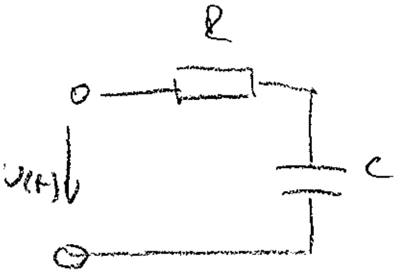
1.A1



$R = 10^3\,\Omega$

$C = 1\,\mu F$

$U_0 = 5V$

$U_m = 10V$

$\omega = 1000\,s^{-1}$

$\varphi = \frac{\pi}{4}$

$u(t) = U_0 + U_m \cdot \sin(\omega t + \varphi)$

$u(t) = 5 + 10 \sin\left(1000t + \frac{\pi}{4}\right)$

$U_m = 10 e^{j\frac{\pi}{4}}\ V$

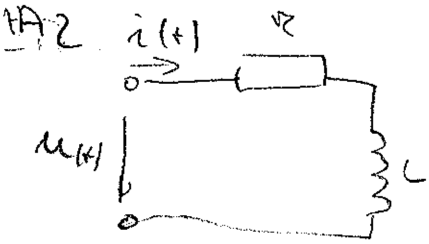
$$Z = R + \frac{1}{j\omega C} = 10^3 + \frac{1}{j \cdot 10^3 \cdot 10^{-6}} = 1000(1-j) = 1414\, e^{-j\frac{\pi}{4}}\,\Omega$$

$U = R \cdot I$

$$\hat{I}_m = \frac{\hat{U}_m}{Z} = \frac{10 e^{j\frac{\pi}{4}}}{1414\, e^{-j\frac{\pi}{4}}} = 7{,}071 \cdot 10^{-3}\, e^{j \cdot 1{,}5707}\ A$$

$$i(t) = \underline{7{,}071 \cdot 10^{-3} \cdot (1000t + 1{,}5707)\ A}$$

1A2



$R = 1k\Omega$

$L = 1H$

$U_0 = 5V$

$U_m = 10V$

$\omega = 10^3\,s^{-1}$

$\varphi = \frac{\pi}{4}$

$u(t) = U_0 + U_m \cdot \sin(\omega t + \varphi)$

$u(t) = 5 + 10 \cdot \sin\left(10^3 t + \frac{\pi}{4}\right)$

$\hat{U}_m = 10 e^{j\frac{\pi}{4}}$

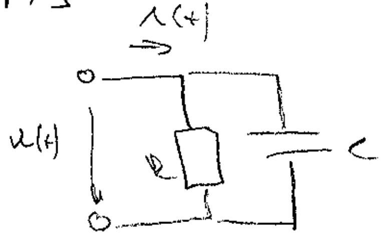
$$Z = R + L = R + j\omega L = 10^3 + j \cdot 10^3 \cdot 1 =$$
$$= 10^3 (1+j) = 1414{,}213\, e^{j\,0{,}785}\,\Omega$$

$I = \frac{U}{R}$

$$\hat{I}_m = \frac{\hat{U}_m}{Z} = \frac{10 e^{j\frac{\pi}{4}}}{1414{,}213 e^{j\,0{,}785}} = 7{,}071 \cdot 10^{-3}\ A$$

$$i(t) = \frac{U_0}{R} + \hat{I}_m \sin(\omega t) = \underline{5 \cdot 10^{-3} + 7{,}071 \cdot 10^{-3} \sin(10^3 t)\ A}$$

1A3



$R = 1k\Omega$ $\quad \varphi = \frac{\pi}{4}$

$C = 1\mu F$

$U_0 = 5V$

$U_{m1} = 10V$

$\omega = 10^3 s^{-1}$

$u(t) = U_0 + U_{m1} \sin(\omega t + \varphi)$

$u(t) = 5 + 10 \sin(10^3 t + \frac{\pi}{4})$

$\hat{U}_m = 10 e^{j\frac{\pi}{4}} V$

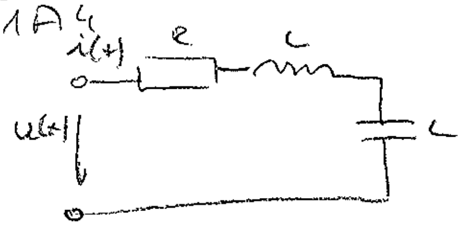
$$Z = \frac{R \cdot C}{R + C} = \frac{R \cdot \frac{1}{j\omega C}}{R + \frac{1}{j\omega C}} = \frac{\frac{R}{j\omega C}}{\frac{j\omega CR + 1}{j\omega C}} = \frac{R}{j\omega CR + 1} =$$

$$= \frac{10^3}{j \cdot 10^3 \cdot 10^{-6} \cdot 10^3 + 1} = \frac{10^3}{j + 1} = 500 - 500j = 707{,}106 e^{-j\frac{\pi}{4}} \Omega$$

$$I = \frac{U}{R} \Rightarrow \hat{I}_m = \frac{\hat{U}_m}{Z} = \frac{10 e^{j\frac{\pi}{4}}}{500 - 500j} = 14{,}1421 \cdot 10^{-3} e^{j1{,}5707} A$$

$$i(t) = \frac{U_0}{R} + \hat{I}_m \sin(\omega t + \varphi) = 5 \cdot 10^{-3} + 14{,}1421 \cdot 10^{-3} \sin(10^3 t + 1{,}5707) A$$

1A4



$R = 10^3 \Omega$ $\quad \omega = 2 \cdot 10^3 \cdot s^{-1}$

$L = 1H$ $\quad \varphi = \frac{\pi}{4}$

$C = 10^{-6} F$

$U_0 = 5V$

$U_{m1} = 10V$

$u(t) = U_0 + U_{m1} \sin(\omega t + \varphi) =$

$= 5 + 10 \cdot \sin(2 \cdot 10^3 t + \frac{\pi}{4})$

$\hat{U}_m = 10 e^{j\frac{\pi}{4}}$

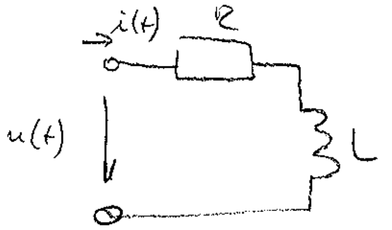
$$Z = R + L + C =$$

$$= R + j\omega L + \frac{1}{j\omega C} = 10^3 + j2 \cdot 10^3 \cdot 1 + \frac{1}{j \cdot 2 \cdot 10^3 \cdot 10^{-6}} = 1000 + 1500j = 1802{,}775 e^{j0{,}982} \Omega$$

$$\hat{I}_m = \frac{\hat{U}_m}{Z} = \frac{10 e^{j\frac{\pi}{4}}}{1802{,}775 e^{j0{,}982}} = 5{,}547 \cdot 10^{-3} e^{-j0{,}197}$$

$$i(t) = 5{,}547 \cdot 10^{-3} \cdot \sin(2 \cdot 10^3 t - 0{,}197) A$$

1B1



$R = 10^3\,\Omega$, $\varphi = \frac{1}{4}\pi$

$L = 1\,H$

$I_0 = 10\,mA$

$I_{m1} = 5\,mA$

$\omega = 10^3\,s^{-1}$

$i(t) = I_0 + I_{m1} \cdot \sin(\omega t + \varphi)$

$i(t) = 10^{-2} + 5 \cdot 10^{-3} \cdot \sin\left(10^3 t + \frac{\pi}{4}\right)$

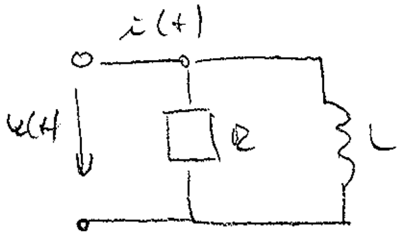
$\hat{I}_m = 5 \cdot 10^{-3} e^{j\frac{\pi}{4}}$

$$Z = R + L = R + j\omega L = 1000 \cdot (1 + j) = 1414{,}213\, e^{j\frac{\pi}{4}}\ \Omega$$

$$U = R \cdot I \Rightarrow \hat{U}_m = Z \cdot \hat{I}_m = 1414{,}213\, e^{j\frac{\pi}{4}} \cdot 5 \cdot 10^{-3} e^{j\frac{\pi}{4}} = 7{,}071\, e^{j\frac{\pi}{2}}$$

$$u(t) = R \cdot I_0 + \hat{U}_m = \underbrace{10 + 7{,}071 \cdot \sin\left(10^3 t + \frac{\pi}{2}\right)\ V}$$

