Name: _____

Determining Snell's Law

- For this lab you will be expected to submit a complete lab write-up.
- Refer to the handout from the beginning of the year if you are unsure of the required sections or the order.
- For the procedure and materials section you may write: "refer to handout", but be sure to include this handout with your lab.

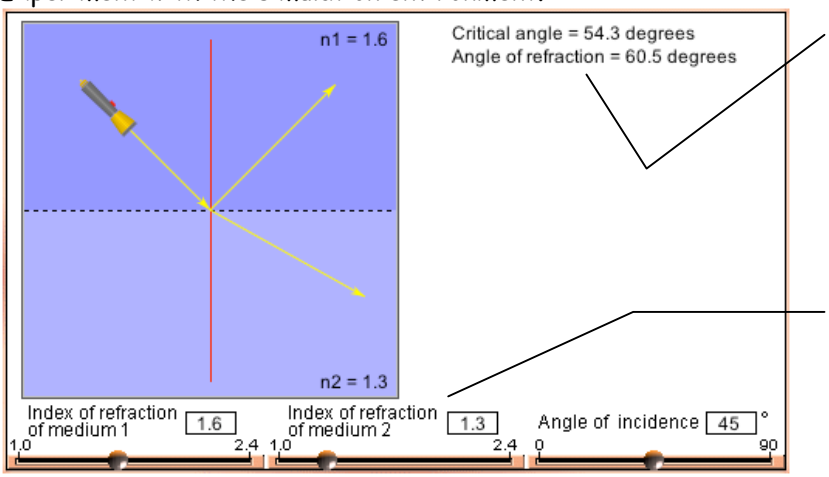
Materials:

- On-line simulation: http://www3.interscience.wiley.com:8100/legacy/college/halliday/0471320005/simulations6e/index.htm
- calculator

Procedure:

1. Listen to the audio introduction.

2. Experiment with the simulation environment.



The critical angle (when applicable) and angle of refraction are listed in the top right hand corner.

Notice that you can change the index of refraction of the 2 mediums by sliding the bar along the bottom left and bottom middle scales. You can also change the angle of incidence by sliding the bar on the bottom right scale. The values are listed above the scales.

3. Set the index of refraction of medium 1 to 1.0 (air) and the index of refraction of medium 2 to 1.5 (crown glass).

4. Set the initial angle of incidence to be 10°. Determine the angle of refraction. Record all information in a table like this:

Refractive Index of Medium 1 (n_i)	Refractive Index of Medium 2 (n_R)	Angle of Incidence (θ_i)	Angle of Refraction (θ_R)	$\sin \theta_i$	$\sin \theta_R$	$n_i \sin \theta_i$	$n_R \sin \theta_R$

5. Continue the procedure for increasing angles of incidence.

6. What do you observe about the critical angle?

7. Calculate sin θ_I, sin θ_R, n_i sin θ_I, and n_R sin θ_R. Look for a pattern.

8. Repeat the experiment but now set medium 1 to be crown glass and medium 2 to be air. Look for a pattern. Watch what happens to the value of the critical angle.

9. Based on your observations, determine the mathematical relationship between angle of incidence, angle of refraction and the refractive indices of the two mediums. Explain the variables in your equation.

Questions:

1. When light travels from a less optically dense material to a more optically dense material, how does the light ray bend relative to the normal? When light travels from a more optically dense material to a less optically dense material, how does the light ray bend relative to the normal?

2. There are two cases in which the angle of refraction is the same as the angle of incidence. What are they?

3. The situation where n2 = n1 is a special case. What happens with the reflected ray in this situation? How does the angle of refraction compare to the angle of incidence?

4. Refraction occurs because light has wave properties. When light passes from one medium to a second medium with a larger index of refraction, what happens to the speed, wavelength, and frequency of the light?

For questions 5 – 7, use Snell's Law to calculate the correct answer, then use the simulation to check your results.

5. A light ray travels from air (n = 1.0) into water (n = 1.3). The angle of incidence is 34°. What is the angle of refraction?

6. A light ray travels from water into air. The angle of refraction is 56°. What was the angle of incidence?

7. A light ray travels from air into an unknown material. The angle of incidence is 35° and the angle of refraction is 14°. What is the material? (Hint: refer back to the Optical Density and Light Speed web page from the reading)

8. If n1 > n2 and the angle of incidence is exactly equal to the critical angle, what is the angle of refraction? Combining this information with Snell's law, derive an expression for the critical angle in terms of n1 and n2.