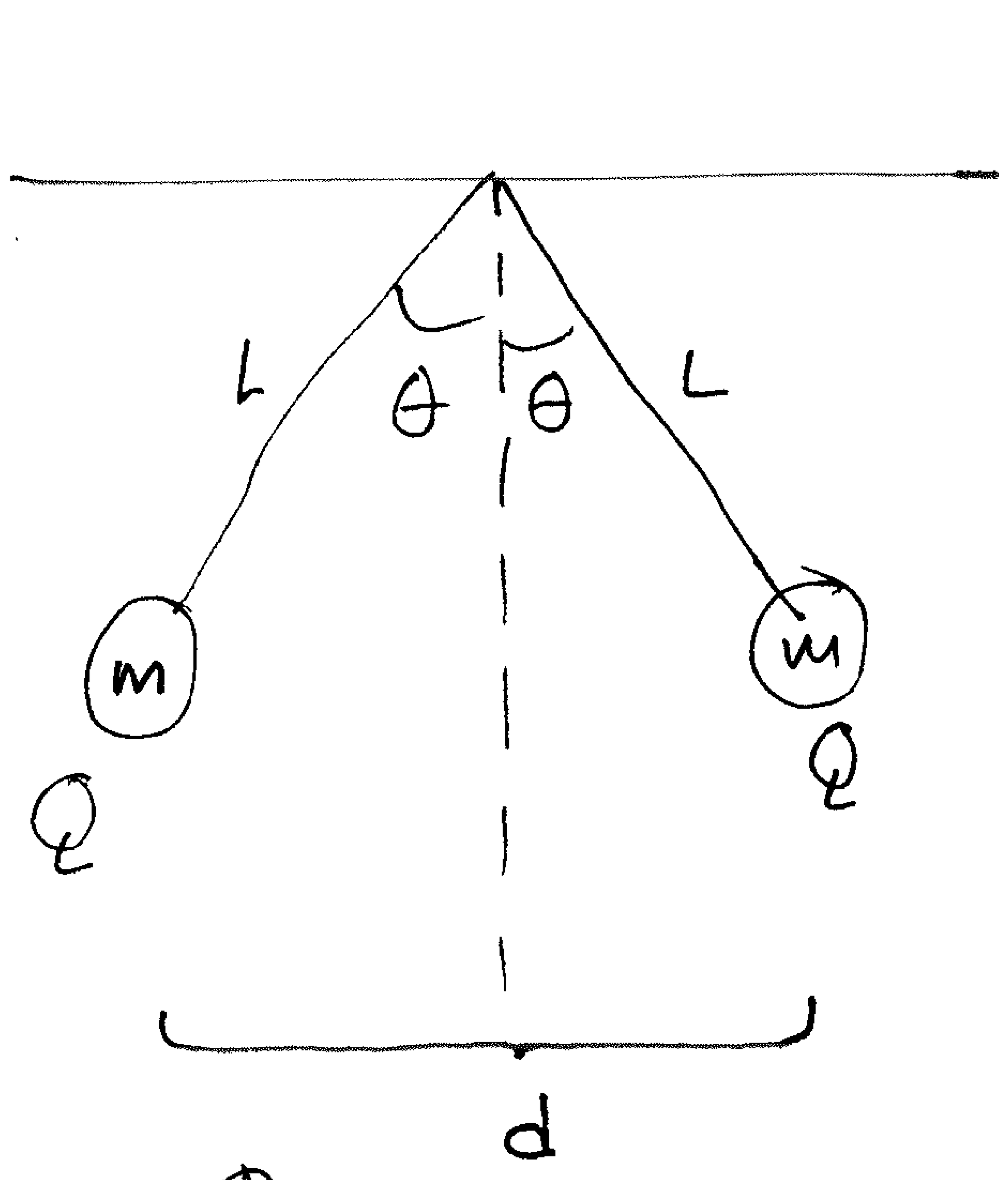
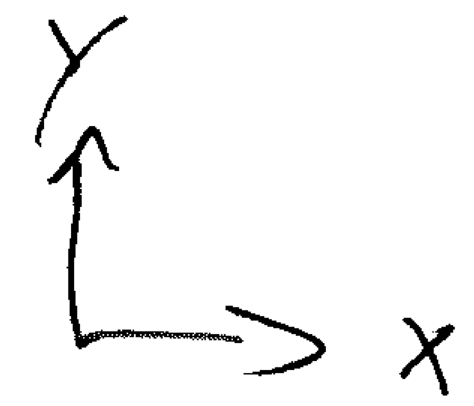
Lausnir vor 2000 $\boxed{V}$

