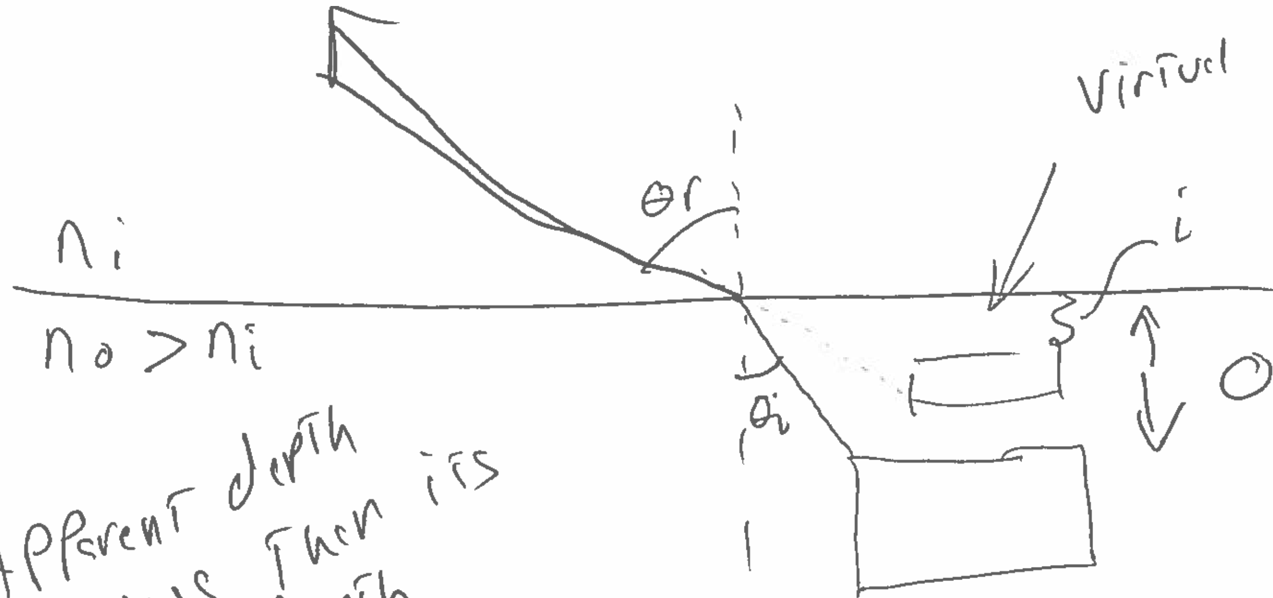


Apperent depth is less then its Actual depth.

