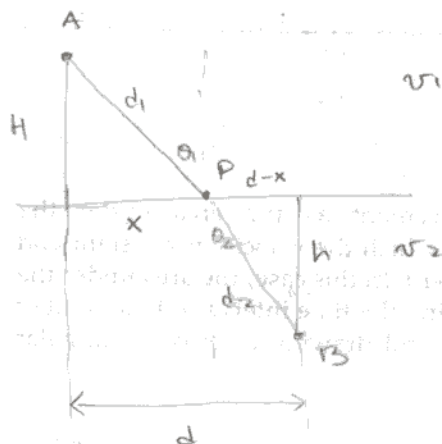


P1



Det. pto P tal que tiempo $A \rightarrow B$

Sea mínimo.

Datos: H, h, d, v_1, v_2

$$T = \frac{d_1}{v_1} + \frac{d_2}{v_2}$$

$$T(x) = \frac{\sqrt{x^2 + H^2}}{v_1} + \frac{\sqrt{(d-x)^2 + h^2}}{v_2}$$

Minimizar T

$$\frac{dT(x)}{dx} = 0$$

$$\Rightarrow \frac{dT(x)}{dx} = \frac{1}{v_1} \frac{1}{\sqrt{x^2 + H^2}} \cdot 2x + \frac{1}{v_2} \frac{1}{\sqrt{(d-x)^2 + h^2}} \cdot 2(x-d) = 0$$

$$\Rightarrow \frac{1}{v_1} \frac{x}{\sqrt{x^2 + H^2}} = \frac{1}{v_2} \frac{d-x}{\sqrt{(d-x)^2 + h^2}}$$

$\sin \theta_1 \quad \sin \theta_2$

$$\Rightarrow \frac{\sin \theta_2}{\sin \theta_1} = \frac{v_2}{v_1}$$

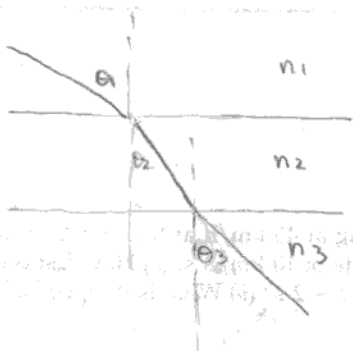
$$n_i \equiv \frac{c}{v_i} \leftarrow \text{vel luz en vacío}$$

$$v_i \leftarrow \text{vel luz en medio } i$$

$$\Rightarrow \frac{\sin \theta_2}{\sin \theta_1} = \frac{n_1}{n_2}$$

$$\frac{1}{v_1} \frac{x}{\sqrt{x^2 + H^2}} = \frac{1}{v_2} \frac{d-x}{\sqrt{(d-x)^2 + h^2}}$$

P1



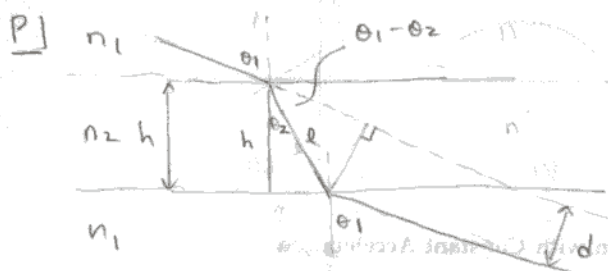
datos: n_1, n_2, n_3, θ_1

θ_3 ?

$$\frac{\sin \theta_2}{\sin \theta_1} = \frac{n_1}{n_2} \quad \frac{\sin \theta_3}{\sin \theta_2} = \frac{n_2}{n_3}$$

$$\Rightarrow \frac{\sin \theta_3}{\sin \theta_1} = \frac{n_1}{n_3} \rightarrow \theta_3 \text{ no depende del medio 2}$$

Si $n_1 = n_3 \Rightarrow$ rayo en ① = rayo en ③



datos: θ_1, n_1, n_2

d ?