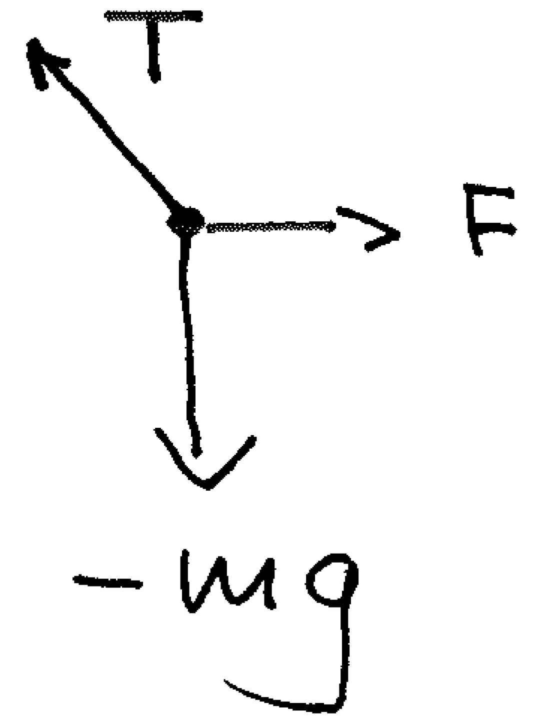
1





Finna Q

Kraftar



$$d = 2L\sin\theta$$

Y-þáttur: $T\cos\theta - mg = 0$

x-þáttur: $-T\sin\theta + \frac{kQ^2}{d^2} = 0$

leysa saman

$$T = \frac{mg}{\cos\theta}$$

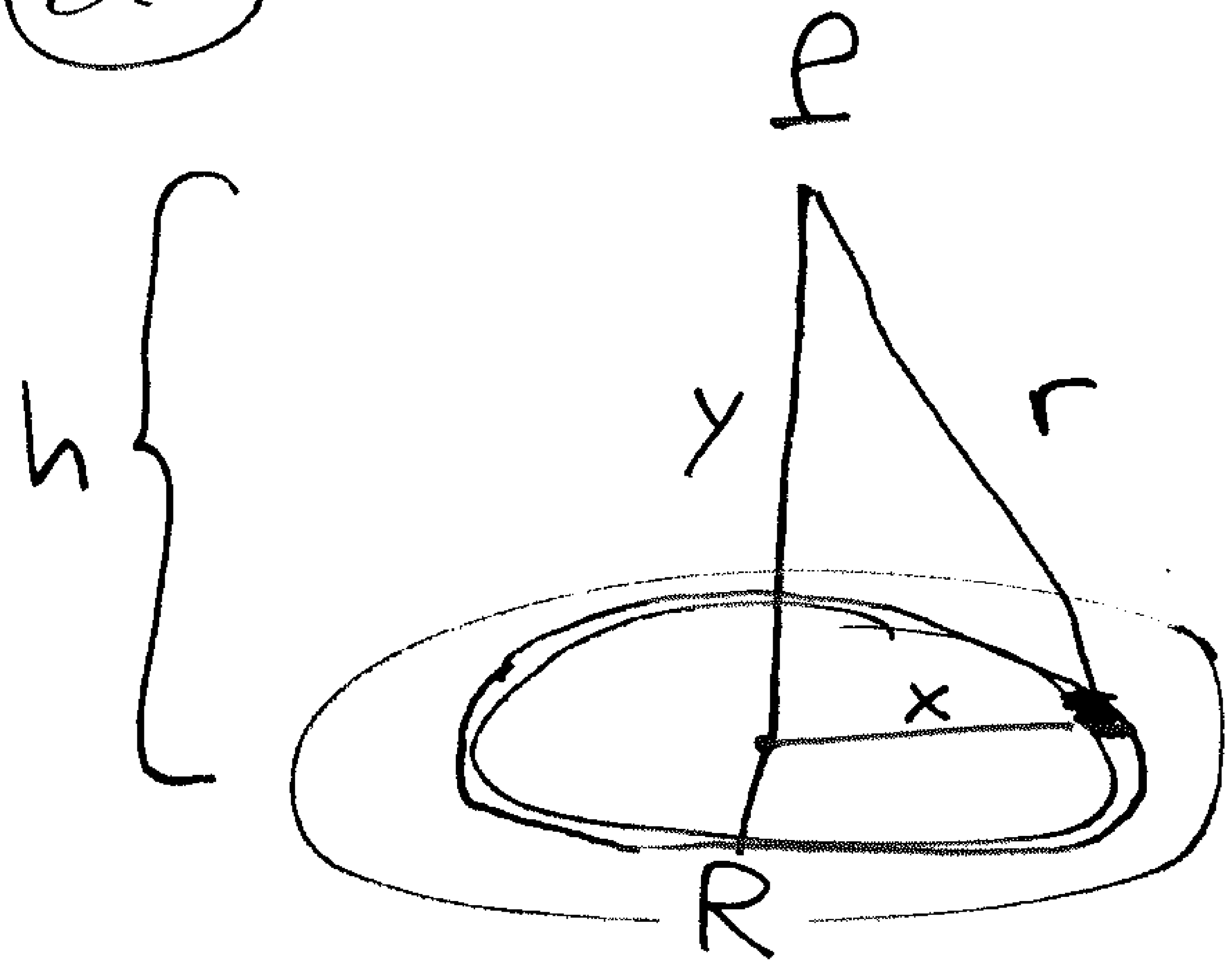
því fæst

$$-mg\tan\theta + \frac{kQ^2}{4L^2\sin^2\theta} = 0$$

$$\rightarrow Q^2 = \frac{mg\tan\theta \cdot 4L^2\sin^2\theta}{k}$$

$$= \frac{mg\,4L^2}{k}\,\frac{\sin^3\theta}{\cos\theta}$$

2



Vinnan er

$$W = qV$$

þar sem V er mættið frá hleðsludr. dist í P

Finnum V

notum hringsamhverfu: $dq = 2\pi x\,dx \cdot \sigma$

$$dV = \frac{k\,dq}{r} = \frac{k\sigma(2\pi x\,dx)}{\sqrt{x^2+y^2}}$$

$$\rightarrow V = \int_0^R dV = 2\pi k\sigma \int_0^R \frac{x\,dx}{\sqrt{x^2+y^2}}$$

