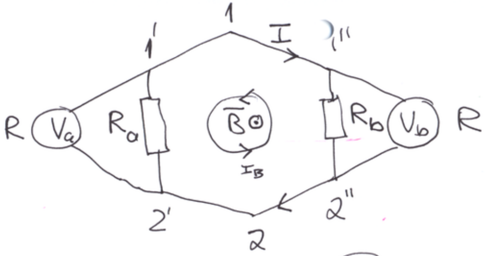


$\Phi(t) = \alpha t$ vaxandi
myndar straum í rásinni
(spanar): I

Regla Lenz gefur að strauminn sé réttsælis, eins og sýnt er á mynd, Faraday

$$\mathcal{E} = -\frac{d\Phi}{dt} = -\alpha \longrightarrow I(R_a+R_b) = \alpha$$

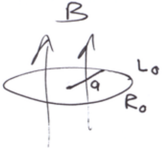
$$\longrightarrow I = \frac{\alpha}{R_a+R_b} \quad \text{andsælis}$$

spennufallið $V_a = \dfrac{\alpha R_a}{R_a+R_b}$, ($V_{2'}$ er hærri en $V_{1'}$)

$\longrightarrow$ $V_b = -\dfrac{\alpha R_b}{R_a+R_b}$, ($V_{1''}$ er hærri en $V_{2''}$)

$V_a \neq -V_b$ þó við séum í raun að mæla spennumun sömu punkta 1 og 2

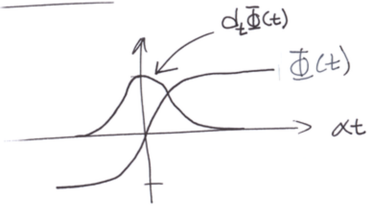
② Lykkja, L_0, R_0, a, með segulflæði ②



$$\Phi(t) = \Phi_0 \operatorname{erf}(\alpha t)$$

① Finna $i(t)$

$$\frac{d\Phi(t)}{dt} = \frac{2\Phi_0 \alpha e^{-(\alpha t)^2}}{\sqrt{\pi}}$$



Heildarflæðið um lykkjuna er

$$\Phi(t) = \Phi_0 \operatorname{erf}(\alpha t) + L_0 i(t)$$

Sjálfspan lykkju

Faraday

$$\oint_C \bar{E}\cdot d\bar{l} = -\frac{d\Phi}{dt} \longrightarrow R_0 i(t) = -\frac{2\Phi_0 \alpha e^{-(\alpha t)^2}}{\sqrt{\pi}} - L_0 \frac{di(t)}{dt}$$

$R_0 i$

Sjá

$$\boxed{L_0 \frac{di(t)}{dt} + R_0 i(t) = -\frac{2\Phi_0 \alpha e^{-(\alpha t)^2}}{\sqrt{\pi}}}$$

1. stigs afleiðujafna
upphafsskilyrði
$i(t \to -\infty) = 0$

Ef við höfum $y' + p(t) y = q(t)$

þá er almenna lausnin

$$y(t) = y(t_0) e^{-P(t)} + e^{-P(t)} \int_{t_0}^{t} ds\, e^{P(s)} q(s)$$

$$P(t) = \int_{t_0}^{t} ds\, p(s)$$

Hér verða þá

$$P(t) = \int_{-\infty}^{t} ds \frac{R_0}{L_0}$$

Notum því t_0 og setjum seinna $t_0 \to -\infty$

$$\underline{P}(t) = \frac{R_0}{L_0}(t - t_0)$$

$$i(t) = \underbrace{\frac{1}{L_0} i(t_0) e^{-\frac{R_0}{L_0}(t-t_0)}}_{\longrightarrow 0} - e^{-\frac{R_0}{L_0}(t-t_0)} \frac{1}{L_0} \int_{t_0}^{t} ds\, e^{\frac{R_0}{L_0}(s-t_0)} \frac{2\Phi_0 \alpha}{\sqrt{\pi}} e^{-(\alpha s)^2}$$

þegar $(t - t_0) \to \infty$
og $i(-\infty) = 0$

$$\to i(t) = -\frac{2\Phi_0 \alpha}{\sqrt{\pi} L_0} \exp\left\{-\frac{R_0 t}{L_0}\right\} \int_{-\infty}^{t} ds \exp\left\{-(\alpha s)^2 + \frac{R_0}{L_0} s\right\}$$

$$= -\frac{\Phi_0}{L_0} \exp\left\{-\frac{t}{\tau_L} + \frac{\tau_\phi^2}{4\tau_L^2}\right\} \left[\operatorname{erf}\left(\frac{t}{\tau_\phi} - \frac{\tau_\phi}{2\tau_L}\right) + 1\right]$$

ef $\boxed{\tau_L = \frac{L_0}{R_0}}$, og $\boxed{\tau_\phi = \frac{1}{\alpha}}$ tveir tímaskalar

