

## Polarization of light:

Light is an electromagnetic wave.

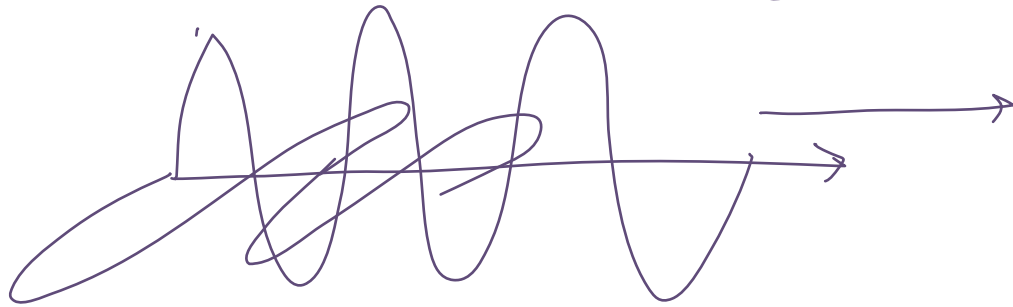
↓

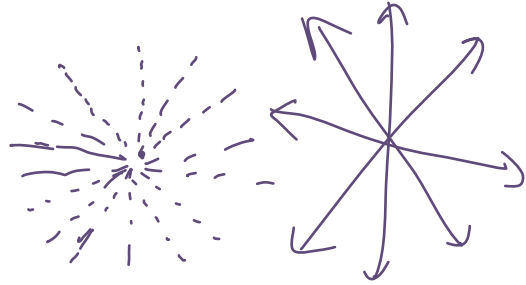
It consists of electric and magnetic field which oscillate perpendicular to each other.

95% +

NCERT.

$$c = 3 \times 10^8 \text{ m/s.}$$

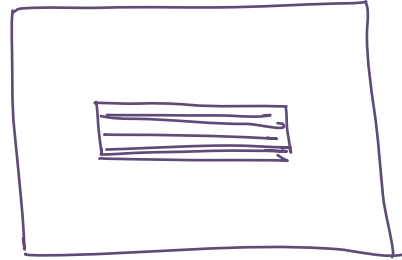




Unpolarized light

I.

Wave passed many polarized axis, so it is called unpolarized-



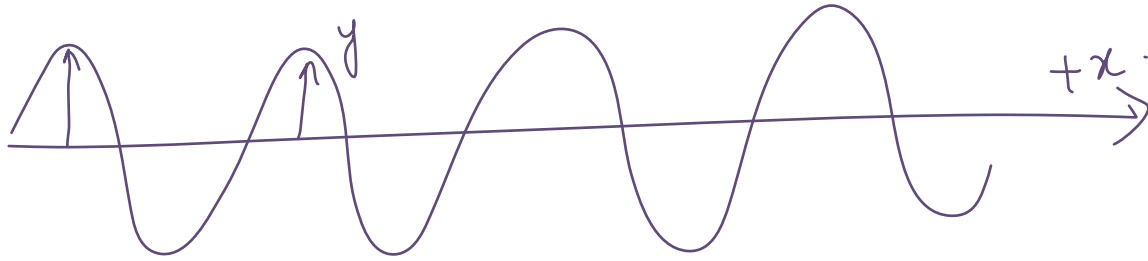
Polaroid [Filter]-



Polarized light.

Intensity  $\downarrow$  I'

Polaroids:



$$T = \frac{2\pi}{\omega}$$


$$y = a \sin(Kx - \omega t)$$

y-polarized wave [particles oscillating in y-direction].

Linearly polarized  $\rightarrow$  each point of the wave moves on a straight line

Plane polarized wave:

xy plane · [ wave confined in xy plane, therefore, it is called plane polarized wave .