Refrection at interface

$$\frac{n_o}{o} + \frac{n_i}{i} = \frac{n_i - n_o}{R}$$

— radius of curvature between two mediums

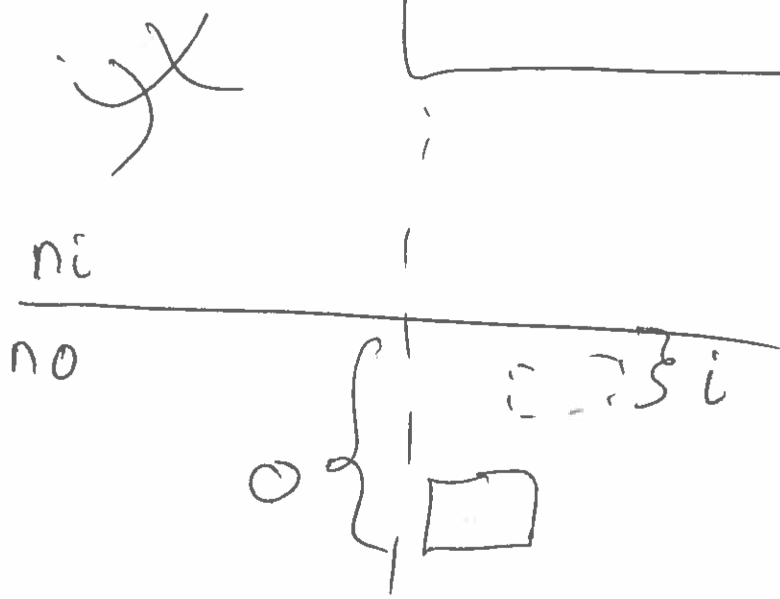
for flat surface such as water

$$R = \infty$$

$$\frac{n_o}{o} + \frac{n_i}{i} = \frac{n_i - n_o}{R} \rightarrow 0$$

$$\frac{n_o}{o} + \frac{n_i}{i} = 0 \Rightarrow \frac{n_o}{o} = -\frac{n_i}{i}$$

$$\boxed{i = -o\,\frac{n_i}{n_o}}$$ ← apparent depth



eg/ coin at bottom of a fountain it appears to be 0.75 m below surface. How far actually?

$n_i = n_{air} = 1.00$ $\qquad$ $n_o = n_w = 1.333$

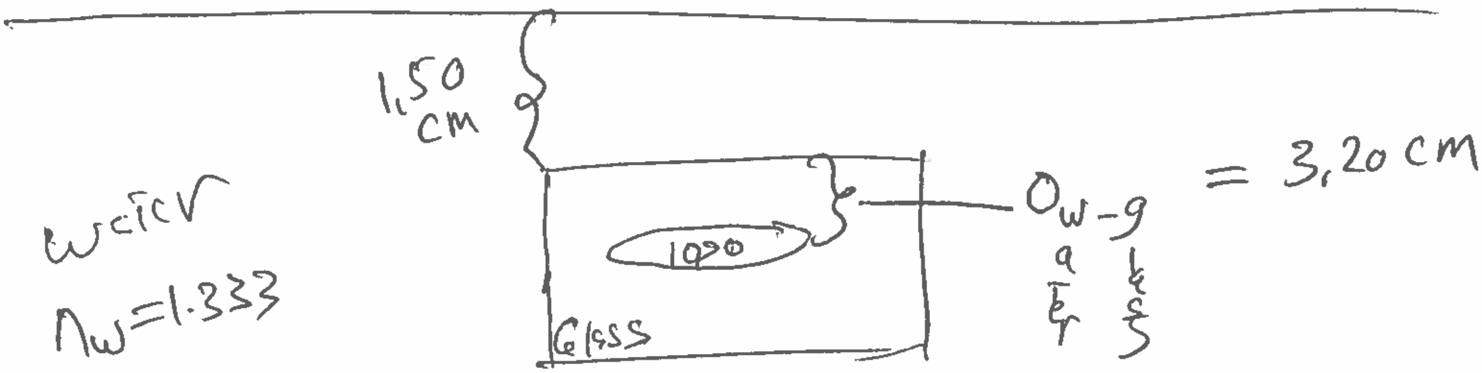
$i = -0.75\text{ m}$ $\qquad$ $o = ?$

$$o = -i\,\frac{n_o}{n_i} = -\frac{(-0.75\text{m})(1.333)}{(1.00)}$$

$$\boxed{o = +0.975\text{m}}$$

26-25

$n_{air} = 1.00$



$n_g = 1.52$

Law of superposition ⇒ Total optical effect is The sun of Thie individual optical interfaces,

