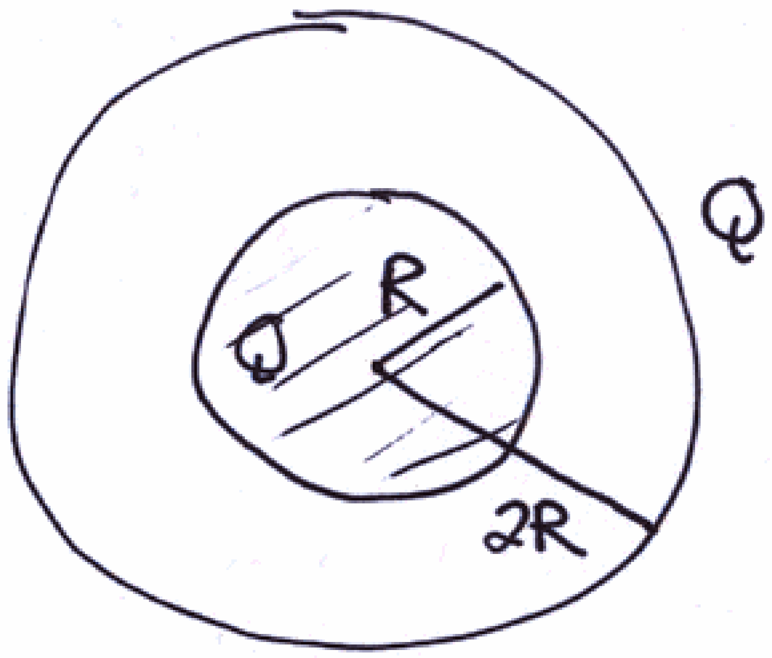
(1) (1)



