

Phys111 Report

Experiment #6: Index of Refraction

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Section:	
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(1) Abstract:

- Aim of the experiment:

is to calculate the index of refraction for unknown medium.

- The main result is:

▪ The index of refraction of the block is $\mu = 1,50 \pm 0,05$.

(2) Data:

	i		\bar{i}	$\sin(\bar{i})$	r		\bar{r}	$\sin(\bar{r})$
	i_1	i_2			r_1	r_2		
1	10°	11°	10,5	0,182	6°	6°	6	0,106
2	20°	20°	20	0,342	13°	13°	13	0,225
3	30°	29°	30 29,5	0,500 0,492	18°	18°	18	0,309
4	40°	39°	39,5	0,636	25°	25°	25	0,423
5	50°	50°	50	0,766	30°	30°	30	0,500
6	60°	60°	60	0,866	34°	34°	34	0,559

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(3) Calculations:

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

x_i	y_i	$x_i y_i$	x_i^2
0,106	0,182	0,019	0,011
0,225	0,342	0,077	0,051
0,309	0,508 0,442	0,157	0,095
0,423	0,636	0,269	0,179
0,500	0,766	0,383	0,250
0,559	0,866	0,484	0,742 0,312
$\Sigma x_i =$ 2,122	$\Sigma y_i =$ 3,300	$\Sigma x_i y_i =$ 1,389	$\Sigma x_i^2 =$ 1,335 0,898

$$D = 6 \left(\sum_{i=1}^6 x_i^2 \right) - \left(\sum_{i=1}^6 x_i \right)^2 = 6(0,898) - (2,122)^2 = \del{0,88} \underline{0,8851}.$$

$$\mu = \frac{6(\sum_{i=1}^6 x_i y_i) - (\sum_{i=1}^6 x_i)(\sum_{i=1}^6 y_i)}{D} = \frac{6(1,389) - (2,122)(3,300)}{0,8851} = \underline{1,5042}.$$

$$b = \frac{(\sum_{i=1}^6 x_i^2)(\sum_{i=1}^6 y_i) - (\sum_{i=1}^6 x_i)(\sum_{i=1}^6 x_i y_i)}{D} = \frac{(0,898)(3,3) - (2,122)(1,389)}{0,8851} = \underline{0,018}.$$

$(y_i - mx_i - b)$	$(y_i - mx_i - b)^2$
$0,182 - (0,16112) - 0,018 = 2,88 \times 10^{-3}$	$8,294 \times 10^{-6}$
$0,342 - (0,342) - 0,018 = -0,018$	$3,24 \times 10^{-4}$
$0,508 - (0,469) - 0,018 = 0,021$	$4,41 \times 10^{-4}$
$0,636 - (0,642) - 0,018 = -0,024$	$5,76 \times 10^{-4}$
$0,766 - (0,76) - 0,018 = -0,012$	$1,44 \times 10^{-4}$
$0,866 - (0,849) - 0,018 = -1 \times 10^{-3}$	1×10^{-6}
	$\Sigma (y_i - mx_i - b)^2 = 1,494 \times 10^{-3}$

$$\sigma_y^2 = \frac{1}{4} \sum_{i=1}^N (y - mx_i - b)^2 = \frac{1}{4} (1,494 \times 10^{-3}) = 3,735 \times 10^{-4}$$

$$\Delta \mu = \Delta m = \sqrt{\frac{6\sigma_y^2}{D}} = \sqrt{\frac{6(3,735 \times 10^{-4})}{0,8851}} = 0,0503 \approx 0,05$$

(4) Results:

- The index of refraction of the block is $\mu = 1.50 \pm 0.05$.

(5) Conclusions:

By applying the Discrepancy test $|M_{true} - M_{exp}| < 200M$. We found $(1.52 - 1.50) < 2 \times 0.05 \rightarrow 0.02 < 0.1$ an accepted result.

Note that our medium was a glass ^{with} true value of 1.52.

⊗ The Sources of error:

- 1- if the glass was broken from inside it will affect the readings of r_i and r_e as the light will refract inside.
- 2- The big width of the main source light, so we will approximate the central point of the light.
- 3- The index of refraction of the air will affect the refraction of the glass, so the light will affect by two refractions.
- 4- the light beam wasn't strong enough.