Suppose the light having passed thru the 1st polaroid film - now passes thru a second film which has a transmission axis that makes an angle of \( \Theta \) W a that of the 1st polaroid sheet.

\[
\begin{align*}
I &= I_0 \cos^2 \Theta \\
I'' &= I' \cos^2 \Theta \\
\therefore I &\approx E^2
\end{align*}
\]

What is the magnitude of \( |E_1|, |E_2| \) in light incident on Earth from the Sun.

\[
\text{Dist Earth - Sun} = 1.49 \times 10^8 \text{ km}
\]

\[
\text{Total power output from Sun} = 3.9 \times 10^{26} \text{ watts}
\]

\[
\text{Intensity of light at Earth} = \frac{\text{Power}}{\text{Area}}
\]

\[
I = \frac{3.9 \times 10^{26} \text{ watts}}{4\pi \left( 1.49 \times 10^9 \text{ m} \right)^2} \approx 1360 \text{ W/m}^2
\]

\[
I = \frac{1}{2} \frac{E_0 B_0}{\mu_0 c} = \frac{1}{2} \frac{E_0^2}{\mu_0}
\]

\[
B_0 = \frac{E_0}{c}
\]
If $\phi = -\pi/2$, you'll see left circular polarization.

If $E_x \neq E_y$, you get elliptical polarization.

Natural light is unpolarized.

No coherence correlation between emission of light from different sources.

$I_0 \Rightarrow I' = \frac{1}{2} I_0$

$E'' = E' \cos \theta$

Many ways to polarize light:

- Polaroid sheets
- Dichroic crystals
- Reflection

Do this in problem 3.4.

Intensity $I_0$.

Suppose unpolarized light passes through a Polaroid film.

What is the intensity?

$I'' = I' \cos^2 \theta$

TRANSMISSION Axis 1

ON AVERAGE, $\theta$ is the E-vector.

The incident light has an $E$ vector along the TRANSMISSION Axis 1.

$I = \frac{1}{2} I_0$
More Properties of Light - Geometrical Optics

Recall

\[ c = \frac{1}{\varepsilon_0 \mu_0} \]

Do some derivation... but in materials find

\[ c = \frac{1}{\varepsilon \mu} \]

No longer \( c \)

But \( v < c \)

\[ n = \frac{c}{v} \]

\( n \) = index of refraction

\( \Rightarrow \) light moves slower in a medium than in vacuum

different media can have different \( n \)'s

\( \Rightarrow \) leads to interesting effects

\[ \Theta_r \]

\[ \Theta_i \]

\[ n_1 \]

\[ n_2 \]

Air

Water

Law of reflection:

\[ \Theta_i = \Theta_r \]

Law of refraction (Snell's Law)

\[ n_1 \sin \Theta_i = n_2 \sin \Theta_r \]
Geometrical Optics cont'd

\[ \theta_i = \theta_r \quad \text{law of reflection} \]
\[ n_1 \sin \theta_i = n_2 \sin \theta_r \]

Dispersion: variation of \( n \) w/ \( V \) or \( \lambda \)

\( n \)

Blue red \( \lambda \)

Draw this

\( \theta_I \) increased

\( \theta_r \) increases

\( \theta_i \) increases

down to high \( n \)

Air \( \to \) glass

Bend toward normal

High \( n \) to low \( n \) away from normal