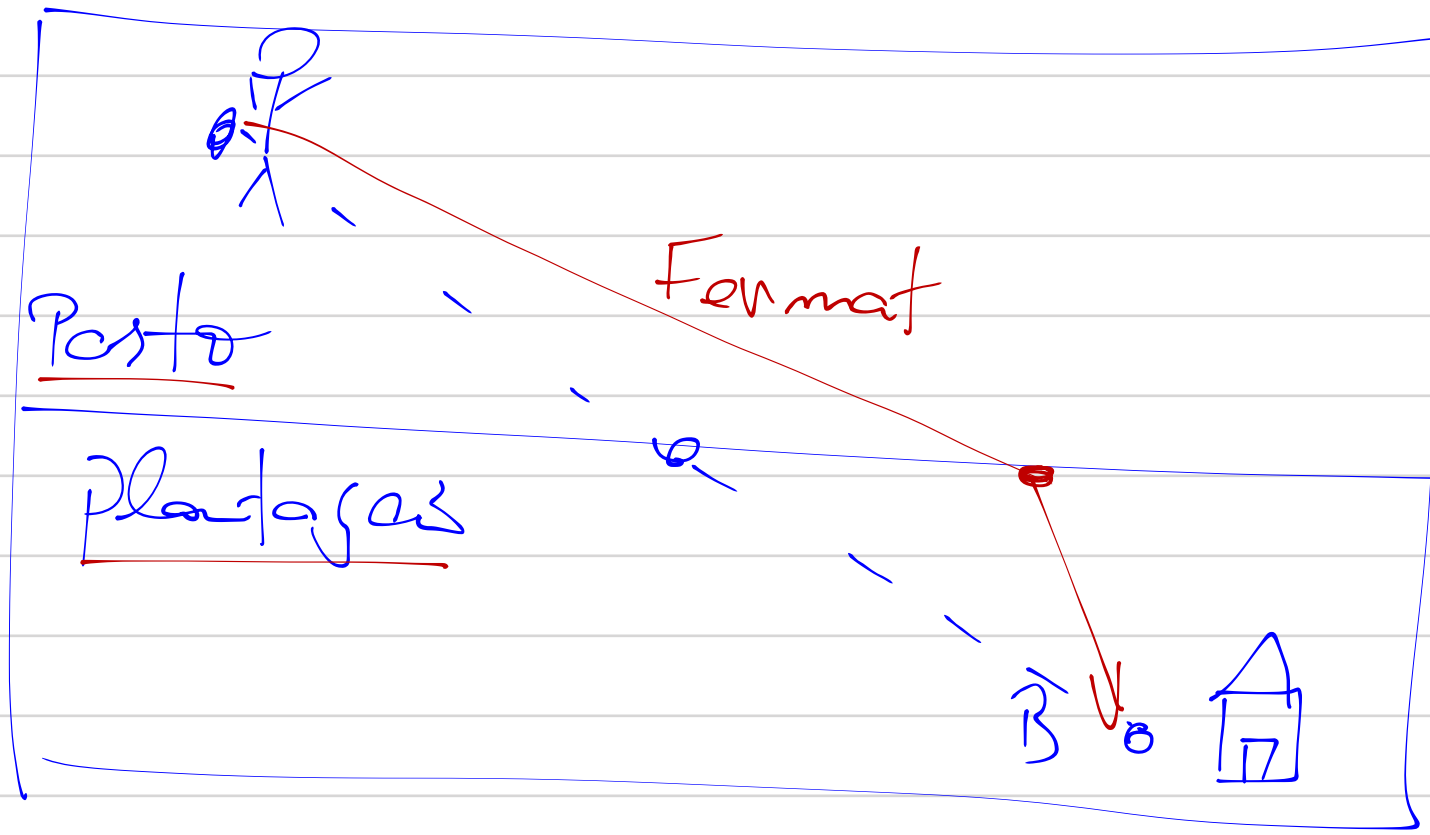