1) find imase due To water–Glass Interface

2) Tha imase (due To water–Glass) becomes obiect for The air–water interface

3) find The final imase relative To air–water

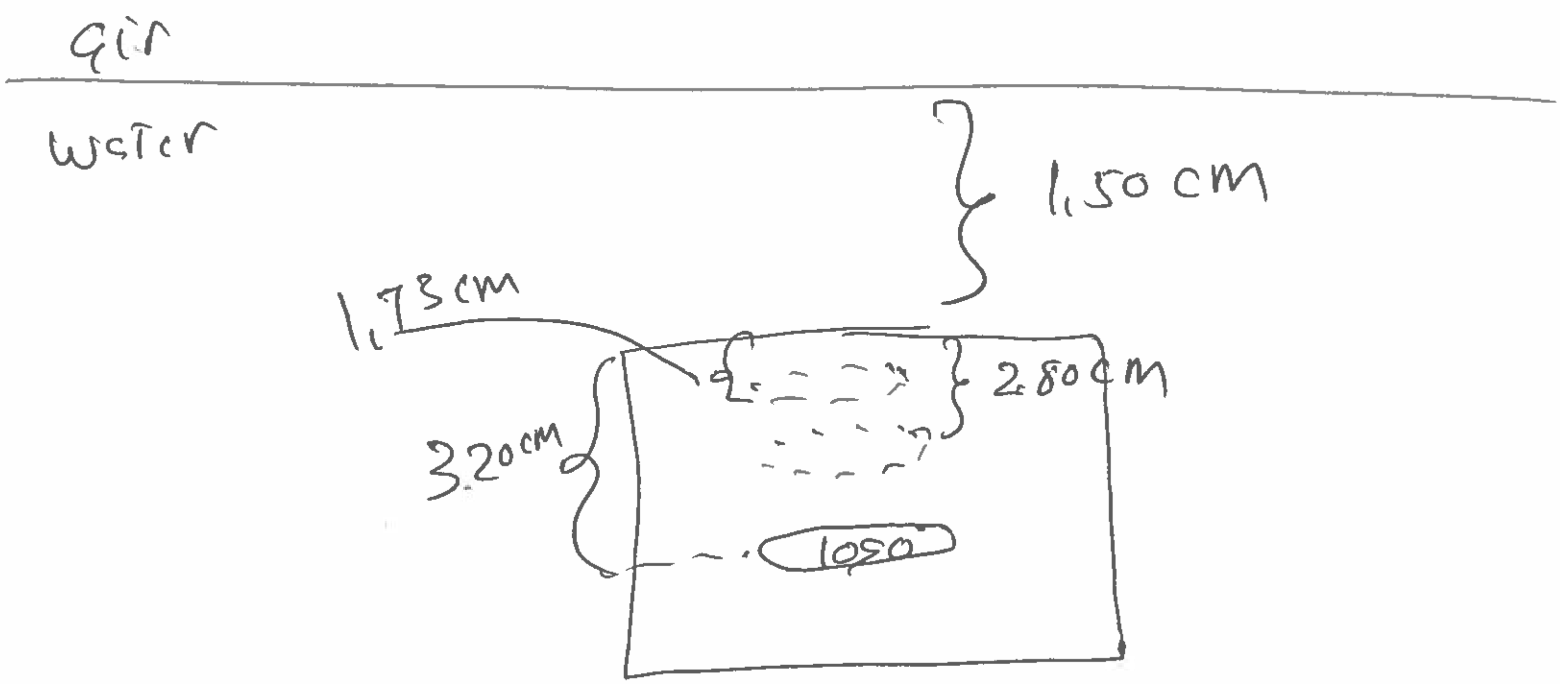
Step 1)