$$V = 2\pi k \sigma \left[(x^2+y^2)^{1/2} \right]_0^R$$

$$= 2\pi k \sigma \left\{ (R^2+y^2)^{1/2} - y \right\}$$

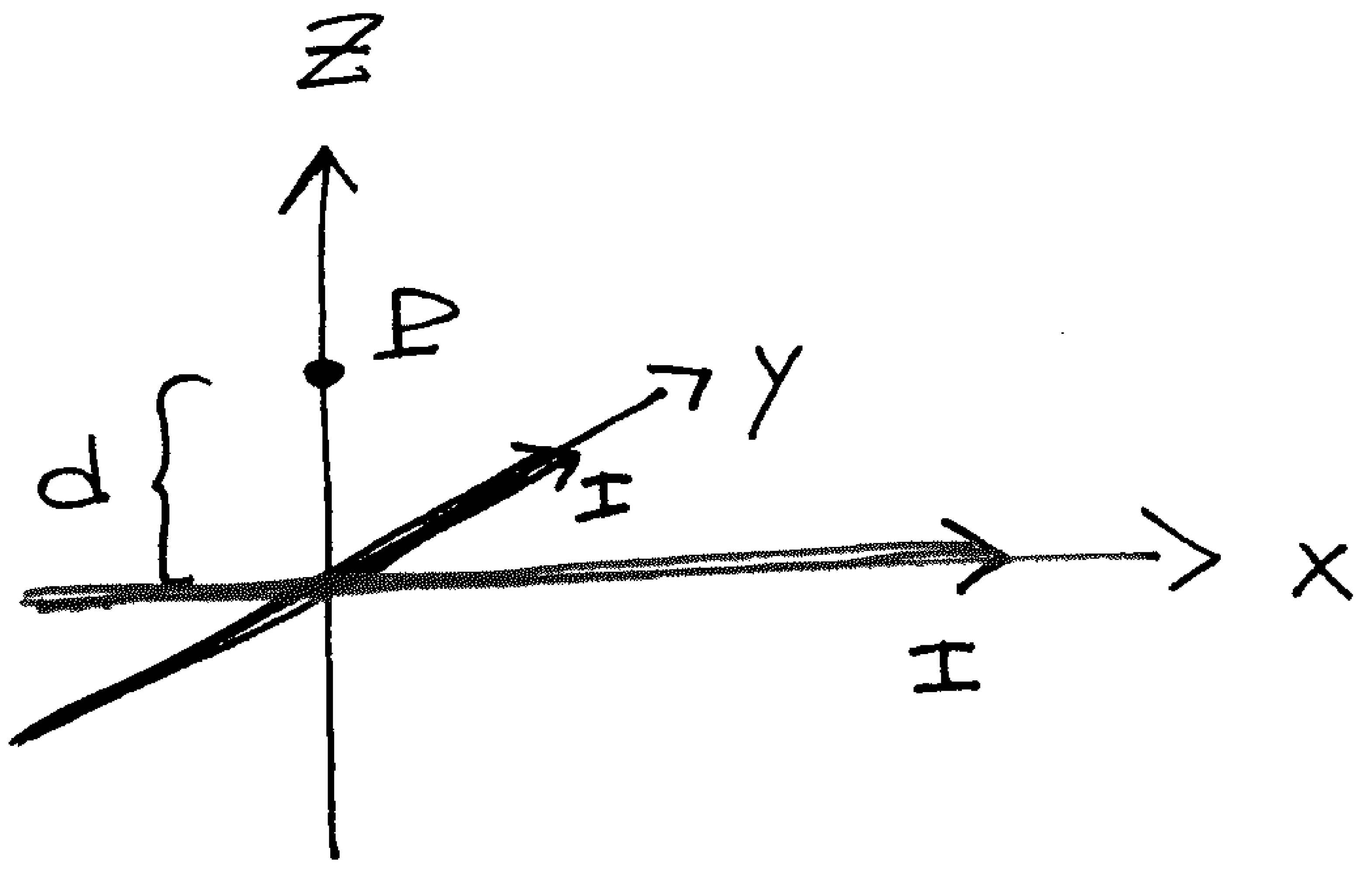
í P er $y = h$

$$\rightarrow V_P = 2\pi k \sigma \left\{ (R^2+h^2)^{1/2} - h \right\}$$

$$\rightarrow W = 2\pi k \sigma q \left\{ \sqrt{R^2+h^2} - h \right\}$$