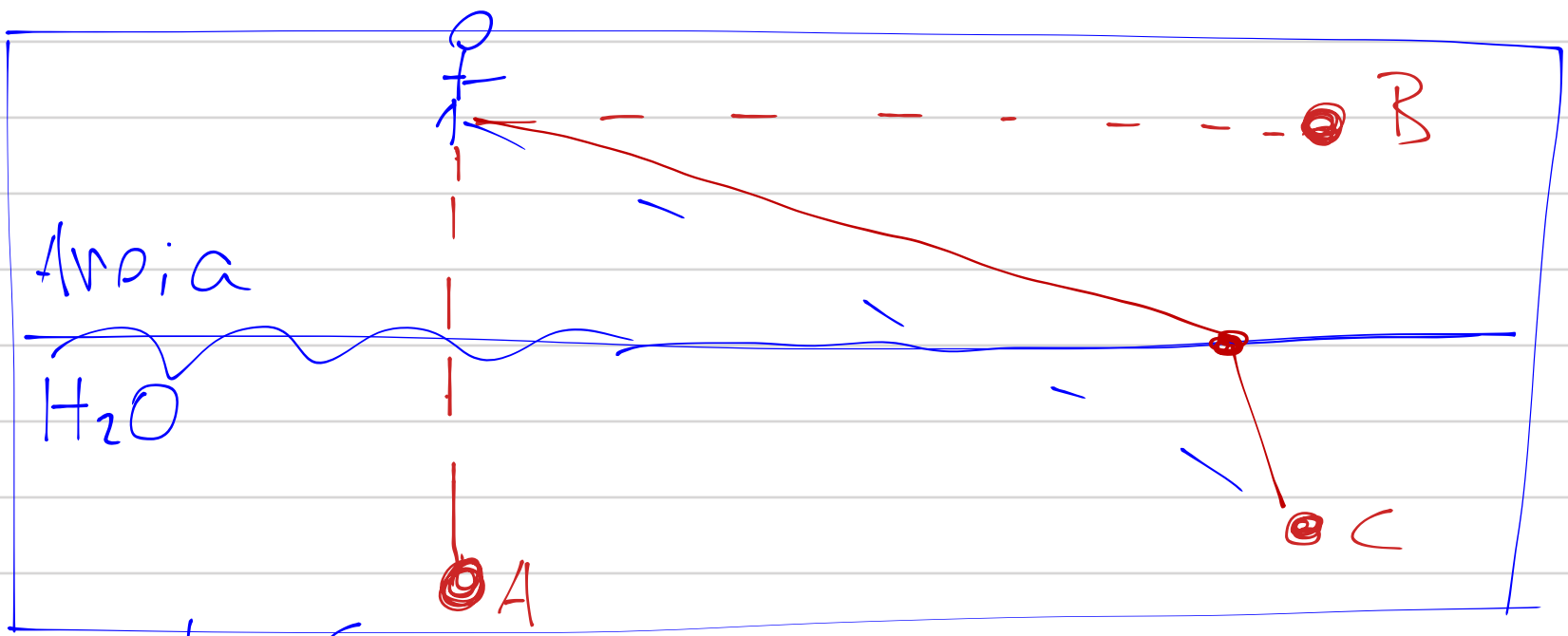
Princípio de Fermat