a) finna rafsviðið á hverju svæði

Notum lögmál Gauß

$$\oint \bar{E} \cdot d\bar{A} = \Phi_E = \frac{Q}{\epsilon_0}$$

Kúlusamhverfa hleðsla → sama samhverfa fyrir $\bar{E}$
Einungis radial þáttur

r > 2R

Heildarhleðsla 2Q → $4\pi r^2 \bar{E} \cdot \hat{r} = \frac{2Q}{\epsilon_0}$

→ $\bar{E} = \frac{1}{4\pi\epsilon_0} \frac{2Q}{r^2} \hat{r}$

r < R

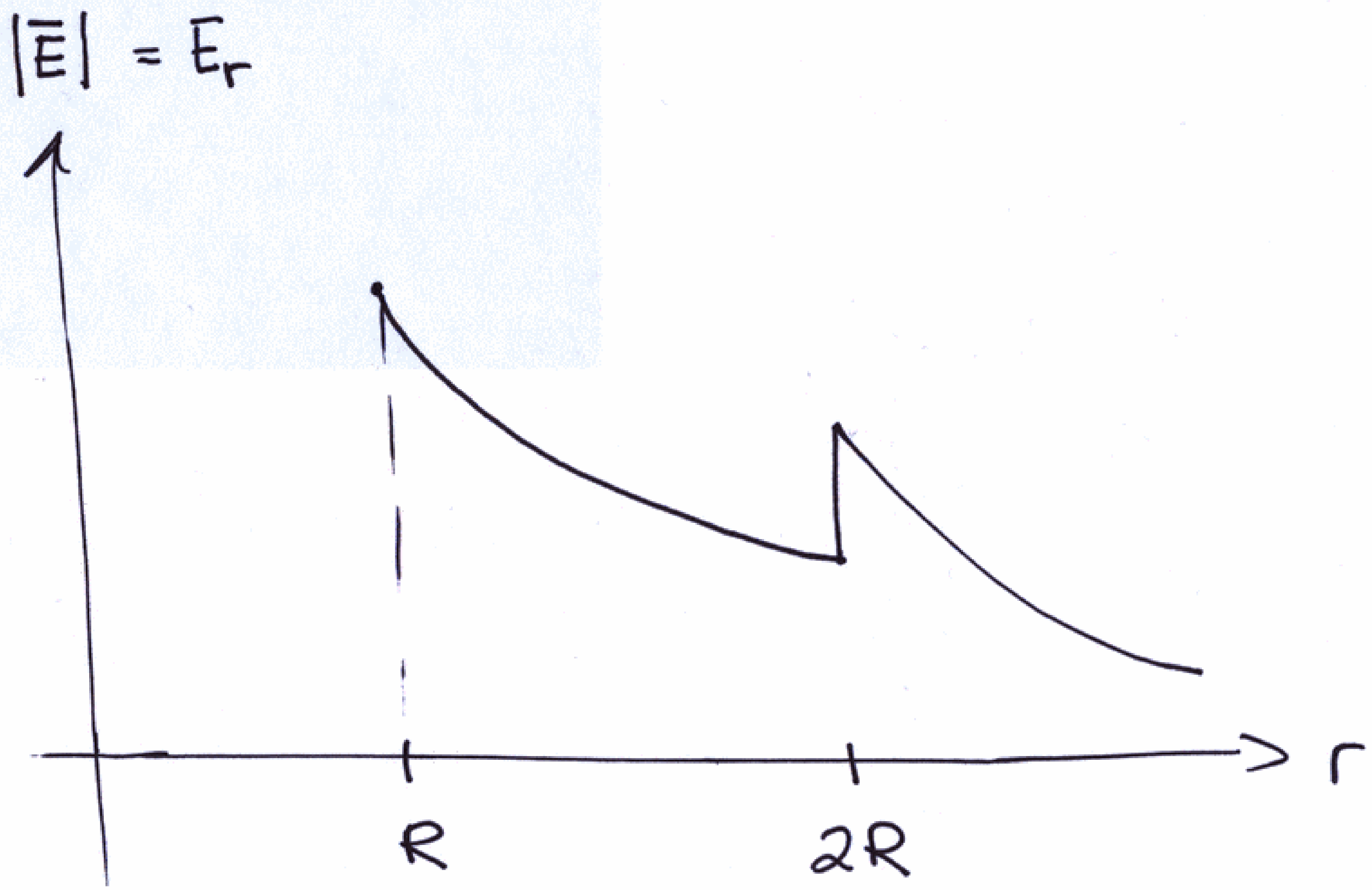
leiðandi kúla → hleðslan safnast á yfirborð hennar → $\bar{E} = 0$ innan kúlunnar

$R < r < 2R$

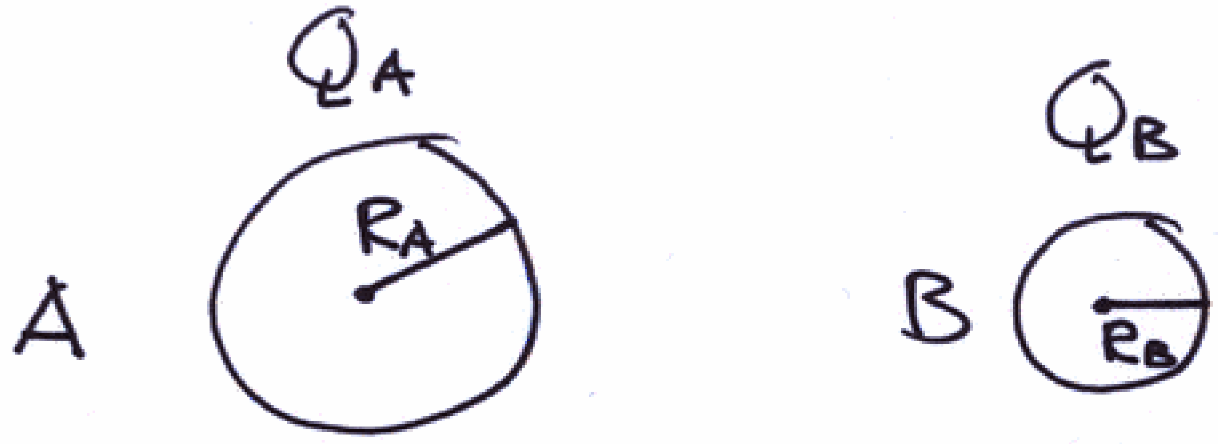
Innan þessa Gauß yfirborðs er hleðslan Q

$$\rightarrow \quad \bar{E} = \frac{1}{4\pi\epsilon_0} \frac{Q}{r^2} \hat{r}$$

b)



