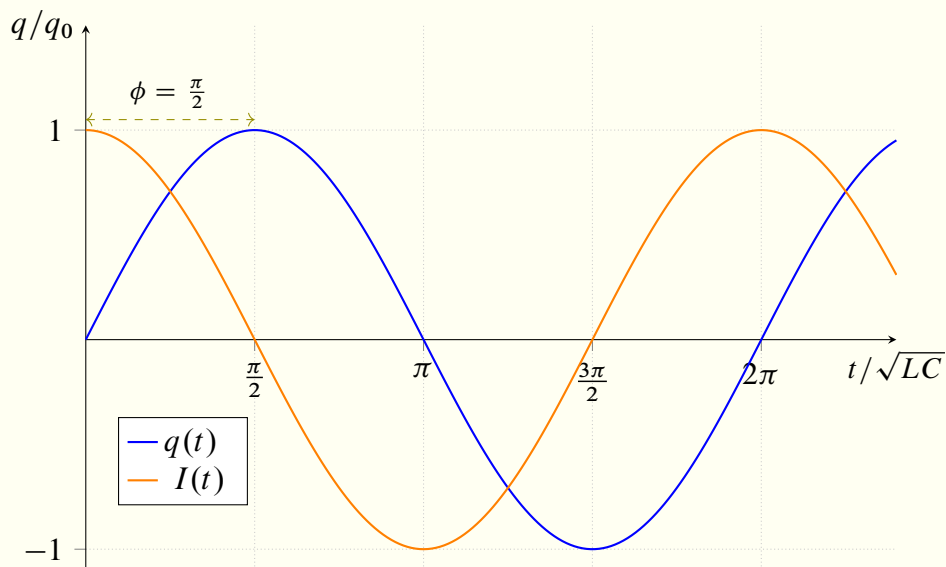


## 1. LC-Schaltkreis mit/ohne Wechselstrom

(a)

$$\frac{q(t)}{C} = L \frac{d^2 q}{dt^2}$$

$$q(t) = q_0 \cos\left(\frac{1}{\sqrt{LC}} t\right)$$

(b)  $U(t) = U_{max} \cos(\omega t); \quad U_{max} = 100 \text{ V}$ 

$$I_L = \frac{U_0}{L\omega}$$

$$I_C = \underline{\underline{U_0 C \omega}}$$

$$\phi_L = \underline{\underline{\frac{\pi}{2}}}$$

$$\phi_L = \underline{\underline{-\frac{\pi}{2}}}$$

$$\omega L = \frac{1}{\omega C}$$

$$\omega = \sqrt{\frac{1}{LC}} = 100 \text{ s}^{-1}$$

$$I_C(t) = \underline{\underline{-U_0 C \omega \sin(\omega t)}}$$

$$I_L(t) = \underline{\underline{\frac{U_0}{L\omega} \sin(\omega t)}}$$

## 2. Serienschwingkreis

$$L = 0.1 \text{ H}; \quad R = 100 \, \Omega; \quad C = 0.47 \, \mu\text{F}; \quad U_0 = 3 \text{ V}$$

$$(a) \quad U(t) = U_0 e^{i\omega t}; \quad q(t) = \frac{I_0}{\omega i} e^{i\omega t}$$

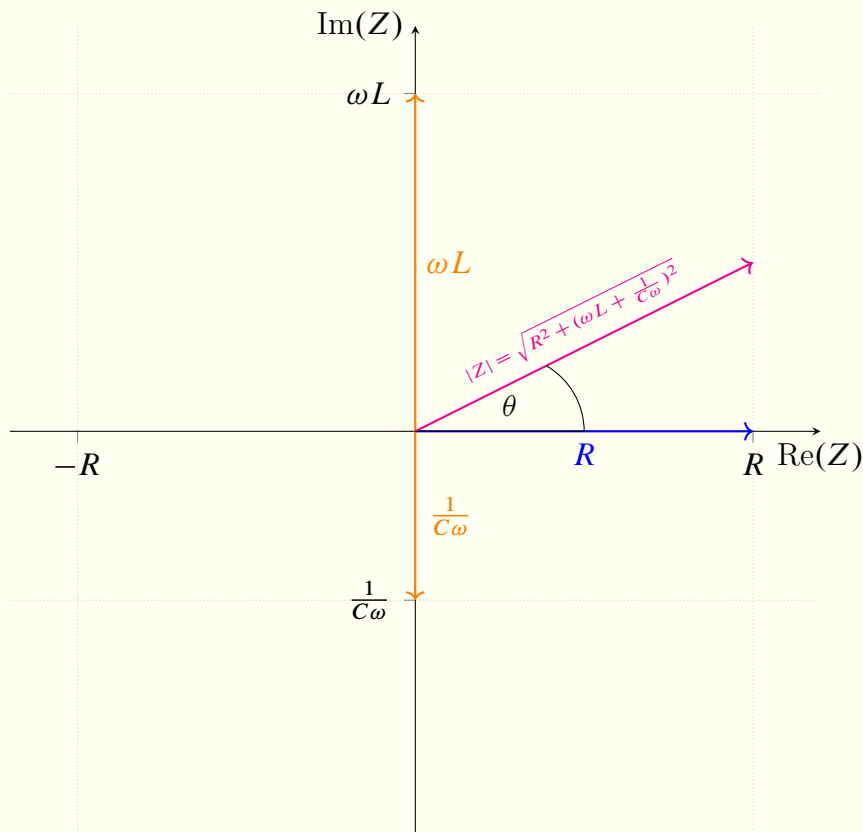
$$U(t) = R \frac{dq}{dt} + \frac{q(t)}{C} + L \frac{d^2 q}{dt^2}$$

$$U_0 = R I_0 + \frac{I_0}{\omega i C} + L I_0 \omega i$$

$$I_0 = \frac{U_0}{R + L\omega i - \frac{i}{\omega C}}$$

(b)

$$Z = \frac{U}{I} = R + L\omega i - \frac{i}{\omega C} = R + i \left( \omega L - \frac{1}{C\omega} \right)$$