→ livro: Nós e a natureza

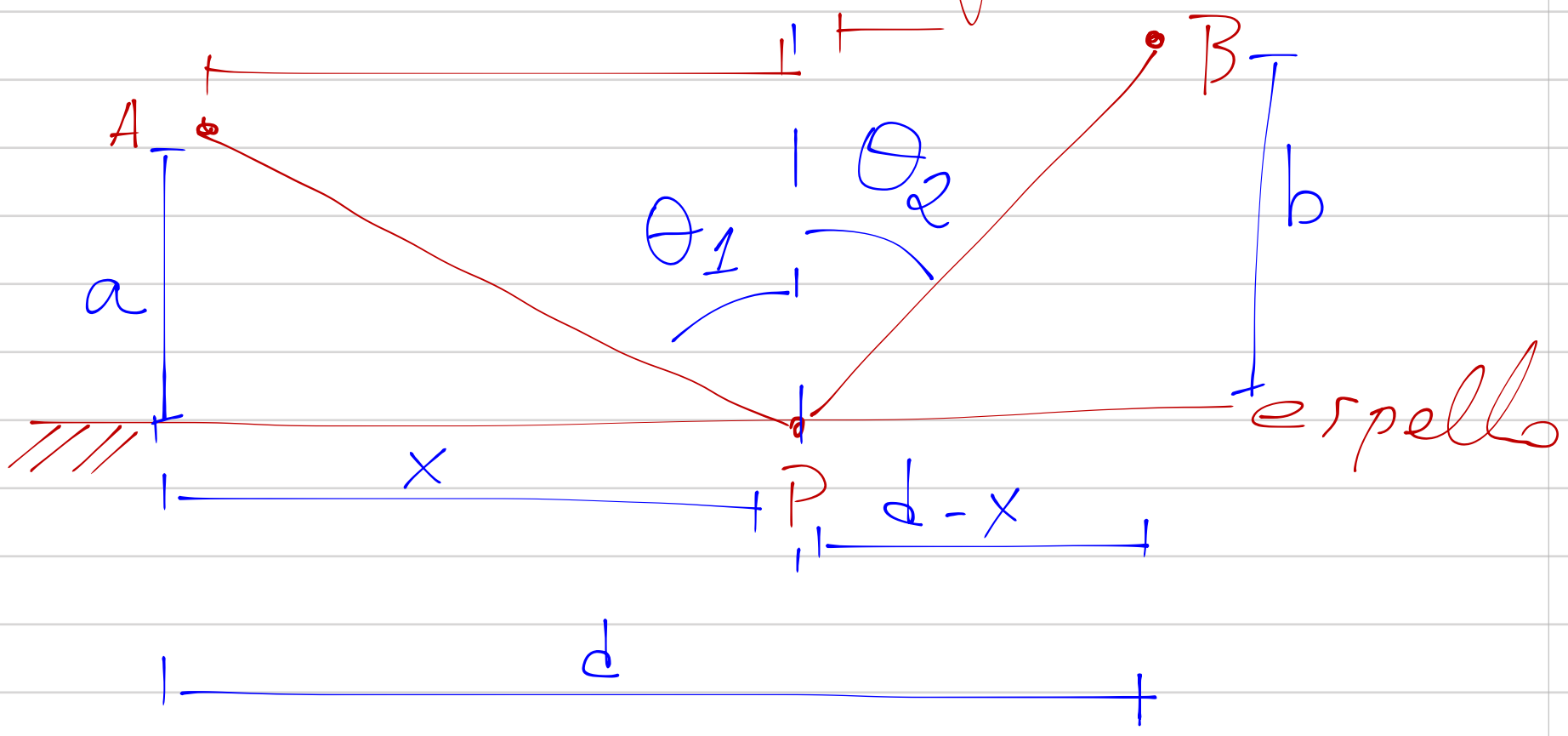


→ Instinto Matemático



Vista Superior

→ Reflexão e Refração



caminho = AP + PB

$$v = \frac{\Delta z}{\Delta t} \qquad c = cte$$

$\Delta t \rightarrow$ mínimo

$$\Delta t = \frac{1}{c}\left[\sqrt{a^2+x^2} + \sqrt{b^2+(d-x)^2}\right]$$

$x \longrightarrow$ variável

$$\frac{dt}{dx} = 0 = \frac{1}{k}\left[\frac{1}{2}(a^2+x^2)^{-\frac{1}{2}} \cdot 2x + \frac{1}{2}\left[b^2+(d-x)^2\right]^{-1/2} \cdot 2(d-x)(-1)\right]$$