$$i = -o \frac{n_i}{n_o}$$

$$i_{wg} = -o_{wg}\left(\frac{n_w}{n_g}\right)$$

$$i_{wg} = -(3.20\,\text{cm})\left(\frac{1.333}{1.52}\right)$$

$$i_{wg} = -2.80\,\text{cm}$$



$$o_{a-w} = d_w + d_{w-g}$$

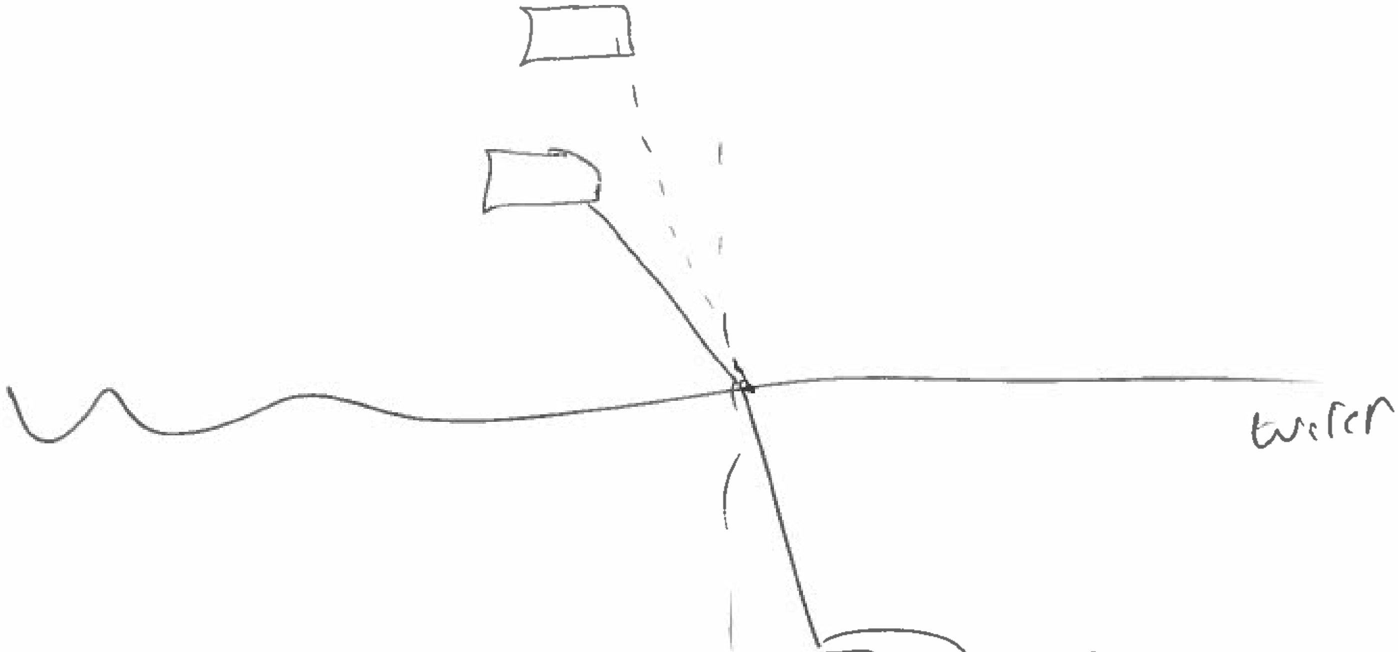
$$o_{a-w} = 1.50\,\text{cm} + 2.80\,\text{cm} = \underline{4.30\,\text{cm}}$$

$$i_{a-w} = -o_{a-w}\left(\frac{n_a}{n_w}\right) = -(4.30\,\text{cm})\left(\frac{1.00}{1.333}\right)$$

$$i_{a-w} = \underline{-3.23\,\text{cm}}$$

− sign ⇒ virtual

below surface of water



for flat interfaces

$$\frac{n_o}{o} + \frac{n_i}{i} = 0$$

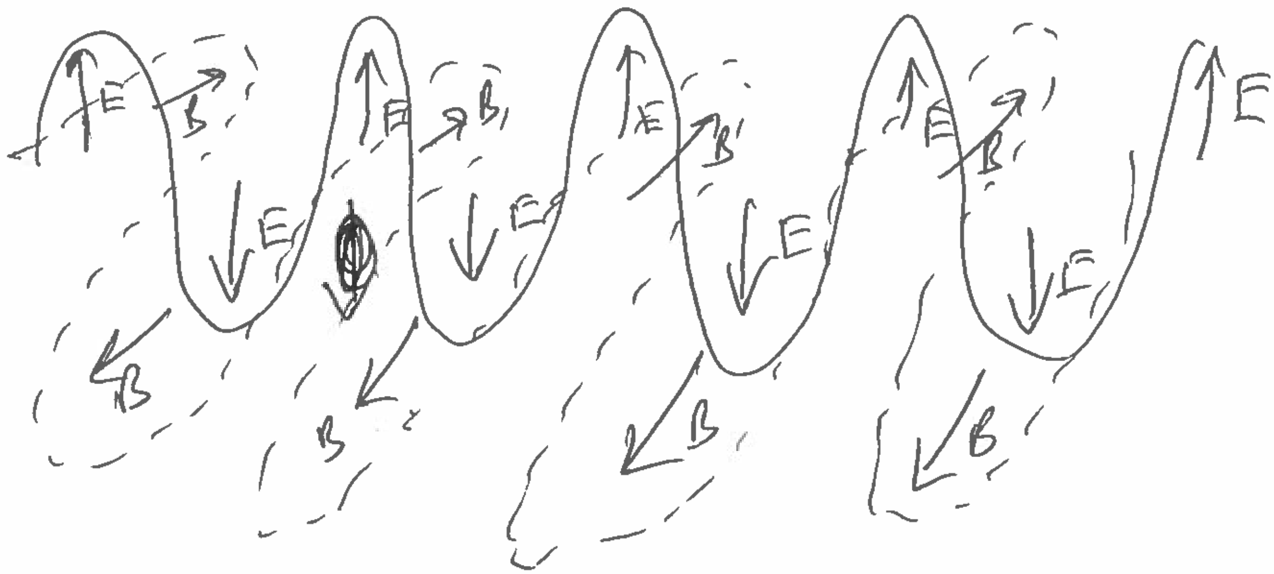
$$o = -i \frac{n_o}{n_i}$$ ← sign ⇒ virtual