1B2



$R = 10^3\,\Omega$

$L = 1\,H$

$I_0 = 10\,mA$

$I = 5\,mA$

$\omega = 10^3\,s^{-1}$

$\varphi = \frac{\pi}{4}$

$i(t) = I_0 + I_m \cdot \sin(\omega t + \varphi) =$

$= 10^{-2} + 5 \cdot 10^{-3} \cdot \sin\left(10^3 t + \frac{\pi}{4}\right)$

$\hat{I}_m = 5 \cdot 10^{-3} \cdot e^{j\frac{\pi}{4}}\ A$

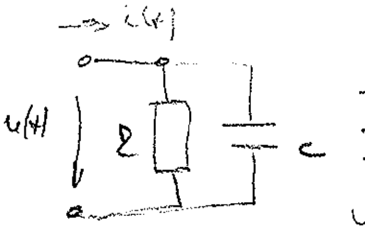
$$Z = \frac{R \cdot L}{R + L} = \frac{R \cdot j\omega L}{R + j\omega L} = \frac{10^3 \cdot j \cdot 10^3 \cdot 1}{10^3 + j \cdot 10^3 \cdot 1} = \frac{10^6 j}{10^3 (1 + j)} =$$

$$= 500 + 500j = 707{,}106\, e^{j\frac{\pi}{4}}\ \Omega$$

$$\hat{U}_m = Z \cdot \hat{I}_m = 707{,}106\, e^{j\frac{\pi}{4}} \cdot 5 \cdot 10^{-3} \cdot e^{j\frac{\pi}{4}} = 3{,}5355\, e^{j\frac{\pi}{2}}\ V$$

$$\underbrace{u(t) = 3{,}5355 \cdot \sin\left(10^3 t + \frac{\pi}{2}\right)\ V}$$

1B3



$R = 10^3\,\Omega$ $\varphi = \frac{\pi}{4}$

$C = 10^{-6}\,F$

$I_0 = 10\,mA$

$I_m = 5\,mA$

$\omega = 10^3\,s^{-1}$

$$i(t) = I_0 + I_m \cdot \sin(\omega t + \varphi) =$$

$$= 10^{-2} + 5 \cdot 10^{-3} \sin\left(10^3 t + \frac{\pi}{4}\right)$$

$$\hat{I}_m = 5 \cdot 10^{-3} \cdot e^{j\frac{\pi}{4}}$$

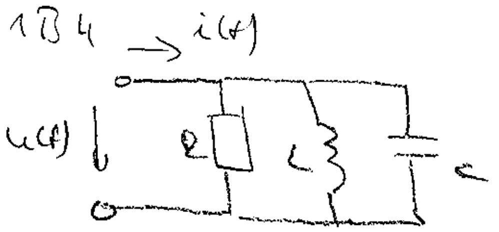
$$Z = \frac{R \cdot C}{R + C} = \frac{R \cdot \frac{1}{j\omega C}}{R + \frac{1}{j\omega C}} = \frac{\frac{R}{j\omega C}}{\frac{j\omega RC + 1}{j\omega C}} = \frac{R}{j\omega RC + 1} =$$

$$= \frac{10^3}{j \cdot 10^3 \cdot 10^3 \cdot 10^{-6} + 1} = \frac{10^3}{j + 1} = 500 - 500j = \boxed{707{,}106\, e^{-j\frac{\pi}{4}}\,\Omega}$$

$$\hat{U}_m = Z \cdot \hat{I}_m = 707{,}106\, e^{-j\frac{\pi}{4}} \cdot 5 \cdot 10^{-3} e^{j\frac{\pi}{4}} = 3{,}5355\,V$$

$$u(t) = \frac{I_0}{R} + \hat{U}_m \sin(\omega t + \varphi) = \boxed{10 + 3{,}5355 \sin(10^3 t)\,V}$$

1B4



$R = 10^3\,\Omega$ $\varphi = \frac{\pi}{4}$

$L = 1\,H$

$C = 10^{-6}\,F$

$I_0 = 10\,mA$

$I_m = 5\,mA$

$\omega = 2 \cdot 10^3\,s^{-1}$

$$i(t) = I_0 + I_m \sin(\omega t + \varphi)$$

$$i(t) = 10^{-2} + 5 \cdot 10^{-3} \sin\left(2 \cdot 10^3 t + \frac{\pi}{4}\right) A$$

$$\hat{I}_m = 5 \cdot 10^{-3} e^{j\frac{\pi}{4}} A$$

$$Z = \left(\frac{1}{R} + \frac{1}{L} + \frac{1}{C}\right)^{-1} = \left(\frac{LC + RC + LR}{R \cdot L \cdot C}\right)^{-1} = \frac{R \cdot L \cdot C}{LC + RC + LR} =$$

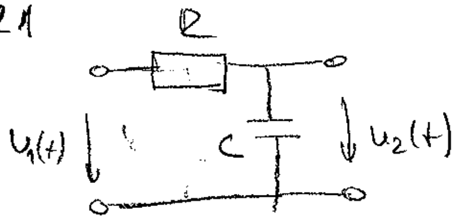
$$= \frac{10^3 \cdot j\omega L \cdot \frac{1}{\cancel{j\omega C}}}{\frac{j\omega L}{\cancel{j\omega C}} + \frac{R}{\cancel{j\omega C}} + \frac{j\omega L \cdot R \cdot j\omega C}{\cancel{j\omega C}}} = \frac{10^3 \cdot j\omega L}{j\omega L + R + j^2\omega^2 R \cdot C} =$$

$$= \frac{10^3 \cdot j \cdot 2 \cdot 10^3 \cdot 1}{j \cdot 2 \cdot 10^3 \cdot 1 + 10^3 + (-1) \cdot (2 \cdot 10^3)^2 \cdot 10^3 \cdot 10^{-6}} = \frac{2 \cdot 10^6 j}{-3000 + 2000j} = \boxed{554{,}7001\, e^{-j0{,}982}\,\Omega}$$

$$\hat{U}_m = \hat{I}_m \cdot Z = 5 \cdot 10^{-3} e^{j\frac{\pi}{4}} \cdot 554{,}7001\, e^{-j0{,}982} = 2{,}7735 \cdot e^{-j0{,}1973}\,V$$

$$\boxed{u(t) = 2{,}7735 \cdot \sin(2 \cdot 10^3 t - 0{,}1973)\,V}$$

1C1



$R = 10^3\,\Omega$

$C = 10^{-6}\,F$

$U_0 = 5V$

$U_{m1} = 10V$

$\omega = 10^3\,s^{-1}$

$\varphi = \frac{\pi}{4}$

$u(t) = U_0 + U_m \sin(\omega t + \varphi)$

$u(t) = 5 + 10 \sin\left(10^3 t + \frac{\pi}{4}\right)$

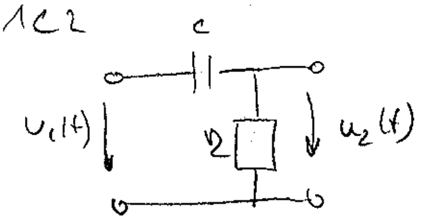
$\underline{\hat{U}_m = 10 e^{j\frac{\pi}{4}}\,V}$

$$\hat{U}_{2m} = \frac{\hat{U}_{1m} \cdot C}{R + C} = \frac{\frac{\hat{U}_{1m}}{j\omega C}}{R + \frac{1}{j\omega C}} = \frac{\hat{U}_{1m}}{j\omega RC + 1} =$$

$$= \frac{10 e^{j\frac{\pi}{4}}}{j \cdot 10^3 \cdot 10^3 \cdot 10^{-6} + 1} = \frac{10 e^{j\frac{\pi}{4}}}{j + 1} = 5\sqrt{2} \doteq \underline{7{,}071\,V}$$

$$u_2(t) = U_0 + \hat{U}_{2m} \sin(\omega t + \varphi) = \underline{5 + 7{,}071 \sin\left(10^3 t\right) V}$$

1C2



$R = 10^3\,\Omega$

$C = 10^{-6}\,F$

$U_0 = 5V$

$U_m = 10V$

$\omega = 10^3\,s^{-1}$

$\varphi = \frac{\pi}{4}$

$u(t) = U_0 + U_m \cdot \sin(\omega t + \varphi)$

$u(t) = 5 + 10 \sin\left(10^3 + \frac{\pi}{4}\right)$

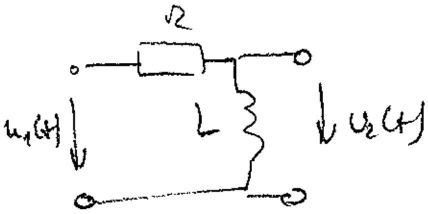
$\hat{U}_{m1} = 10 e^{j\frac{\pi}{4}}\,V$

$$\hat{U}_{m2} = \frac{\hat{U}_{m1} \cdot R}{R + C} = \frac{\hat{U}_{m1} \cdot R}{R + \frac{1}{j\omega C}} = \frac{10 e^{j\frac{\pi}{4}} \cdot 10^3}{10^3 + \frac{1}{j \cdot 10^3 \cdot 10^{-6}}} =$$

