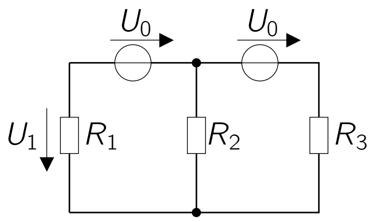
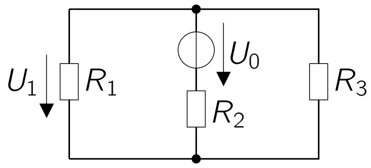
Aufgabe 1

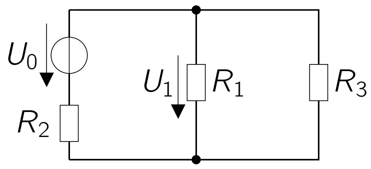
a)



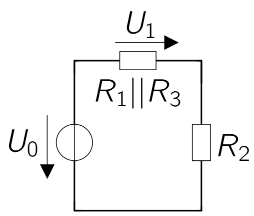
⇒



⇒



⇒



$$U_1 = \frac{R_1||R_3}{(R_1||R_3) + R_2} U_0 = \frac{\frac{R_1 R_3}{R_1 + R_3}}{\frac{R_1 R_3}{R_1 + R_3} + R_2} U_0$$

Aufgabe 2

a)

- [ ] Schaltung 2 ist identisch mit Schaltung 1.
- [x] Schaltung 3 ist identisch mit Schaltung 1.
- [ ] Schaltung 2 ist identisch mit Schaltung 4.
- [x] Schaltung 3 ist identisch mit Schaltung 4.
- [ ] Nichts trifft zu.

b)

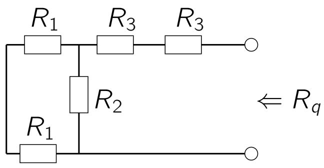
- [x] Graph 1.
- [x] Graph 2.
- [ ] Graph 3.
- [ ] Graph 4.
- [ ] Nichts trifft zu.

c)

- [x] $U_1 = U_2$
- [ ] $U_1 = 2U_2$
- [x] $I_1 = 2I_2$
- [ ] $2I_1 = I_0$
- [ ] Nichts trifft zu.

Aufgabe 3

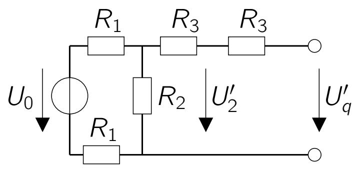
a)



$R_q = 2R_3 + (R_2||2R_1) = 2R_3 + \frac{R_2 \cdot 2 \cdot R_1}{2R_1 + R_2}$

b)

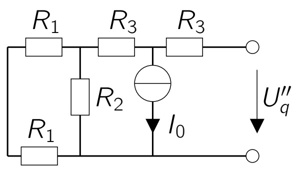
i)

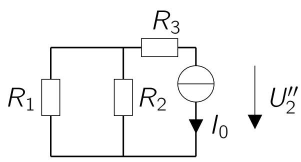


$I_0 = 0$

$U_q' = \frac{R_2}{R_1 + R_2 + R_1} U_0 = \frac{R_2}{2R_1 + R_2} U_0$

ii)



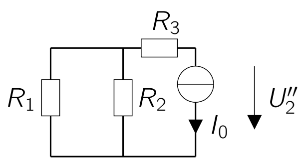


$U_0 = 0$

$U_q'' = -\left(R_3 + \frac{R_2 \cdot 2R_1}{R_2 + 2R_1}\right) I_0$

$U_q = U_q' + U_q'' = \frac{R_2}{R_2 + 2R_1} U_0 - \left(R_3 + \frac{R_2 \cdot 2R_1}{R_2 + 2R_1}\right) I_0$

iii)



$$U_L = \frac{R_L}{R_q+R_L}U_q = \frac{R_L}{2R_3+\frac{R_2\cdot 2R_1}{R_2+2R_1}+R_L}\cdot\left(\frac{R_2}{R_2+2R_1}U_0-\left(R_3+\frac{R_2\cdot 2R_1}{R_2+2R_1}\right)I_0\right)$$

