Course and Section_____ Names _____

Date_____ _____

REFLECTION AND REFRACTION EXPERIMENT

Introduction

Use the ray optics kit to study how light reflects off a shiny surface, and how it refracts when entering a transparent material. You'll use a light source, a mirror and a plastic trapezoid to observe the reflected and the refracted rays of light.

Equipment: plastic trapezoid, plastic mirror, light source, paper, protractor.

PART 1 - Reflection

What you are to investigate if whether the angle of reflection equals the angle of incidence. This is a very simple law, and is easily verified.

Procedure

Step 1. Take the triangular shaped shiny piece that looks like silver metal. This piece has two curved and one plane mirror side.

Step 2. Set the light to emit only one ray of light. Place the light source on top of the sheet of paper on the desk: you should be able to see the ray of light shining on the paper.

Step 3. Place the plane mirror side on the paper and in front of the light source. Measure various angles of incidence and reflection. Use the table below to collect your data.

Analysis

1. Table of the angles of incidence and reflection.

Measurement index	Angle of incidence	Angle of reflection	% difference
1			
2			
3			
4			
5			

PART 2 – Refraction

Theory

Snell's Law provides the relation between the angles of incidence and of refraction:

$$n_1 \sin(\theta_1) = n_2 \sin(\theta_2)$$

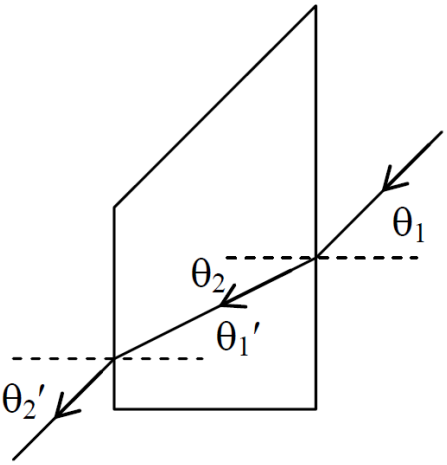
where n_1 and n_2 are the indexes of the refraction of the two materials light travel through. Your goal is to find the index of refraction of the trapezoidal piece of plastic by using the Snell's Law.

Procedure

Step 1. Take the trapezoidal piece of plastic and place it on top of a piece of paper on the desk.

Step 2. Set the light to emit only one ray of light. Place the light source on the desk and orient it such that the light ray shine through the trapezoidal piece of plastic.

Step 3. Measure the angles θ_1, θ_2 at the entry point and the angles θ_1', θ_2' at the exit point. To do so use a pencil to indicate points on the path of the ray on the paper. For instance, make a dot where the ray leaves the light source, where it hits the plastic, where it leaves the plastic, and where it is about an inch away from the plastic. You'll also need to trace the surface of the trapezoid. Then connect the dots to show the lines followed by the light ray.



Step 4. Use the protractor to measure the angles on the piece of paper.

Analysis

2. Use this table to collect your data.

Measurement	Angle of incidence	Angle of refraction
Entry point	θ_1 =	θ_2 =
Exit point	θ_1' =	θ_2' =

3. What is the index of refraction of the air?

n_{AIR} = _____

4. Use Snell Law to calculate the index of refraction of the plastic trapezoid n_{PT} at the two points

Entry point n_{PT} = _____ Exit point n_{PT} = _____

5. The two values of n_{PT} should be equal, calculate their percentage difference:

If your percentage difference is greater than 15%, check or repeat your measurements and calculations.

6. In order to obtain get a better value of n_{PT} , take measurements at the entry point only of the angles of incidence and refraction over a range of incident angles between 10° and 80°.

Measurement index	θ_1	θ_2	sin θ_1	sin θ_2
1				
2				
3				
4				
5				
6				

7. Make a plot of sin θ_1 versus sin θ_2 and determine n_{PT} from the slope.

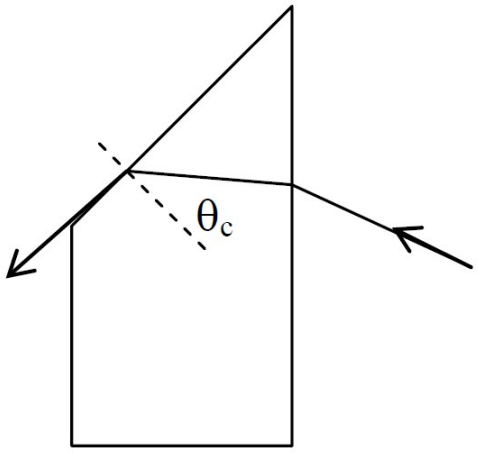
n_{PT} = _____

8. Print a copy of your plot showing the linear fit and value of the slope.

PART 3 - Total Internal Reflection

Step 1. Rotate the trapezoid slowly and watch as the refracted rays get closer and closer to the outer surface of the trapezoid. At the angle where the refracted rays disappear, and only reflection takes place at the inner face, stop rotating the trapezoid.

Step 2. Draw the light rays as you did in the previous section by marking the entry and exit points.



Analysis

9. Use your drawing to estimate the critical angle.

θ_C = _____

10. Calculate one more time n_{PT} using the critical angle. Show your calculations.

n_{PT} = _____

11. Calculate the percentage difference between n_{PT} found in question 7 and question 10:

If your percentage difference is greater than 15%, check or repeat your measurements and calculations.