3

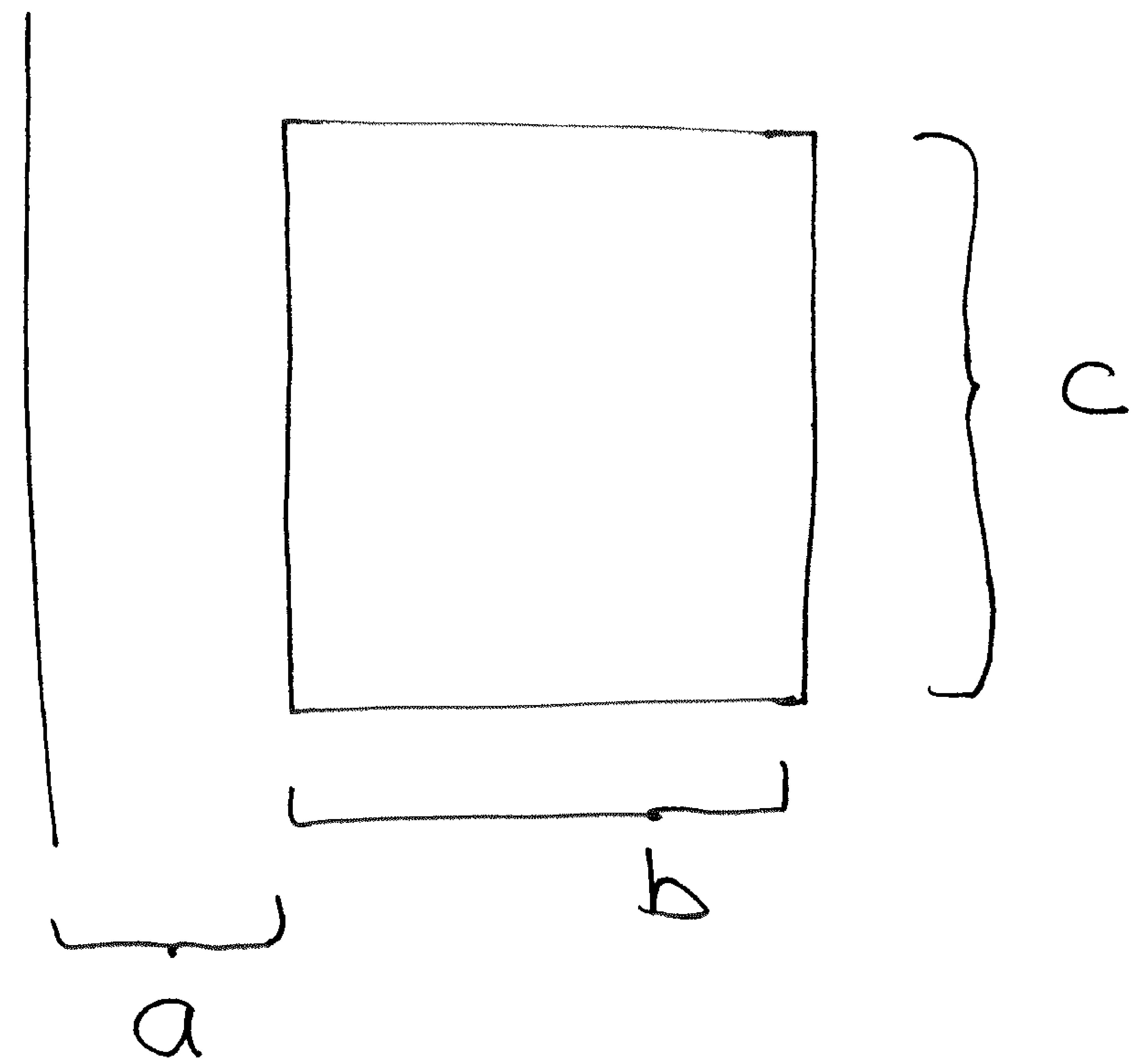
finna $\bar{B}$ í P



Hér þarf að nota vigur eiginleika

$$\bar{B} = \frac{\mu_0 I}{2\pi d} (\hat{x} - \hat{y})$$

4



þetta má leysa á mism. vegu, ég nota

$$d\Phi = B\,dA = \frac{\mu_0 I}{2\pi x}(c\,dx)$$