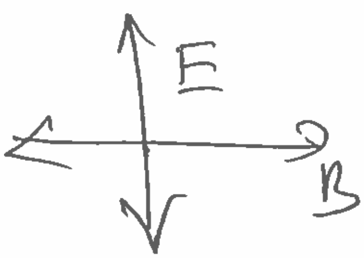
or

$$i = -o \frac{n_i}{n_o}$$

Polarization of Light

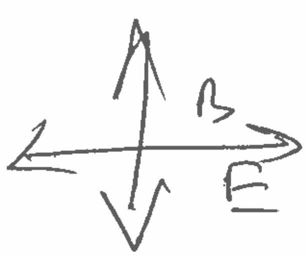
Light is an Electromagnetic Wave





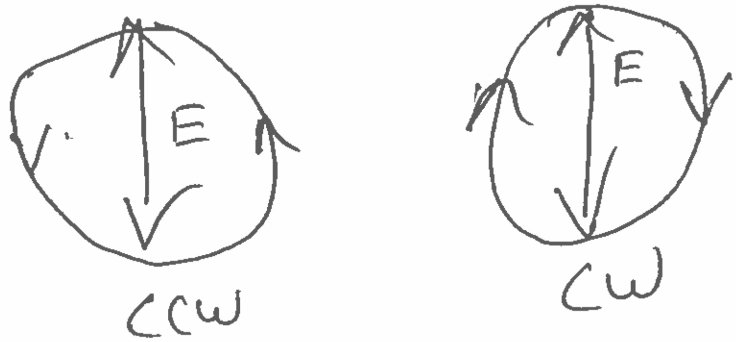
By convention Polarization of light is the direction the $\vec{E}$ is oscillating in

This orientation ⇒ vertically Polarized Light



⇒ horizontally Polarized Light.

In addition we can have circularly polarized light where $\vec{E}, \vec{B}$ are rotating (clockwise or counter clockwise

