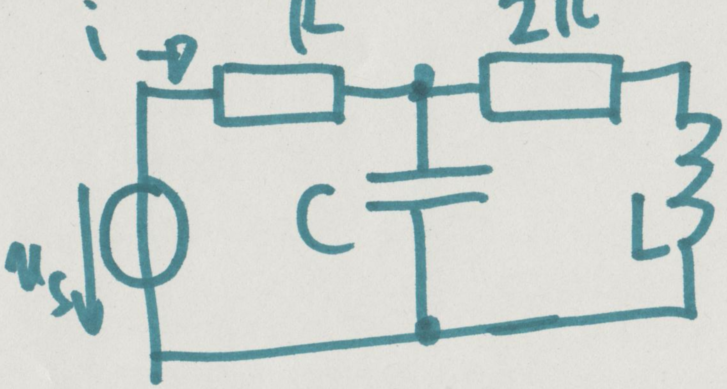
$t=+0$ kezdeti érték

$t=-0$ kiindulási érték



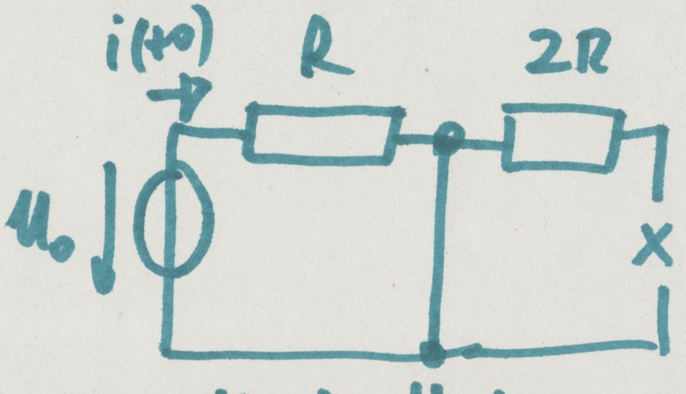
$$u_s(t) = \begin{cases} 0, & t<0 \\ U_0, & t>0 \end{cases}$$

1.) "bekapcsolási folyamat"

$t<0$-ra energiamentes hálózat

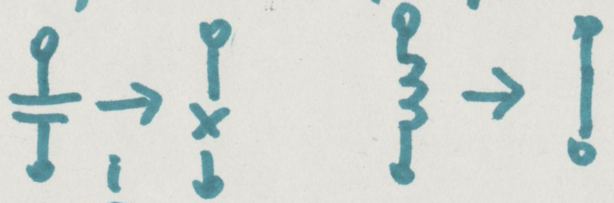
2.) $t=-0$ $i(-0)=0$
(minden 0)

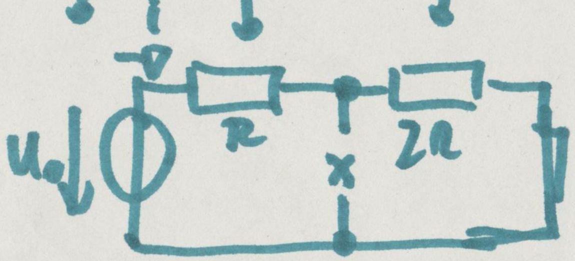
3.) $t=+0$ bekapcsolás utáni pillanat



$i(+0) = U_0/R$

4.) $t\to\infty$ (nagyon sokára)

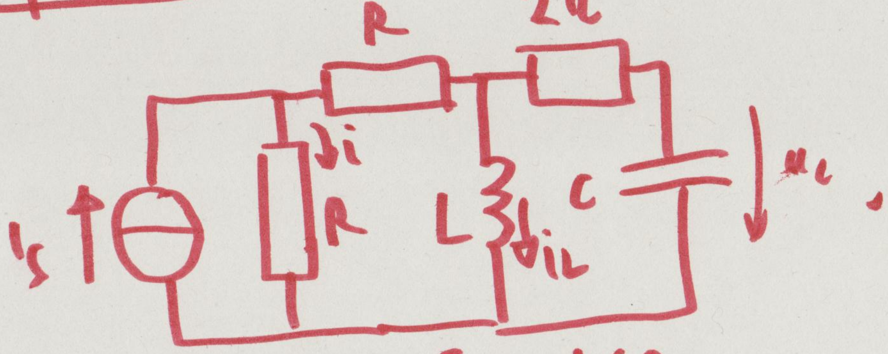




$i(\infty) = \dfrac{U_0}{3R}$

A tranziens után (sok idő múlva) ide tart $i(t)$.

