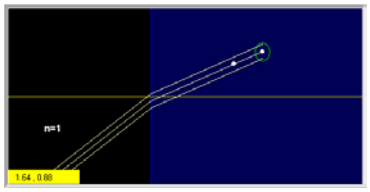
Worksheet for Exploration 34.2: Snell's Law and Total Internal Reflection



Light rays from a beam source, initially in air (n = 1), are shown incident on material with an index of refraction that you can vary by moving the slider **(position is given in meters and angle is given in degrees)**. Restart. You can move the beam source and change the angle of the light from the source by clicking on the beam and click-dragging the hotspot.

a. Verify that Snell's law holds. Measure the incident angle and refracted angle. You can use the pink "protractor" to measure angles. You can drag the protractor around and click-drag to adjust the angle.

n =_____

Incident angle =_____

Refracted angle =_____

Calculate the value of the index of refraction of the material. (Use the values you found above and Snell's Law)

Theoretically, what is the maximum angle of incidence (the animation limits the angle of incidence to 45^{o} but that is not the maximum)?

Given the maximum incidence angle, what is the maximum angle of refraction? This angle is sometimes called the critical angle.

Develop a general expression for the critical angle as a function of the indices of refraction of the two materials.

b. Move the light source inside the material and change the beam so it leaves the blue material and goes into the air (black). Measure the angles of incidence and refraction and calculate the index of refraction of the material.

Incident angle =_____

Refracted angle =_____

Index of Refraction =_____

What happens if the angle of incidence (from inside the material) is greater than the critical angle of refraction found in part (a) above? Why? This is called total internal reflection.

c. Change the index of refraction. Calculate the new critical angle. Measure the critical angle and compare it with your calculated value.

n =_____

Incident angle =_____

Refracted angle =_____

Critical angle =_____

d. Why is it only possible to have total internal reflection when light travels from a medium of higher index of refraction to one of lower index of refraction?