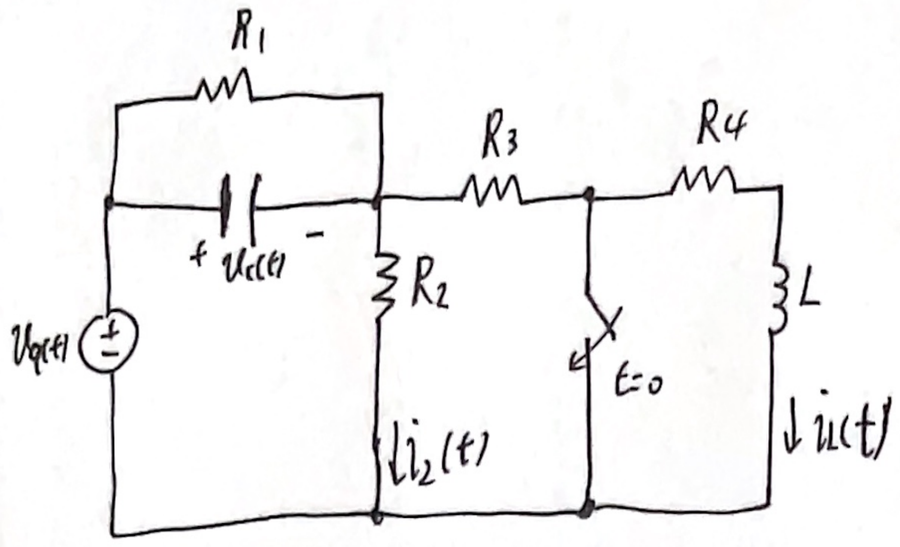
Aufgabe 8

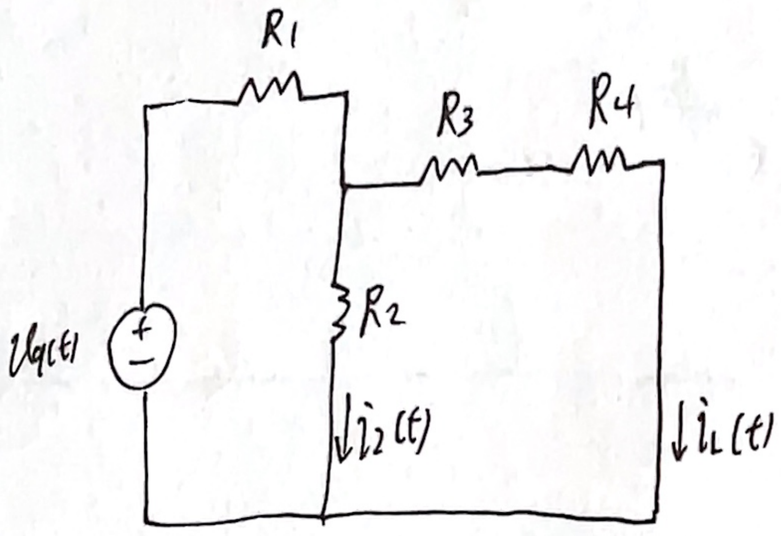


$u_q(t) = V_0$

$t<0$ eingeschwungen

a. $t<0$, $i_2(t)$, $u_c(0^-)$, $i_L(0^-)$

eingeschwungen $\Rightarrow$ $\begin{cases} -|\!|- \triangleq \text{Leerlauf} \\ -\!\!\sim\!\!- \triangleq \text{Kurzschluss} \end{cases}$



