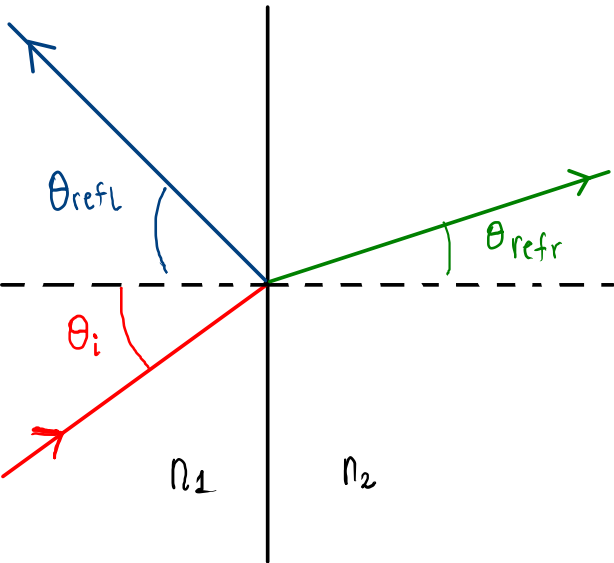


REFLEXIÓN & REFRACCIÓN

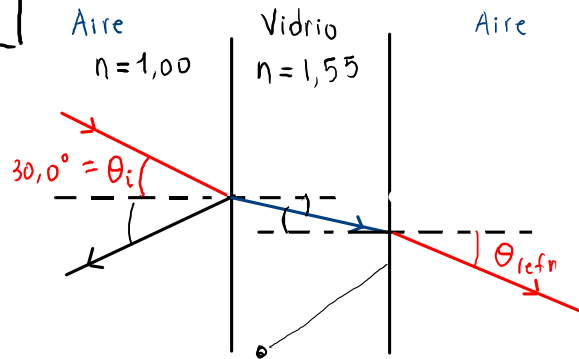


- $\theta_i = \theta_{\text{refl}}$

- $n_1 \sin \theta_i = n_2 \sin \theta_{\text{refr}}$

$$n \equiv \frac{c}{v}$$

5.2



$$\underline{a} \quad \theta_{refl} \quad \theta_{refr}$$

$$n_v \sin \theta_{refr} = n_a \sin \theta_i$$

$$\sin \theta_{refr} = \frac{n_a}{n_v} \sin \theta_i$$

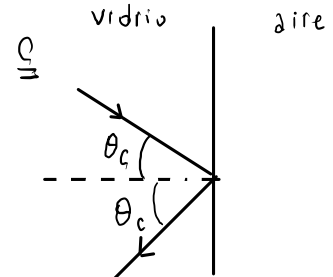
$$\theta_{refr} = \arcsen \left[\frac{n_a}{n_v} \sin \theta_i \right] = 18,8^\circ$$

$$\underline{b} \quad \theta_{refr}^1 = \theta_{inc}^2$$

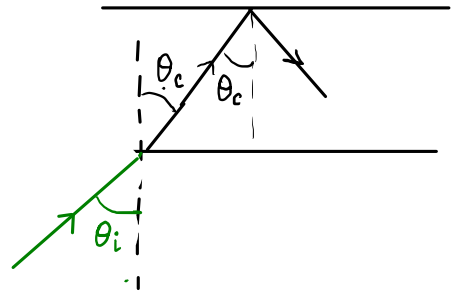
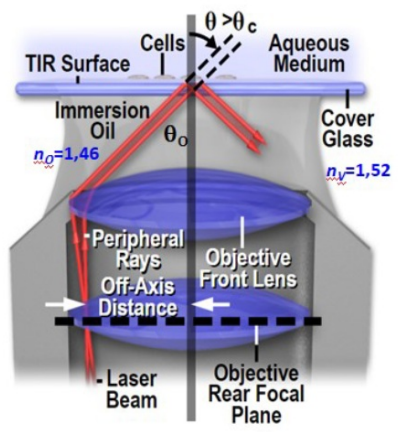
$$\Rightarrow n_v \cdot \sin(\theta_{inc}^2) = n_v \cdot \sin(\theta_{refr}^1) = n_a \sin(\theta_{refr}^2)$$

$$\Leftrightarrow \theta_{refr}^{(2)} = \theta_i = 30,0^\circ$$

$$\theta_c = \arcsen \left(\frac{n_a}{n_v} \right) = 40,2^\circ$$



5.3



células $n = 1,37$

vidrio $n = 1,52$

aceite $n = 1,46$

$$\theta_c^i = \arcsen\left(\frac{n_2}{n_1}\right)$$

(a) $\theta_c = 64,3^\circ$

$$n_a \cdot \text{sen } \theta_i = n_v \text{ sen } \theta_c$$

$$\theta_i = \arcsin\left[\frac{n_v}{n_a} \cdot \text{sen}(64,3^\circ)\right] = 69,7^\circ$$