$$\doteq 7{,}071\, e^{j\frac{\pi}{2}}\,V$$

$$\underline{u_2(t) = 7{,}071 \sin\left(10^3 + \frac{\pi}{2}\right) V}$$

1C3



$R = 10^3\ \Omega$

$L = 1\,H$

$U_0 = 5\,V$

$U_m = 10\,V$

$\omega = 10^{+3}\ s^{-1}$

$\varphi = \frac{\pi}{4}$

$u(t) = U_0 + U_{m1} \cdot \sin(\omega t + \varphi) =$

$= 5 + 10 \cdot \sin\left(10^3 t + \frac{\pi}{4}\right)$

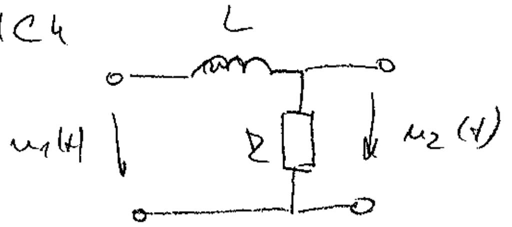
$\hat{U}_m = 10 e^{j\frac{\pi}{4}}\ V$

$$\hat{U}_{2m} = \frac{\hat{U}_{1m} \cdot L}{R + L} = \frac{\hat{U}_{1m} \cdot j\omega L}{R + j\omega L} = \frac{10 \cdot e^{j\frac{\pi}{4}} \cdot j \cdot 10^3 \cdot 1}{10^3 + j\,10^3 \cdot 1} =$$

$$\doteq 7{,}071\, e^{j\frac{\pi}{2}}\ V$$

$$u_2(t) = 7{,}071 \sin\left(10^3 t + \frac{\pi}{2}\right)\ V$$

1C4



$R = 10^3\ \Omega$

$L = 1\,H$

$U_0 = 5\,V$

$U_m = 10\,V$

$\varphi = \frac{\pi}{4}$

$\omega = 10^3\ s^{-1}$

$u(t) = U_0 + U_m \cdot \sin(\omega t + \varphi)$

$u(t) = 5 + 10 \sin\left(10^3 t + \frac{\pi}{4}\right)$

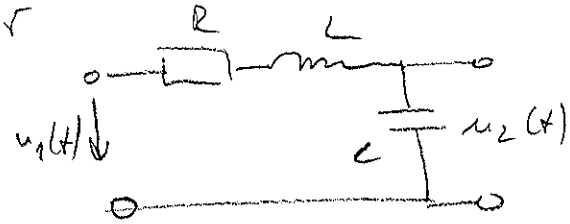
$\hat{U}_{m1} = 10 e^{j\frac{\pi}{4}}\ V$

$$\hat{U}_{2m} = \frac{\hat{U}_{1m} \cdot R}{L + R} = \frac{\hat{U}_{1m} \cdot R}{j\omega L + R} = \frac{10 e^{j\frac{\pi}{4}} \cdot 10^3 \cdot 1}{j\,10^3 \cdot 1 + 10^3} =$$

$$\doteq 7{,}071\ V$$

$$u_2(t) = 5 + 7{,}071 \cdot \sin\left(10^3 t\right)\ V$$

1C5



$R = 10^3\,\Omega$
$L = 1\,H$
$C = 10^{-6}\,F$
$U_0 = 5\,V$
$U_{m1} = 10\,V$
$\varphi = \frac{\pi}{4}\,;\ \omega = 10^3\,s^{-1}$

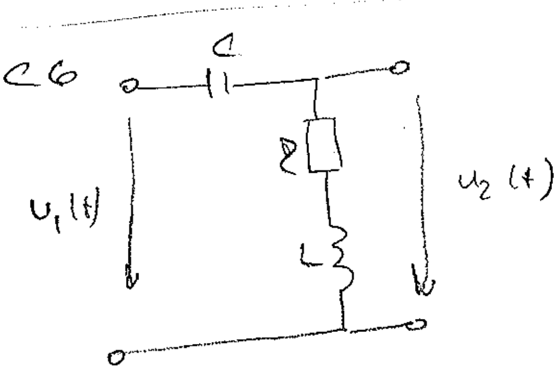
$u(t) = U_0 + U_m \cdot \sin(\omega t + \varphi)$
$u(t) = 5 + 10 \cdot \sin(10^3 t + \frac{\pi}{4})$
$\boxed{\hat{U}_{m1} = 10 e^{j\frac{\pi}{4}}\,V}$

$$\hat{U}_{m2} = \frac{U_{m1} \cdot C}{L + R + C} = \frac{\frac{\hat{U}_{m1}}{j\omega C}}{j\omega L + R + \frac{1}{j\omega C}} = \frac{\hat{U}_{m1}}{j^2\omega^2 LC + j\omega RC + 1} =$$

$$= \frac{10 e^{j\frac{\pi}{4}}}{j^2 \cdot (10^3)^2 \cdot 1 \cdot 10^{-6} + j \cdot 10^3 \cdot 10^3 \cdot 10^{-6} + 1} = \frac{10 e^{j\frac{\pi}{4}}}{\cancel{j^2} + j \cancel{+1}} =$$

$$\frac{10 e^{j\frac{\pi}{4}}}{j} = \boxed{10 e^{-j\frac{\pi}{4}}\,V} \Rightarrow \boxed{u_2(t) = 5 + 10 \cdot \sin\left(10^3 t - \frac{\pi}{4}\right) V}$$

1C6



$R = 10^3\,\Omega$
$C = 10^{-6}\,F$
$L = 1\,H$
$U_0 = 5\,V$
$U_{m1} = 10\,V$
$\varphi = \frac{\pi}{4}\,;\ \omega = 10^3\,s^{-1}$

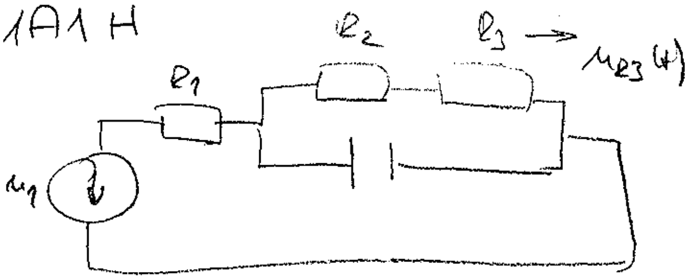
$u_1(t) = U_0 + U_m \sin(\omega t + \varphi)$
$u_1(t) = 5 + 10 \cdot \sin(10^3 t + \frac{\pi}{4})\,V$
$\boxed{\hat{U}_{1m} = 10 e^{j\frac{\pi}{4}}\,V}$

$$\hat{U}_{2m} = \frac{\hat{U}_{1m} \cdot (R + L)}{R + L + C} = \frac{\hat{U}_{1m} \cdot (R + j\omega L)}{R + j\omega L + \frac{1}{j\omega C}} =$$

$$= \frac{10 e^{j\frac{\pi}{4}} \cdot (10^3 + j \cdot 10^3 \cdot 1)}{10^3 + j \cdot 10^3 \cdot 1 + \frac{1}{j \cdot 10^3 \cdot 10^{-6}}} = \boxed{14{,}142\, e^{j\frac{\pi}{2}}\,V}$$

$$\boxed{u_2(t) = 14{,}142 \sin\left(10^3 t + \frac{\pi}{2}\right) V}$$

1A1H



$R_1 = 10^3\,\Omega$ $\qquad \omega = 10^3$

$R_2 = 2 \cdot 10^3\,\Omega$ $\qquad \varphi_1 = \frac{\pi}{4}$

$R_3 = 4 \cdot 10^3\,\Omega$ $\qquad \varphi_2 = -\frac{\pi}{3}$

$C = 10^{-6}\,F$

$U_0 = 5V$; $U_{1m} = 10V$; $U_{m3} = 2V$

$$u_1(t) = U_0 + U_{1m} \cdot \sin(\omega t + \varphi_1) + U_{3m} \sin(3\omega t + \varphi_2) =$$
$$= 5 + 10 \cdot \sin\left(10^3 + \frac{\pi}{4}\right) + 2 \cdot \sin\left(3 \cdot 10^3 - \frac{\pi}{3}\right) \rightarrow$$

$\hat{U}_{1m} = 10\, e^{j\frac{\pi}{4}}$

$U_{2m} = 2\, e^{-j\frac{\pi}{3}}$

$$\hat{U}_{02} = \frac{\hat{U}_0 \cdot R_3}{R_1 + R_2 + R_3} = \frac{5 \cdot 4 \cdot 10^3}{7 \cdot 10^3} = \frac{20}{7}\,V$$

(C - je zkrat při SS)

$$Z_{23C} = \frac{(R_2+R_3) \cdot C}{(R_2+R_3+C)} = \frac{\frac{R_2+R_3}{j\omega C}}{\frac{j\omega C(R_2+R_3)+1}{\cancel{j\omega C}}} = \frac{R_2+R_3}{j\omega C(R_2+R_3)+1} = 986{,}393\,e^{-j1{,}405}\,\Omega$$

$$\hat{U}_m = \left(\frac{U \cdot Z_{23C}}{R_1 + Z_{23C}}\right) \cdot \frac{R_3}{R_2+R_3} = U \cdot \left(\frac{986{,}393\,e^{-j1{,}405}}{10^3 + 986{,}393\,e^{-j1{,}405}}\right) \cdot \frac{4 \cdot 10^3}{6 \cdot 10^3} \Rightarrow$$

