PhysicsTutor

Polarizer

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Problem:

- Unpolarized light with electric field amplitude 0.25 V/m is incident on a polarizer.
- Calculate the electric field amplitude of the transmitted light.

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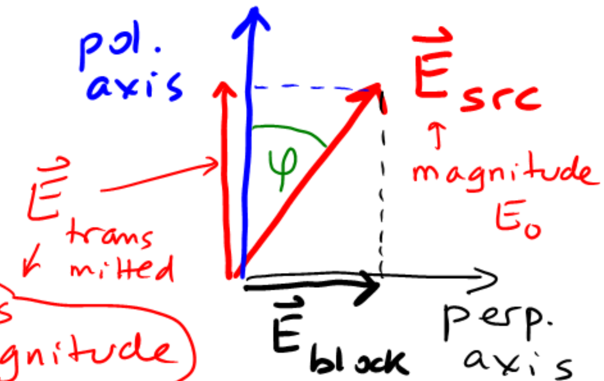
- Intensity is prop. to E field strength squared.

Equations associated with ideas:

Malus : $I(\varphi) = I_0 \cos^2\varphi$

$E(\varphi) = E_0 \cos\varphi$

has magnitude



Allow all orientations φ

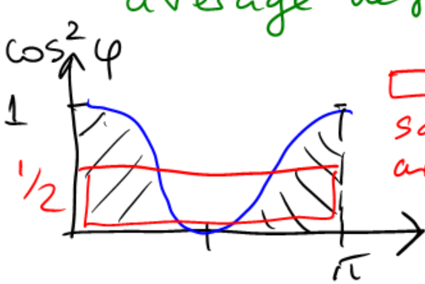
Average $I(\varphi)$ over φ :

$$I_{avg} = \frac{1}{\pi}\int_0^\pi d\varphi \; I(\varphi) = \frac{I_0}{\pi}\int_0^\pi \cos^2\varphi \, d\varphi = \frac{I_0}{2\pi}\left(\int_0^\pi d\varphi + \int_0^\pi \cos 2\varphi \, d\varphi\right)$$

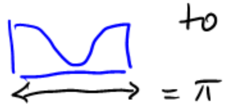
average definition

$\cos^2\varphi = \frac{1}{2}(1+\cos 2\varphi)$

$$= \frac{I_0}{2\pi}(\pi + 0) = \frac{1}{2} I_0$$



box same area as



divide base length to get height from area

or "see it" by looking at a careful graph

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- Take the root to obtain the E field strength.

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- The polarizer is NOT selecting a subset of waves with $\vec{E}$ aligned with its axis. All but the perpendicular

$\vec{E}$-directions do contribute. That we obtain half the original intensity for this polarizer orientation, and another half if the polarizer were rotated by $\pi/2$ should make sense.