$$\frac{x}{\sqrt{a^2+x^2}} = \frac{d-x}{\sqrt{b^2+(d-x)^2}}$$

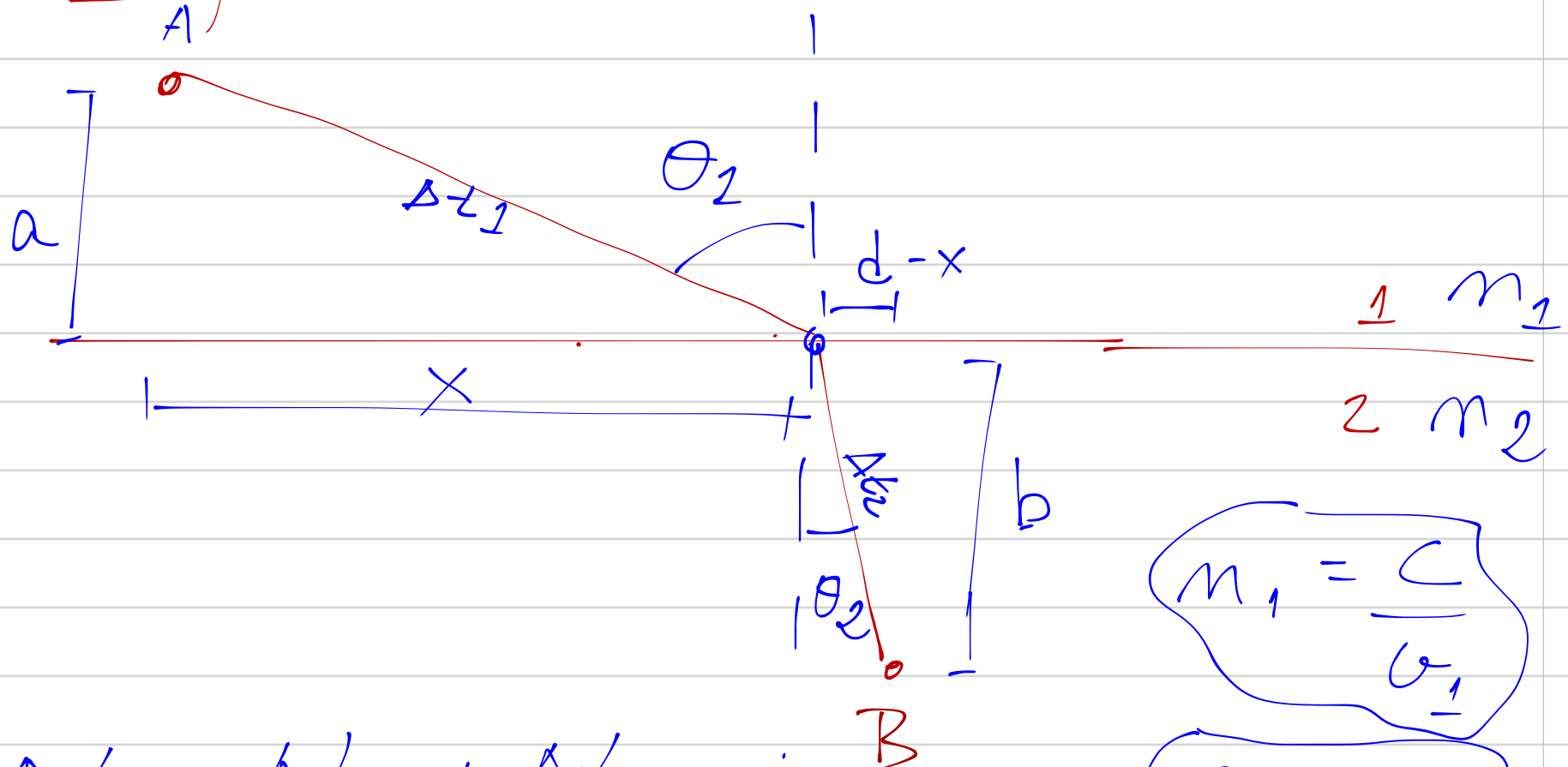
$\sqrt{b^2 + (d-x)}$

$$\sin\theta_1 = \sin\theta_2$$

$$\theta_1 = \theta_2$$

x x x

Rifrazione



$$n_1 = \frac{c}{v_1}$$

$$n_2 = \frac{c}{v_2}$$

$$\Delta t = \Delta t_1 + \Delta t_2 = \frac{AP}{v_1} + \frac{PB}{v_2} = \frac{n_1}{c}\sqrt{a^2+x^2} + \frac{n_2}{c}\sqrt{b^2+(d-x)^2} =$$

$$\frac{dt}{dx} = \frac{1}{c} n_1 \cdot \frac{1}{2}(a^2+x^2)^{-\frac{1}{2}} 2x + n_2 \frac{1}{2}\left(b^2+(d-x)^2\right)^{-\frac{1}{2}} 2(d-x)(-1)$$

$$\frac{n_1 x}{\sqrt{a^2+x^2}} = n_2 \frac{d-x}{\sqrt{b^2+(d-x)^2}}$$

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