$\Rightarrow \hat{U}_{1m} \doteq 4{,}337\,e^{j0{,}077}$

$\hat{U}_{3m} \doteq 0{,}4142\,e^{-j2{,}247}$

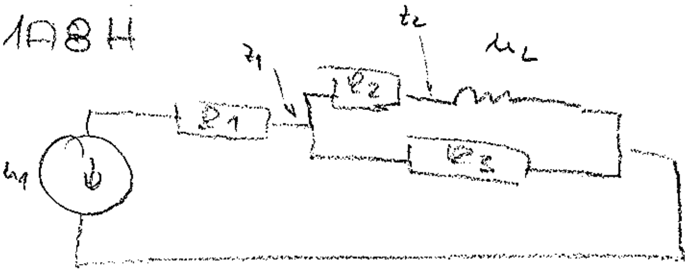
(Z_{23C} - jiné ω $\Rightarrow$ $Z_{23C_3} \doteq 332{,}820\,e^{-j1{,}515}$)

$$u(t) = \hat{U}_{0R} + \hat{U}_{1m} + \hat{U}_{3m}$$

$$\boxed{u(t) = 2{,}857 + 4{,}337 \sin(10^3 t + 0{,}077) + 0{,}4142 \sin(3 \cdot 10^3 - 2{,}247)\,V}$$

$$U_{2ef} = \sqrt{U_0^2 + \frac{U_{1m}^2}{2} + \frac{U_{3m}^2}{2}} = \sqrt{2{,}857^2 + \frac{4{,}337^2}{2} + \frac{0{,}4142^2}{2}} \doteq 4{,}201\,V$$

1A8H



$R_1 = 10^3\,\Omega$

$R_2 = 2\cdot 10^3\,\Omega$

$R_3 = 4\cdot 10^3\,\Omega$

$L = 1H$

$U_0 = 5V$

$U_{m1} = 10V$

$U_{m3} = 2V$

$\omega_0 = 10^3\,s^{-1}$

$\varphi_1 = \frac{\pi}{4}$

$\varphi_2 = -\frac{\pi}{3}$

$$u_1(t) = 5 + 10\sin\left(10^3 t + \frac{\pi}{4}\right) + 2\sin\left(3\cdot 10^3 t - \frac{\pi}{3}\right)$$

$\hat{U}_0 = 5V \qquad \hat{U}_{1m} = 10 e^{j\frac{\pi}{4}} \qquad U_{3m} = 2e^{-j\frac{\pi}{3}}$

$\omega_1 = 10^3$

$\omega_2 = 3\cdot 10^3$

$\hat{U}_{0L} = 0$ – L v SS je rozpojeno

$$Z_{1L} = \left(\frac{(R_2 + j\omega L)\cdot R_3}{R_2 + R_3 + j\omega L}\right) = \begin{cases} \omega_1 = 1470{,}429\, e^{j\,0{,}298}\ \Omega & (A) \\ \omega_2 = 2149{,}935\, e^{j\,0{,}519}\ \Omega & (B) \end{cases}$$

$$Z_2 = \frac{j\omega L}{R_2 + j\omega L} = \begin{cases} \omega_1 \doteq 0{,}4472\, e^{j\,1{,}107} & (C) \\ \omega_2 \doteq 0{,}832\, e^{j\,0{,}588} & (D) \end{cases}$$

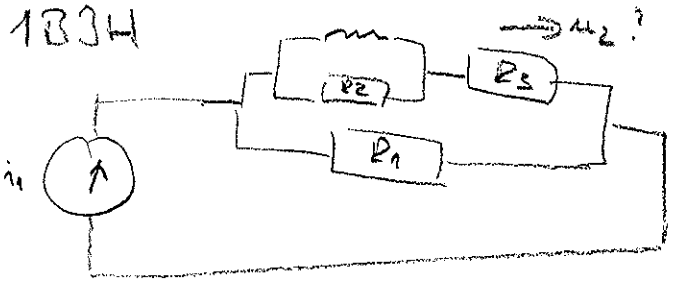
$$\hat{U}_{1mL} = \frac{\hat{U}_{1m}\cdot Z_1A}{R_1 + Z_1A}\cdot Z_2C \doteq 2{,}6905\, e^{j\,2{,}012}\ V$$

$$\hat{U}_{2mL} = \frac{\hat{U}_{2m}\cdot Z_1B}{R_1 + Z_1B}\cdot Z_2D \doteq 1{,}1695\, e^{-j\,0{,}296}\ V$$

$$\underbrace{u(t) = 0 + 2{,}6905\sin(10^3 t + 2{,}012) + 1{,}1695\sin(3\cdot 10^3 t - 0{,}296)\ V}$$

$$U_{ef} = \sqrt{U_0^2 + \frac{U_1^2}{2} + \frac{U_3^2}{2}} = \sqrt{0^2 + \frac{2{,}6905^2}{2} + \frac{1{,}1695^2}{2}} \doteq \boxed{2{,}074\ V}$$

133H



$R_1 = 10^3\,\Omega$ $\quad I_0 = 1\,mA$

$R_2 = 2 \cdot 10^3\,\Omega$ $\quad I_1 = 10\,mA$

$R_3 = 4 \cdot 10^3\,\Omega$ $\quad I_3 = 2\,mA$

$\omega_0 = 10^3\,s^{-1}$ $\quad \varphi_1 = \frac{\pi}{4}$ $\quad \varphi_2 = -\frac{\pi}{3}$

$$i(t) = 1 \cdot 10^{-3} + 10^{-2} \cdot \sin\left(10^3 t + \frac{\pi}{4}\right) + 2 \cdot 10^{-3} \sin\left(3 \cdot 10^3 t - \frac{\pi}{3}\right)$$

$$I_{0R_3} = \frac{I_0 \cdot R_1}{R_1 + R_3} \doteq 4 \cdot 10^{-3}\,\Omega \Rightarrow U_{R_3} = R_3 \cdot I_{0R_3} \doteq 4\,V$$

(zdroj I_1 tak je L zkrat) $\Rightarrow$ R_2 ve zkratu

$$Z_1 = \frac{R_2 \cdot j\omega L}{R_2 + j\omega L} = \frac{2 \cdot 10^3 \cdot j \cdot \omega \cdot 1}{2 \cdot 10^3 + j \cdot \omega \cdot 1} = \begin{cases} \omega_0 = 894{,}427\, e^{j\,1{,}107}\,\Omega \\ \omega_1 = 1664{,}100\, e^{j\,0{,}588}\,\Omega \end{cases}$$

$$\hat{I}_{1mR_3} = \frac{\hat{I}_{1m} \cdot R_1}{Z_1 + R_1 + R_3} = \frac{10\,e^{j\frac{\pi}{4}} \cdot 10^3}{Z_1 + 10^3 + 4 \cdot 10^3} \doteq 1{,}8318 \cdot 10^{-3}\, e^{j\,0{,}6383}\,A$$

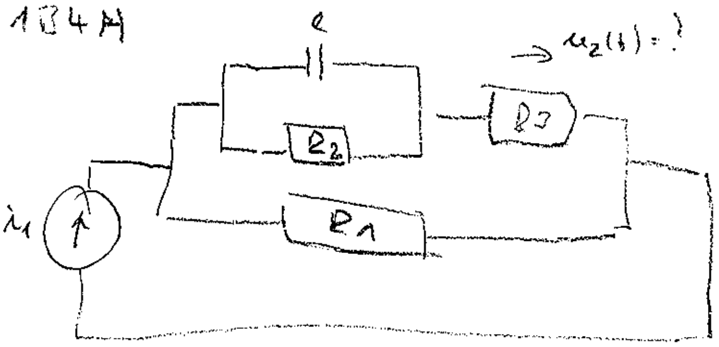
$$\Rightarrow \hat{U}_{1mR_3} = \hat{I}_{1mR_3} \cdot R_3 = 7{,}3274\, e^{j\,0{,}6383}$$

$$\hat{I}_{3mR_3} = \frac{\hat{I}_{3m} \cdot R_1}{Z_1 + R_1 + R_3} \doteq 3{,}1 \cdot 10^{-4}\, e^{-j\,1{,}190}\,A \Rightarrow \hat{U}_{2m} \doteq 1{,}240\, e^{-j\,1{,}190}\,V$$?

$$u(t) = 4 + 7{,}3274 \cdot \sin\left(10^3 t + 0{,}6383\right) + 1{,}240 \sin\left(3 \cdot 10^3 t - 1{,}190\right)\,V$$

$$U_{ef} = \sqrt{U_{0m}^2 + U_{1m}^2 + U_{3m}^2} = \sqrt{4^2 + \frac{7{,}3274^2}{2} + \frac{1{,}240^2}{2}} \doteq 6{,}604\,V$$