↑ spólunnar ↑ flæðisins

$$i(t) = -\frac{\Phi_0}{L_0} \exp\left\{-\frac{t}{\tau_L} + \frac{\tau_\Phi^2}{4\tau_L^2}\right\}\left[\operatorname{erf}\left(\frac{t}{\tau_L}\left(\frac{\tau_L}{\tau_\Phi}\right) - \frac{\tau_\Phi}{2\tau_L}\right) + 1\right]$$

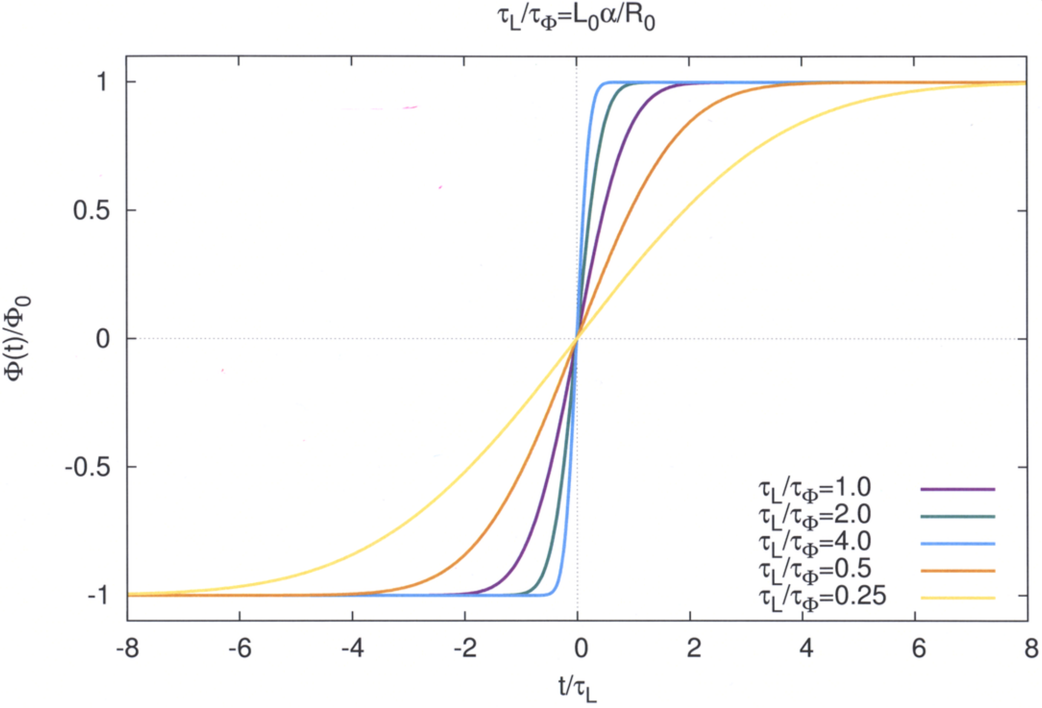
$$\Phi(t) = \Phi_0 \operatorname{erf}\left(\frac{t}{\tau_L}\left(\frac{\tau_L}{\tau_\Phi}\right)\right)$$

Heildar hleðsla um hvern punkt

$$Q = \int_{-\infty}^{\infty} dt\, i(t) = -\frac{2\Phi_0}{\alpha} \exp\left\{-\frac{1}{4}\left(\frac{\tau_\Phi}{\tau_L}\right)^2\right\}$$

$$= -\frac{2\Phi_0}{\alpha} \exp\left\{-\frac{1}{4}\left(\frac{R_0}{\alpha L_0}\right)^2\right\}$$

Ef α er haldið föstu (sami hraði á Φ-breytingu) þá flyst meiri hleðsla þegar $\alpha L_0 \gg R_0$, mikið sjálf-span í rásinni. Stórt viðnám kemur í veg fyrir mikinn hleðslu flutning.


$\tau_L/\tau_\Phi = L_0\alpha/R_0$
$\Phi(t)/\Phi_0$
1
0.5
0
-0.5
-1
-8
-6
-4
-2
0
2
4
6
8
t/τ_L
τ_L/τ_Φ=1.0
τ_L/τ_Φ=2.0
τ_L/τ_Φ=4.0
τ_L/τ_Φ=0.5
τ_L/τ_Φ=0.25

$\tau_L/\tau_\Phi = L_0\alpha/R_0$