$R_{34} = R_3 + R_4$

$R_{11} = \frac{R_{34} \cdot R_2}{R_{34} + R_2}$

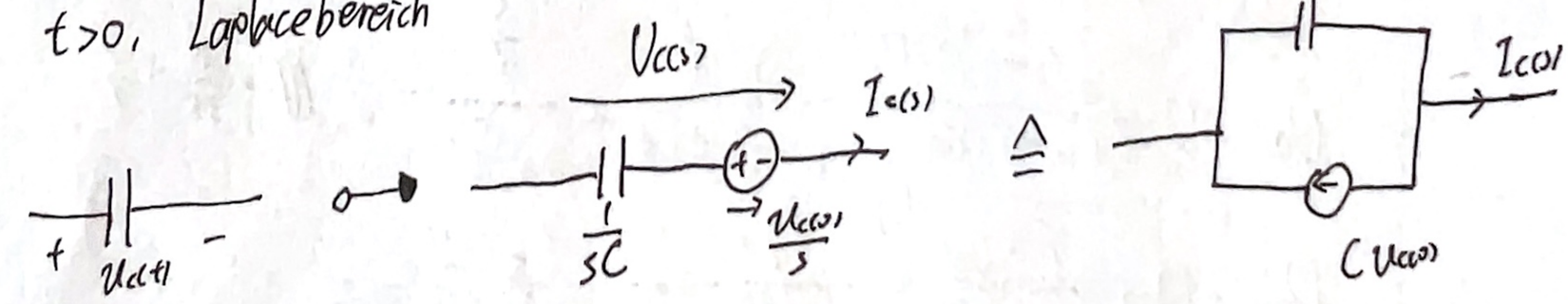
$I = \frac{u_{q(t)}}{R_1 + R_{11}}$, $U_{11} = I \cdot R_{11}$

$\Rightarrow i_2(t) = \frac{U_{11}}{R_2} = \frac{1}{R_2} I R_{11} = \frac{1}{R_2} \frac{V_0}{R_1 + R_{11}} R_{11} = \frac{R_{11}}{R_1 + R_{11}} \frac{V_0}{R_2}$

$i_L(t) = \frac{U_{11}}{R_{34}} = \frac{1}{R_3 + R_4} I R_{11} = \frac{R_{11}}{R_1 + R_{11}} \frac{V_0}{R_3 + R_4} = i_L(0^-)$

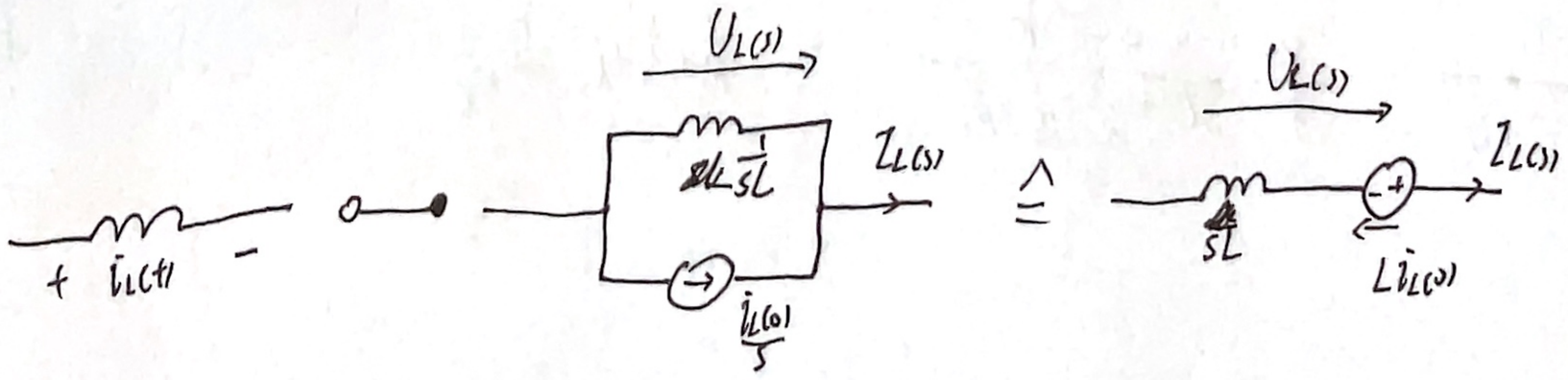
$u_{c(t)} = I \cdot R_1 = \frac{R_{11}}{R_1 + R_{11}} V_0 = u_c(0^-)$