1B4A



$R_1 = 10^3\,\Omega$ $\quad \omega = 10^3\,s^{-1}$

$R_2 = 2\cdot 10^3\,\Omega$ $\quad \varphi_1 = \frac{\pi}{4}$

$R_3 = 4\cdot 10^3\,\Omega$ $\quad \varphi_2 = -\frac{\pi}{3}$

$C = 10^{-6}\,F$

$I_0 = 5\,mA$

$I_{m_1} = 10\,mA$

$I_{m_3} = 2\,mA$

$$i_0(t) = I_0 + I_{m_1} \sin(\omega t + \varphi) + I_{m_3} \sin(3\omega t + \varphi) \rightarrow$$
$$= 5\cdot 10^{-3} + 10^{-2} \sin\left(10^3 t + \frac{\pi}{4}\right) + 2\cdot 10^{-3} \sin\left(3\cdot 10^3 t - \frac{\pi}{3}\right)$$

$$Z_{CR_2} = \frac{R_2\cdot C}{R_2 + C} = \frac{\frac{R_2}{j\omega C}}{R_2 + \frac{1}{j\omega C}} = \frac{R_2}{j\omega C R_2 + 1} = \frac{2\cdot 10^3}{j\cdot\omega\cdot 10^{-6}\cdot 2\cdot 10^3 + 1} =$$

$$\rightarrow \omega(10^3)\quad Z_{CR_2} \doteq 894{,}427\, e^{-j1{,}107}\,\Omega \quad (A)$$

$$\rightarrow \omega(3\cdot 10^3)\quad Z_{CR_2} \doteq 328{,}797\, e^{-j1{,}405}\,\Omega \quad (B)$$

$$\hat{I}_{0R_3} = \frac{I_0\cdot R_1}{(R_1 + R_2 + R_3)} = \frac{5\cdot 10^{-3}\cdot 1\cdot 10^3}{7\cdot 10^3} \doteq \frac{1}{1400} \rightarrow \boxed{\hat{U}_{R_3} \doteq 2{,}857\,V}$$

(C – rozpojení v ss)

$$\hat{I}_{1R_3} = \frac{\hat{I}_1\cdot R_1}{R_1 + R_3 + Z_{CR_2A}} = \frac{10^{-2} e^{j\frac{\pi}{4}}\cdot 10^3}{5\cdot 10^3 + 894{,}427\, e^{-j1{,}107}} \doteq 1{,}831\cdot 10^{-3} e^{j0{,}932} \rightarrow$$

$$\rightarrow \boxed{\hat{U}_{1R_3} \doteq 7{,}327\, e^{j0{,}932}\,V}$$

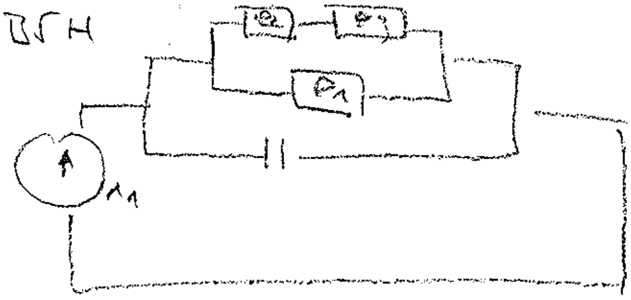
$$\hat{I}_{3R_3} = \frac{\hat{I}_3\cdot R_1}{R_1 + R_3 + Z_{CR_2B}} = \frac{2\cdot 10^{-3} e^{-j\frac{\pi}{3}}\cdot 10^3}{5\cdot 10^3 + 328{,}797\, e^{-j1{,}405}} \doteq 3{,}949\cdot 10^{-4} e^{-j0{,}983} \rightarrow$$

$$\rightarrow \boxed{\hat{U}_{3R_3} \doteq 1{,}5796\, e^{-j0{,}983}\,V}$$

$$\boxed{u(t) = 2{,}857 + 7{,}327 \sin(10^3 t + 0{,}932) + 1{,}5796 \sin(3\cdot 10^3 t - 0{,}983)\,V}$$

$$U_{EF} = \sqrt{U_0^2 + \frac{U_1^2}{2} + \frac{U_3^2}{2}} = \sqrt{2{,}857^2 + \frac{7{,}327^2}{2} + \frac{1{,}5796^2}{2}} \doteq \boxed{6{,}021\,V}$$

1B5H



$R = 1;2;4 \cdot 10^{3}\,\Omega$

$C = 10^{-6}\,F$ $\qquad I = 5;10;2 \cdot 10^{-3}\,A$

$\varphi = \frac{\pi}{4};\ -\frac{\pi}{3}$

$\omega = 10^{3}\,s^{-1}$

$$\hat{I}_0 = \frac{\hat{I}_{0m} \cdot R_1}{R_1+R_2+R_3} = \frac{5\cdot 10^{-3}\cdot 10^{3}}{7\cdot 10^{3}} = \frac{5}{7}\cdot 10^{-3} = \frac{1}{1400} \Rightarrow$$

$$\Rightarrow \hat{U}_0 = \frac{20}{7} \doteq \boxed{2{,}857\ V}$$

$$\hat{I}_1 = I_1 \cdot \frac{\frac{1}{j\omega C}}{\frac{1}{j\omega C} + \frac{R_1(R_2+R_3)}{R_1+R_2+R_3}} \cdot \frac{R_1}{R_1+R_2+R_3} = \frac{10^{-2} e^{j\frac{\pi}{4}} \cdot \frac{1}{j\cdot 10^{3}\cdot 10^{-6}}}{\frac{1}{j\cdot 10^{3}\cdot 10^{-6}} + \frac{6\cdot 10^{3}}{7}} \cdot \frac{1}{7} =$$

$$\doteq 1{,}084 \cdot 10^{-3} e^{j0{,}0767} \Rightarrow \boxed{\hat{U}_1 \doteq 4{,}3386\, e^{j0{,}0767}\ V}$$

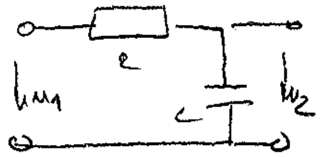
$$\hat{I}_3 = \frac{2\cdot 10^{-3} e^{-j\frac{\pi}{3}} \cdot \frac{1}{j\cdot 3\cdot 10^{3}\cdot 10^{-6}}}{\frac{1}{j\cdot 3\cdot 10^{3}\cdot 10^{-6}} + \frac{6\cdot 10^{3}}{7}} \cdot \frac{1}{7} =$$

$$\doteq 1{,}035 \cdot 10^{-4} e^{-j2{,}247} \Rightarrow \boxed{\hat{U}_3 \doteq 0{,}4142\, e^{-j2{,}247}\ V}$$

$$u_2(t) = 2{,}857 + 4{,}3386 \sin(10^{3}t + 0{,}0767) + 0{,}4142 \sin(3\cdot 10^{3}t - 2{,}247)\ V$$

$$U_{2EF} = \sqrt{U_0^2 + \frac{U_1^2}{2} + \frac{U_3^2}{2}} = \sqrt{2{,}857^2 + \frac{4{,}3386^2}{2} + \frac{0{,}4142^2}{2}} \doteq \boxed{4{,}202\ V}$$

2A1



$R = 10^3\,\Omega$
$C = 10^{-6}\,F$
$U_1 = 5V$

$$P = \frac{\frac{1}{pC}}{R + \frac{1}{pC}} = \frac{\frac{1}{pC}}{\frac{1+pCR}{pC}} = \frac{1}{1+pCR} = \frac{1}{CR}\cdot\frac{1}{p+\frac{1}{CR}} = 10^3\cdot\frac{1}{p+10^3}$$

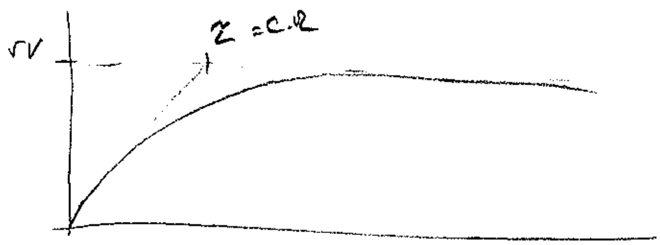
$$a(t) = \frac{P(p)}{p} = \frac{10^3}{p}\cdot\frac{1}{p+10^3};$$

$$A = \frac{10^3}{p+10^3}\bigg|_{p=0} = 1$$

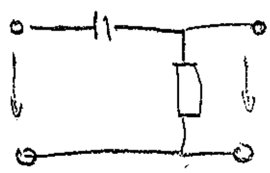
$$B = \frac{10^3}{p}\bigg|_{p=-10^3} = -1$$

