Physics 132
Thursdays 9:00 AM
ILC S110
July 25, 2017

Lenses and Geometric Optics Lab

Abstract

In this experiment, we saw the difference in the properties of light with converging and diverging lenses. We applied Snell's Law to a laser beam in order to calculate and compare the refractive index to the published value. Additionally, we used converging and diverging lenses to investigate the characteristics of real and virtual images, respectively.

Questions & Answers

1. *Comment on how the measured angle (of refraction) would have changed, if you were to use diamond ndiamond=1.6 (instead of D-shape lens) as the medium for Part 2.2. Would the angle of refraction be larger, smaller or stay the same? Explain. (2 point)*

The angle of refraction would be much smaller because the combination of diamond and natural air provides one of the largest differences in the index of refraction values. A small critical angle forms therefore causing most rays to enter the diamond at angle of incidence greater than the critical angle.

2. *A 1.75 m tall man is 4.0 m from the converging lens of a camera. His image appears on a piece of film that is 40 mm behind the lens. How tall is his image on the film? (2 point)*

Using the equation $h_i/h_o=-d_i/d_o$ (Height of image/height of object is equal to the negative distance of the image/distance from the object) with the numbers from the problem we know d_i=.004m (40 mm converted to m), d_o=4m and d_o=1.75 m.
So the equation can become h_i/1.75=-.0040/ 4, so h_i=-.0006m so the height of his image on film is .0006m

3. *Use your data to verify the Law of Reflection and then use Snell's Law to calculate the refractive index for D-shape lens (lens) . Compare it with the known value of 1.52. (2 points)*

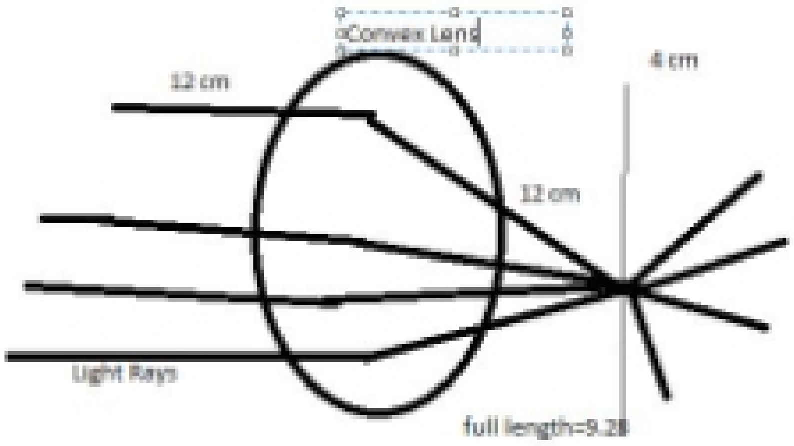
Calculations:
Law of Reflection: θ1=θ2
Law of Refraction n1sinθ1=n2sinθ2

Tank 1
Known: $n1=1$ $\theta 1=30$ $\theta 2=18$
$1\sin(30)=n\ 2\ \sin(18)$
$n2=1.61$
Tank 2
Known: $n1=1$ $\theta 1=20$ $\theta 2=12$
$1\sin(20)=n\ 2\ \sin(12)$
$n2=1.64$

The refraction index we got was 1.61 and 1.64 which is fairly close to 1.52, our expected value. The known value for the refractive index is 1.52. When using Snell's law to calculate the refractive index in tank 1 and 3, we see that a value of 1.61 and 1.64 which are both not that different from the expected value.

4. *Calculate the focal length of the given converging lens based on the measurements of s and s' and thin lens equation. Tabulate your results (for all the three trials). Compare ratios of the image and object distances and heights for the three object distances to show $-(s'/s)=(h'/h)$ is true. Draw a ray diagram and show the different lengths for one trial. Section 2.4 "Real Images" in your manual. (2 points)*

The equation we used was: $1/s + 1/s' = 1/f$
The focal lengths were 94.3mm, 100mm, 98.5mm
The ratios were found by s'/s and h'/h
While the ratio of the image and object distances appear to be close, the relationship $-(s'/s)=(h'/h)$, is not precisely true from the values used from our data set. This is probably due to errors in measurement from ourselves.
Ratio 1: $s'/s= 3.67$ $h'/h=-3.75$ Close
Ratio 2: $s'/s= 2.0$ $h'/h= -2.125$ Close
Ratio 3: $s'/s= 4.58$ $h'/h= -4.25$ Close



5. Describe the virtual image seen in Section 2.4 "Virtual Image" (observing an object through a converging lens). Is the image larger/smaller than the object? Is the image upright? (2 point)

The virtual image produced was larger than the given object (the target) and was upright.

6. Use: $s=15$ cm and $f=-10$ cm to calculate s'. Show / explain why it is not possible to get a real image using your diagram and the equations above. Section 2.5 "Diverging Lens". (2 point)

1/f-1/s=1/s'
1/-10-1/15=1/s'
s'=-5.99cm
It is impossible to have a real image because the image will never be projected. It will always have a negative s' and because of this it will always be visualized on the same side of the lens/mirror as the object

7. Calculate a value for f_D (the focal length of the diverging lens) using the method described in Section 1.4 "Lens Combinations" of the lab use the lenses as one lens, and thin lens equation to find $f_{combined}$ then use $1/f_{combined}=1/f_C+1/f_D$ to find f_D. Would this experiment be possible if $f_C > |f_D|$? (2 points)

$1/f_{combined}=1/f_C+1/f_D$

1/183= 1/98.0+1/fD
1/fD=1/183-1/98.0
1/fD=-.00474
1/-.00474=-211

This experiment would not be possible if fc>fd. When using both the converging lens and the diverging lens to view the image, the image that is produced is a virtual image instead of a real image.