b. $t>0$, Laplacebereich



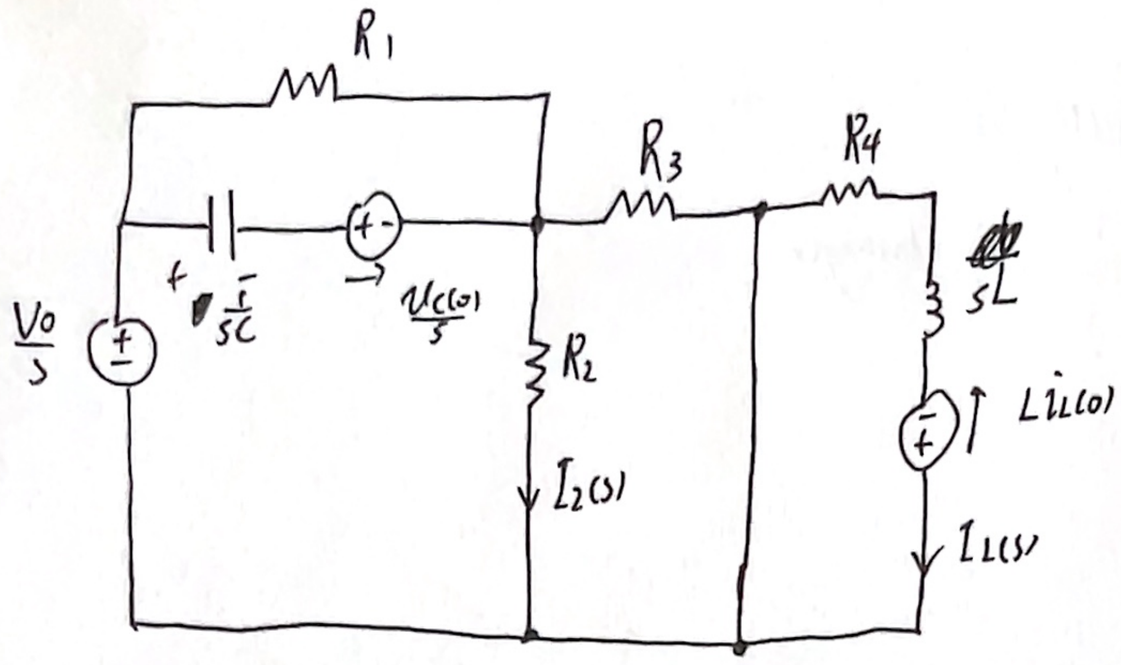
$U_{C(s)} = \frac{1}{sC} I_{C(s)} + \frac{u_{c(0)}}{s}$

$I_{C(s)} = sC U_{C(s)} - C u_{c(0)}$

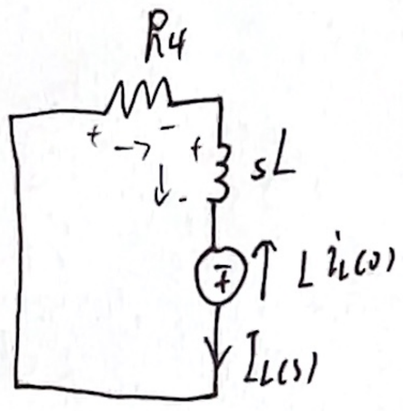


$I_{L(s)} = \frac{1}{sL} U_{L(s)} + \frac{i_{L(0)}}{s}$

$U_{L(s)} = sL I_{L(s)} - L i_{L(0)}$



C. 求 $i_2(t)$, $i_L(t)$

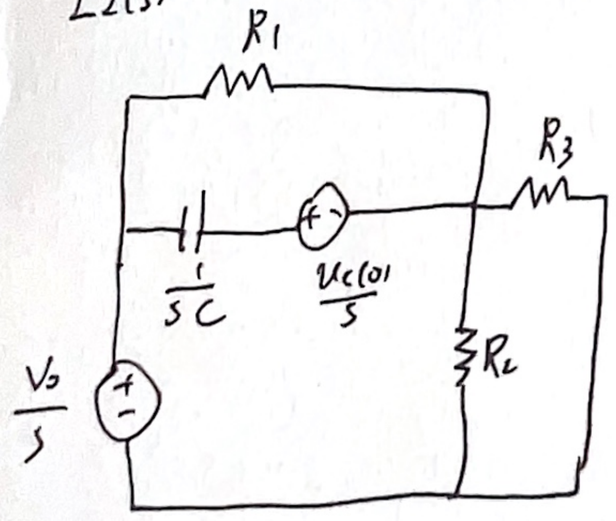


$$I_L(s)(R_4+sL) = L\dot{i}_L(0)$$

$$I_L(s) = \frac{L}{sL+R_4}\dot{i}_L(0) = \frac{1}{s+\frac{R_4}{L}}\dot{i}_L(0)$$

$$\dot{i}_L(t) = \dot{i}_L(0)e^{-\frac{R_4}{L}t} = \frac{R_{11}}{R_1+R_{11}}\frac{V_0}{R_3+R_4}e^{-\frac{R_4}{L}t}, \quad t>0$$

