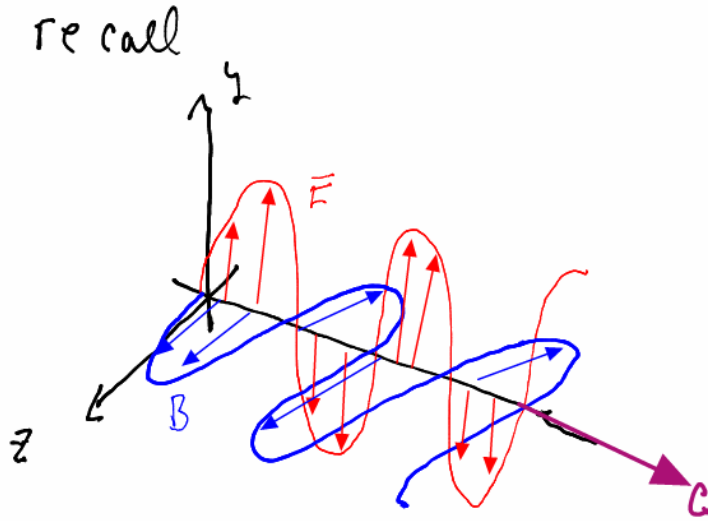


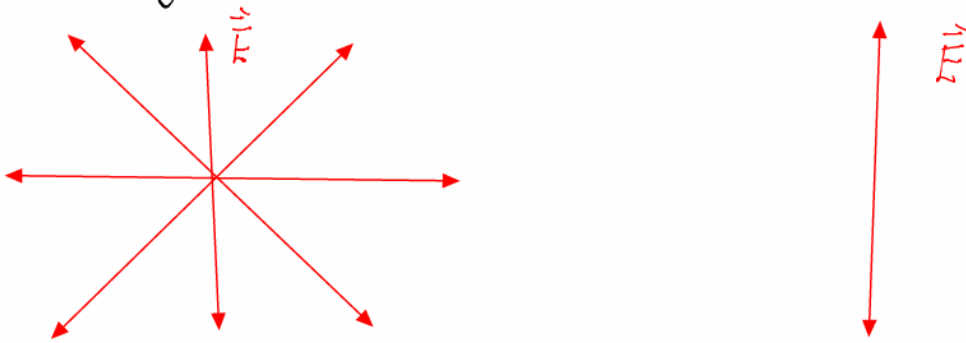
Polarization



Light travels
as a coupled
electromagnetic
wave.

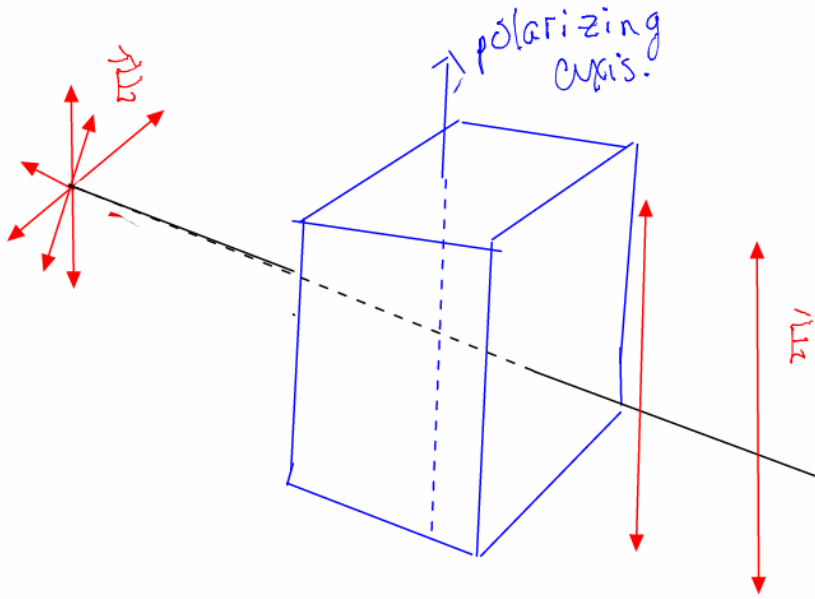
\vec{B} & \vec{E} always
perpendicular.