$$a(t) = \left(\frac{1}{p} - \frac{1}{p+10^3}\right)\cdot U_1$$

$$a(t) = 5\cdot\left(1 - e^{-10^3 t}\right) = \boxed{5 - 5e^{-10^3 t}\ V}$$



2A2

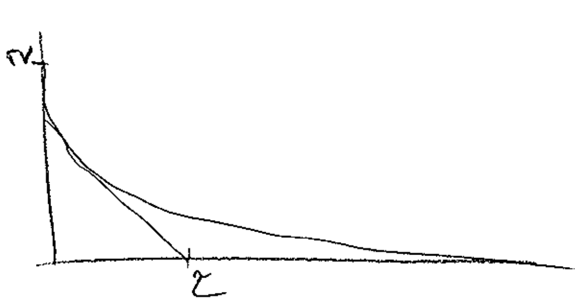


$R = 10^3\,\Omega$
$C = 10^{-6}\,F$
$U_0 = 5V$

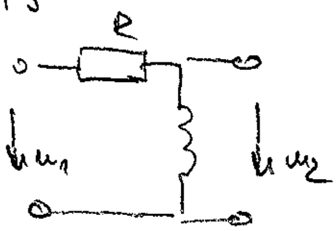
$$P = \frac{R}{\frac{1}{pC}+R} = \frac{pCR}{1+pCR} = 1\cdot\frac{p}{p+\frac{1}{\tau}}$$

$$\tau = CR = 10^{-3}$$

$$a(t) = \frac{U_0\cdot P(p)}{p} = \frac{\cancel{p}}{\cancel{p}\cdot\left(p+\frac{1}{\tau}\right)} = U_0\,\frac{1}{p+\frac{1}{\tau}} = 5\cdot e^{-\frac{t}{\tau}} = \boxed{5e^{-10^{-3}t}}\ V$$



2A3

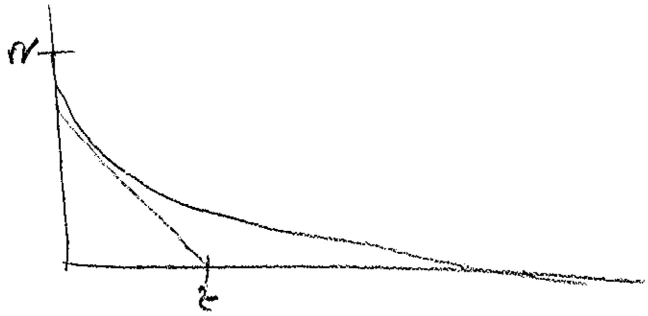


$R = 10^3\,\Omega$
$L = 1H$
$U_1 = 5V$

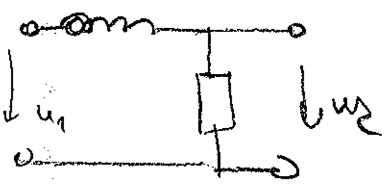
$$P = \frac{pL}{R+pL} = \frac{L}{L}\cdot\frac{p}{p+\frac{R}{L}} = \frac{p}{p+\lambda}$$

$$a(t) = \frac{P(p)}{p} = \frac{1}{p+\lambda} \doteq \frac{1}{p+10^3}$$

$$\boxed{a(t) = 5\cdot e^{-10^3 t}\ V}$$



2A4



$R = 10^3\,\Omega$
$L = 1H$
$U_1 = 5V$

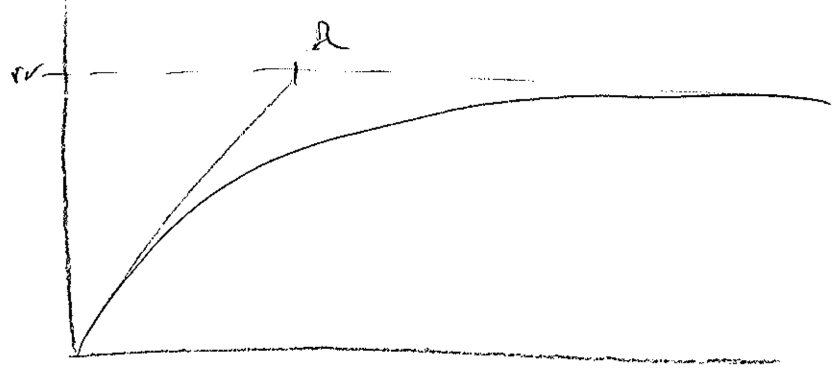
$$P = \frac{R}{pL+R} = \frac{R}{L}\cdot\frac{1}{p+\frac{R}{L}} = 10^3\cdot\frac{1}{p+10^3}$$

$$a(t) = \frac{10^3}{p}\cdot\frac{1}{p+10^3} = \frac{A}{p} + \frac{B}{p+10^3}\ ;\quad \boxed{A = \left.\frac{10^3}{p+10^3}\right|_{p=0} = 1}$$

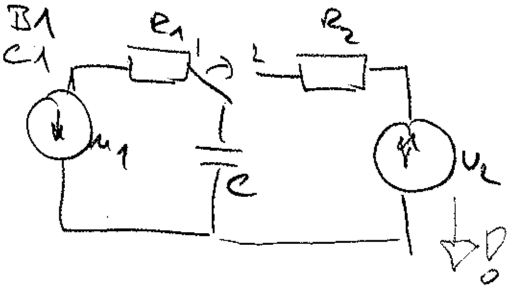
$$\boxed{B = \left.\frac{10^3}{p}\right|_{p=-10^3} = -1}$$

$$a(t) = U_1\left(\frac{1}{p} - \frac{1}{p+10^3}\right) V \doteq$$

$$= 5\cdot\left(1 - e^{-10^3 t}\right) = \boxed{5 - 5e^{-10^3 t}\ V}$$



2 B1
C1



$R_1 = 10^3 \Omega$
$R_2 = 2 \cdot 10^3 \Omega$
$C = 10^{-6} F$
$U_{01} = 5V$
$U_{02} = 10V$

$i = C \cdot \frac{du}{dt}$
$u(0-) = 5V$
$u(\infty) = -10V$

$$C \cdot \frac{du}{dt} + \frac{U_c - U_2}{R} = 0$$

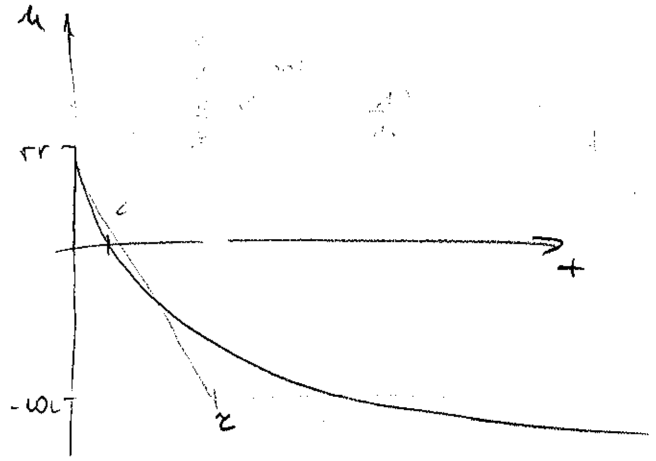
$$R \cdot C \cdot \frac{du}{dt} + u_c + U_{02} = 0 \Rightarrow$$

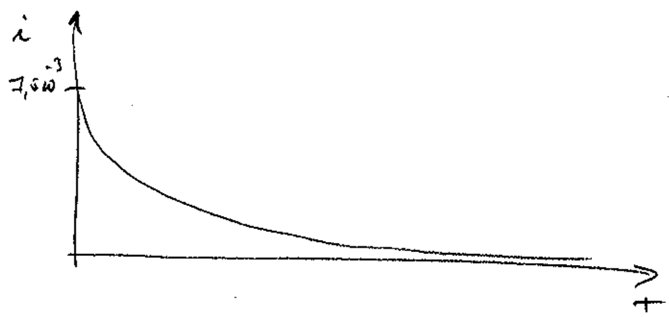
$$RC\lambda + 1 = 0 \Rightarrow \lambda = \frac{-1}{R_2 C} = -500$$

$$u(t) = k_1 \cdot e^{-500t} + u(\infty)$$
$$u(t) = k_1 \cdot e^{-500t} + (-10)$$

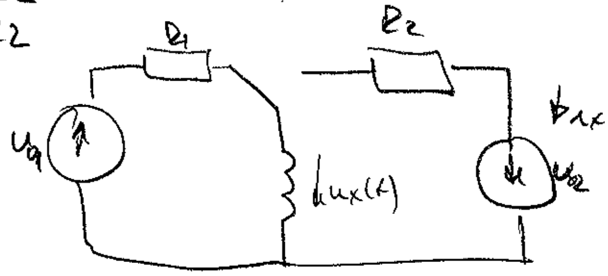
$$u(0): \quad 5 = k_1 - 10 \Rightarrow k_1 = 15$$

$$\boxed{u(t) = 15 \cdot e^{-500t} - 10 \ V} \Rightarrow i = C \cdot \frac{du}{dt} = 10^{-6} \cdot (-500) \cdot 15 \cdot e^{-500t} =$$
$$\boxed{= 7{,}5 \cdot 10^{-3} \cdot e^{-500t} \ A}$$





2B2
C2



$R_1 = 10^3\,\Omega$
$R_2 = 2\cdot 10^3\,\Omega$
$L = 1H$
$U_0 = 5V$
$U_{02} = 10V$