2. példa

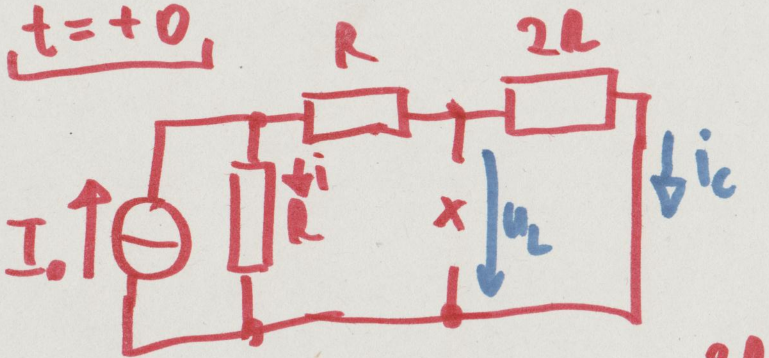


$$i_s(t) = I_0 \cdot \varepsilon(t) = \begin{cases} 0, & t<0 \\ I_0, & t>0 \end{cases}$$

t < 0, energiamentes állapot

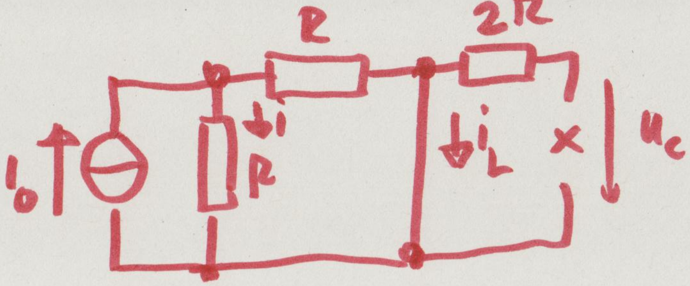
$u_C = 0$; $i_L = 0$; $i = 0$

t = +0



$$i(+0) = \frac{R \times 3R}{R} I_0 = \frac{\frac{3R}{4}}{R} I_0 = \frac{3I_0}{4}$$

$t \to \infty$



$i(\infty) = I_0 \cdot \frac{1}{2}$ $\quad u_C(\infty) = 0$

$i_L(\infty) = I_0 \cdot \frac{1}{2}$

állapotváltozó

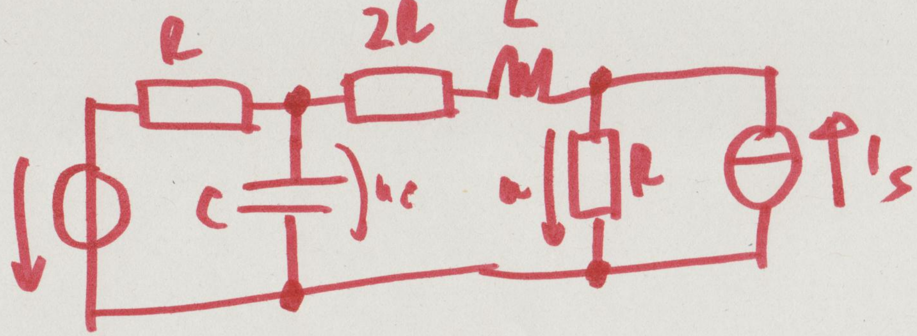
Vegyük észre, hogy $u_C = 0$ és $i_L = 0$, de