generally a beam of light consists
of many waves

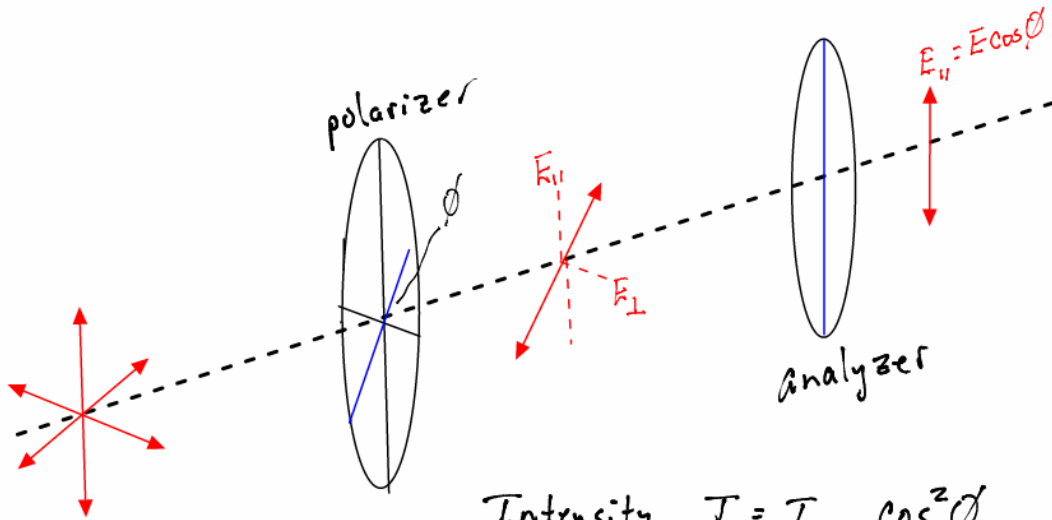


polarized light consists of a wave with
an electric field oscillating on one axis

Some materials will only allow light to pass through with an E in one direction,

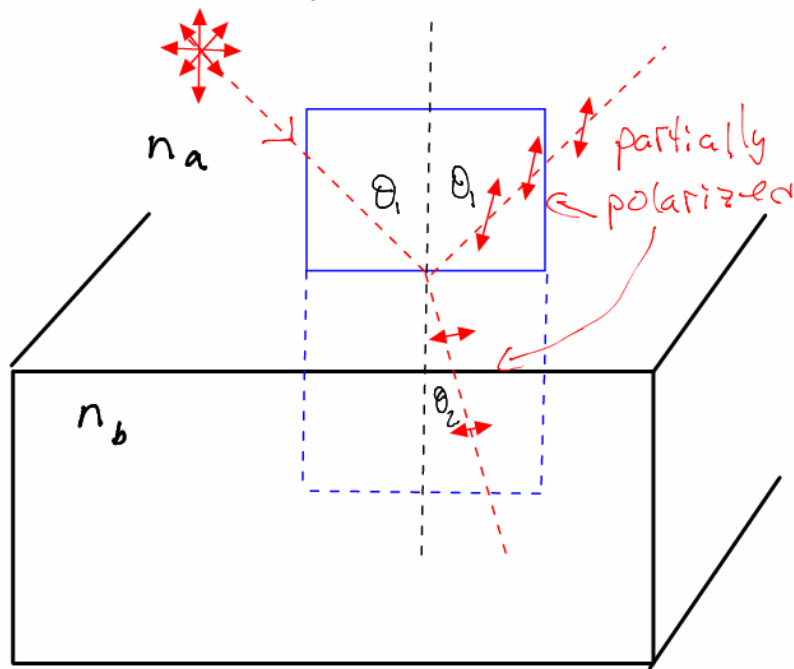


Polarizer



Intensity $I = I_{\max} \cos^2 \phi$
 Malus's Law

Polarization By reflection.



For angle θ_p the reflected ray is completely polarized \parallel to surface. and angle between ref +

from snell's law

$$n_a \sin \theta_p = n_b \sin(90 - \theta_p) \quad \theta_2 = 90^\circ - \theta_p$$

+
refrac
is 90°

$$= n_b \cos(\theta_p)$$

$$\tan \theta_p = \frac{n_b}{n_a}$$

Brewster's law

1. Natural light passes through a perfect polarizer. What fraction of the light passes through? Now, a second polarizer is introduced with its axis inclined at an angle of 22° relative to the first. What fraction of the light incident on the second polarizer passes through? What fraction of light entering the first polarizer emerges from the second?

Assume uniform mixture of angles with intensity $\overline{I_0}$

$$\frac{\overline{I_1}}{\overline{I_0}} = ? \quad I = I_0 \cos^2 \theta$$

Average of $\cos^2 \theta$ is $\frac{1}{2}$

$$\frac{\overline{I_1}}{\overline{I_0}} = \frac{1}{2}$$

$$\overline{I_2} = \overline{I_1} \cos^2(22^\circ) \quad \frac{\overline{I_2}}{\overline{I_1}} = 0.86$$

$$\frac{\overline{I_2}}{\overline{I_0}} = \frac{\overline{I_0} \left(\frac{1}{2}\right) (0.86)}{\overline{I_0}} = 0.43$$

2. I start with 2 ideal polarizers with their polarization axes at right angles. Obviously, no light gets through. Now insert a third ideal polarizer with its polarization axis at a 45° angle relative to either of the others.

- (a) What fraction of the natural light now passes through this set of 3 polarizers?
 (b) Remove that third polarizer and replace it with 9 polarizers, each inclined 9° from the previous one. What fraction of natural light gets through now?

$$\overline{I_1} = \overline{I_0} \cos^2 45 = \overline{I_0} / 2$$

$$\overline{I_2} = \overline{I_1} / 2 = \overline{I_0} / 4$$

$$\overline{I_3} = \overline{I_0} / 8$$