②



③

Gefið $V = V_A = V_B$

yfirborðsspenna A

$R_A = 3R_B$

a) finna $\frac{Q_B}{Q_A}$

$$V = \frac{1}{4\pi\epsilon_0}\frac{Q_A}{R_A} = \frac{1}{4\pi\epsilon_0}\frac{Q_B}{R_B}$$

$$= \frac{1}{4\pi\epsilon_0}\frac{Q_A}{3R_B} \longrightarrow Q_B = \frac{Q_A}{3}$$

eða $\frac{Q_B}{Q_A} = \frac{1}{3}$

Hér er verið að bera saman eiginleika kúlna sem ekki eru nærri hvor annari, því er gert ráð fyrir einsleit-inni hleðslu-dreifingu.

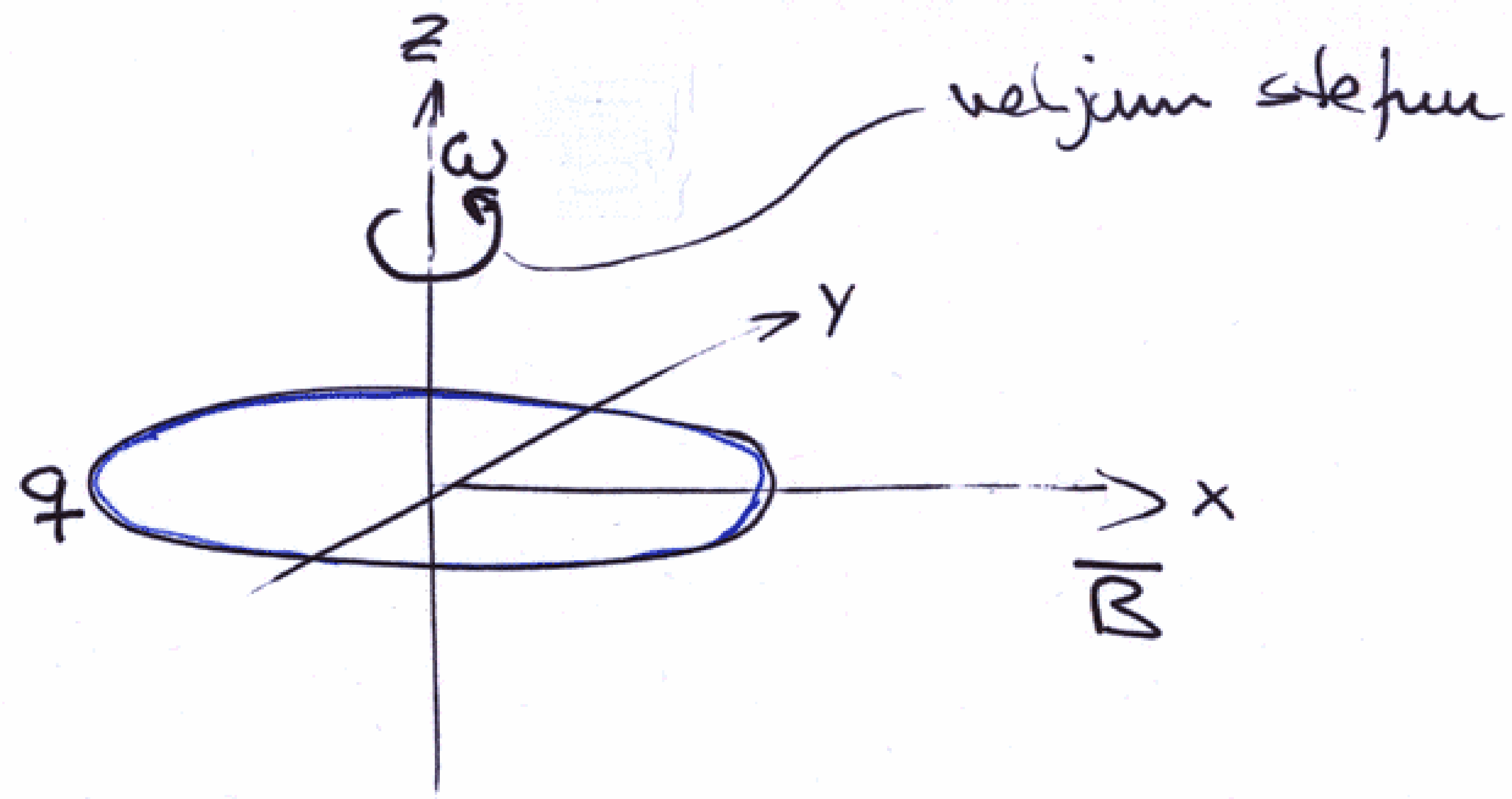
b) finna $\frac{E_B}{E_A}$ (Hutfall svidsstyrka!)

