Mr. RadTke's

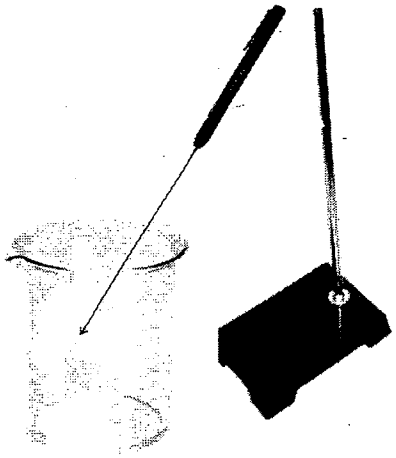
THE REFRACTION OF LIGHT (Rev 5/2013)

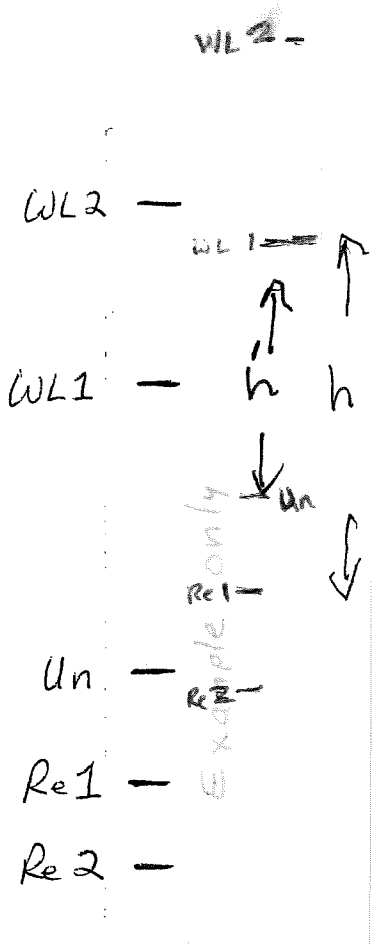
In this lab, you will study the refraction of light rays passing from one substance into another to confirm Snell's Law. You will use Snell's law to determine the index of refraction of various materials. Use pencil on sketches.

Groups of 3. Full lab report due _____, worth 40 points.

Part 1: Index of refraction of water

1. Start with an empty 1000ml beaker, and place a piece of masking tape vertically along the side of the beaker.
2. Position a laser pointer, mounted on a ring stand, so that it is pointing down at a small angle (10-15°) to the vertical and hitting the masking tape from the inside of the beaker.





3. Mark the point where the laser beam is striking the tape; if the beam spot is distorted due to the angle, mark the top of the beam on the tape.
4. Without moving anything, add water to the beaker until it is about 2/3 full. Mark the waterline and the new laser beam positions on the tape.
5. Add more water to the beaker so that it is nearly full; mark waterline and laser beam positions again.
6. Remove the tape and place on this page to the right. For both trials measure the height **h'** of the unrefracted spot from the waterline and the height **h** of the refracted spot from the waterline.
7. Make a **table** below listing the data for your 2 trials, calculated index of refraction (**h/h'**), and error between your values and the actual value.

Water Depth	h' (m)	h (m)	n (h/h')	error
~2/3 full	.0335	.046	1.373	3.0 %
full	.0605	.086	1.421	6.6 %

Calculations

1. $n = \frac{h}{h'} = \frac{.046m}{.0335m}$

$n = 1.373$

2. $\%\text{ error} = \frac{1.373 - 1.333}{1.333}$

$\%\text{ error} = 3.0\%$ error

Part 2: Snell's Law

Steps 1-5 are to be done by <u>each group member</u>:

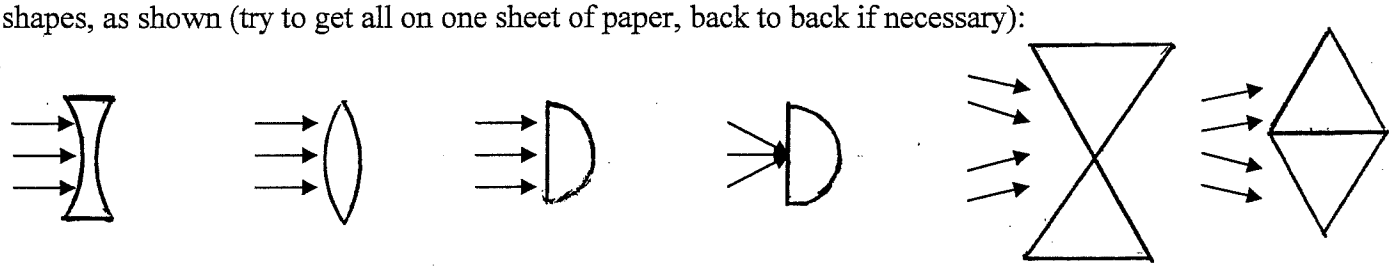
1. Each person will sketch one block of material. Each group will be using a glass block, a plastic block, and 1-2 specimen blocks.
2. On a clean sheet of paper, label block type and your name. Outline the block and carefully trace a laser ray entering and leaving the block through the clear edges. Use an incident angle of at least 25 degrees for best results. Use a straightedge to draw accurate lines representing the ray of light entering, passing through, and leaving the block. Be sure the ray of light enters and exits through opposing sides of the block.
3. Carefully measure angles of incidence and refraction at both interfaces. If the 2 inside and 2 outside angles are not congruent, average them. Use the average values to do a Snell's law calculation solving for the index of refraction of your material.
4. On your sheet also show a calculation for the speed of light through your block material.
5. Investigation: Compare your material's index of refraction to the accepted value provided by your teacher (error).

<u>As a group</u>:

6. Compile all individual measured data and calculated values from steps 1-5 above in a logically-presented <u>data table</u>. Present data on a clean page, typed.

Part 3: Effect of Shape on Light

1. This part is done as a <u>group</u>. Trace the paths of 3-4 light rays through each of the following numbered shapes, as shown (try to get all on one sheet of paper, back to back if necessary):



2. Test several shapes with a laser for the <u>reversibility</u> of light (i.e., does light follow the same path in the opposite direction?).
3. As a group, prepare a <u>summary table</u> categorizing each shape as converging or diverging. Place on the same page as the sketches.

Lab report questions (typed, complete sentences):

1. How do objects underwater appear to our eyes? If a pond appears to be 3 m deep, what is its actual depth?
2. Comment on how successful/unsuccessful you were in identifying the blocks used in part 2.
3. How does light behave when it enters the more dense block material from air (speed and angle of refraction)?
4. What are the 2 ways light can pass into a different material without being refracted?
5. When light passes through your blocks, how do the outside angles compare? The inside angles? Does this make sense? Explain.
6. What general shape is a converging lens? Diverging lens? What happens to light passing through each?
7. What did you find out about the reversibility of light? Does this make sense?

Each group member write a conclusion and summary (typed) discussing how you met the purpose.