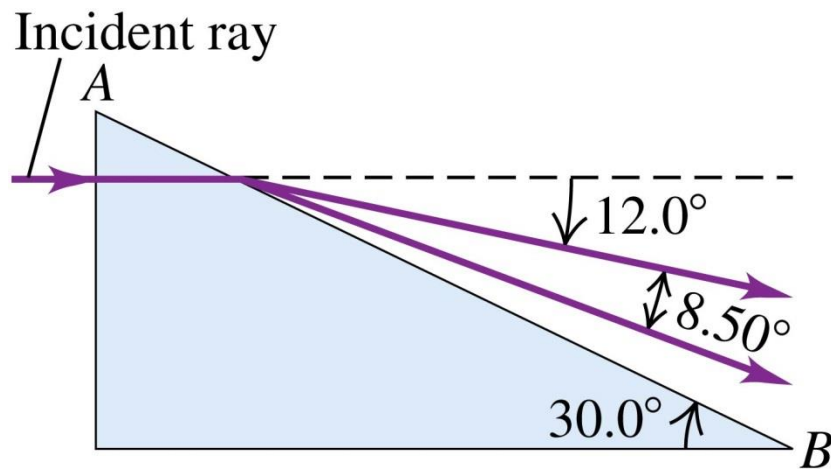


Homework Assignment#4 – Due Thursday, July 11th

Due: Thursday, July 11th, not later than 11:59 p.m. in my dropbox on the 3rd Floor of the STEM building, just down the hall from STEM 372. Alternately, you can hand the assignment in to me during the Wednesday lecture, July 10th (however, the material needed to do the last question probably won't be covered until the lecture Wednesday morning; to complete by Wednesday morning, you'll need to read ahead.)

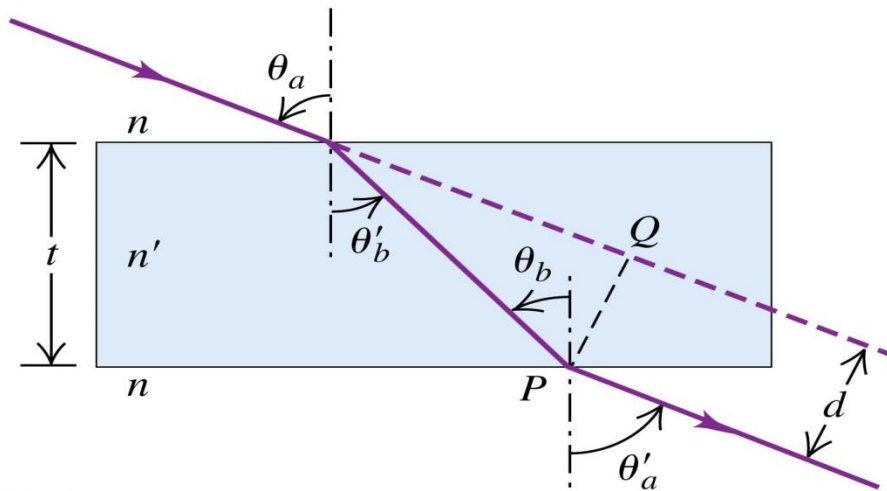
1. A light ray in air strikes the right-angle prism shown in below. The prism angle β is 30.0° . When the ray emerges at the face AB , it has been split into two different wavelengths that differ from each other by 8.5° as indicated. Find the index of refraction of the prism for each of the two wavelengths.



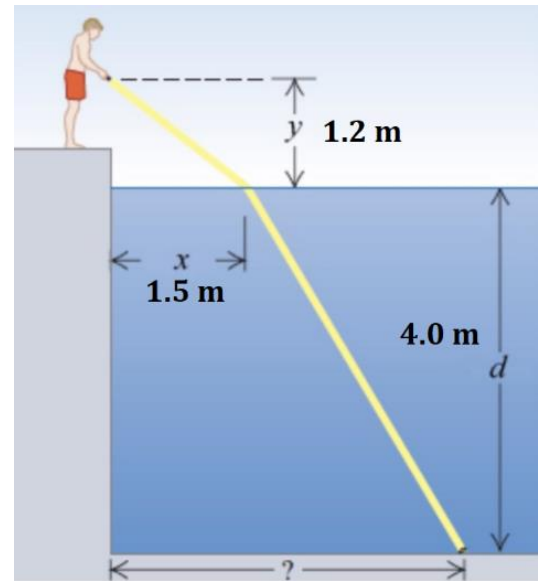
2. Light in air at an angle of θ_a is incident upon the surface of a pane of glass, as shown below. (a) Prove that the angle of incident entering the pane is equal to the angle of incident of the emergent beam leaving the pane, i.e. $\theta_a = \theta_a'$. (b) Show that the displacement d of the emergent beam is given by