$$E_B(R_B) = \frac{1}{4\pi\epsilon_0}\frac{Q_B}{R_B^2} = \frac{1}{4\pi\epsilon_0}\frac{(Q_A/3)}{(R_A/3)^2} = \frac{3}{4\pi\epsilon_0}\frac{Q_A}{R_A^2}$$

$$E_A(R_A) = \frac{1}{4\pi\epsilon_0}\frac{Q_A}{R_A^2}$$

$$\frac{E_B}{E_A} = 3$$

③



$$\bar{\tau} = \bar{\mu} \times \bar{B}$$

$$\bar{\mu} = N I A \hat{n}$$

lengd lykkju

$$L = 2\pi R$$

$$R = \frac{L}{2\pi}$$

$$N = 1 \,, \quad \hat{n} = \hat{z}$$

$$A = \pi R^2 = \pi \left(\frac{L}{2\pi}\right)^2 = \frac{\pi L^2}{4\pi^2}$$

$$= \frac{L^2}{4\pi}$$

Veljum $\bar{B} = B\hat{x}$

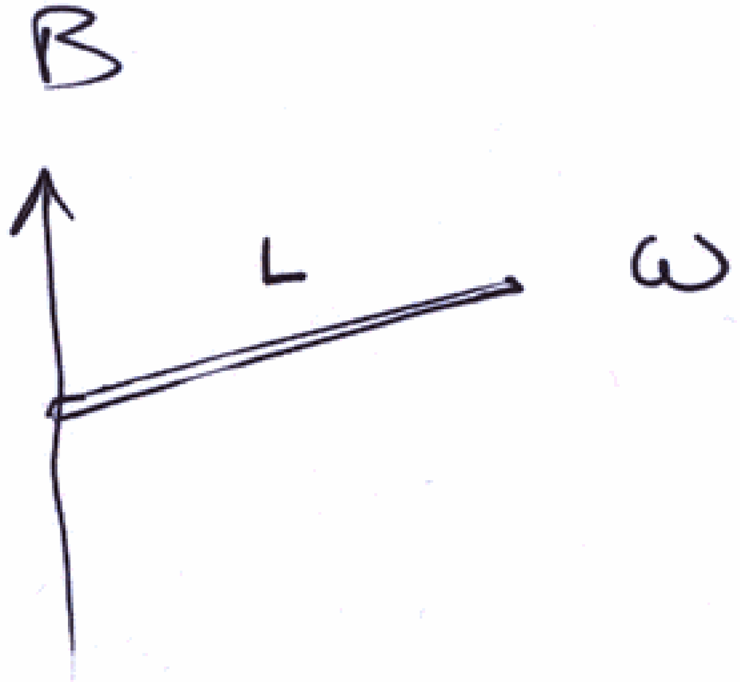
$$I = qf = q\frac{\omega}{2\pi}$$

$$|\tau| = \left(q\frac{\omega}{2\pi}\right)\frac{L^2}{4\pi} \cdot B$$

$$= q\omega\frac{L^2}{8\pi^2} B$$

Samkvæmt ~~þessari~~ teikningu verði $\bar{\tau}$ í $\hat{y}$-stefnu

4



a) Reikna íspennu í stöng

Almennt gildir um íspennuna

$$\mathcal{E} = \frac{1}{q}\oint \bar{F}\cdot d\bar{l}$$

Her er ekki lokuð rás → enginn sístøður streymur

$\bar{F} = q(\bar{E} + \bar{v}\times\bar{B})$ Her er eingin broyting á $\bar{B}$ við tíma og eftir ytra rafsvið