$I_2(s)$



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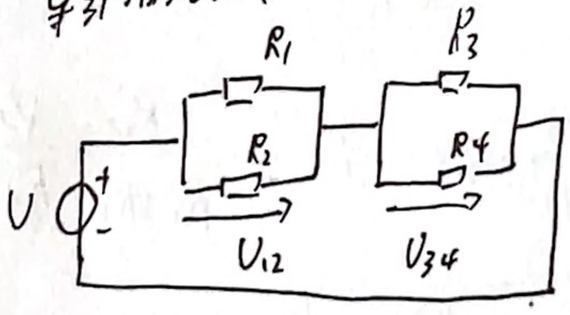


$R_1=3\Omega$ $R_3=2\Omega$

$R_2=2\Omega$ $R_4=8\Omega$

$$R_{ges} = R_1\|R_2 + R_3\|R_4 = \frac{R_1R_2}{R_1+R_2} + \frac{R_3R_4}{R_3+R_4} = \frac{6}{5}+\frac{16}{10} = \frac{14}{5}$$

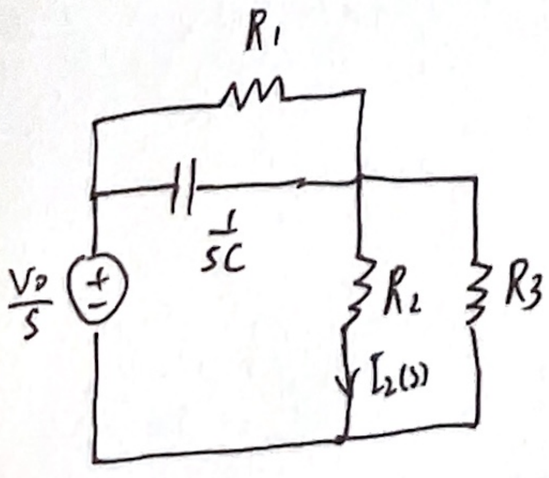
$$U_2 = U\frac{(R_1\|R_2)\text{我方}}{R_1\|R_2+R_3\|R_4} = \frac{\frac{6}{5}}{\frac{14}{5}} = \frac{6}{14} = \frac{3}{7}$$

$$U_{34} = U\frac{(R_3\|R_4)\text{我方}}{R_1\|R_2+R_3\|R_4} = \frac{\frac{8}{5}}{\frac{14}{5}} = \frac{8}{14} = \frac{4}{7}$$

$$U_{12} = U\frac{(Y_3+Y_4)\text{对方}}{Y_1+Y_2+Y_3+Y_4} = \frac{\frac{1}{2}+\frac{1}{8}}{\frac{1}{3}+\frac{1}{2}+\frac{1}{2}+\frac{1}{8}} = \frac{\frac{5}{8}}{\frac{35}{24}} = \frac{5}{8}\cdot\frac{24}{35} = \frac{3}{7}$$

$$U_{34} = U\frac{(Y_1+Y_2)\text{对方}}{Y_1+Y_2+Y_3+Y_4} = \frac{\frac{1}{3}+\frac{1}{2}}{\frac{35}{24}} = \frac{5}{6}\frac{24}{35} = \frac{4}{7}$$

① $\frac{v_c(0)}{s} = 0$



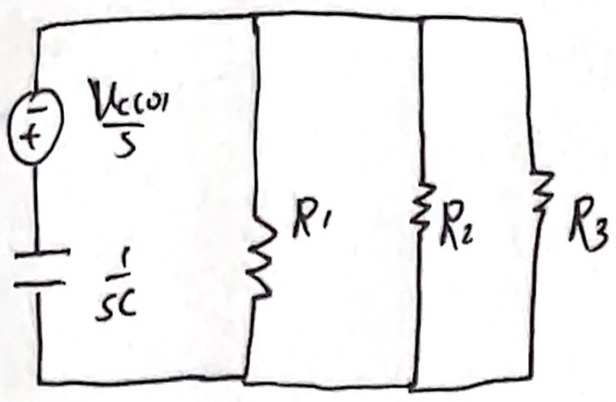
$$\Rightarrow U_{23} = \frac{V_0}{s}\frac{Y_C+Y_1}{Y_C+Y_1+Y_2+Y_3} = \frac{V_0}{s}\frac{sC+\frac{1}{R_1}}{sC+\frac{1}{R_1}+\frac{1}{R_2}+\frac{1}{R_3}}$$