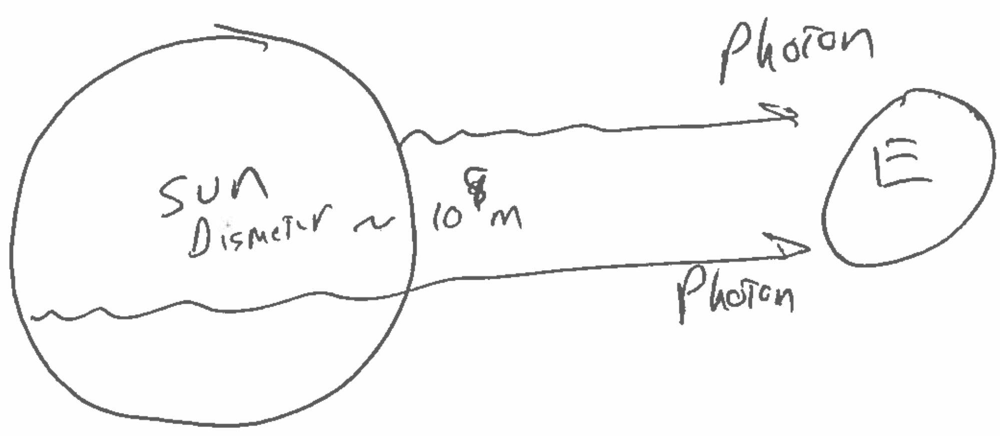


or unpolarized light

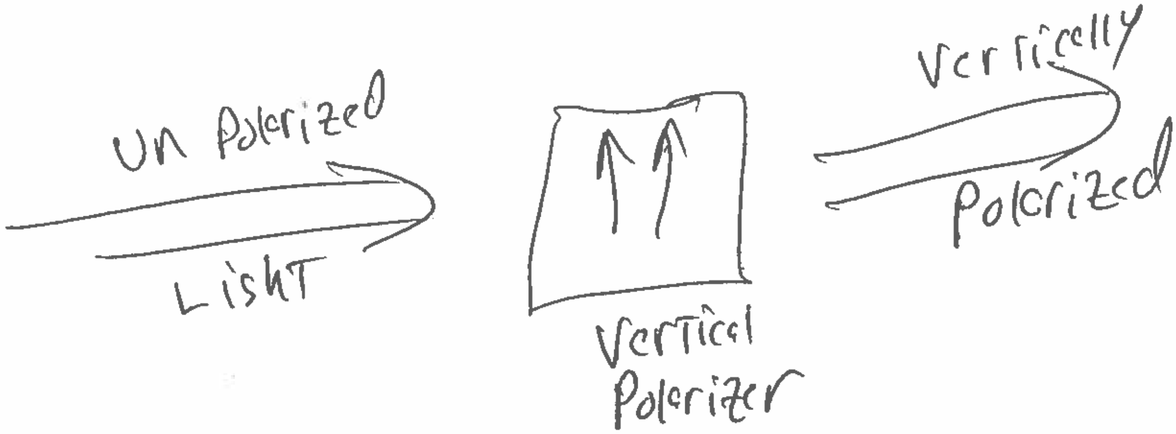
all at same time

unpolarized light occurs from incoherent light.