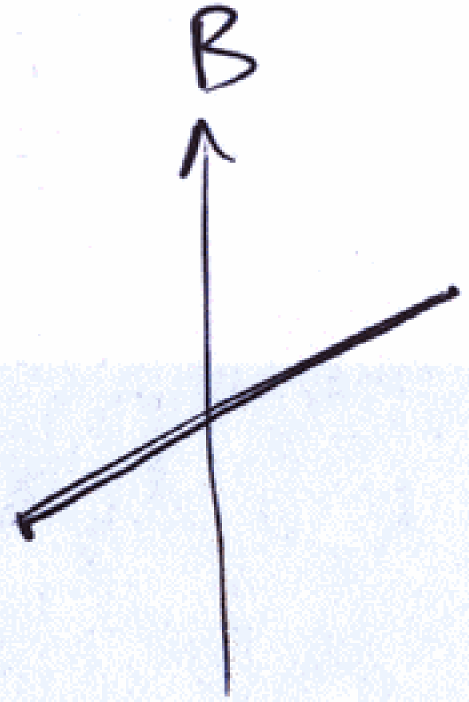
Hreyfing stangar í segulsviðinum leiðir til krafts á frjálsar hleðslur hennar í átt at øðrum endanum

$$\mathcal{E} = \int_0^L (\bar{v}\times\bar{B})\,dr = \int_0^L (\omega\cdot r)\,B\,dr$$

$$= \int_0^L r\,dr\cdot\omega B = \frac{1}{2}\omega L^2 B$$

b) Spennumunur enda stangarinnar er íspennan reiknuð í liðnum á undan $\Delta V = \mathcal{E}$

c)



Snúningsás í gegnum miðja stöng

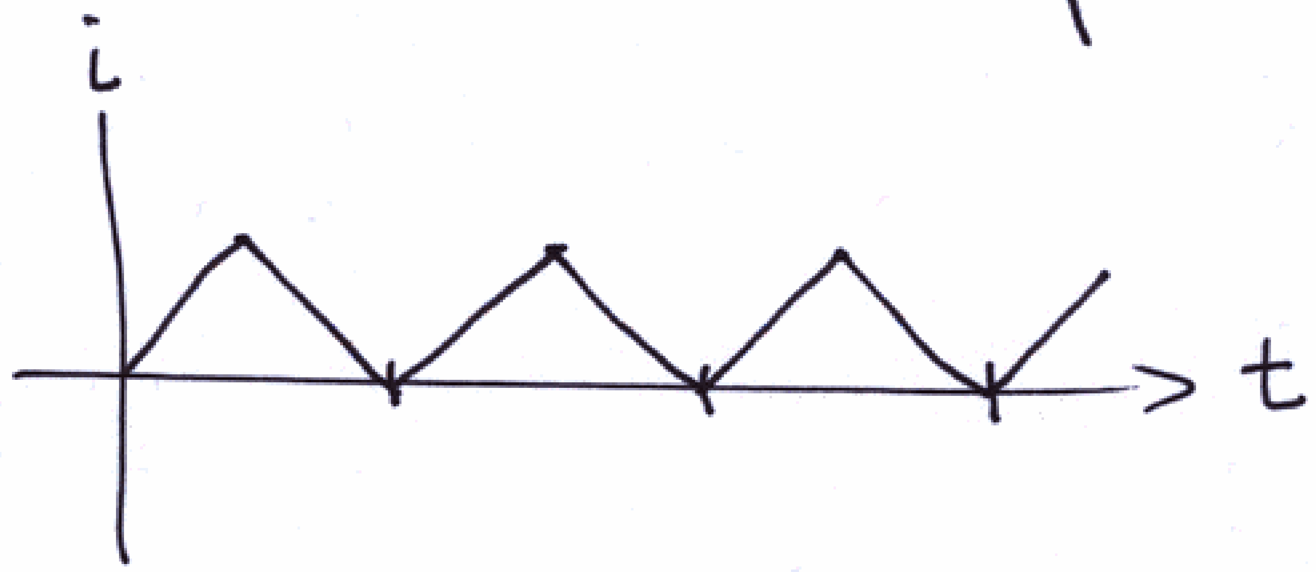
Endar stangarinnar eru þá við sömu spennu, en spennumunur miðjunnar og annars enda reiknast eins og í lið a) með