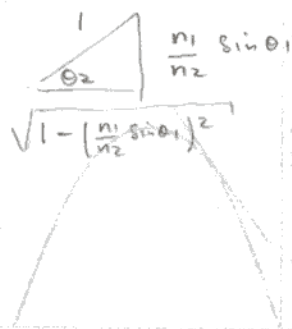
$$\frac{\sin \theta_2}{\sin \theta_1} = \frac{n_1}{n_2} \rightarrow \sin \theta_2 = \frac{n_1}{n_2} \sin \theta_1$$

$$h = l \cos \theta_2 \rightarrow l = \frac{h}{\cos \theta_2}$$

$$d = l \sin(\theta_1 - \theta_2) = \frac{h}{\cos \theta_2} (\sin \theta_1 \cos \theta_2 - \cos \theta_1 \sin \theta_2)$$

$$= h (\sin \theta_1 - \cos \theta_1 \tan \theta_2)$$

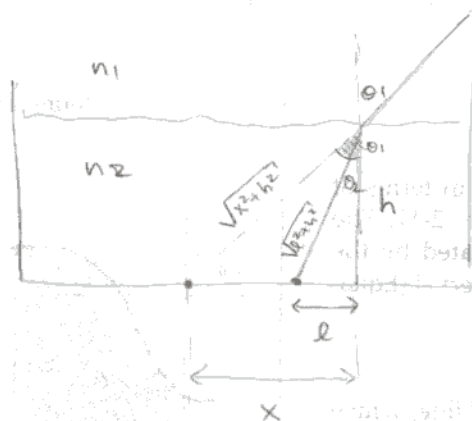
$$d = h \left(\sin \theta_1 - \cos \theta_1 \frac{\frac{n_1 \sin \theta_1}{n_2}}{\sqrt{1 - \left(\frac{n_1 \sin \theta_1}{n_2} \right)^2}} \right)$$



PJ

Dates : n_1, n_2, h, l

$c \times ?$



$$\sin \theta_2 = \frac{l}{\sqrt{l^2 + h^2}} \quad (1)$$

$$\frac{\sin \theta_2}{\sin \theta_1} = \frac{n_1}{n_2}$$

pero $\tan \theta_1 = \frac{x}{h} \rightarrow x = h \tan \theta_1$

$$\Rightarrow x = h \frac{n_2}{n_1} \frac{l}{\sqrt{l^2 + h^2}}$$

$$\sqrt{1 - \left(\frac{n_2}{n_1} \frac{l}{\sqrt{l^2 + h^2}} \right)^2}$$

Si $n_1 = n_2$ $X =$

$$\frac{h \frac{l}{\sqrt{l^2 + h^2}}}{\sqrt{1 - \left(\frac{n_2}{n_1} \frac{l}{\sqrt{l^2 + h^2}} \right)^2}} = \frac{x \frac{l}{\sqrt{l^2 + h^2}}}{\frac{l}{\sqrt{l^2 + h^2}}} = l \quad \checkmark$$

$$\sqrt{1 - \frac{l^2}{l^2 + h^2}} = \frac{h}{\sqrt{l^2 + h^2}}$$

$$\frac{dh}{dt} = \frac{dx}{dt} \frac{dx}{dh}$$

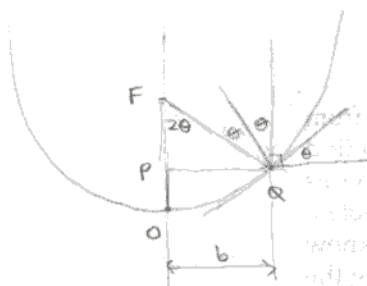
The average acceleration is the rate of the change in velocity. The average velocity is the change in position divided by the change in time. The average acceleration is the rate of the change in velocity. The average velocity is the change in position divided by the change in time. The average acceleration is the rate of the change in velocity. The average velocity is the change in position divided by the change in time.

$$\frac{dx}{dt} = \frac{dx}{dh} \frac{dh}{dt}$$

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$$\frac{dx}{dt} = \frac{dx}{dh} \frac{dh}{dt}$$

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$$y = ax^2$$


Det. distance $f_{\text{acoustic}} = 1000$ m

$$OF = PF + OP$$

$$\tan 2\theta = \frac{b}{PF}$$

$$PF = \frac{b}{2} \frac{1 - \tan^2 \theta}{\tan \theta}$$

$$\frac{2 \tan \theta}{1 - \tan^2 \theta}$$

$$\Rightarrow OF = \frac{b}{2} \frac{1 - \tan^2 \theta}{\tan \theta} \quad \tan \theta = \frac{dy}{dx} = 2ab$$

$$= \frac{b}{2} \frac{1-4a^2/b^2}{2ab} + a/b^2$$

$$= \frac{1}{4a} - \cancel{a/b^2} + \cancel{a/b^2}$$

$$OF = \frac{1}{4a}$$

distance for each