$u_L = \frac{I_0}{4} \cdot 2R = \frac{I_0 R}{2}$ és $i_C = \frac{I_0}{4}$

tehát $\Delta u_L = u_L(+0) - u_L(-0) = \frac{I_0 R}{2}$

és $\Delta i_C = \frac{I_0}{4}$ mert u_L és i_C <u>nem</u> állapot-változók

3. példa

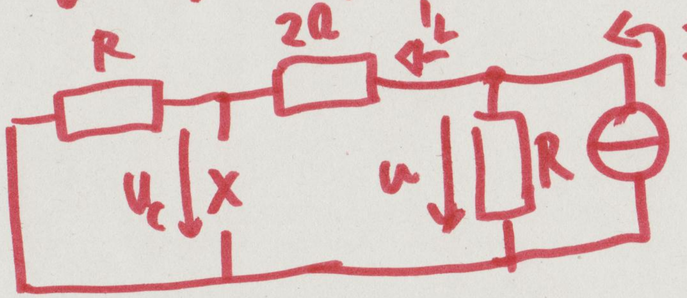


$I_S = I_0$ $\quad u_S = U_0 \cdot \varepsilon(t)$

$\Delta u = u(+0) - u(-0) = ?$

$u(\infty) = ?$

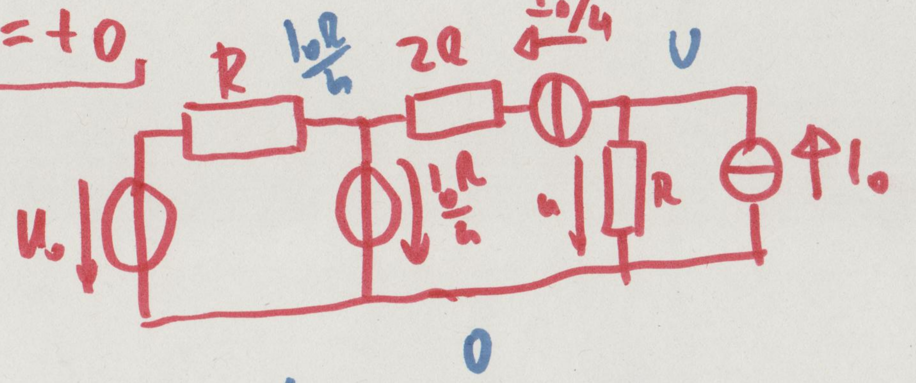
$t = -0$ $\quad I_S = I_0$, de $U_S = 0$