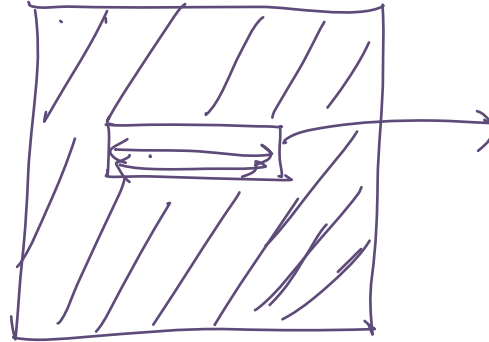
If the plane of vibration of particles is changed randomly to

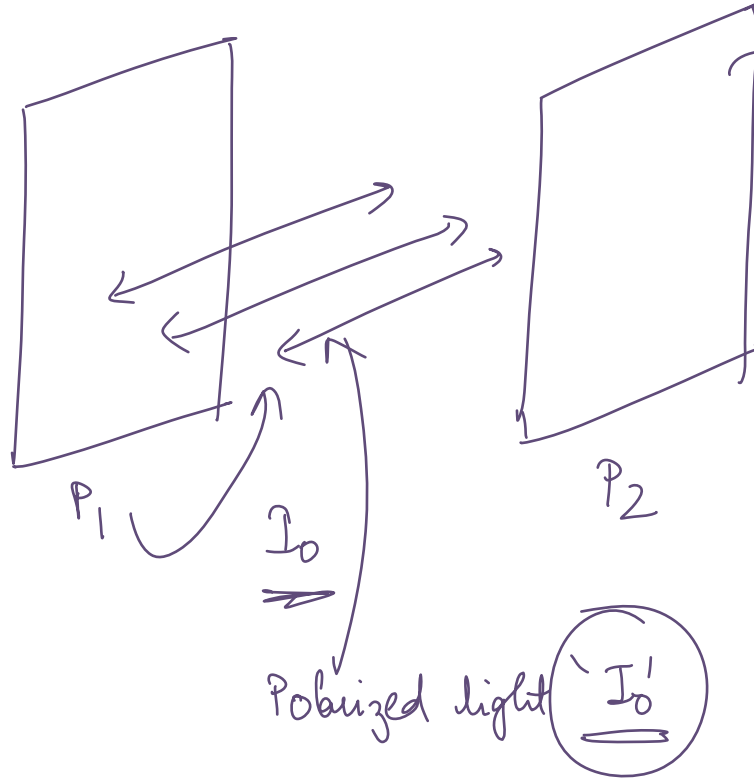
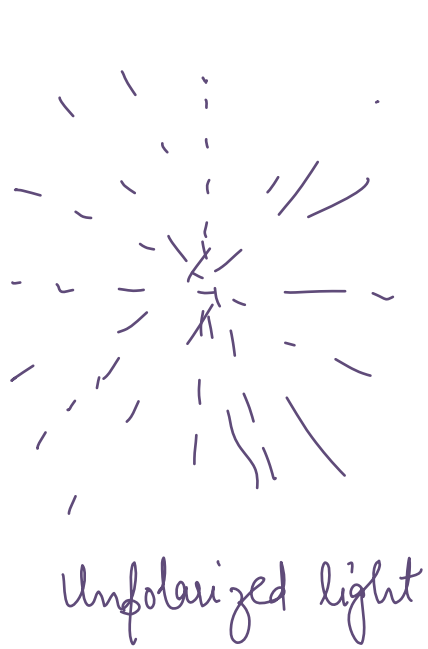
Z-direction → xz plane

Polaroid:

Thin plastic like sheet.

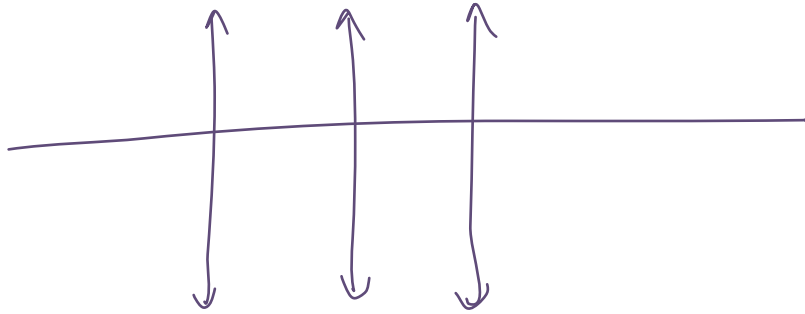
It consists of long chain molecules aligned in a particular direction.





Intensity of light after passing through second polaroid =  $I_0 \cos^2 \theta$ .