$L \rightarrow L/2$

$\rightarrow \Delta V = \frac{1}{4}\mathcal{E}_{a\,lið}$

5 Viðnámslaus spóla

a) Rissa upp spennunni útganga spólunnar

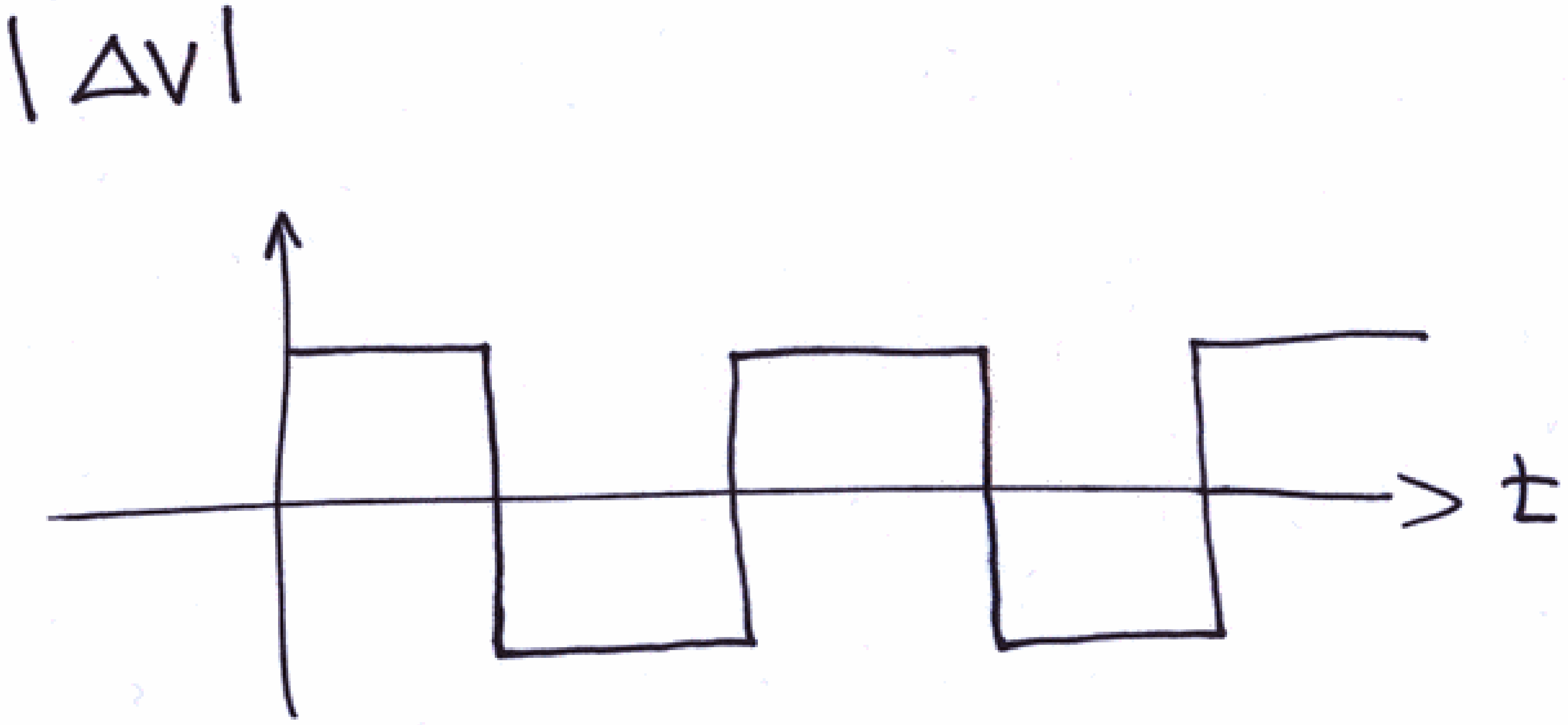


Um spólu gildir $\mathcal{E} = -L\dfrac{di}{dt}$

Því er ljóst að spennumunurinn er afleiðan af i

b) Vegna

$$|\Delta V| \sim \frac{di}{dt}$$



(6)