$u(-0) = I_0 \cdot R \times 3R = \frac{3R}{4} \cdot I_0$

$i_L(-0) = \frac{1}{4} I_0$ és $u_C(-0) = R \cdot i_L(-0) = \frac{R}{4} I_0$

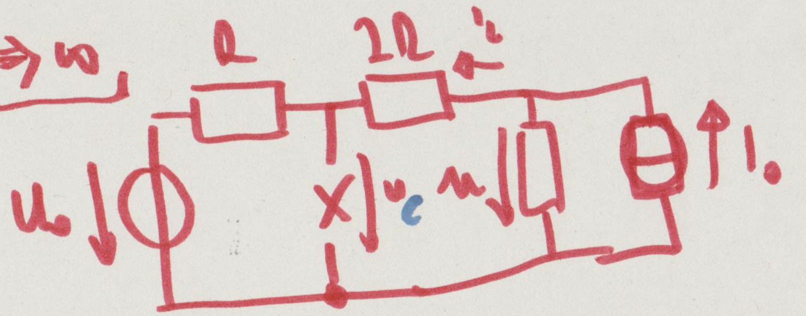
$t = +0$



$-I_0 + \frac{I_0}{4} + \frac{U}{R} = 0$ $\quad U = \frac{3 I_0 R}{4}$

$\Delta u = 0$

$t \Rightarrow \infty$

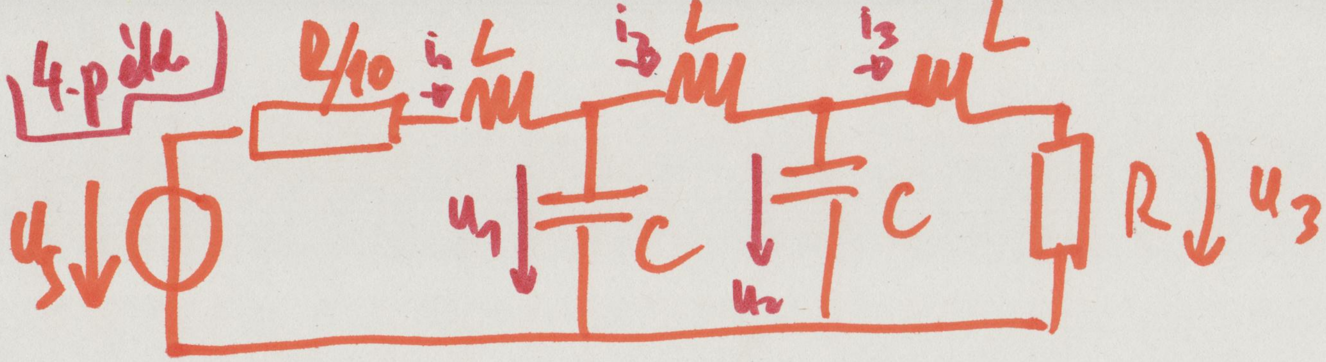


$\frac{U - U_0}{3R} + \frac{U}{R} - I_0 = 0$ $\quad U = \frac{U_0 + 3R I_0}{4}$

$\frac{U_C - U_0}{R} + \frac{U_C - U}{2R} = 0$ $\quad U_C = \frac{2U_0 + U}{3}$

$I_L = \frac{U - U_0}{3R}$

4. példa



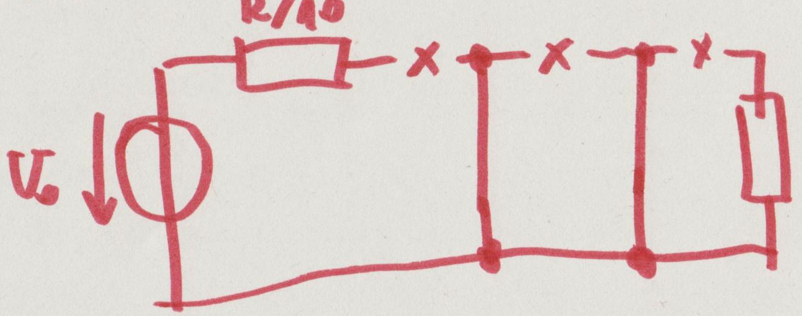
$$u_s = \begin{cases} 0, & t<0 \\ U_0, & t>0 \end{cases}$$