$$d = t \frac{\sin(\theta_a - \theta_b')}{\cos \theta_b'}$$

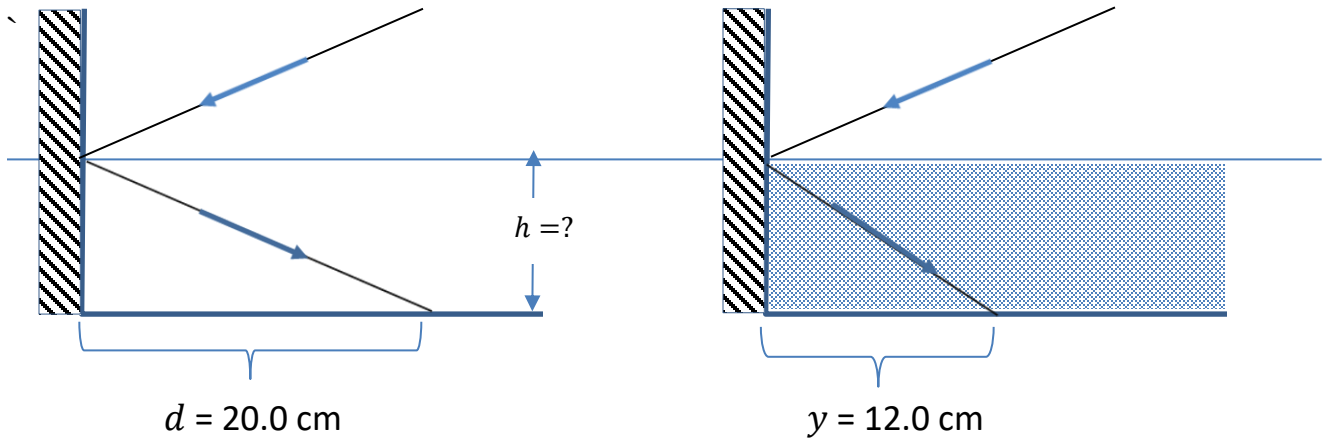
- (c) Assume an incidence angle of $\theta_a = 66.0^\circ$ from the normal on the top surface of a glass plate, with $t = 2.40$ cm thick and the glass having an index of refraction of 1.80. Assume the medium on either side is air. Find the value of d between the incident and emergent rays.



3. A hotel guest accidentally drops his keys into a hotel swimming pool late one evening, and is locked out of his room. The lifeguard offers to retrieve the keys from the bottom of the pool. Holding a flashlight 1.2 m above the surface of the water, he illuminates the keys by shining the light onto the water 1.5 m out from the point where he is standing, according to the configuration shown at right. Assuming the keys are at the bottom of the pool that is 4.0 m deep, how far away from the edge of the pool are the keys actually located?



4. A laser beam is directed at the inner wall of a silver-plated container. When it hits the wall at a height h from the bottom of the container, the light reflected off the wall falls a distance $d = 20.0 \text{ cm}$ from the wall on the bottom of the container. The container is then filled with water ($n_{\text{water}} = 1.333$), and as it fills, the reflected beam moves closer to the wall due to the refraction of the beam passing through the water. When the water fills the container to just below h , the light beam is $y = 12.0 \text{ cm}$ from the wall. What is the height of the water, h , at this point?



5. The left end of a long glass rod is 6.00 cm in diameter with an index of refraction of 1.60. It is ground and polished to a convex hemispherical surface with a radius of 4.00 cm. An object in the form of an arrow 1.50 mm tall, pointing up at right angles to the axis of the rod, is located on the axis 24.0 cm to the left of the vertex of the convex surface (similar to the situation in the class notes). Find the position and height of the image of the arrow formed by paraxial rays incident on the convex surface. Is the image erect or inverted?

6. An object is placed 16.0 cm from a thin lens. The image forms 12.0 cm from the lens *on the same side as the object* (a) What is the focal length of the lens? Is the lens converging or diverging? (b) If the object is 8.50 mm tall, how tall is the image? Is it erect or inverted (c) Draw a diagram indicating the principal rays involved your analysis of this situation.