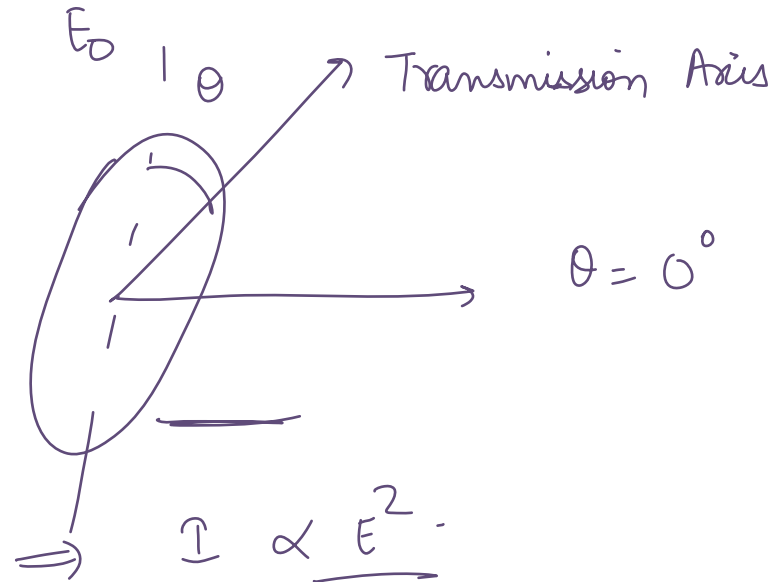
Malus's law :



Polarized

$$E_1 = E_0 \cos \theta$$

$$\frac{E_1}{E_0} = \cos \theta$$



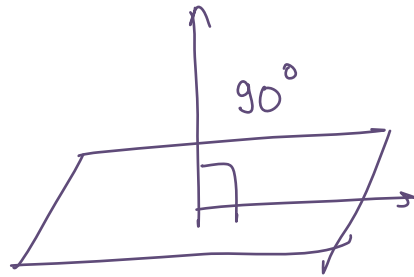
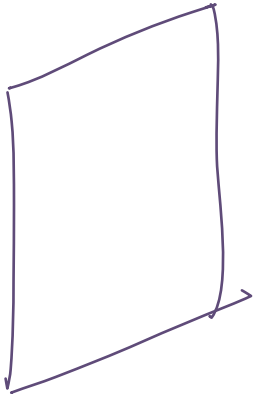
$$I \propto E^2$$

$$E_1^2 = E_0^2 \cos^2 \theta$$

$$I = I_0 \cos^2 \theta$$

If  $\theta = 0^\circ$ ,  $P_1$  (first Polaroid is placed parallel to second polaroid)