Aufgabe 4

a)

- ☐ $I = \frac{U_0}{3R}$
- ☐ $I = \frac{I_0}{2} + \frac{I_0}{3} + \frac{U_0}{2R}$
- ☐ $I = I_0 + U_0$
- ☒ $I = \frac{I_0}{3} + \frac{U_0}{3R}$
- ☐ Nichts trifft zu.

b)

- ☐ $R_x = \frac{\frac{1}{R_1+R_2+R_3}}{\frac{1}{R_1}+\frac{1}{R_2}}$
- ☐ $\frac{1}{R_x} = \frac{\frac{1}{R_1}\frac{1}{R_2}\frac{1}{R_3}}{\frac{1}{R_1}+\frac{1}{R_2}}$
- ☐ $R_x = \frac{R_1 R_1}{R_1+R_2+R_3}$
- ☒ $\frac{1}{R_x} = \frac{\frac{1}{R_2}\frac{1}{R_3}}{\frac{1}{R_1}+\frac{1}{R_2}\frac{1}{R_3}}$
- ☐ Nichts trifft zu.

c)

- ☐ $U_3 = \frac{R_1}{R_1+\frac{R_2R_3}{R_2+R_3}}U_0$
- ☒ $U_3 = \frac{\frac{R_2R_3}{R_2+R_3}}{R_1+\frac{R_2R_3}{R_2+R_3}}U_0$
- ☐ $U_3 = \frac{R_3}{R_1+R_2+R_3}U_0$
- ☐ $U_3 = \frac{(R_2+R_3)}{R_1+(R_2+R_3)}U_0$
- ☐ Nichts trifft zu.

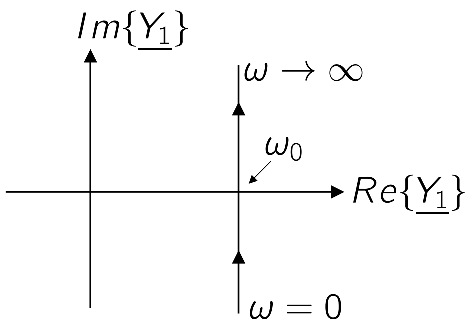
Aufgabe 5

a)

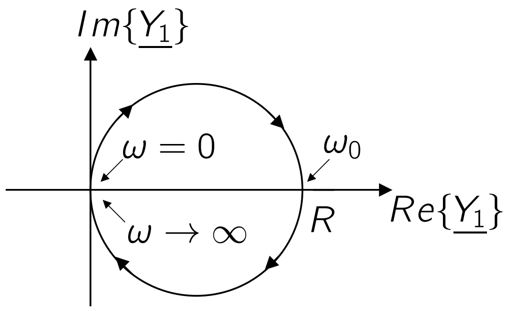
$$\underline{Z} = \frac{\underline{U}}{\underline{I}} = R + \frac{1}{\frac{1}{R} + j\omega C + \frac{1}{j\omega L}}$$

b)+c)

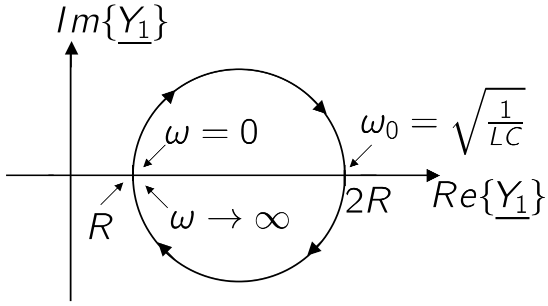
$$\begin{aligned} Y_1 &= \frac{1}{R} + j\omega C + \frac{1}{j\omega L} \\ &= \frac{1}{R} + j\big(\omega C - \frac{1}{\omega L}\big) \\ \Rightarrow \omega_0 &= \sqrt{\frac{1}{LC}} \end{aligned}$$