$$\rightarrow \Phi = \int B\,dA = \frac{\mu_0 I c}{2\pi}\int_a^{a+b}\frac{dx}{x}$$

$$= \frac{\mu_0 I c}{2\pi}\ln\left(\frac{b+a}{a}\right)$$

$$\Phi = LI \qquad (L \text{ eða } M)$$

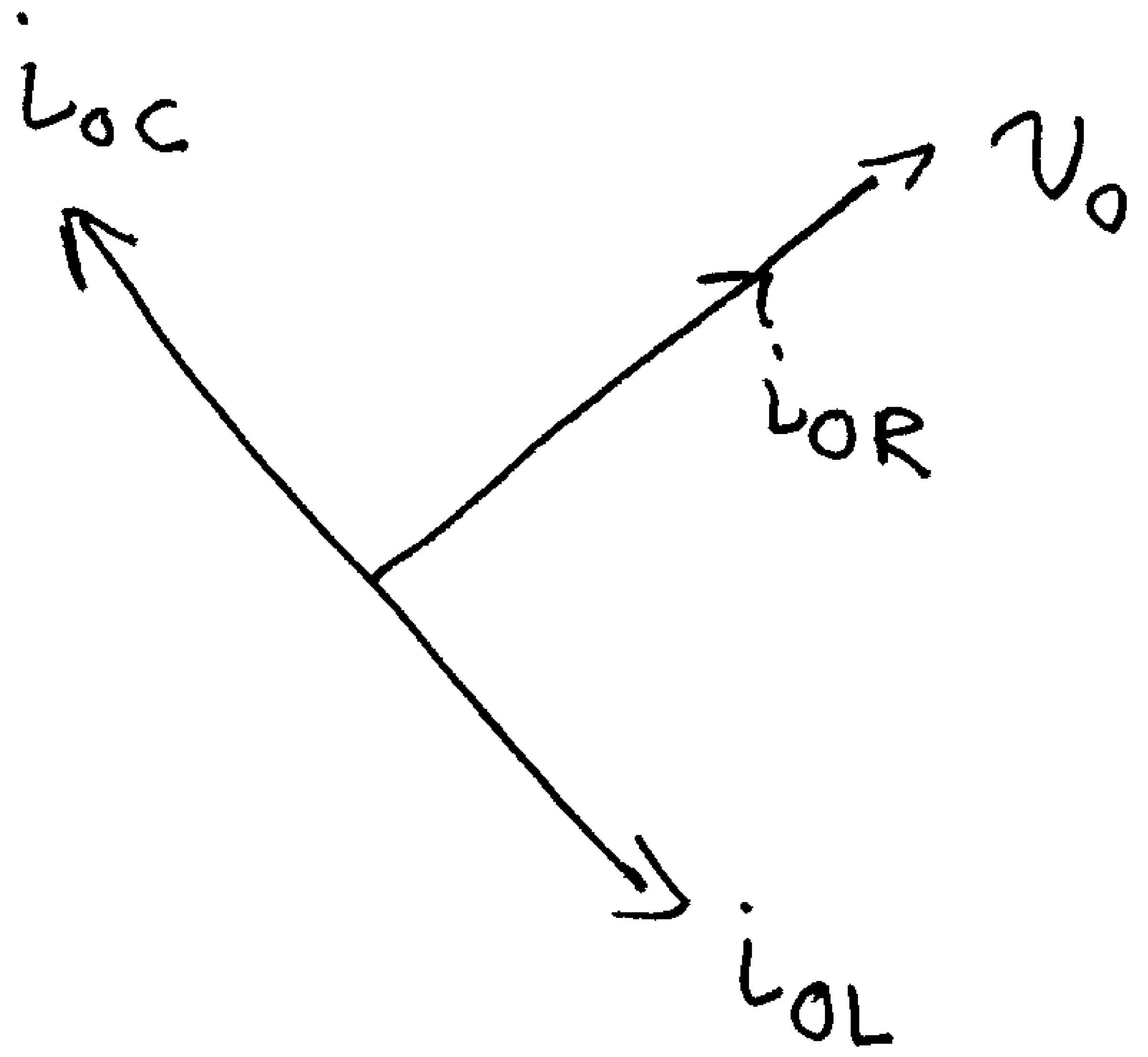
$$\hookrightarrow \quad L = \frac{\mu_0 c}{2\pi}\ln\left(\frac{b+a}{a}\right)$$

