Physics 422 - Spring 2013 - Assignment #8, Due March 29th

1. Brewster's angle corresponds to the angle of incidence for which $r_{\parallel} = 0$ when light in a medium with index of refraction n_1 is incident on the surface of another medium with index of refraction n_2. At this particular angle of incidence, denoted θ_B, the angles of the incident and transmitted light are related by $\theta_i + \theta_t = \pi/2$. Show that

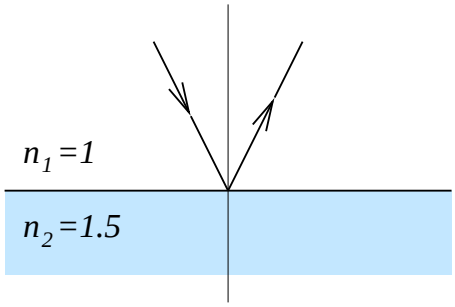
$$\tan(\theta_B) = \frac{n_2}{n_1}.$$

2. Suppose that plane polarized light with a wavelength of 589 nm was incident on a solution of glucose that was prepared with a standard concentration of 1 g/ml but with an unknown fraction of *D*-glucose and *L*-glucose components. If the path length of the light through the solution was 10 cm, determine the relation between the *specific rotation*, α, and the fraction, f_D, of *D*-glucose in the solution.

3. The reflectance and transmittance for light incident on the surface of a maeterial with index of refraction n_2 from a material with index of refraction n_1 are given by

$$\begin{aligned} R_\perp &= \frac{\sin^2(\theta_i - \theta_t)}{\sin^2(\theta_i + \theta_t)} \\ R_\parallel &= \frac{\tan^2(\theta_i - \theta_t)}{\tan^2(\theta_i + \theta_t)} \\ T_\perp &= 1 - R_\perp \\ T_\parallel &= 1 - R_\parallel \end{aligned}$$

(a) Using the numerical values $\theta_i = 30°$, $n_1 = 1$ and $n_2 = 1.5$, calculate the two reflection coefficients, $R_\perp$ and $R_\parallel$ for the reflected ray shown in the diagram below.



(b) Calculate the effective reflection coefficients, $R'_\perp$ and $R'_\parallel$, that account for light reflected from both front and back surfaces of the material, as shown below. (In this example we assume that the light reflected from the front and back surfaces adds incoherently.)