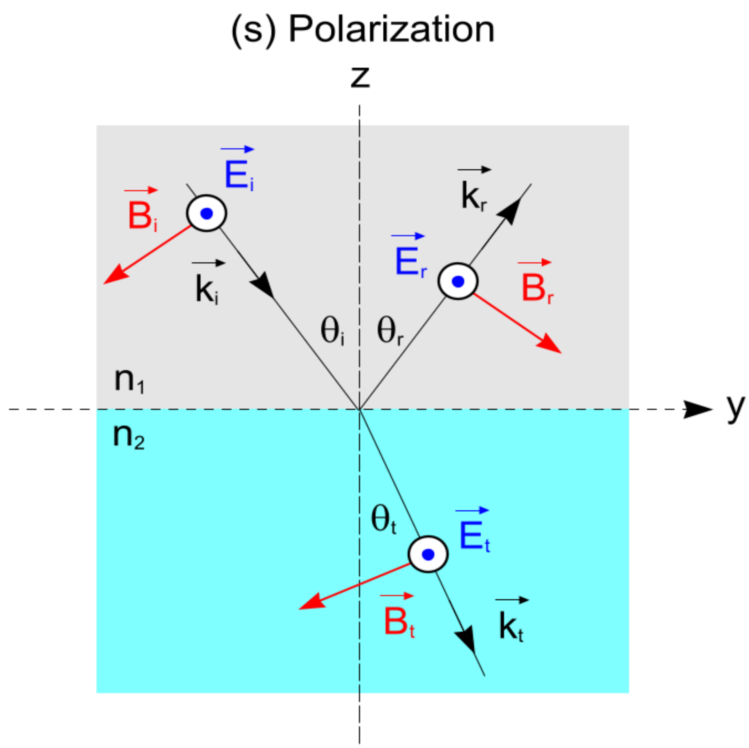
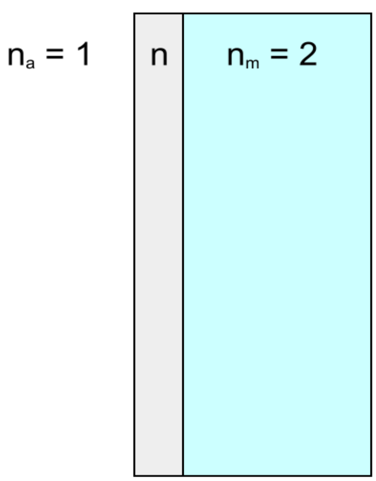
**HW N1. Polarization (s) Theoretical Derivation.** We derived the Fresnel equations for the p-polarization case in class and found $r_p$ and $t_p$.
Derive the Fresnel equations for the s-polarization shown in the figure. The answers are given below.

$$r_s = \frac{n_1 \cos\theta_1 - n_2 \cos\theta_2}{n_1 \cos\theta_1 + n_2 \cos\theta_2}$$

$$t_s = \frac{2 n_1 \cos\theta_1}{n_1 \cos\theta_1 + n_2 \cos\theta_2}$$

Be particular sure to explain your angles in the analysis of the boundary conditions at the interface for the **B** fields, working out one in detail.




**HW N2. Thin-Film Engineering.**

A manufacturing firm is designing a transparent plate using a material that has index of refraction $n_m = 2.00$. They would like you to design a thin film with index of refraction n so that light entering from the air will have as little reflection back into the air as possible and that the transmission to the $n_m$ material is maximized.

Use the Fresnel equations at normal incidence to minimize the reflectivity. Remember that the reflectivity $R_p$ is equal to the square of the reflection coefficient $r_p$ of the Fresnel equations, that $R_s$ is the square of $r_s$, and

$$R = (R_p + R_s) / 2.$$

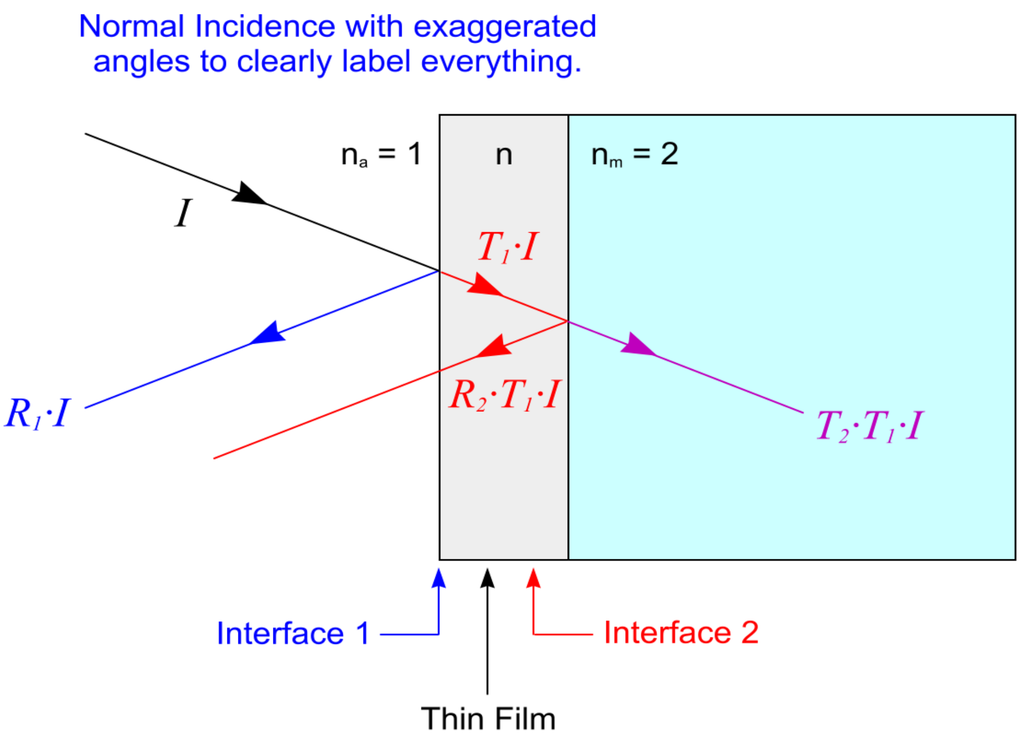
The index of refraction of air is $n_1 = 1.00$ to 3 significant figures and you are given $n_m = 2.00$ to 3 significant figures. Note that there are two R interfaces: reflection at the $n_1$-n interface and reflection at the n-$n_m$ interface. You will need to incorporate these in your analysis as well as worry about $R_p$ and $R_s$. Report your value n for the thin film to 3 significant figures. The following page outlines what you need to do in more detail.

(a) First show that for normal incidence

$$R_s = R_p = \left[\frac{n_1 - n_2}{n_1 + n_2}\right]^2 .$$

Then you can conclude $R = \dfrac{R_s + R_p}{2} = R_s = R_p$ and use solely the $R$ notation.

(b) Set up the reflections and transmissions.




For the first interface: $R_1 = \left[\frac{1-n}{1+n}\right]^2 = \left[\frac{n-1}{n+1}\right]^2$ and $T_1 = 1 - R_1$

For the second interface: $R_2 = \left[\frac{n-2}{n+2}\right]^2$ and $T_2 = 1 - R_2$ .

(c) You want to maximize the transmission $T_2 \cdot T_1 \cdot I$ . Find the index of refraction $n$ that meets this requirement.