Cuando pasamos de n_1 a n_2
con $n_2 > n_1$, $\theta_{\text{refr}} < \theta_{\text{inc}}$

(b)

$$d = \frac{\lambda_0}{4\pi} (n_v^2 \sin^2 \theta - n_c^2)^{-\frac{1}{2}}$$

$$d = 140 \text{ nm} = 140 \times 10^{-9} \text{ m}$$

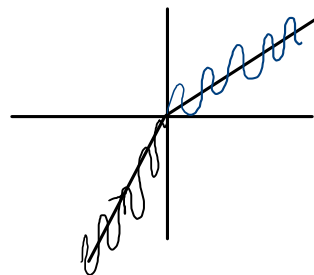
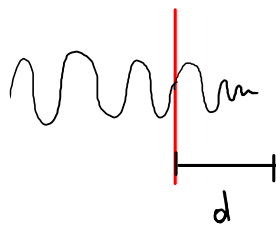
$$\theta = 80,0^\circ$$

$$n_v = 1,52$$

$$n_c = 1,37$$

$$d = \frac{\lambda_0}{4\pi} [n_v^2 \sin^2 \theta - n_c^2]^{-1/2}$$

$$\lambda_0 = \frac{4\pi d}{[n_v^2 \sin^2 \theta - n_c^2]^{-1/2}} = 1,06 \times 10^{-6} \text{ m}$$



(c) mínima longitud de penetración

$$\lambda_0 = 1,06 \times 10^{-6} \text{ m}$$

$$n_v = 1,52$$

$$n_c = 1,37$$

$$\frac{\lambda_0}{4\pi} = \frac{1}{\sqrt{n_v^2 - n_c^2}}$$

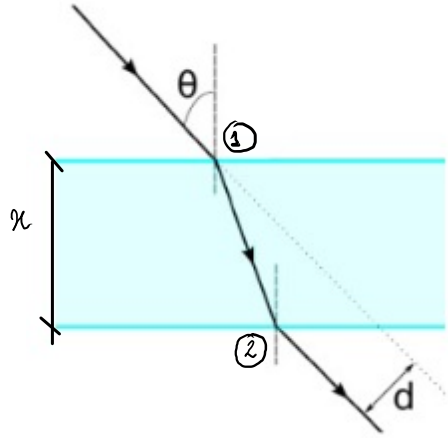
$$d = \frac{\lambda_0}{4\pi} \frac{1}{\sqrt{n_v^2 \sin^2 \theta - n_c^2}}$$

$$\frac{1}{\sqrt{n_v^2 - n_c^2}} = 128 \text{ nm}$$

$$\theta \leq 90^\circ$$

5.6

- $n_v = 1,50 = n$
- $x = 2,00 \text{ cm}$
- $\theta_i = 30,0^\circ$



$$\begin{aligned} \Rightarrow & \begin{cases} \frac{x}{L} = \cos(19,5^\circ) \\ \frac{d}{L} = \sin(10,5^\circ) \end{cases} \end{aligned}$$

(a) $\theta_{\text{refl}}^{(1)} = 30,0^\circ$

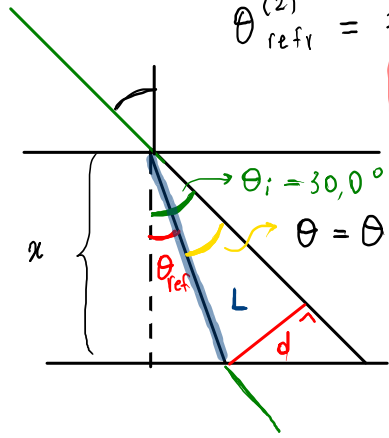
$\theta_{\text{refr}}^{(1)} = \arcsen\left(\frac{n_a}{n_v} \sin(30,0^\circ)\right) = 19,5^\circ$