$\frac{1}{Y_1} = Z_1$



$\underline{Z} = R + \underline{Z_1} = R + \frac{1}{Y_1}$



d)

$$\underline{S} = \frac{1}{2}\underline{U} \cdot \underline{I^*}$$

$$= \frac{1}{2}\underline{Z} \cdot \underline{I} \cdot \underline{I^*}$$

$$= \frac{1}{2}\underline{Z} \cdot |\underline{I}|^2$$

$$= \frac{1}{2}\underline{Z}\left(\frac{\underline{U'}}{\underline{Z}}\right)^*$$

$$= \frac{1}{2}|\underline{U}|^2 \frac{1}{\left(R + \frac{1}{\frac{1}{R} + j\omega C + \frac{1}{j\omega L}}\right)^*}$$

$$= \frac{1}{2}|\underline{U}|^2 \frac{1}{R + \frac{1}{\left(\frac{1}{R} + j\omega C + \frac{1}{j\omega L}\right)^*}}$$

$$= \frac{1}{2}|\underline{U}|^2 \frac{1}{R + \frac{1}{\frac{1}{R} + j\omega C + \frac{1}{j\omega L}}}$$

e)

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

$$\Rightarrow \quad \underline{S}(\omega_0) = \frac{1}{2}|\underline{U}|^2 \frac{1}{R + \frac{1}{\frac{1}{R} - j\underbrace{\left(\omega C + \frac{1}{\omega L}\right)}_{=0}}} \quad \Big| \omega = \omega_0 = \frac{1}{\sqrt{LC}} \quad \rightarrow (\omega_0 C - \frac{1}{\omega_0 L}) = 0$$

$$= \frac{1}{2}|\underline{U}|^2 \frac{1}{R + R}$$

$$= \frac{1}{2}|\underline{U}|^2 \frac{1}{2R} \quad \Rightarrow \quad \text{rein reell}$$

Aufgabe 6

a)

☐ $\begin{pmatrix} \underline{U}_1 \\ \underline{U}_2 \end{pmatrix} = \begin{pmatrix} -j\omega \mathrm{L}_1 & +j\omega M \\ +j\omega M & -j\omega L_2 \end{pmatrix} \begin{pmatrix} \underline{I}_1 \\ \underline{I}_2 \end{pmatrix}$

☒ $\begin{pmatrix} \underline{U}_1 \\ \underline{U}_2 \end{pmatrix} = \begin{pmatrix} +j\omega \mathrm{L}_1 & -j\omega M \\ -j\omega M & -j\omega L_2 \end{pmatrix} \begin{pmatrix} \underline{I}_1 \\ \underline{I}_2 \end{pmatrix}$

☐ $\begin{pmatrix} \underline{U}_1 \\ \underline{U}_2 \end{pmatrix} = \begin{pmatrix} +j\omega \mathrm{L}_1 & +j\omega M \\ -j\omega M & +j\omega L_2 \end{pmatrix} \begin{pmatrix} \underline{I}_1 \\ \underline{I}_2 \end{pmatrix}$

☐ $\begin{pmatrix} \underline{U}_1 \\ \underline{U}_2 \end{pmatrix} = \begin{pmatrix} +j\omega \mathrm{L}_1 & -j\omega M \\ -j\omega M & +j\omega L_2 \end{pmatrix} \begin{pmatrix} \underline{I}_1 \\ \underline{I}_2 \end{pmatrix}$

☐ Nichts trifft zu.

b)

☒ $\underline{Y} = \frac{1}{R} + \frac{1}{j\omega L + \frac{1}{j\omega \frac{C}{2}}}$

