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Optical Micrometer:

Procedure:
We were to measure the index of refraction and the lateral displacement of light through a lens using the optical micrometer. That lens was one of two things, either a semicircle oriented with the straight edge facing the incoming light or the curved section facing the incoming light, or a rectangular plate. The semicircle was used to measure the index of refraction using Snell's Law along with our measurements, noting the average index of refraction and standard deviation and standard deviation of the mean with any uncertainties accounted for. The rectangular block was used to determine the lateral displacement of the incoming light. Measurements were made in ten degree increments after precise collimation and alignment of the optical micrometer.

2. It is important to note that the beam is positioned in the center of the semicircular lens because if it is not, then the starting point, zero degrees, will have a refracted ray of light with more or less intensity than if it were perfectly aligned in the center of the semicircle.

3. The first step is to orient the lens such that the incident ray is going through the flat surface of the semicircle. I then recorded the position of the refracted laser beam for ten separate measurements in increments of ten degrees, starting with zero, then ten, twenty, and so on so forth. The measurements are in a table in my lab notebook under number three. Qualitatively observing the intensity of the light leads one to ascertain that as the incident angle increases, the intensity of the refracted light ~~increases~~ decreases. The intensity of the reflected light follows the same pattern in that as the incident angle increases, the intensity of the reflected light increases.

intensity of reflected light increases

=> you had it right in your lab book

4. This step asked for the index of refraction of each of the measurements separately. Using Snell's Law, n(i)*sin(theta(i)) = n(r)*sin(theta(r)), where i and r correspond to incident and refracted light, I was able to calculate the index of refraction. This is a simple calculation so I feel there is no need to show those calculations for each value, thus it is only noted in the lab notebook in my table for number three under the column heading "Index of Refraction" with the number four above to indicate the values correspond to procedure step number four. I then found the mean value for index of refraction, which came out to be 1.575. The calculations for the mean are on the back side of the first sheet of my lab notebook. I then calculated the standard deviation, +/- .024, and the standard deviation of the mean, +/- .008, using the formulas on page 100 and 102 of Taylor. Both are a unit-less number because the index of refraction has no unit, therefore both the standard deviation and standard

deviation of the mean of the index of refraction should have no unit as well. The calculations for both are also on the back side of the first sheet of my lab notebook under the calculations for mean. Thus, my final value for index of refraction including error is...

1.575 +/- .008

5. Step five wanted the same measurements as number four, but this time with the semicircle oriented the other way, with the curved region facing the incident light. Once again I collimated the beam to keep the procedure uniform. It suffices to note that when the semicircle is oriented this way, there is a critical angle where total internal reflection occurs. I measured the incident angle degree measure where this occurs to be 43.5 degrees. I assigned an error of +/- 1 degree to my calculation of the critical angle taking into account poor eyesight in the morning along with other factors influencing that value and how I measured it. Another issue worth noting is that when theta(i) is greater than theta(c), with i and c corresponding to incident and critical angle, there is only reflection. So in the table of values I made for this problem in my lab notebook under number five, I noted this and explained why I still put a value in the table for an incident angle of 50 degrees even though there is no such refraction at this degree measure. After calculating the index of refraction using Snell's Law for each measurement I found the mean value for index of refraction to be 1.370. I then calculated the standard deviation, +/- .039, and the standard deviation of the mean, +/- .014, of my measurements. I also calculated the index of refraction using my critical angle and the formula, theta(c) = arcsin(n(r)/n(i)), which came out to be 1.453. The error I assigned to my critical angle estimation was +/- 1 degree, so the uncertainty for the index of refraction is equal to one divided by my critical angle, or +/- .023. My calculations for mean, standard deviation, and standard deviation of the mean along with index of refraction from the critical angle can be found on the back side of the first page of my lab notebook under number five. Thus my final values for index of refraction with error are...

1.370 +/- .014 and 1.453 +/- .023

=0 so systematically below part I

Qualitative observation of the light intensity for incident angles greater/less than zero degrees with the normal lead to the conclusion that light intensity decreases for the refracted ray when the incident angle increases. Reflected light follows a different pattern in that as the incident angle increases the intensity of the reflected light increases.

The table comparing my values for number four and number five is on the following page.