$t=-0$ energiamentes hálózat

$$u_{Ci} = 0 = u_1 = u_2 = u_3$$

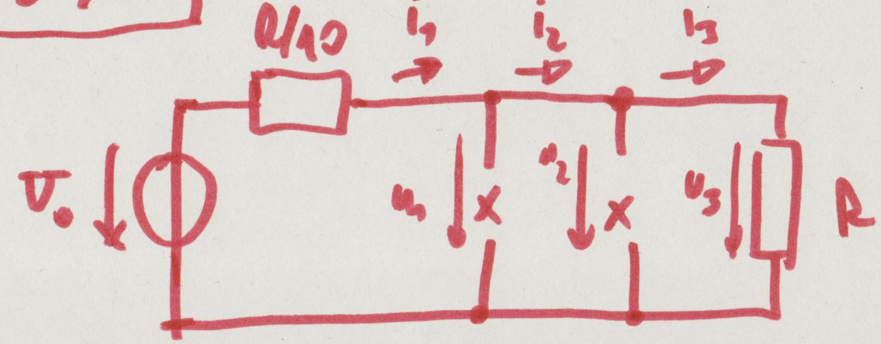
$$i_1 = i_2 = i_3 = 0$$

$t=+0$



$i_1 = i_2 = i_3 = 0$ és $u_1 = u_2 = u_3 = 0$

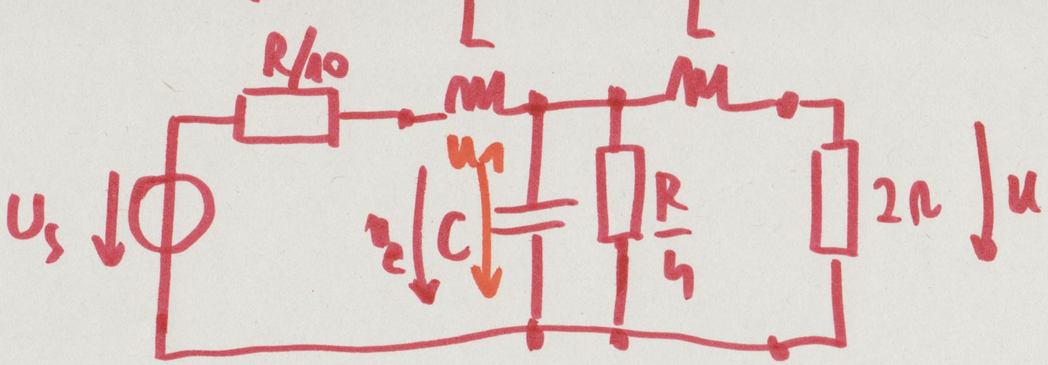
$t \to \infty$



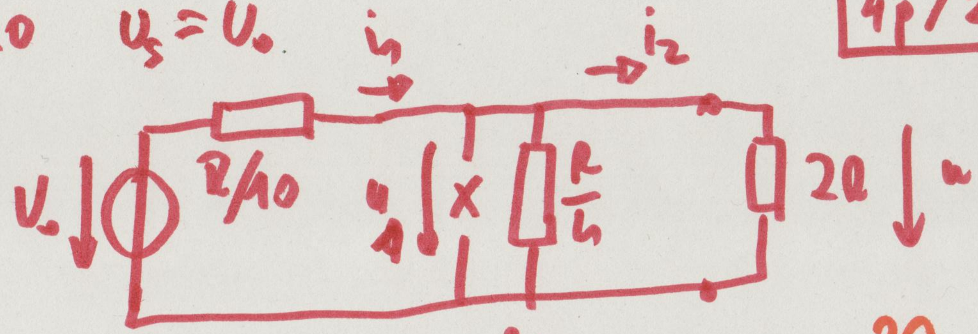
$$u_3 = u_2 = u_1 = \frac{R}{R+\frac{R}{10}} \cdot U_0 = \frac{10}{11} U_0$$

$$i_1 = i_2 = i_3 = \frac{U_0}{R+\frac{R}{10}} = \frac{10 U_0}{11 R}$$

$$u_s(t)=\begin{cases}U_0\\ 2U_0\end{cases}$$



$t<0$ $\quad u_s=U_0$

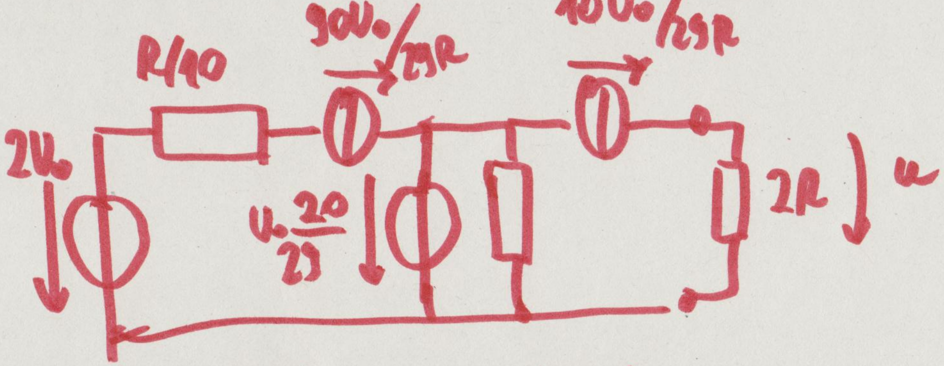


$$u=u_1=\frac{2R\times R/4}{R/10+2R\times R/4}\cdot U_0=\frac{20}{29}U_0$$

$$i_1=\frac{U_0}{R/10+2R\times\frac{R}{4}}=\frac{90U_0}{29R}$$

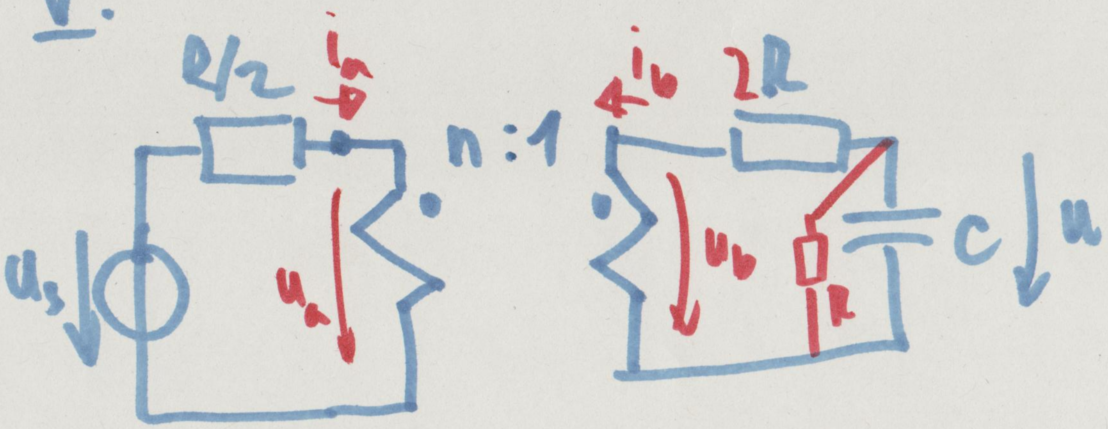
$$i_2=\frac{20}{29}U_0/2R=\frac{10U_0}{29R}$$