Coherent implies phase relationships

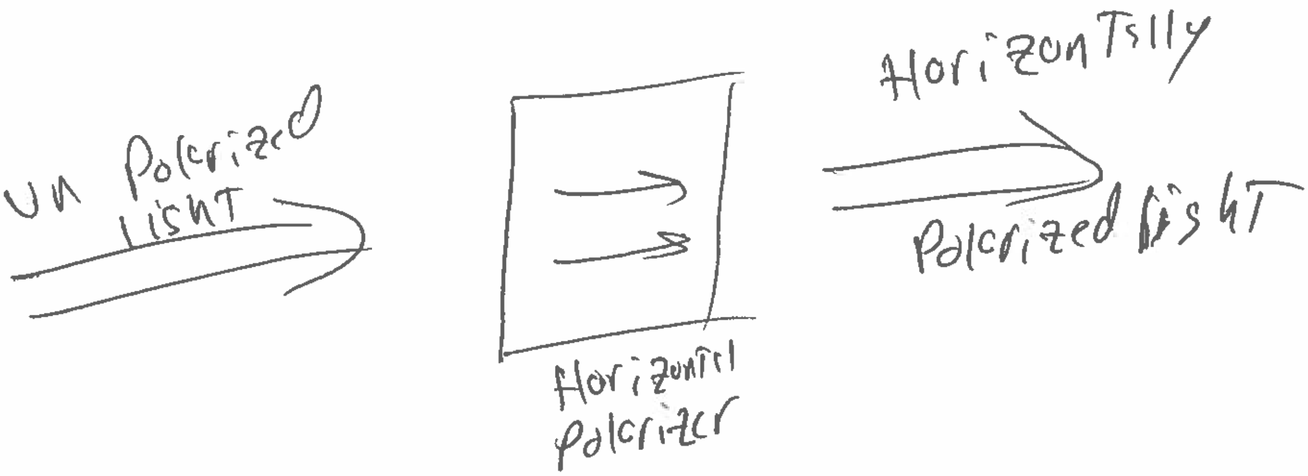


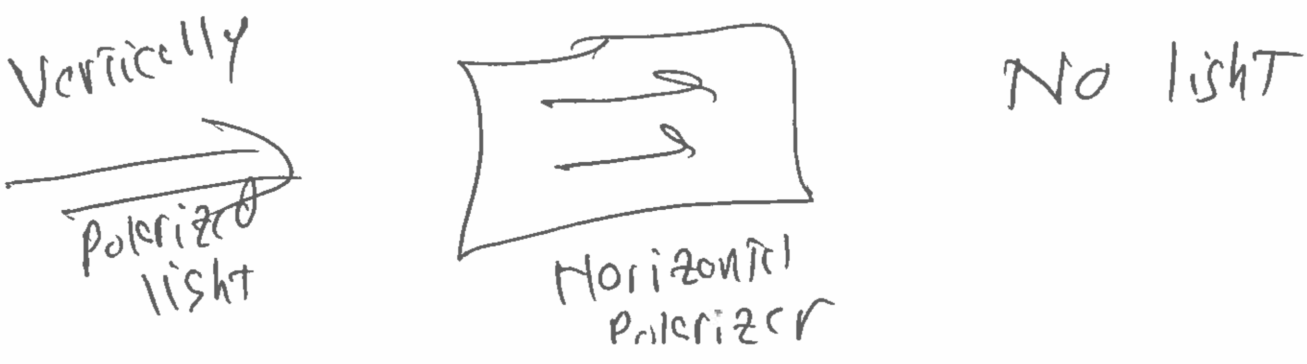
Polarizers ⇒ Polarize light in a preferred direction

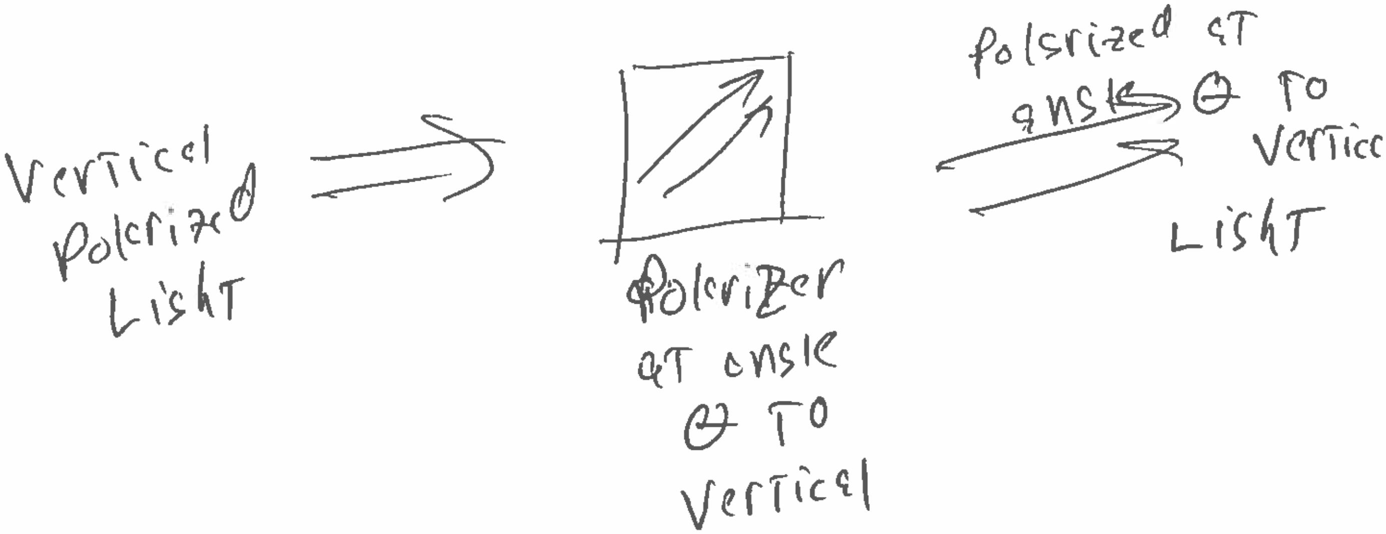


Absorbes
non-vertical
polarizations

$$I_{Trans} = \frac{1}{2} I_0$$







$$I_{Trans} = I_0 \cos^2\theta$$ — Law of Malus

$\cos 0 = 1$

$\cos 10 = 0.9 / 0.8$

$\cos 90 = 0$

$\cos 45 = \frac{1}{\sqrt{2}}$