5

a) Þau eru öll jafn stór og gefin ~~með~~

$$\mathcal{E} = V_0 \sin(\omega t) \qquad (\text{t.d.})$$

b) Þeir hafa mism. fasa



$$i = i_{OR} \sin(\omega t) \qquad \text{viðnám}$$

$$+\ i_{OC} \sin(\omega t + \pi/2) \qquad \text{þéttir}$$

$$+\ i_{OL} \sin(\omega t - \pi/2) \qquad \text{spóla}$$

c) finna Z

Pýþagóras

$$i_0^2 = i_{0R}^2 + (i_{0C} - i_{0L})^2$$

$$= v_0^2 \left\{ \frac{1}{R^2} + \left(\frac{1}{X_C} - \frac{1}{X_L} \right)^2 \right\}$$

$$Z = \frac{v_0}{i_0} = \left\{ \frac{1}{R^2} + \left(\frac{1}{X_C} - \frac{1}{X_L} \right)^2 \right\}^{-1/2}$$

$$= \frac{1}{\sqrt{\frac{1}{R^2} + \left(\omega C - \frac{1}{\omega L}\right)^2}}$$

d) max Z þegar $\omega_0 C = \frac{1}{\omega_0 L}$

$$\rightarrow \omega_0 = \frac{1}{\sqrt{LC}}$$

6

$$\bar{S} = \frac{\bar{E} \times \bar{B}}{\mu_0}$$

Í tómarúmi eru $\bar{E}$ og $\bar{B}$ hornréttir

$$\rightarrow \quad S = \frac{EB}{\mu_0} \qquad \text{notum } E = cB$$

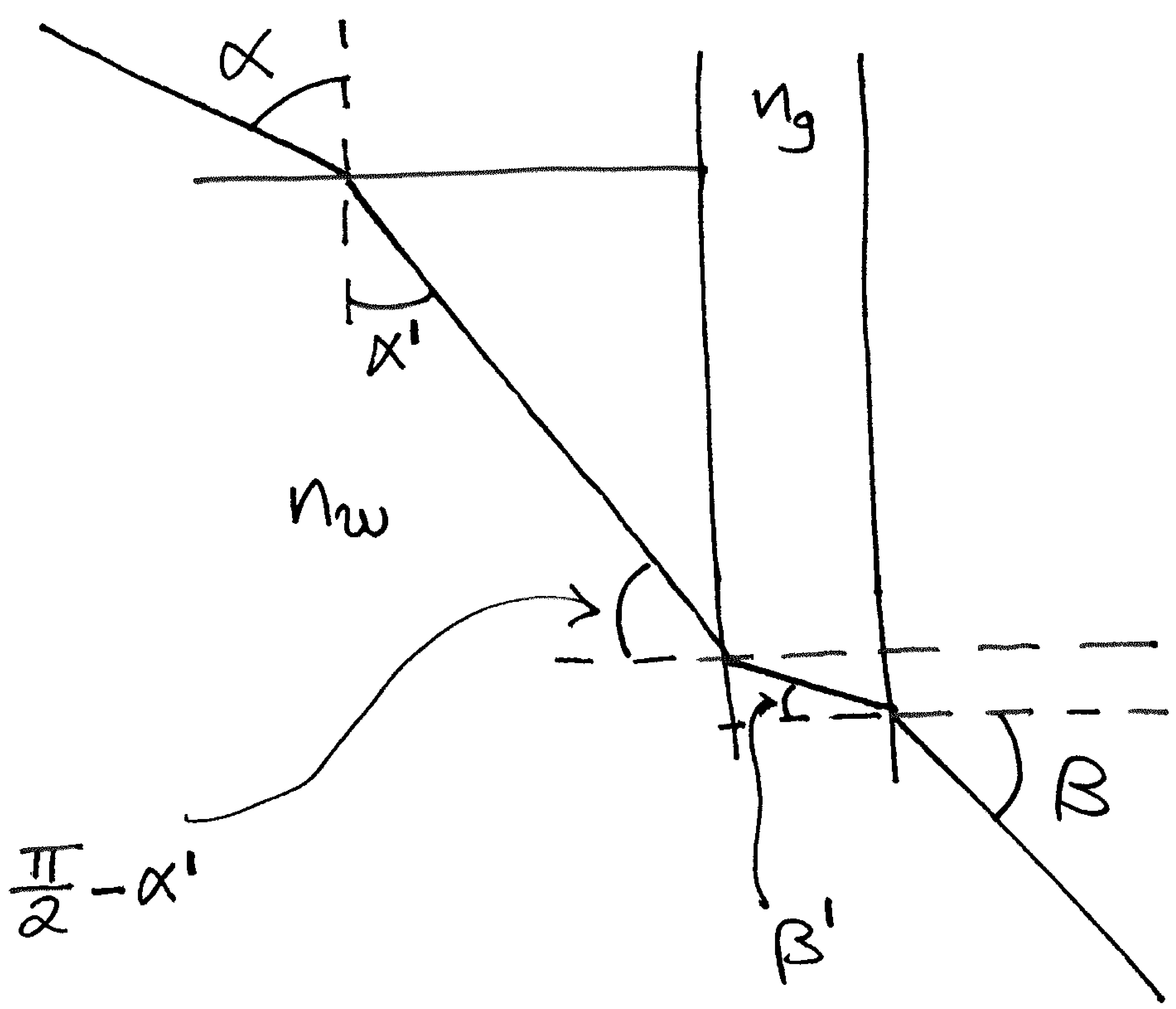
$$= \frac{E^2}{2\mu_0 c} + \frac{cB^2}{2\mu_0}$$

Síðan er $c^2 = \frac{1}{\mu_0 \epsilon_0}$

$$\rightarrow \quad S = \frac{c}{2}\left\{\epsilon_0 E^2 + \frac{B^2}{\mu_0}\right\}$$