$\frac{1}{R_1}+\frac{1}{R_2}+\frac{1}{R_3} \doteq \frac{1}{R_g}$

$$= \frac{V_0}{s}\frac{sC+\frac{1}{R_1}}{sC+\frac{1}{R_g}}$$

$$I_{2.1}(s) = \frac{U_{23}}{R_2} = \frac{V_0}{s}\frac{1}{R_2}\frac{s+\frac{1}{CR_1}}{s+\frac{1}{CR_g}} = \frac{V_0}{R_2}\frac{s+\frac{1}{CR_1}}{s(s+\frac{1}{CR_g})}$$

② $\frac{V_0}{s}=0$



$$\Rightarrow V_{123}=\frac{V_{c(0)}}{s}\frac{Y_c}{Y_c+Y_1+Y_2+Y_3}=\frac{V_{c(0)}}{s}\frac{sC}{sC+\frac{1}{R_1}+\frac{1}{R_2}+\frac{1}{R_3}}=\frac{V_{c(0)}\cdot C}{sC+\frac{1}{R_g}}$$

$$I_{2,(s)}=\frac{V_{123}}{R_2}=\frac{V_{c(0)}}{R_2}\frac{1}{s+\frac{1}{CR_g}}=\frac{V_0}{R_2}\frac{R_1}{R_1+R_{11}}\frac{1}{s+\frac{1}{CR_g}}$$

중첩

$$\Rightarrow I_2(s)=I_{2,1}(s)-I_{2,2}(s)$$

$$=\frac{V_0}{R_2}\frac{s+\frac{1}{CR_1}}{s(s+\frac{1}{CR_g})}-\frac{V_0}{R_2}\frac{R_1}{R_1+R_{11}}\frac{1}{s+\frac{1}{CR_g}}$$

PF

$$\frac{s+\frac{1}{CR_1}}{s(s+\frac{1}{CR_g})}=\frac{A}{s}+\frac{B}{s+\frac{1}{CR_g}}$$

$$\Rightarrow I_2(s)=\frac{V_0}{R_2}\left[\frac{R_g}{R_1}\frac{1}{s}+(1-\frac{R_g}{R_1})\frac{1}{s+\frac{1}{CR_g}}\right]-\frac{V_0}{R_2}\frac{R_1}{R_1+R_{11}}\frac{1}{s+\frac{1}{CR_g}}$$

• $s\cdot s=0$

$$\frac{s+\frac{1}{CR_1}}{s+\frac{1}{CR_g}}=A=\frac{CR_g}{CR_1}=\frac{R_g}{R_1}$$

• $s+\frac{1}{CR_g}\cdot s=-\frac{1}{CR_g}$

$$\frac{s+\frac{1}{CR_1}}{s}=B=\frac{-\frac{1}{CR_g}+\frac{1}{CR_1}}{-\frac{1}{CR_g}}=1-\frac{R_g}{R_1}$$

$$\Rightarrow \frac{s+\frac{1}{CR_1}}{s(s+\frac{1}{CR_g})}=\frac{R_g}{R_1}\frac{1}{s}+(1-\frac{R_g}{R_1})\frac{1}{s+\frac{1}{CR_g}}$$

$$i_2(t)=\frac{V_0}{R_2}\left[\frac{R_g}{R_1}+(1-\frac{R_g}{R_1})e^{-\frac{1}{CR_g}t}\right]-\frac{V_0}{R_2}\frac{R_1}{R_1+R_{11}}e^{-\frac{1}{CR_g}t},\ t>0$$

$$=\frac{V_0}{R_2}\left[\frac{R_g}{R_1}+(1-\frac{R_g}{R_1})e^{-\frac{1}{CR_g}t}-\frac{R_1}{R_1+R_{11}}e^{-\frac{1}{CR_g}t}\right],\ t>0$$