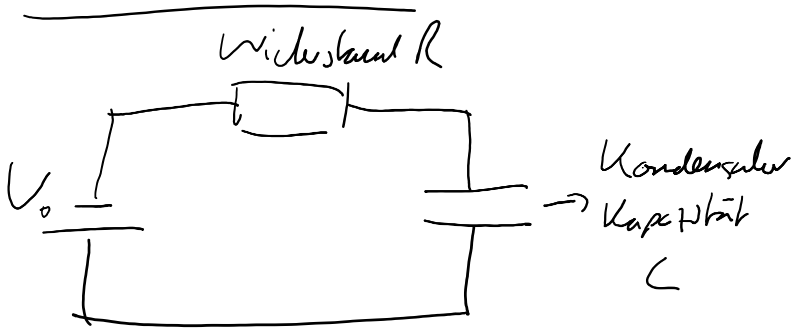
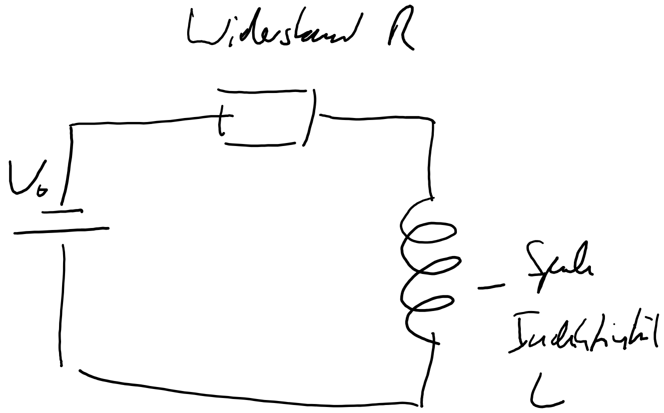
# Wechselstromkreise




$$V_0 = RI + \frac{Q}{C}$$

$$= R\frac{dQ}{dt} + \frac{Q}{C}$$

$$\hookrightarrow \frac{dQ}{dt} = -\frac{1}{RC} Q$$

$$Q = Q_0 e^{-t/\tau} \qquad \tau = RC$$

$$V_0 - L\frac{dI}{dt} = RI$$

$$\frac{dI}{dt} = -\frac{R}{L} I$$

$$\hookrightarrow I = I_0 e^{-t/\tau} \qquad \tau = \frac{L}{R}$$

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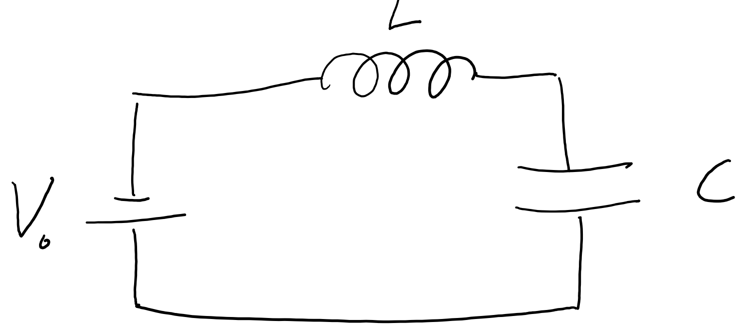
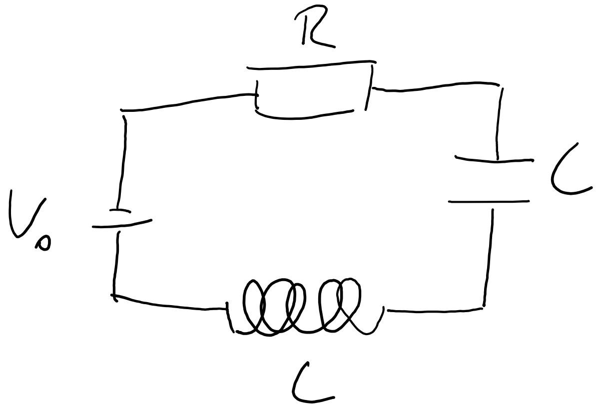



$$V_0 - L\frac{dI}{dt} = \frac{Q}{C} \quad \Big| \frac{d}{dt}$$

$$\frac{dV_0}{dt} - L\frac{d^2I}{dt} = \frac{I}{C}$$

für $\frac{dV_0}{dt} = 0 \Rightarrow \frac{d^2I}{dt^2} = -\frac{1}{LC} I = -\omega_0^2 I$

$$\Rightarrow I = I_0 \cos(\omega_0 t + \varphi) \qquad \omega_0 = \frac{1}{\sqrt{LC}}$$




$$V_0 - L\frac{dI}{dt} = RI + \frac{Q}{C}$$

$$\frac{dV_0}{dt} = L\frac{d^2I}{dt^2} + R\frac{dI}{dt} + \frac{I}{C}$$

für $\frac{dV_0}{dt} = 0$

$$0 = \frac{d^2I}{dt^2} + \frac{R}{L}\frac{dI}{dt} + \frac{1}{LC}I$$

$$0 = \frac{d^2I}{dt^2} + 2\gamma\frac{dI}{dt} + \omega_0^2 I$$

$$2\gamma = \frac{R}{L} \qquad \omega_0 = \frac{1}{\sqrt{LC}}$$

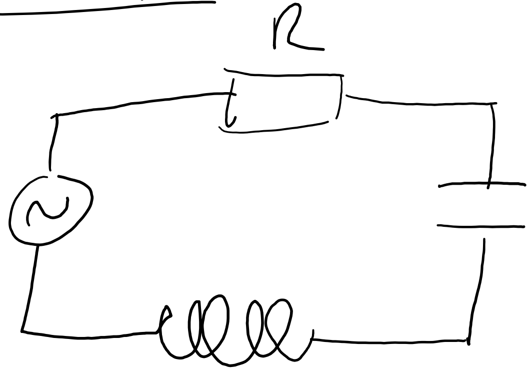
$$I = I_0 e^{-at} \Rightarrow \frac{d^2I}{dt^2} = a^2 I \qquad \frac{dI}{dt} = -aI$$

$$a^2\cancel{I} + 2\gamma(-a)\cancel{I} + \omega_0^2\cancel{I} = 0$$

$$a^2 - 2\gamma a + \omega_0^2 = 0 \Rightarrow a = \frac{2\gamma \pm \sqrt{4\gamma^2 - 4\omega_0^2}}{2}$$

$$= \gamma \pm \sqrt{\gamma^2 - \omega_0^2}$$

# Resonanzkreis




$C \rightarrow Z_C = \frac{1}{i\omega C}$

$L \rightarrow Z_L = i\omega L$

$$V_0 e^{i\omega t} = (R + Z_C + Z_L)\, I_0 e^{i\omega t}$$

$$= \left(R + \underbrace{\frac{1}{i\omega C}}_{\int dt} + \underbrace{i\omega L}_{\frac{d}{dt}}\right) I_0 e^{i\omega t}$$

$$\Rightarrow \quad I_0(t) = \frac{V_0 e^{i\omega t}}{R + \frac{1}{i\omega C} + i\omega L} = \frac{V_0 e^{i\omega t}}{i\omega L\left(\frac{R}{i\omega L} - \frac{1}{\omega^2 LC} + 1\right)}$$

$$\frac{1}{LC} = \omega_0^2 \qquad = \frac{V_0 e^{i\omega t}}{i\omega L\left(\frac{R}{i\omega L} \underline{- \frac{\omega_0^2}{\omega^2} + 1}\right)}$$

$\omega = \omega_0 \rightarrow$ Resonanz