Phys 531 Assignment 3 Due September 28

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.

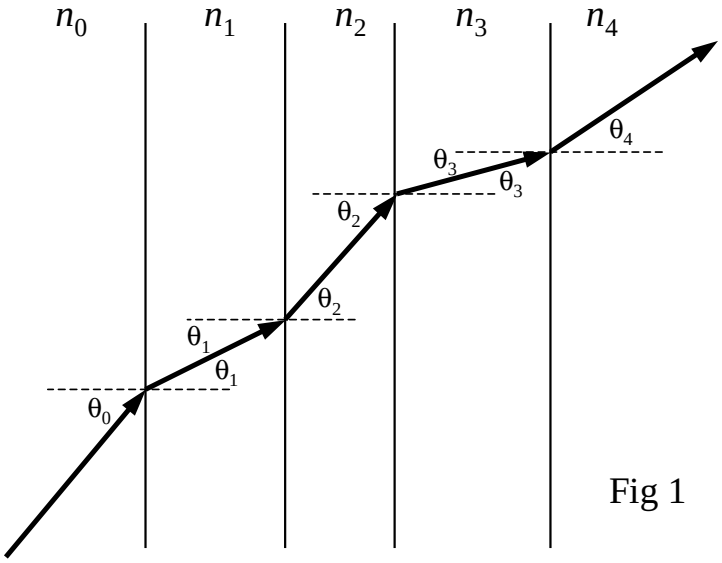

Fig 1

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.

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.

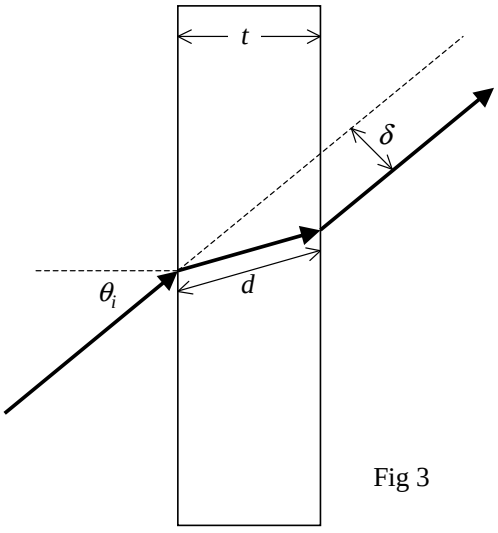

Fig 3

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.

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?