☐ $\underline{Y} = R + j\omega L + \frac{1}{j\omega \frac{C}{2}}$

☐ $\underline{Y} = \frac{1}{R} + \frac{j\omega L}{\frac{1}{j\omega 2C}}$

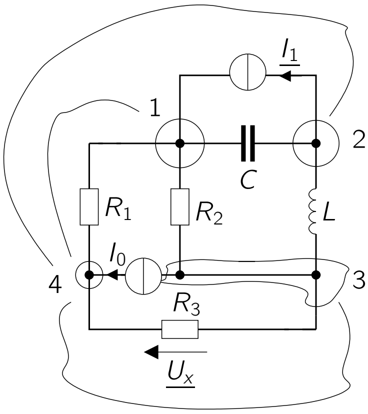
☐ Nichts trifft zu.

c)

- [x] $u_2(t) = \mathrm{Re}\{\underline{U}_1 e^{j\phi} e^{j\omega_0 t}\}$
- [ ] $u_2(t) = U_1 \mathrm{Re}\{e^{j(\phi+\omega_0)t}\}$
- [ ] $u_2(t) = e^{j\omega_0 t}\mathrm{Re}\{\underline{U}_1 e^{j\phi}\}$
- [x] $u_2(t) = U_1 \cos(\omega_0 t + \phi)$
- [ ] Nichts trifft zu.

Aufgabe 7

a)



4 ist Bezugsknoten

b)

$$\underbrace{c}_{[Y_n]}\begin{pmatrix}\underline{U_{n1}}\\\underline{U_{n2}}\\\underline{U_{n3}}\end{pmatrix}=\begin{pmatrix}\underline{I_1}\\\underline{I_2}\\\underline{I_3}\end{pmatrix}$$

c) $\underline{U_{n3}}=\underline{U_x}$

d)

$$\underline{U_{n3}}=\underline{U_x}=\frac{det\begin{pmatrix}\frac{1}{R_1}+\frac{1}{R_2}+sL & -sC & \underline{I_1}\\ -sC & sC+\frac{1}{sL} & \underline{I_1}\\ -\frac{1}{R_2} & -\frac{1}{sL} & \underline{I_0}\end{pmatrix}}{det\left[Y_n\right]}$$

Aufgabe 8

a)

$$U_0 = i_c(t)R + u_c(t) \qquad = C\frac{du_c(t)}{dt}R = u_c(t) = U_0 = u_c(t) + RC\frac{du_c(t)}{dt}$$

b)

$$\begin{aligned} 0 &= u_{n,c}(t) + RC\frac{du_{n,c}(t)}{dt} \quad \text{Ansatz: } u_{n,c}(t) = a \cdot e^{\lambda t} \\ 0 &= \cancel{a \cdot e^{\lambda t}} + RC \cdot \lambda \cancel{a \cdot e^{\lambda t}} \\ 0 &= 1 + RC \cdot \lambda \\ \Leftrightarrow \lambda &= -\frac{1}{RC} \\ &\hookrightarrow u_{n,c}(t) a \cdot e^{(-\frac{t}{RC})} \end{aligned}$$

c)

$$\begin{aligned} U_0 &= RC \cdot \frac{du_{p,c}(t)}{dt} + u_{p,c}(t) \quad \text{Ansatz: } u_{p,c}(t) = konst = U_{konst} \\ U_0 &= RC \cdot \cancel{\frac{du_{p,c}(t)}{dt}} + U_{konst} \\ U_0 &= U_{konst} \end{aligned}$$

d)

$$u_c(t) = u_{n,c}(t) + u_{p,c}(t) = a \cdot e^{(-\frac{t}{RC})} + U_0$$

$$\text{Randbedingung: } u_c(0) = 0 \quad \Rightarrow \quad 0 = a \cdot e^{(-\frac{0}{RC})} + U_0 = a \cdot U_0$$
$$\Rightarrow \quad a = -U_0$$

$$\Rightarrow \text{Lösung: } u_c(t) = -U_0 e^{(-\frac{t}{RC})} + U_0 = U_0\big(1 - e^{(-\frac{t}{RC})}\big)$$