$u = L\cdot\frac{di}{dt}$

$$i(0-) = \frac{U_{01}}{R_1} = 0{,}005$$

$$i(\infty) = -\frac{U_{02}}{R_2} = \frac{-10}{2\cdot 10^3} = -0{,}005$$

$$L\cdot\frac{di}{dt} + R_2\cdot i + U_{02} = 0$$

$$\frac{L}{R_2}\cdot\frac{di}{dt} + \cancel{R_2}\cdot i = 0 \qquad \lambda = -\frac{R_2}{L} = -2000$$

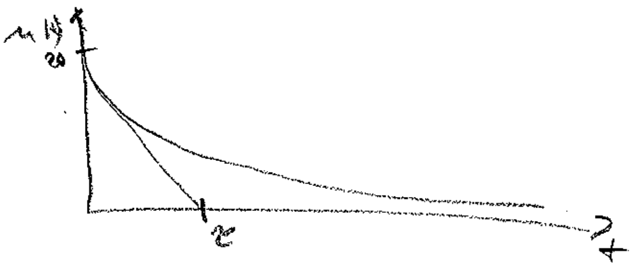
$$i(t) = k_1\cdot e^{-2000t} + (-0{,}005)$$

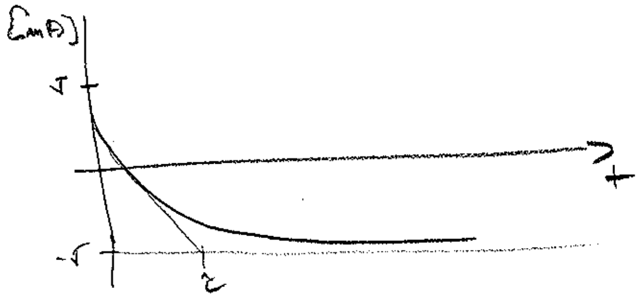
$$0{,}005 = k_1 - 0{,}005$$

$$k_1 = 0{,}01 \Rightarrow \boxed{i(t) = 0{,}01\cdot e^{-2000t} - 0{,}005}$$

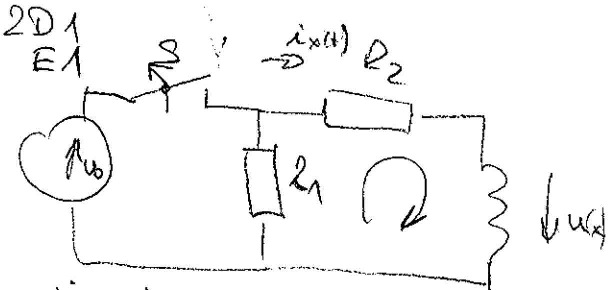
$$u = L\cdot\frac{di}{dt} \Rightarrow u(t) = 1\cdot(-2000)\cdot 0{,}01\cdot e^{-200t} =$$

$$\boxed{= +20\cdot e^{-2000t}\cdot(\text{obrácené})}$$





2D1
E1



$R_1 = 10^3\,\Omega$

$R_2 = 2.10^3\,\Omega$

$L = 1H$

$U_0 = 10V$

$u = L.\frac{di}{dt}$

$u = R.I \Rightarrow I = \frac{u}{R}$

$i(0-) = \frac{U_0}{R_2} = \frac{-10}{2.10^3} = -5.10^{-3}\,A$

$i(\infty) = 0\,A$

$L.\frac{di}{dt} + R_1.i + R_2 i = 0$

$\tau = \frac{L}{R_1+R_2} = \frac{1}{3.10^3} = 3.10^{-3}$

$L.\frac{di}{dt} + i.(R_1+R_2) = 0$

$\tau.\lambda + 1 = 0$

$\lambda = \frac{-1}{\tau} = -\frac{1}{3.10^{-3}} = -3.10^3$

$i(t) = e^{-\lambda t} + i(\infty)$

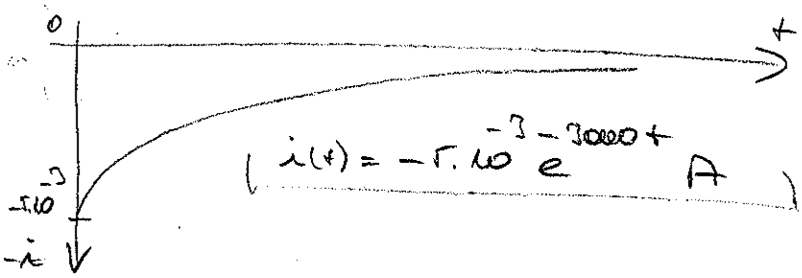
$i(t) = k_1 e^{-3000t} + 0$

$i(0) = -5.10^{-3} = k_1.1 \Rightarrow k_1 = -5.10^{-3}$

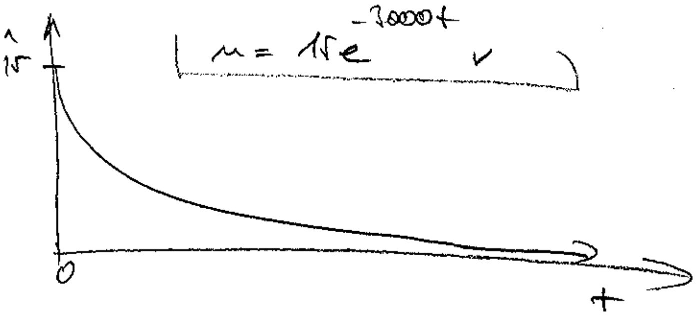
$\boxed{i(t) = -5.10^{-3}.e^{-3.10^3 t}\ A}$

$u = L.\frac{di}{dt} = 1.(+15).\ e^{-3.10^3 t}$

$= \boxed{+15.\ e^{-3000t}\ V}$

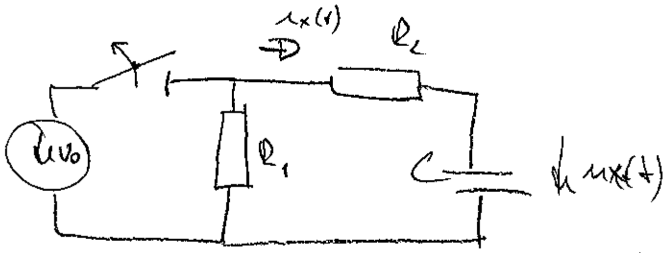


$i(t) = -5.10^{-3} e^{-3000t}\ A$



$u = 15 e^{-3000t}\ V$

2D2
E2



$R_1 = 10^3\ \Omega$
$R_2 = 2 \cdot 10^3\ \Omega$
$C = 10^{-6}\ F$
$U_0 = 10\ V$

$u(0-) = 10V$
$u(\infty) = 0V$

$$C \cdot \frac{du}{dt} + \frac{u_c}{R_1} + \frac{U_c - U_0}{R_2} = 0$$

$$C \cdot \frac{du}{dt} + \frac{u_c}{R_1} + \frac{u_c}{R_2} - \frac{U_0}{R_2} = 0$$

? až po ustálení

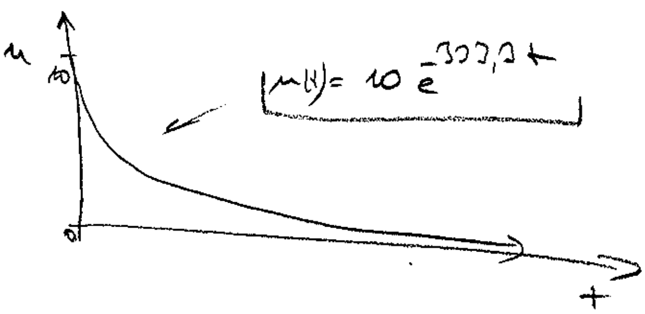
$$C \cdot \lambda + \frac{1}{R_1} + \frac{1}{R_2} = 0 \Rightarrow \lambda = \frac{-1}{(R_1 + R_2)} \cdot \frac{1}{C} \doteq -333{,}\overline{3}$$