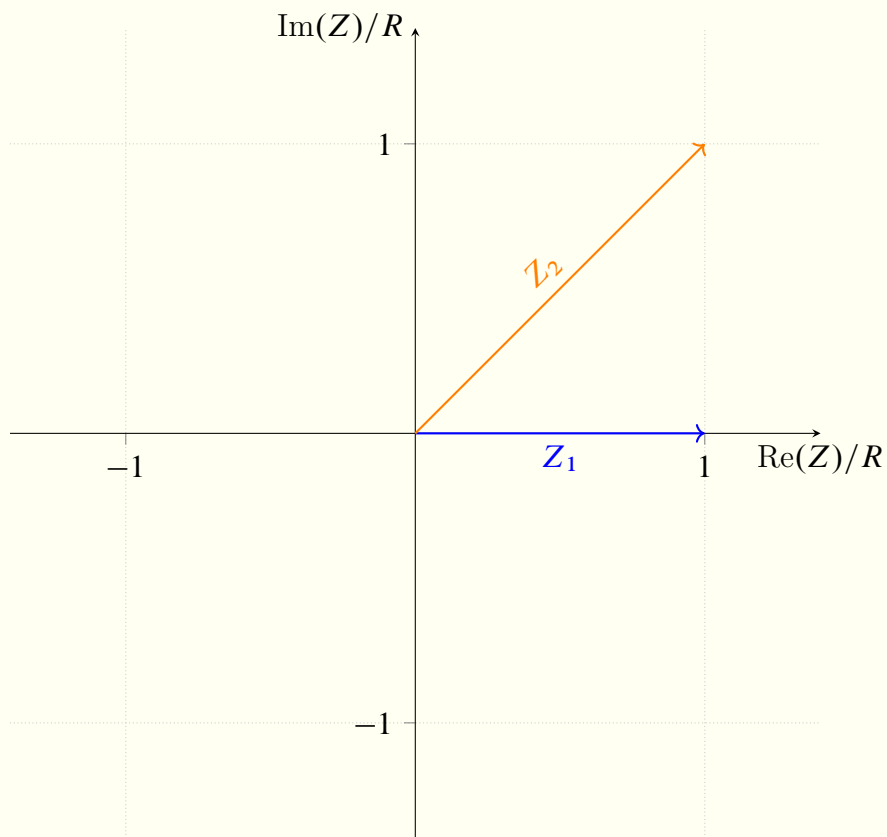


$$\text{For: } \omega L = \frac{1}{C\omega}$$

$$\Rightarrow Z_1 = R$$

$$\text{For: } R = \omega L - \frac{1}{C\omega}$$

$$\Rightarrow Z_2 = R + i R$$



(c)

$$\operatorname{Im}(Z) = 0 \Rightarrow \omega L = \frac{1}{C\omega}$$

$$\omega = \sqrt{\frac{1}{cL}} = 4612.67 \text{ s}$$

$$\phi = \underline{\underline{\frac{\pi}{2}}}$$

### 3. Elektrische Verschiebung

$$\epsilon_1 = 2\epsilon_0; \quad \epsilon_2 = 1.5\epsilon_0$$

(a)

$$\vec{D}_1 = \vec{D}_2 = \underline{\underline{\sigma \hat{z}}}$$

(b)

$$\vec{E}_1 = \frac{\vec{D}_1}{\epsilon_1} = \underline{\underline{\frac{\sigma}{2\epsilon_0} \hat{z}}}$$

$$\vec{E}_2 = \frac{\vec{D}_2}{\epsilon_2} = \underline{\underline{\frac{3\sigma}{2\epsilon_0} \hat{z}}}$$

(c)

$$\vec{P}_1 = \vec{D}_1 - \epsilon_0 \vec{E}_1 = \underline{\underline{\frac{\sigma}{2} \hat{z}}}$$

$$\vec{P}_2 = \vec{D}_2 - \epsilon_0 \vec{E}_2 = \underline{\underline{\frac{\sigma}{3} \hat{z}}}$$

(d)

$$C = \frac{1}{\frac{a}{A\epsilon_1} + \frac{a}{A\epsilon_2}} = \frac{A\epsilon_1\epsilon_2}{a(\epsilon_1 + \epsilon_2)} = \frac{6A\epsilon_0}{7a}$$

$$U = \frac{Q}{C} = \sigma \frac{a(\epsilon_1 + \epsilon_2)}{\epsilon_1\epsilon_2} = \sigma \underline{\underline{\frac{7a}{6\epsilon_0}}}$$

(e) From Top to Bottom:  $\sigma, -\frac{\sigma}{2}, \frac{\sigma}{2}, -\frac{\sigma}{3}, \frac{\sigma}{3}, -\sigma$ 

(f)

$$\vec{E}_1 = \frac{\frac{\sigma}{2}}{\epsilon_0} = \underline{\underline{\frac{\sigma}{2\epsilon_0}}}$$

$$\vec{E}_2 = \frac{\frac{2\sigma}{3}}{\epsilon_0} = \underline{\underline{\frac{2\sigma}{3\epsilon_0}}}$$