$t=+0$ (átkapcsolás után)

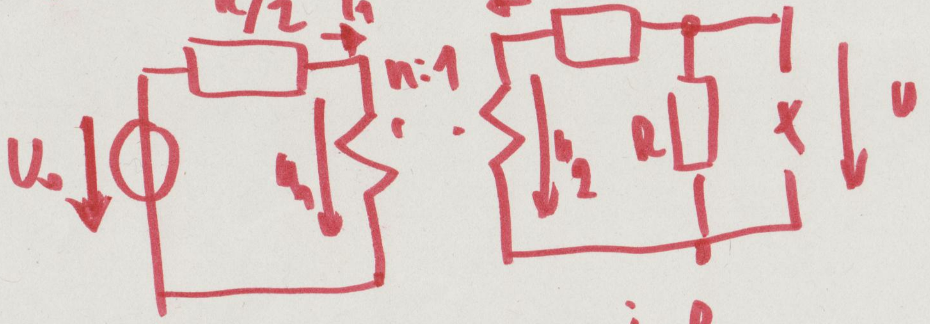


$$u=\frac{10U_0}{29R}\cdot 2R=\frac{20U_0}{29R}$$

V.



$U_s = U_0$



$u = -i_2 \cdot R$

$$i_2 = -\frac{1}{3R} u_2$$

$$i_2 = -n\, i_1$$

$$u_1 = n \cdot u_2$$

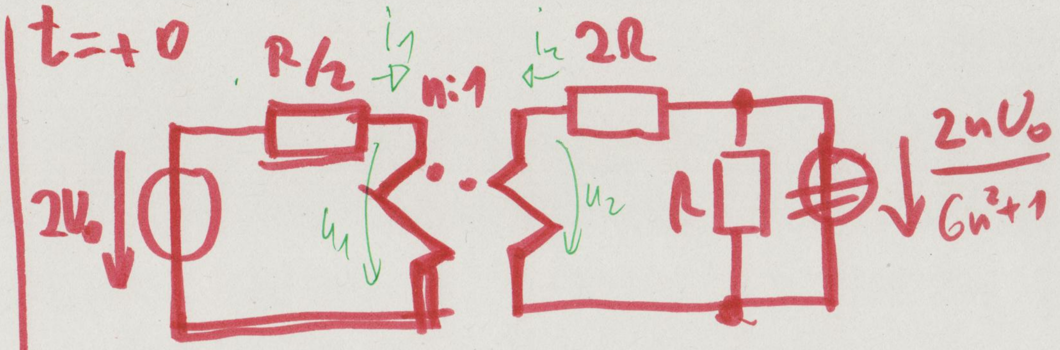
$$U_0 - i_1 \cdot \frac{R}{2} = u_1$$

$$U_0 - \left(-\frac{1}{n} i_2\right) \cdot \frac{R}{2} = n \cdot \cancel{\left(-\frac{1}{3R}\right)} (-3R\, i_2)$$

$$U_0 = -R\left(3n + \frac{1}{2n}\right) i_2$$

$$i_2 = \frac{-U_0/R \cdot 2n}{6n^2+1}$$

$t = +0$



$$2U_0 - i_1 \frac{R}{2} = u_1$$

$$u_1 = n \cdot u_2$$

$$i_2 = -n\, i_1 \; ; \; i_2 = \left(\frac{2nU_0}{6n^2+1} - u_2\right) / 2R$$

$$\frac{\frac{2U_0 n}{6n^2+1} - u_2}{2R} + \frac{\frac{2U_0 n}{6n^2+1}}{R}$$

$$-n i_1 \cdot 2R = \frac{2nU_0}{6n^2+1} - \frac{1}{n} \cdot \left(2U_0 - \frac{R i_1}{2}\right.$$

