Phys 531 Assignment 3 Due September 20

1. Consider a series of m parallel planar interfaces, as shown. Starting from 0, the index of refraction in the ith layer is n_i, and the angle of incidence on the ith interface is θ_{i-1}. Find the output angle θ_m in terms of the input angle θ_0.

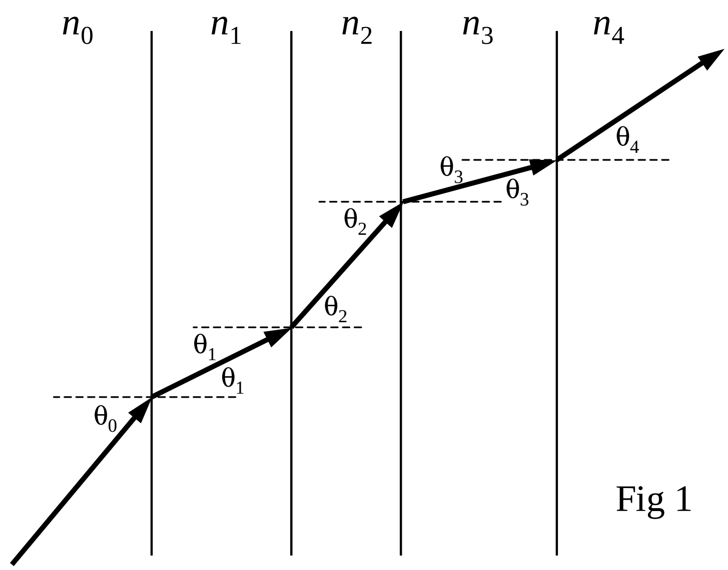

Fig 1

2. Show that to someone looking straight down into a swimming pool, any object in the water will appear to be at about 3/4 of its true depth. (Hint: consider the angle between the rays that enter the observer's two eyes.)

3. A laser beam impinges on the top surface of a parallel glass plate of thickness t and index of refraction n. In terms of the angle of incidence, θ_i, determine the true length of the path through the glass, d, and the lateral displacement of the beam, δ.

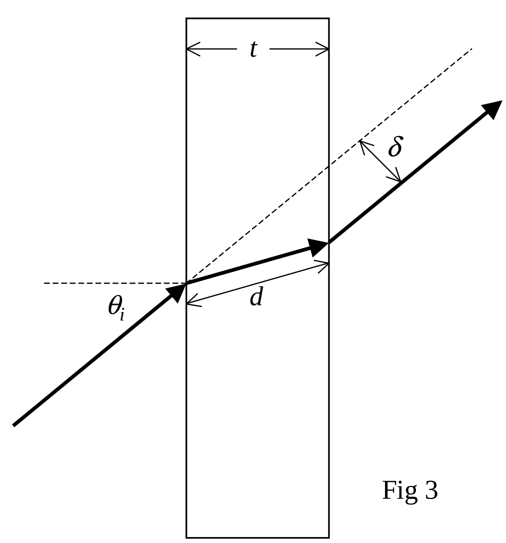

Fig 3

4. Show from the Fresnel equations that $R_{\parallel} + T_{\parallel} = 1$ and $R_{\perp} + T_{\perp} = 1$. Restrict yourself to the case where the index and transmission angle are real.

5. Calculate the reflectances $R_{\perp}$ and $R_{\parallel}$ for the interface beween air and SF11 glass (index $n = 1.7$) at incident angles of $0°$ and $45°$. What is Brewster's angle in this case?

6. You notice the reflection of the sun in the still waters of a pond. If the angle of incidence of the sunlight on the water is about $60°$, what fraction of the incident light are you actually observing? Note that sunlight, like most natural light, is an equal mixture of both polarization states. You will therefore need to average over the parallel and perpendicular polarizations.

7. A beam of light is normally incident on a right angle prism, as shown. What is the minimum value of the index of refraction such that the beam is totally internally reflected from the back surfaces?