í tómarúmi

(7)



$$\boxed{\begin{aligned} \sin\alpha &= n_w \sin\alpha' \\ n_g \sin\beta' &= \sin\beta \\ n_w \sin\left(\tfrac{\pi}{2}-\alpha'\right) &= n_g \sin\beta' \end{aligned}}$$

$$\sin\alpha = n_w \sin\alpha'$$

$$n_w \sin\left(\tfrac{\pi}{2}-\alpha'\right) = \sin\beta$$

$$\sin\alpha = n_w \sin\alpha'$$

$$n_w \cos\alpha' = \sin\beta$$

$$\rightarrow \sin^2\alpha + \sin^2\beta = n_w^2 \left[\cos^2\alpha' + \sin^2\alpha'\right]$$

$$= n_w^2$$

$$\rightarrow \sin^2\beta = n_w^2 - \sin^2\alpha$$

$$\rightarrow \beta = \arcsin\left[\sqrt{n_w^2 - \sin^2\alpha}\right]$$

R-klukti

(6) m_0 med E_{kin}

<u>finna E</u>

$$E = E_{kin} + m_0 c^2$$

<u>finna v</u>

$$E_{kin} = E - m_0 c^2$$

$$E = \gamma m_0 c^2$$

$$\to E_{kin} = (\gamma - 1) m_0 c^2$$

$$\to \frac{E_{kin}}{m_0 c^2} + 1 = \gamma$$

$$\to \frac{1}{\sqrt{1-\beta^2}} = 1 + \frac{E_{kin}}{m_0 c^2}$$

$$1 - \beta^2 = \frac{1}{\left(1 + \frac{E_{kin}}{m_0 c^2}\right)^2}$$

$$\beta^2 = \frac{v^2}{c^2} = 1 + \frac{1}{\left(1 + \frac{E_{kin}}{m_0 c^2}\right)^2}$$

$$\rightarrow \quad \frac{v}{c} = \sqrt{1 + \frac{1}{\left(1 + \frac{E_{kin}}{m_0 c^2}\right)^2}}$$

