Name _____ Date _____

SI Physics Lab #40 (90 pts)

Period _____ Mrs. Nadworny

Due Date _____

Refraction of Light

NO Lab Write-Up Required

Research Problem

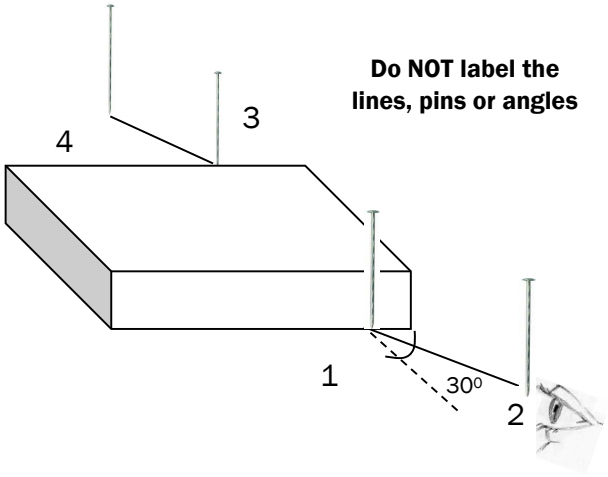
When a ray of light passes obliquely (at an angle) from air to glass, it is refracted. The degree to which any particular kind of glass refracts light depends upon its index of refraction. This index is also the ratio of the speed of light in a vacuum to the speed of light in the medium. In this experiment you are going to determine the index of refraction of a given sample of glass.

Materials

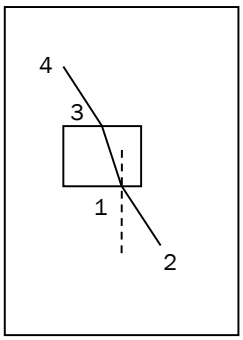
- Glass Block
- Protractor
- Ruler
- PENCIL
- 4 Pins
- Cardboard

Procedure

1. Carefully remove the last page of the lab. Write your name on it. Place the paper on top of the cardboard. Place the block so the bottom lines up with the pre-drawn line. Use the pencil to draw a line along the top edge of the block.
2. Place a pin at the point where the normal, the incident rays and the glass meet. (At point 1 in the diagram to the right)
3. Place a pin at the end of the 30^{o} incident ray. (At point 2 in the diagram to right)
    - These two pins fix the path of the incident ray.



4. Get at eye level with the edge of the block. Line up your sight with pins 1 and 2. You will know they are lined up when they *appear* as only one pin instead of two side by side.
5. Take a third pin and hold it along the top edge of the glass block. Make sure you are looking through the edge of the block and not above it. Move pin 3 from side to side until it lines up with pins 1 and 2. Once it is lined up, push it into the paper.
6. Take a fourth pin and hold it in an area beyond the third pin. Make sure you are looking through the edge of the block and not above it. Move pin 4 from side to side until it lines up with pins 1, 2 and 3. Once it is lined up, push it into the paper.
7. If you are unsure if you have correctly lined it up, ask for help before proceeding.
8. Carefully slide the glass block out of the way.
9. Draw a straight line connecting pins 3 and 4 to the top edge of the block.
    - This line represents the path that the light traveled once it emerged from the glass block



Do NOT label the lines, pins or angles

10. Then connect pin 1 to the spot on the block edge where line 3-4 was drawn to.
    - This line represents the path that the light traveled through the glass block.
11. Using a protractor measure the angle of refraction. This is the angle between the normal line in the block and the line connecting pins 1 and the far edge of the block. Record this in the data table (under 30.0^0).
12. Repeat steps 2 – 11 using incident rays starting at 0^0 (the normal line) and increasing until 60.0^0 using 10.0^0 intervals. It may be helpful to use a different colored pencil for each angle to help differentiate your lines.
13. Once you have completed the angle of refractions, calculate the sin of both the angles of incidence and the angles of refraction.
14. Attach your diagram to the lab before turning in. (20 pts)

Data Collection (15 pts)

Angle of Incidence (θ_1)	**0^0**	**10.0^0**	**20.0^0**	**30.0^0**	**40.0^0**	**50.0^0**	**60.0^0**
Angle of Refraction (θ_2)							
sin (θ_1)							
sin (θ_2)							

Uncertainty in angle measurements ± _____

Data Processing (15 pts)

1. Make a graph **by hand** by plotting sin (θ_1) versus sin (θ_2). Your graph will be graded on how well proper graphing conventions were followed.