$$\underline{\underline{I_1 = I_0}}$$

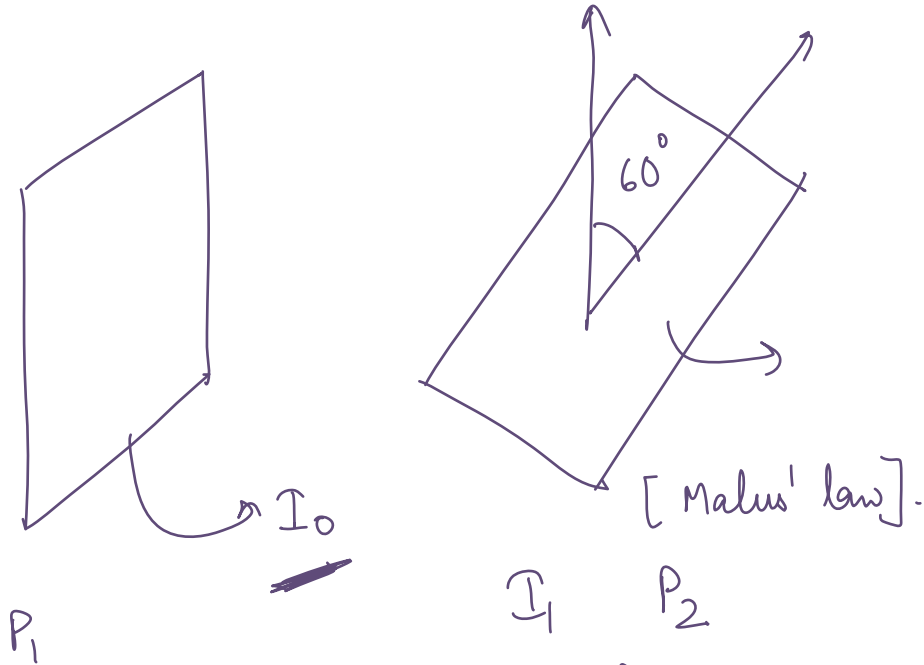


$$I = I_0 \cos^2 \theta$$

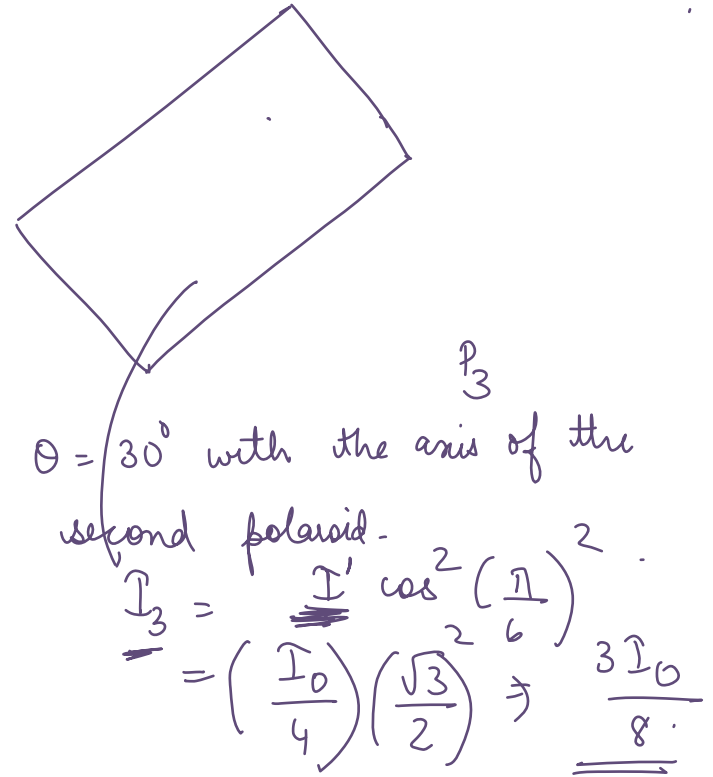
$\uparrow$   
 $90^\circ$

$$\underline{\underline{= 0}}$$





$$\begin{aligned}
 \underline{I_1} &= I_0 \cos^2(60) \\
 &= I_0 \times \left(\frac{1}{2}\right)^2 = \underline{\underline{\frac{I_0}{4}}}
 \end{aligned}$$



$$\begin{aligned}
 \underline{I_3} &= \underline{I_1} \cos^2\left(\frac{\pi}{6}\right) \\
 &= \left(\frac{I_0}{4}\right) \left(\frac{\sqrt{3}}{2}\right)^2 \Rightarrow \underline{\underline{\frac{3I_0}{8}}}
 \end{aligned}$$

→ was not explain polarization of light.

Huygen's → Light is a longitudinal wave.

↳ Polarizing axis is parallel to propagation

All light wave will pass through polaroid as unfiltered.

Newton's Corpuscular : Light consists of particles.

→ Unfiltered.

