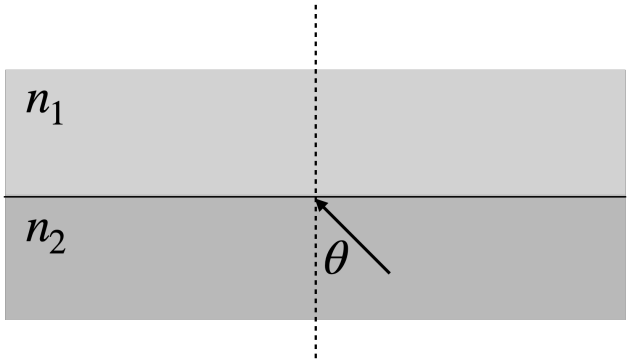
PHYS2063 Wave Physics Homework #17 Due Tuesday 25 Oct 2022

This homework assignment is due at the start of class on the date shown. You may submit a PDF of your solutions to the Canvas page for the course, or bring a paper copy to class.

(1) Light impinges on the interface between two materials as shown below:



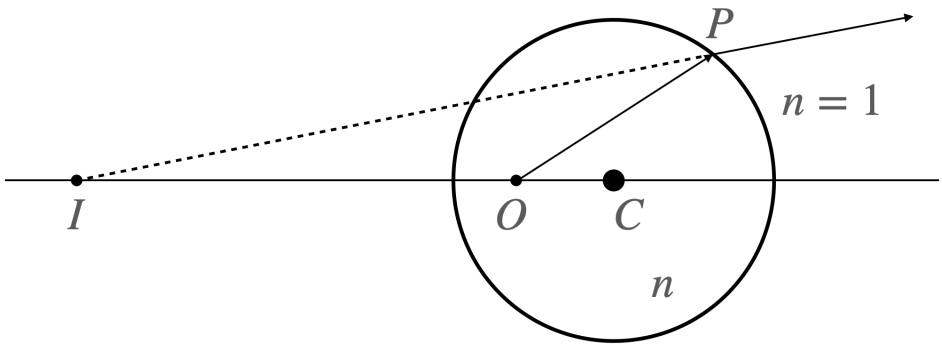
Under the condition that $n_2 > n_1$, find an angle θ for which the light cannot propagate into the top medium. (This phenomenon is called "total internal reflection.")

(2) (Pain Problem 11.2) A parallel plate of glass of thickness d has a non-uniform refractive index n given by

$$n = n_0 - \alpha r^2$$

where n_0 and α are constants and r is the distance from a dertain line perpeiduclar to the sides of the plate. Show that this plate behaves as a converging lens of focal length $1/2\alpha d$.

(3) (Pain Problem 11.8) An object O is imbedded inside a glass sphere of radius R and index of refraction n, as shown in the figure.



The object is located at a distance R/n from the center of the sphere. Outside the sphere is a vacuum ($n = 1$). Show that any ray OP, when projected back to the line connecting the object with the center of the sphere, meets at the distance $IC = nR$. (This is, apparently, the principle used in the "oil immersion microscope."