$\theta_{\text{inc}}^{(2)} = 19,5^\circ = \theta_{\text{refl}}^{(2)}$

$\theta_{\text{refr}}^{(2)} = 30,0^\circ$

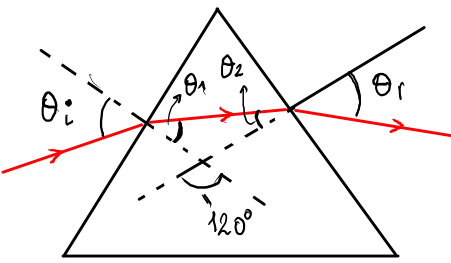
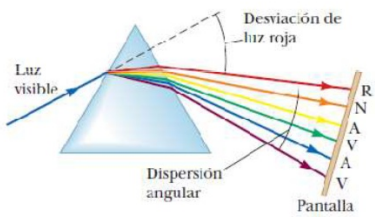
$d = 3,87 \times 10^{-3} \text{ m} \leftarrow \frac{d}{x} = \frac{\sin 10,5}{\cos 19,5}$

(b)



$\frac{(2)}{(1)} = \frac{\frac{d}{L}}{\frac{x}{L}} = \frac{\sin 10,5^\circ}{\cos 19,5^\circ}$

5.7



suma ángulos 4-látero = 360°

$$n_R = 1,62$$

$$n_V = 1,66$$

$$\theta_i = 50,0^\circ$$

θ_1 : ángulo refracción 1^{er} incidencia

θ_2 : " incidencia 2^{da} "

$$\theta_1 + \theta_2 + 120^\circ = 180^\circ$$

$$\theta_1 + \theta_2 = 60^\circ$$

$$\theta_2 = 60^\circ - \theta_1$$

$$n_a \cdot \sin(50^\circ) = n_{\text{vidrio}_R} \cdot \sin(\theta_1)$$

$$\theta_1^R = \arcsen \left[\frac{\sin(50^\circ)}{n_{V_R}} \right] = 28,22^\circ$$

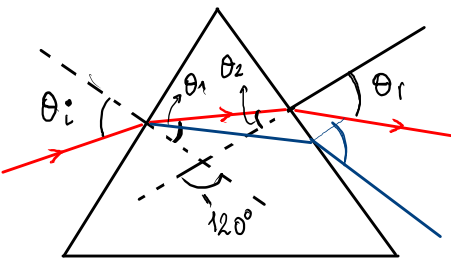
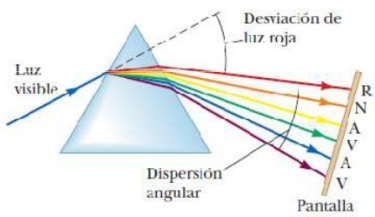
$$\theta_2^R = 60^\circ - 28,22^\circ = 31,78^\circ$$

$$n_a \sin(\theta_r) = n_{V_R} \sin(\theta_2)$$

$$\Rightarrow \theta_r = \arcsen [n_{V_R} \cdot \sin \theta_2]$$

$$\theta_r^R = 58,56^\circ$$

5.7



Suma ángulos 4-látero = 360°

$$n_R = 1,62$$

$$n_V = 1,66$$

$$\theta_i = 50,0^\circ$$

θ_1 : ángulo refracción 1^{er} incidencia
 θ_2 : " " " " 2^{da} " "