Maxwell. EM. Transverse → wave

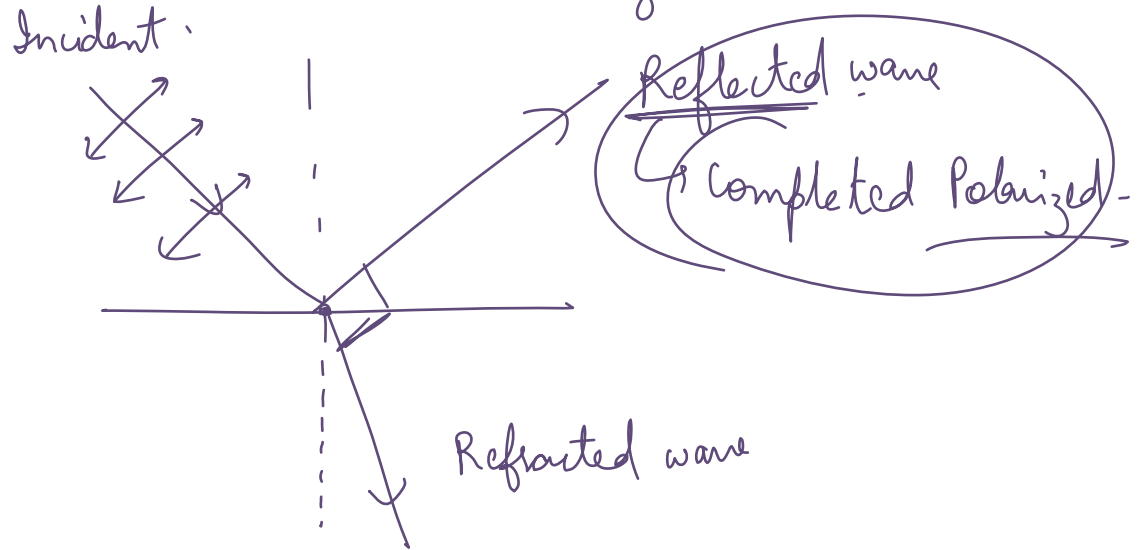
↳ Polarizing axis is  $\perp$  to propagation → Intensity is reduced during polarization.

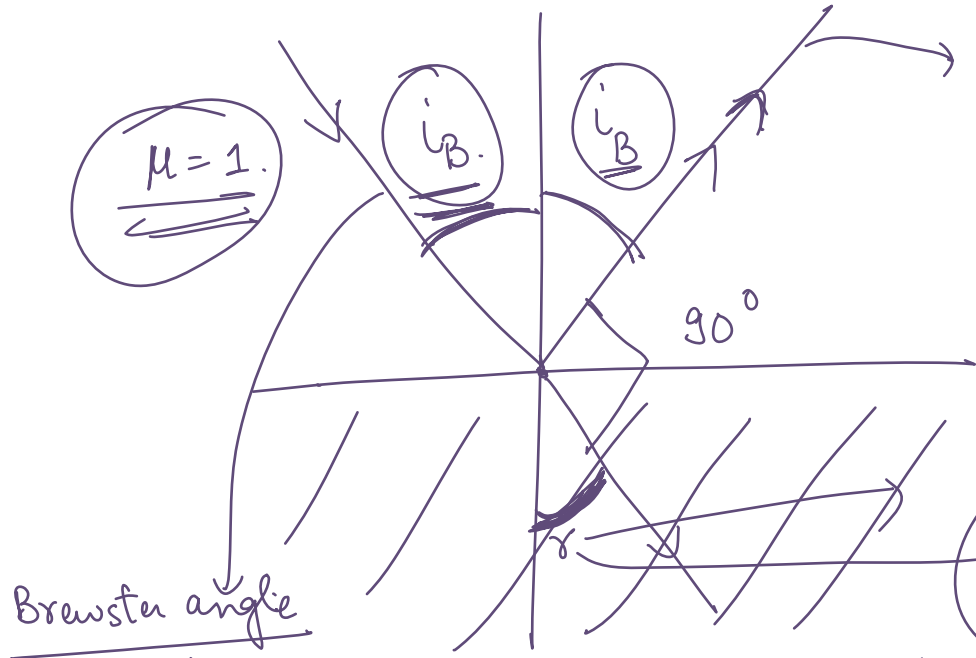
Polarization by Scattering:

Scattering of light by molecules → CV Raman ,

↳ Noble Prize in 1930 -

Incident Sunlight .  
Unpolarized .





Reflected wave -

$$\mu_1 \sin i_1 = \mu_2 \sin i_2$$

$$1 \sin i_B = \mu \sin \left( \frac{\pi}{2} - i_B \right)$$

$$\sin i_B = \mu \cos i_B$$

$$\Rightarrow \boxed{\mu = \tan i_B}$$

Brewster angle

Unpolarized light is incident on the boundary b/w two transparent media

Light will be completely polarized if the reflected ray makes angle  $90^\circ$  with the refracted ray.