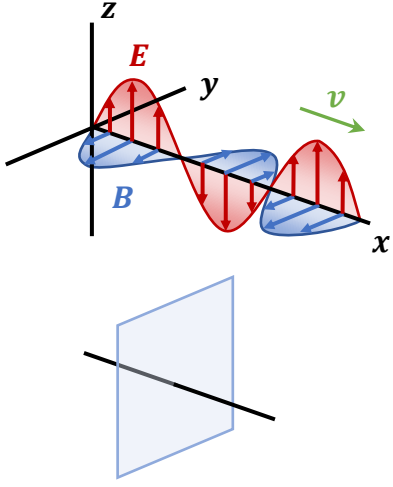
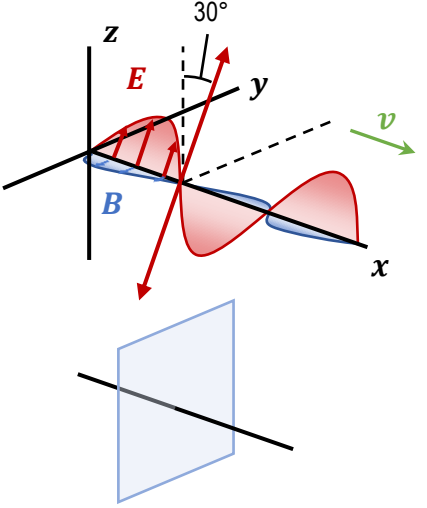
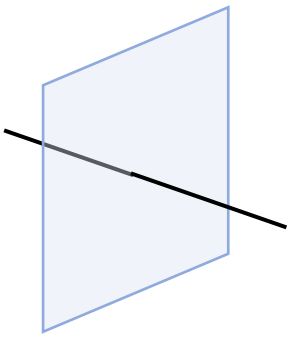


CONCEPT: INTRO TO POLARIZATION

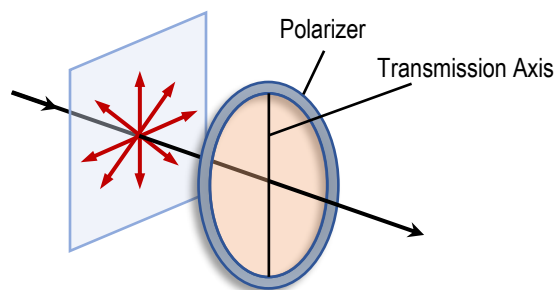
- The **polarization** of an EM wave is ALWAYS the _____ that the _____ oscillates along.
- UNpolarized light = Electric Fields point in many random directions

POLARIZED LIGHT	POLARIZED LIGHT	UNPOLARIZED LIGHT
 Polarization: _____	 Polarization: _____	(e.g. sunlight, lightbulbs) 
Indicated with double-arrows along appropriate direction		Double-arrows in _____ directions

- Polarizers are filters that only allow light components _____ to its transmission axis to pass through.
- When **unpolarized light** (I_0) passes through a polarizer, intensity I decreases by ____ and becomes **polarized**.

$I = \frac{I_0}{2}$

(One-Half Rule)



EXAMPLE: For the above diagram, if the intensity of the unpolarized light was 100 W/m^2 , what is the intensity of the transmitted light?

PROBLEM: Unpolarized light with intensity of 6 W/m^2 is incident on a polarizer. If the polarizer's transmission axis is at an angle of 45° above the horizontal, draw a diagram of this system and find the intensity of transmitted light.

E.M. WAVES EQUATIONS

$$I = \frac{1}{2} I_0 \text{ (if } I_0 \text{ is unpolarized)}$$

CONCEPT: MULTIPLE POLARIZERS AND MALUS'S LAW

- Remember: **Unpolarized light** becomes **polarized** when it passes through a polarizer & decreases in intensity.

- If **polarized** light passes through *another* polarizer ("analyzer") oriented at a different _____:

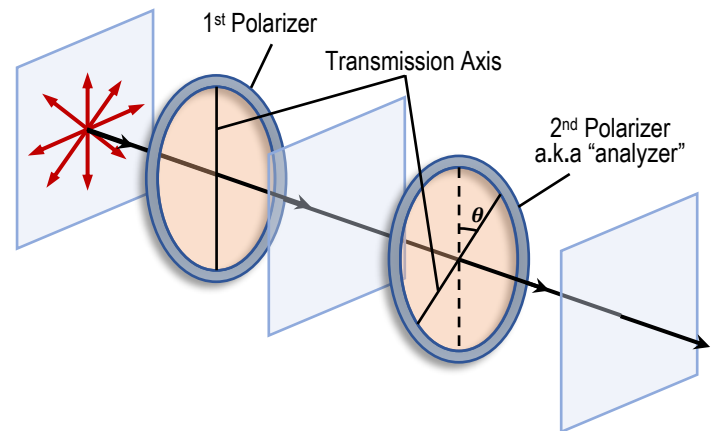
- 1) The light is polarized in the direction of the _____.
- 2) intensity decreases *again*, based on the _____ angle *between* the 2 polarizers.

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

(One-Half Rule, use only when light is **UN**polarized)

$$I = \underline{\hspace{2cm}}$$

(Cosine-Squared Rule, use only when light is **polarized**)
"Malus's Law"



EXAMPLE: Unpolarized light with an intensity of 100 W/m² passes through 2 polarizers. The 1st makes an angle of 30° with the vertical, and the 2nd is oriented along the horizontal axis. What is the intensity of light after passing both polarizers?

POLARIZATION

- 1) Draw diagram, label initial light as I_0
- 2) For each "nth" polarizer:
Use $I_n = \frac{1}{2} I_{n-1}$ **OR** $I_n = I_{n-1} \cos^2 \theta$
- 3) Solve for Target

PROBLEM: Horizontally polarized light is incident on a polarization filter. Initially, the intensity of the light is 0.55 W/m^2 , and 0.40 W/m^2 after passing through the filter. Calculate the angle of the transmission axis of the polarization filter, with respect to the horizontal.

POLARIZATION

- 1) Draw diagram, label initial light as I_0
- 2) For each " n^{th} " polarizer:
 - a) Use $I_n = \frac{1}{2} I_{n-1}$ **OR** $I_n = I_{n-1} \cos^2 \theta$
 - b) If using $\cos^2$ EQ, find θ **between** polarizers
- 3) Solve for Target

PROBLEM: Sunlight is unpolarized light that has an average intensity of 1350 W/m^2 near the Earth's surface.

a) If sunlight passes through two polarizers angled 90° with respect to each other, find the intensity of the light after passing through the second polarizer.

b) A third filter with a transmission axis at an angle of 30° to the horizontal is inserted between the first two. Find the intensity of the sunlight after passing through all three polarizers.

POLARIZATION
1) Draw diagram, label initial light as I_0
2) For each " n^{th} " polarizer: a) Use $I_n = \frac{1}{2} I_{n-1}$ OR $I_n = I_{n-1} \cos^2 \theta$ b) If using $\cos^2$ EQ, find θ between polarizers
3) Solve for Target