$$\theta_1 + \theta_2 + 120^\circ = 180^\circ$$

$$\theta_1 + \theta_2 = 60^\circ$$

$$\theta_2 = 60^\circ - \theta_1$$

$$n_a \cdot \sin(50^\circ) = n_{\text{vidrio}} \cdot \sin(\theta_1)$$

$$\theta_1^V = \arcsen \left[\frac{\sin(50^\circ)}{n_V} \right] = 27,48^\circ$$

$$\theta_2^V = 60^\circ - 27,48^\circ = 32,52^\circ$$

$$n_a \sin(\theta_r) = n_V \sin(\theta_2^V)$$

$$\Rightarrow \theta_r = \arcsen [n_V \cdot \sin \theta_2^V]$$

$$\theta_r^V = 63,17^\circ$$

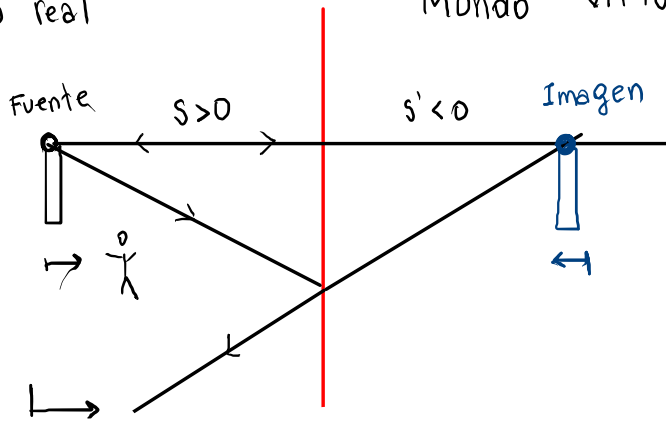
$$\theta_r^R = 58,56^\circ$$

$$\Delta \theta = 4,61^\circ$$

ESPEJOS PLANOS

Mundo real

Mundo virtual

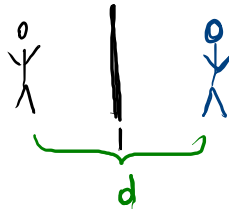


$$m = \frac{y'}{y} = -\frac{s'}{s} = 1$$

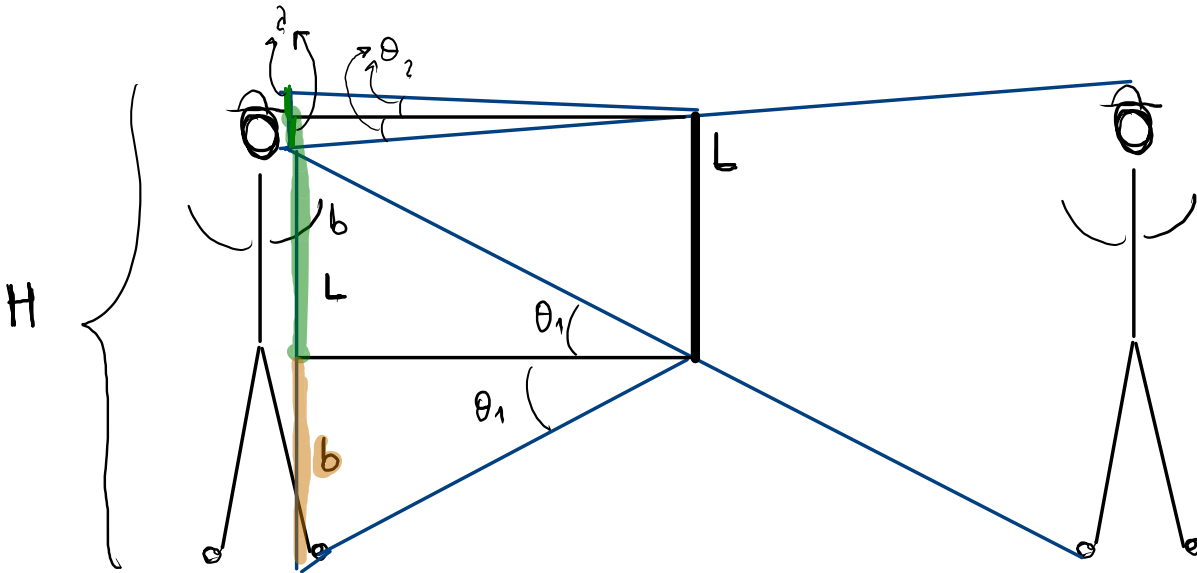
$$-s' = s$$

5.8 $\Rightarrow s = 2,00 \text{ m}$

$$d = s + |s'|$$
$$= 2 \cdot s = 4,00 \text{ m}$$



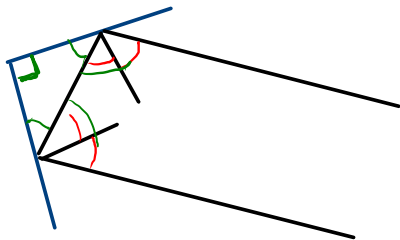
(b)



$$L = a + b$$

$$H = b + b + a + a = 2(a + b) = 2L \Leftrightarrow L = \frac{H}{2}$$

(c)



$$\begin{aligned}\theta_{TOT} &= 2(\theta_{i_1} + \theta_{i_2}) \\ &= 2 \cdot (180 - 90) \\ &= 2 \cdot 90 \\ &= 180^\circ\end{aligned}$$