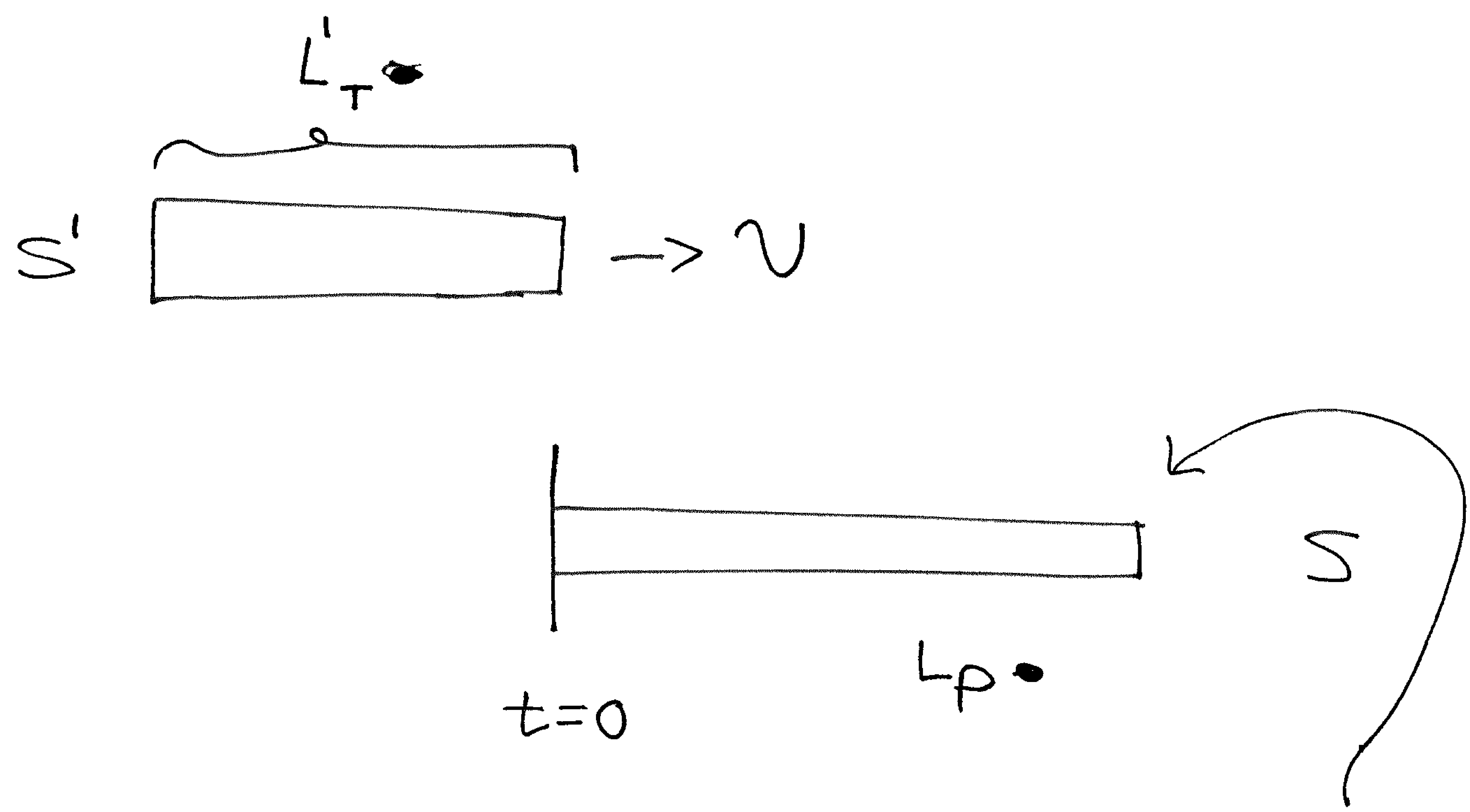
<u>finna p</u>

$$p = \gamma m_0 v$$

$$= \left(\frac{E_{kin}}{m_0 c^2} + 1\right) m_0 c \sqrt{1 + \frac{1}{\left(1 + \frac{E_{kin}}{m_0 c^2}\right)^2}}$$

$$= m_0 c \sqrt{1 + \left(1 + \frac{E_{kin}}{m_0 c^2}\right)^2}$$

7



hvenær er afturendi lestar hér

$$\Delta t = \frac{L_p}{v} + \frac{L'_T}{\gamma v} \quad !$$

framendi framhjá palli

lengd lestar eins og í S framhjá horni palls