$$u(-0) = +\frac{U_0}{\cancel{R}} \cdot \frac{2n}{6n^2+1}$$

$$i_1 = -\frac{1}{n} i_2 = \frac{U_0}{R} \frac{2}{6n^2+1}$$

$$\left.\begin{aligned} &2U_0 - \frac{R}{2} i_1 = u_1 \\ &u_1 = n \cdot u_2 \\ &i_2 = -n \cdot i_1 \\ &\left(u_C(0) - u_2\right)\frac{1}{2R} = i_2 \end{aligned}\right\}$$

$$-n i_1 = \frac{1}{2R}\left(\frac{2nU_0}{6n^2+1} - \frac{1}{n}\cdot\left(2U_0 - \frac{R}{2} i_1\right)\right)$$

$$-n i_1 - \frac{1}{2R}\frac{1}{n}\cdot\frac{R}{2} i_1 = \frac{1}{2R}\frac{2nU_0}{6n^2+1} - \frac{2U_0}{n2R}$$

$$-\left(n + \frac{1}{4n}\right) i_1 = \frac{U_0}{R}\left(\frac{n}{6n^2+1} - \frac{1}{n}\right) = \frac{U_0}{R}\cdot\frac{-5n^2-1}{n(6n^2+1)}$$

$$-\frac{4n^2+1}{4n} i_1 = \dots$$

$$i_1 = \frac{4n}{4n^2+1}\cdot\frac{U_0}{R}\cdot\frac{5n^2+1}{n(6n^2+1)} = \frac{4U_0}{R}\cdot\frac{5n^2+1}{(4n^2+1)(6n^2+1)}$$

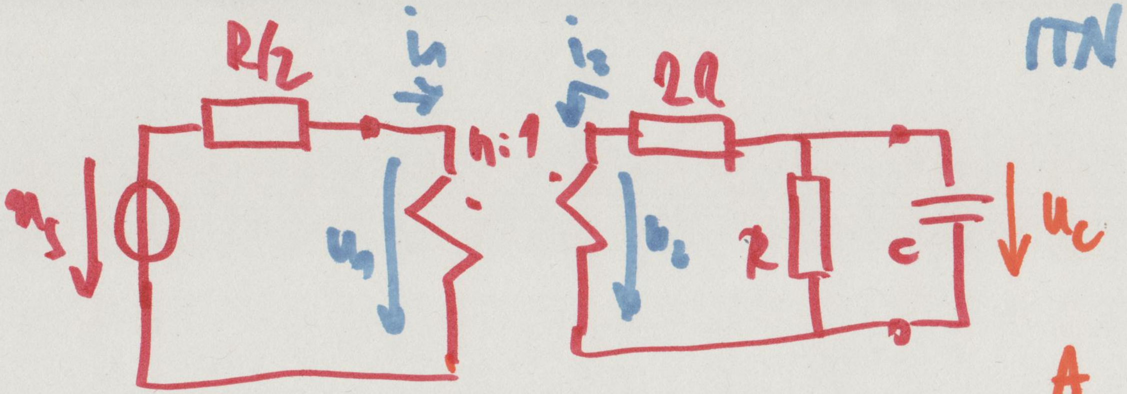
$R = 1\,k\Omega;\ U_0 =$

pl. $n = 5$

$$\Delta i_1 = i_1(+0) - i_1(-0) =$$

$$= \frac{2U_0}{R(4n^2+1)}$$

ITN392 $\quad n=5;\ R=1\,k\Omega;\ C=2\,nF$ $\quad$ V/3.



$$\left.\begin{aligned}
&C u_c' + \frac{u_c}{R} + \frac{u_c - u_2}{2R} = 0\\
&i_2 + \frac{u_2 - u_c}{2R} = 0\\
&u_s - i_1 \cdot \frac{R}{2} = u_1\\
&u_1 = n\, u_2\\
&i_2 = -n\, i_1
\end{aligned}\right\}$$

$$u_c' = \overbrace{-\frac{6n^2+1}{CR(4n^2+1)}}^{\underline{A}} u_c + \overbrace{\frac{2n}{CR(4n^2+1)}}^{\underline{B}} u_s$$

$$i_1 = \underbrace{-\frac{2n}{R(4n^2+1)}}_{\underline{C}^T} u_c + \underbrace{\frac{2}{R(4n^2+1)}}_{\underline{D}} u_s$$

$$u_c' = -0{,}7475\, u_c + 0{,}0495\, u_s$$

$$i_1 = -0{,}0991\, u_c + 0{,}0198\, u_s$$