REFRACTION OF LIGHT

OBJECTIVE

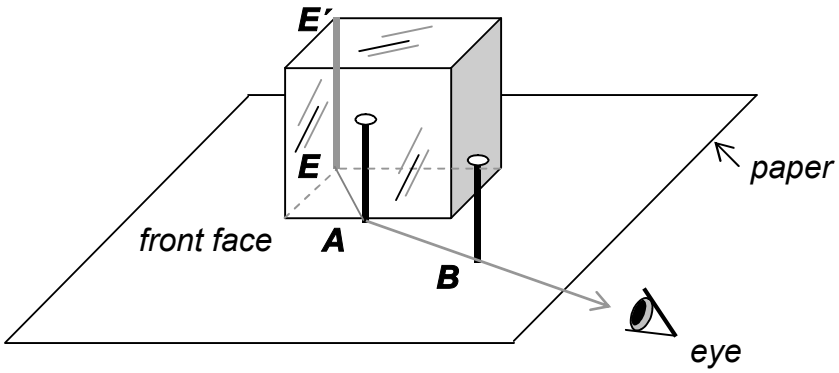
To verify the Law of Refraction ($n_1 \sin \theta_1 = n_2 \sin \theta_2$) by measuring the index of refraction of glass and water.

EQUIPMENT

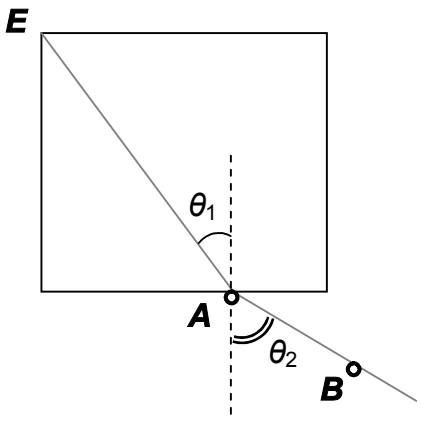
corkboard, two 8½ × 11 in. pieces of paper, glass cube, glass microscope slide, large pins, pencil, protractor, masking tape, water

PROCEDURE

Part A: Measuring the Index of Glass



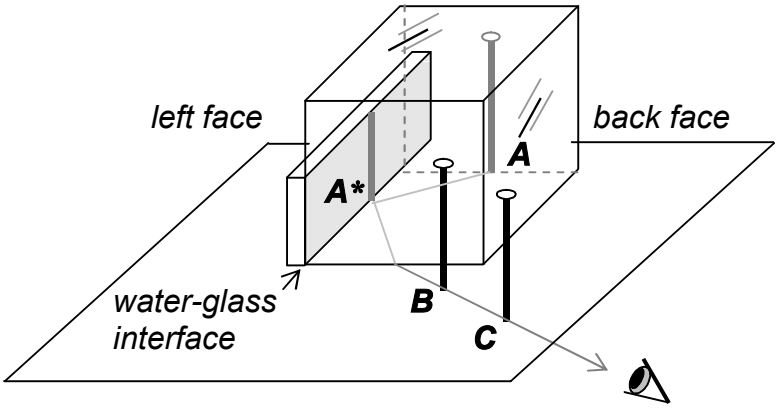
1) Tape a piece of paper to the corkboard. Place the glass cube at the center. Draw an outline around its bottom edge.
2) Place pin A flush with the front face of the cube. Be sure that the pin is perpendicular to the paper.
3) Move your head so that your line of sight is in the same direction as the eye shown above. Your eyes should be about 1 cm above the paper.
4) Look for the refracted (virtual) image of edge E′E in the glass. Move your head until pin A and the virtual image line up. Push pin B into your paper so that *it also lines up with pin A and the virtual image of E′E*.
5) Remove the cube and pins A and B. Use your ruler to draw ray EA (*incident ray*) and AB (*refracted ray*) as shown below.



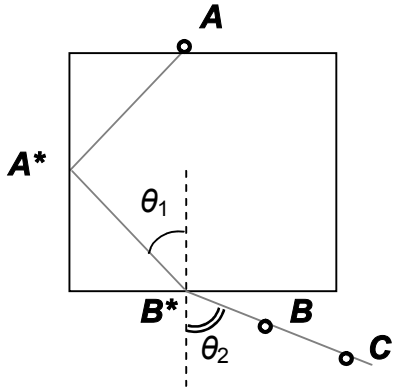
6) Use your protractor and your ruler to draw a line perpendicular to the cube at point A. Measure (to the nearest 0.5°) the angle of incidence θ_1 and the angle of refraction θ_2 and record their values in the table on your data sheet. Calculate the index n_g of the glass and the percent error. Assume that the index of air n_{air} = 1.00. The accepted value of n_g = 1.52.

7) Return the cube to its position and repeat Steps 3 through 6 with three different locations for pin A.

Part B: Measuring the Index of Water



1) Tape a new piece of paper to the corkboard. Place the glass cube at the center. Draw an outline around its bottom edge.
2) Apply a drop of water to the glass slide and push the wet side of the slide against the cube as shown in the diagram.
3) Place pin A flush with the back face of the cube. Be sure that the pin is perpendicular to the paper.
4) Move your head so that your line of sight is in the same direction as the eye shown above. Your eyes should be about 1 cm above the paper.
5) Look for the sharpest image of pin A *reflected off the interface between the water-glass interface*. At that position (A*) the light ray is totally internally reflected. (If you look immediately above the slide you will see another image: the reflection of pin A off the air-glass interface.) Push pins B and C into your paper *so that they line up with image A* in the slide*.
6) Remove the cube and pins A, B, and C. Use your ruler to draw ray BC.



7) Use your protractor and your ruler to draw a line perpendicular to the front face of the cube at point B*. Measure angle θ_2 as shown above. Record your result on your data sheet.
8) Calculate angle θ_1. If your value from Part A for n_g is between 1.44 and 1.60, then use it in your calculation; otherwise, use $n_g = 1.52$.
9) Use your protractor and your ruler to draw the rays AA* and A*B*.
10) Calculate the index of water n_w assuming total internal reflection at point A*. Calculate the percent error (take the accepted value of $n_w = 1.33$).
11) Answer the questions on the reverse side of the data sheet.

ASSIGNMENT: due by the end of the lab period
Each group must submit a completed data sheet with the two ray diagrams (from Parts A and B) stapled to it.

Name _____ **Date** _____

Partners _____

_____

REFRACTION OF LIGHT

Part A: Measuring the Index of Glass

θ_1 [degrees]	θ_2 [degrees]	n_g [no unit]
	Average =	

Calculate the % error in your average n_g. Show your work below.

Part B: Measuring the Index of Water

Measured value of θ_2 = _____

Calculate θ_1. Show your work below.

Calculate n_w. Show your work below.

Calculate the % error in your calculated n_w. Show your work below.

QUESTIONS

1) Is it possible for light to reflect off a surface but not to refract into the surface? Explain your answer.

2) Is it possible for light to refract into a surface but not to reflect off the surface? Explain your answer.

3) What is total internal reflection and under what conditions will it occur?

4) Suppose that light ray of different colors strike a glass surface at the same angle of incidence. Will their angles of refraction be equal? Explain your answer.