 0.14 ≤ 0.14 **(it's correct).**

The result is accepted. (The true value of the plastic is 1.46).

Using my calculations and the final result, I can confirm that the refractive index I determined for plastic is consistent with the real value.

Although the result I obtained was acceptable, it doesn't necessarily mean that it is free from any errors.

That means there are errors in the experiment such as:

The plastic block that could have scratches or refraction that will lead to irregular refraction patterns could as well as distributing the expected behavior of the light passing through the block, also the protractor could be damaged , or the numbers may not be visible clearly because of its age , as well as the light may not be bright enough to get through the block, and the light might be shaking, spreading out the rays. This is may be the systematic error.

The random error may be that the Incorrect protractor readings may occur due to a lack of proper usage information. Also, might be some errors with the calculation that lead to the random errors.
