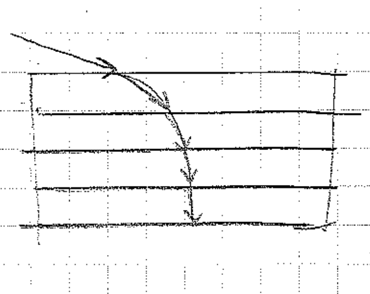
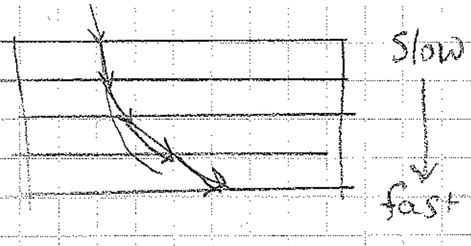
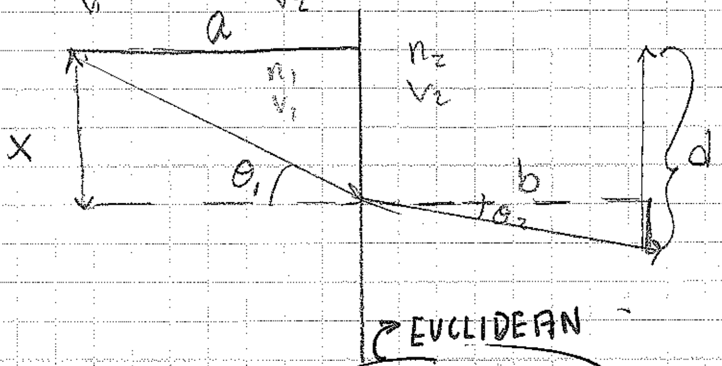
(3)





$n_1 = \frac{c}{v_1}$ $n_2 = \frac{c}{v_2}$

Fermat's principle: Light follows the path of least time



EUCLIDEAN

Since we are in educlidian space

$t = t_x + t_y = \frac{\text{distance}}{\text{velocity}}$ ✓

$t = \frac{\sqrt{a^2+x^2}}{v_1} + \frac{\sqrt{b^2+(d-x)^2}}{v_2}$

$\frac{dt}{dx} = \frac{x}{v_1\sqrt{a^2+x^2}} - \frac{(d-x)}{v_2\sqrt{b^2+(d-x)^2}}$ ✓

By definition $\sin\theta_1 = \frac{x}{\sqrt{a^2+x^2}}$ and $\sin\theta_2 = \frac{(d-x)}{\sqrt{b^2+(d-x)^2}}$ ✓

So $\frac{dt}{dx} = \frac{\sin\theta_1}{v_1} - \frac{\sin\theta_2}{v_2}$

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Good!

If we set $\frac{dt}{dx} = 0$ then

$\frac{\sin\theta_1}{v_1} = \frac{\sin\theta_2}{v_2} \Rightarrow \frac{\sin\theta_1}{\sin\theta_2} = \frac{v_1}{v_2} = \frac{\frac{c}{v_2}}{\frac{c}{v_1}} = \frac{n_2}{n_1}$ } Snell's law ✓

We set $\frac{dt}{dx} = 0$ because light takes path of least time so we want a minimum for the equation. $\Rightarrow dt = 0$

good