2. Draw a straight line that **best fits** the plotted points and passes through the origin (0, 0).
    a. The slope of this line is the ratio of sin (θ_1) to sin (θ_2) and is therefore equal to the index of refraction of the glass with respect to the air.

3. Determine the slope of the line by selecting two points **on the line**.
    a. Box these points on the graph and write the coordinates next to the points.
    b. Show all of your work for calculating slope on the graph, using proper GUESS method (coordinates count as givens and unknowns).
    c. **This is the index of refraction!**
    d. Record this value and label it n.

Graph Analysis (3 pts)

4. Write the general and specific equations for the graph.

Post- Lab Questions

Answer the following questions in the space below. If you need more room, use a separate piece of paper. Show all work, and use the GUESS method and proper significant figures when appropriate.

1. What type of glass do you believe that you have? (Circle one) Crown Glass Flint Glass (2 pts)

2. Calculate a percent error between your experimental value from the graph and the accepted value from the reference tables. (5 pts)

3. Knowing the speed of light (c), and the index of refraction for **your** glass block (n - from the graph), calculate the speed of light in **your** glass block (v). (5 pts)

4. Calculate the critical angle for **your** glass block. (5 pts)

5. Why should the ray emerging from the glass block come out parallel to the incident ray? (2 pts)

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6. Identify two possible sources of error that may have occurred during data collection (not graphing or calculations). Explain how each error occurred. Explain how each error affected your data collection (θ_1, θ_2). Explain how each error affected your results (n). (8 pts)

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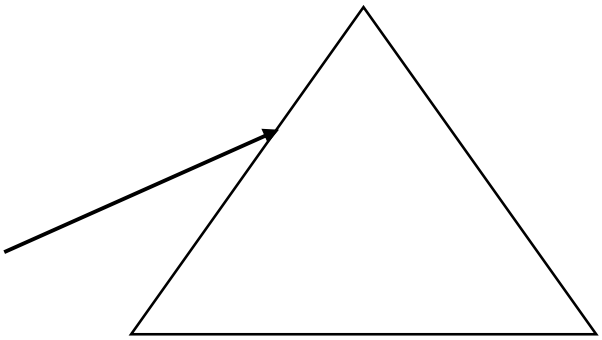
7. For the following glass shapes complete the steps below to draw the path of a light ray through the shapes. (10 pts)
    a. Draw the dotted normal line where the light ray strikes the block.

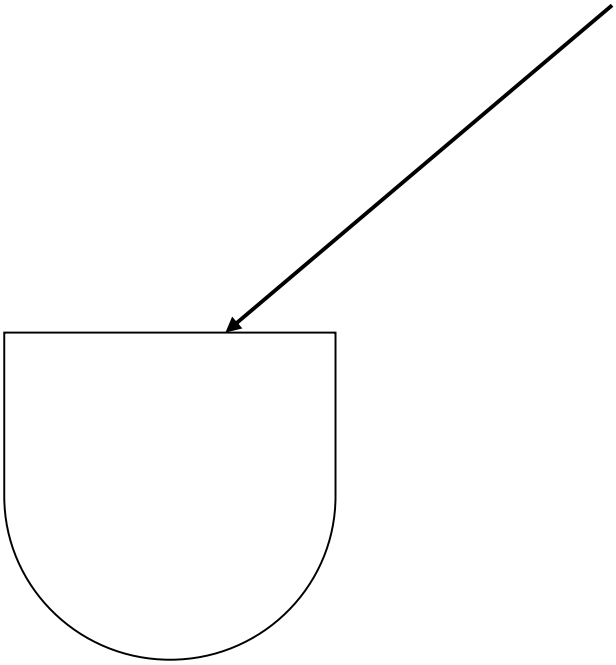
    b. Sketch the light ray as it travels through the block. Do NOT calculate; simply sketch if it bends towards or away from the normal.

    c. Draw a second dotted normal line where the light ray strikes the block edge to exit.

    d. Sketch the emergent light ray. Do NOT calculate; simply sketch if it bends towards or away from the normal.

    e. Label each angle appropriately. Use θ_1 for incident angles and θ_2 for refracted angles.





Name _____