$i_{rms} = I_0$

$v_{rms} = V_0$

X_c

gefið

finna meðal afl ið sem spennugjafinn setur í rásina

$$Z = \sqrt{R^2 + X_c^2}$$

$$Z = \frac{v_{rms}}{i_{rms}} = \frac{V_0}{I_0}$$

$$Z^2 = R^2 + X_c^2$$

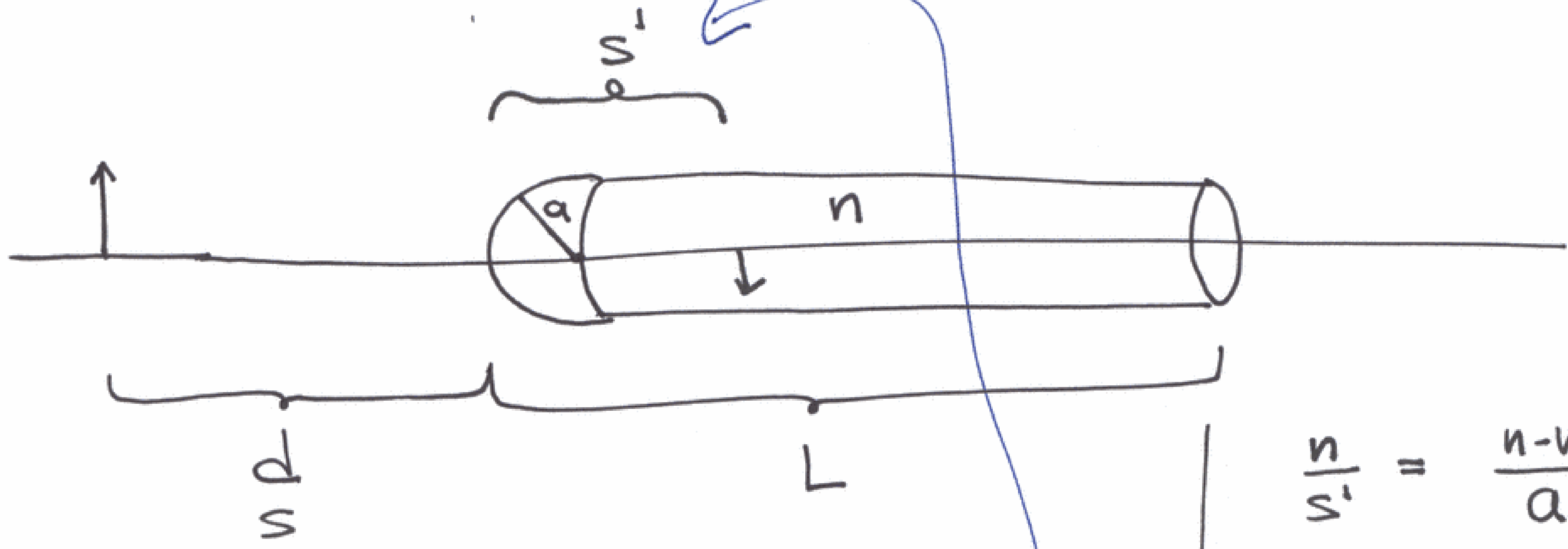
$$R^2 = Z^2 - X_c^2$$

$$= \left(\frac{V_0}{I_0}\right)^2 - X_c^2$$

$$R = \sqrt{\left(\frac{V_0}{I_0}\right)^2 - X_c^2}$$

$$P = i_{rms}^2 R = I_0^2 \sqrt{\left(\frac{V_0}{I_0}\right)^2 - X_c^2}$$

7



a) Hvar sést ímyndin

um þessa uppsetningu gildir

$$\frac{n_0}{s} + \frac{n}{s'} = \frac{n - n_0}{a}$$

$$s = d$$

$$s' =$$

$$\frac{n}{s'} = \frac{n-n_0}{a} - \frac{n_0}{d}$$

$$= \frac{d(n-n_0) - an_0}{ad}$$

$$s' = \frac{nad}{d(n-n_0) - an_0}$$

$$= \frac{nad}{d\Delta n - an_0}$$

ef $\Delta n = n - n_0$

b) $m = -\dfrac{n_0 s'}{n s} = -\dfrac{n_0 a}{d(n-n_0) - an_0} = -\dfrac{n_0 a}{d\Delta n - an_0}$