$u_x(t) = k_1 \cdot e^{-333{,}3t}$; $k_1 = 10$

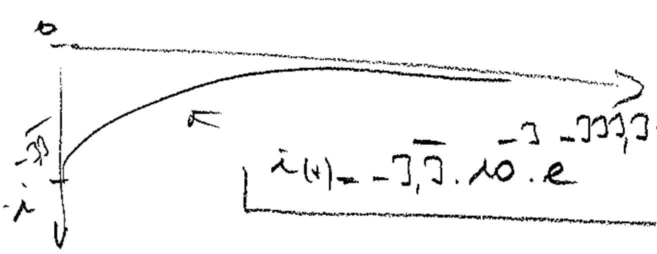
$$\boxed{u_x(t) = 10\, e^{-333{,}3t}\ V}$$

$$i_x(t) = C \cdot \frac{du}{dt} = 10^{-6} \cdot (-333{,}3) \cdot e^{-333{,}3t}\ A$$

$$= \boxed{-3{,}\overline{3} \cdot 10^{-3} \cdot e^{-333{,}3t}\ A}$$



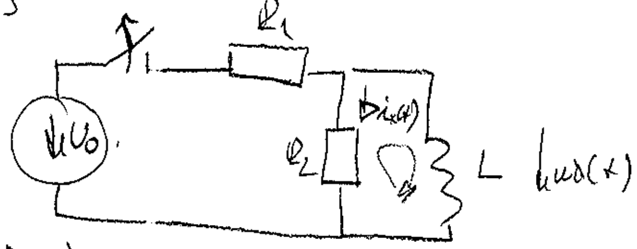
$\boxed{u(t) = 10\, e^{-333{,}3t}}$



$\boxed{i(t) = -3{,}\overline{3} \cdot 10^{-3} \cdot e^{-333{,}3t}\ A}$

i

2D3
E3



$R_1 = 10^3 \Omega$
$R_2 = 2.10^3 \Omega$
$L = 1H$
$U_0 = 10V$

$U = R.I$

$i(0) = \frac{U_0}{R_1} = \frac{10}{10^3} = 0{,}01A$

$i(\infty) = 0A$

$R_2 i(0) = -\frac{U_0 \cdot R_2}{R_1 + R_2} = -10.$

$L\frac{di}{dt} + R_2 i = 0$

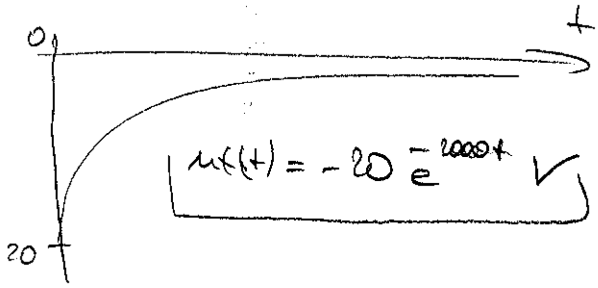
$\frac{L}{R_2}\lambda + 1 = 0 \longrightarrow \lambda = -\frac{R_2}{L} = -2000$

$i_x(t) = k_1 \cdot e^{-2000t}$

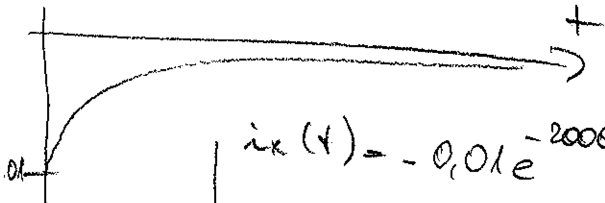
$0{,}01 = k_1$

$\boxed{i_x(t) = -0{,}01 e^{-2000t} \, A} \; ?$

$u = L \cdot \frac{di}{dt} = 1 \cdot (-20) \cdot e^{-200t} = \boxed{-20 \cdot e^{-2000t} \, V}$

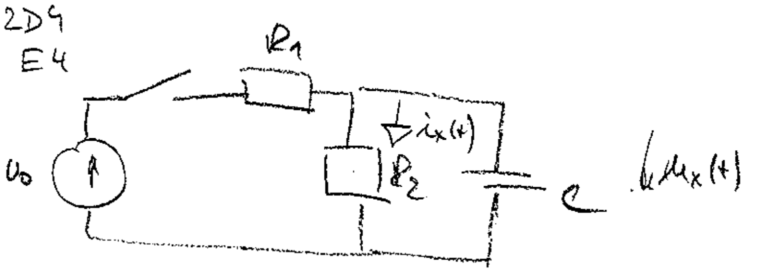


$\boxed{u_L(t) = -20 e^{-2000t} \, V}$



$\boxed{i_x(t) = -0{,}01 e^{-2000t} \, A}$

2D4
E4



$R_1 = 10^3\,\Omega$

$R_2 = 2\cdot 10^3\,\Omega$

$C = 10^{-6}\,F$

$U_0 = 10V$

$i = C\cdot\frac{du}{dt}$

$u(0^-) = -U_0 \cdot \frac{R_2}{R_1+R_2} = \frac{10\cdot 2\cdot 10^3}{3\cdot 10^3} = -\frac{20}{3} = -6,67V$

$u(\infty) = 0$

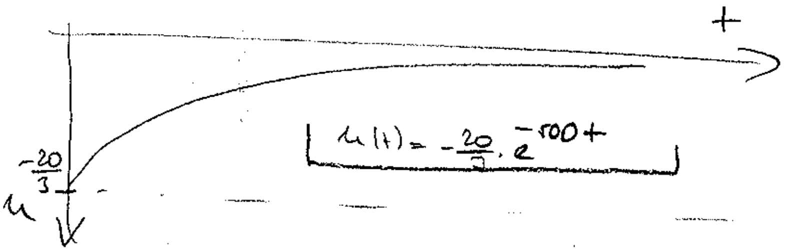
$$C\cdot\frac{du}{dt} + \frac{u_c}{R_2} = 0$$

$$R_2C\cdot\lambda + 1 = 0 \Rightarrow \lambda = -\frac{1}{R_2C} = -\frac{1}{2\cdot 10^{-3}} = -500$$

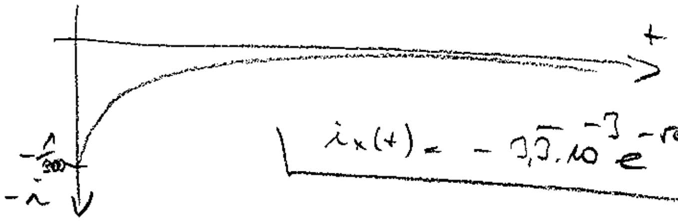
$u_x(t) = k_1\cdot e^{-500t} + 0$

$-6,67 = k_1 \Rightarrow \boxed{u_x(t) = -\frac{20}{3}e^{-500t}\,V}$

$-i_x(t) = C\cdot\frac{du}{dt} = 10^{-6}\cdot -\frac{500\cdot 20}{3}\cdot e^{-500t} = \boxed{-3,\bar{3}\cdot 10^{-3}\cdot e^{-500t}\,A}$

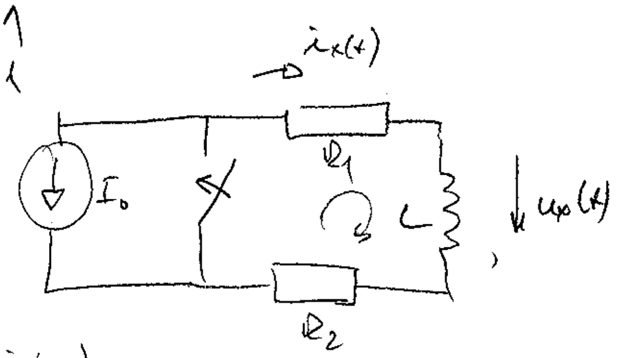


$\boxed{u(t) = -\frac{20}{3}\cdot e^{-500t}}$



$\boxed{i_x(t) = -3,\bar{3}\cdot 10^{-3}e^{-500t}\,A}$

2F1
G1



$R_1 = 10^3 \Omega$
$R_2 = 2 \cdot 10^3 \Omega$
$L = 1H$
$I_0 = 0{,}01 A$

$i(0_-) = -0{,}01 A$

$i(\infty) = 0$

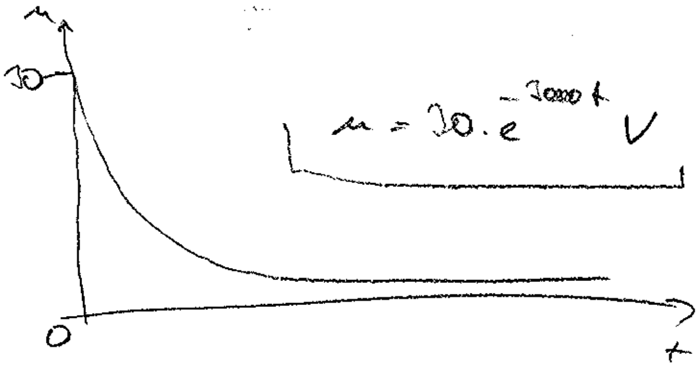
$$L \cdot \frac{di}{dt} + R_1 i + R_2 i = 0$$

$$\frac{L}{R_1+R_2} \cdot \lambda + 1 = 0 \Rightarrow \lambda = -\frac{R_1+R_2}{L} = -3000$$

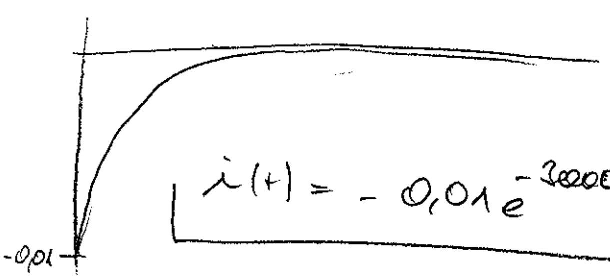
$$i_x(t) = k_1 \cdot e^{-3000t} + 0$$

$t(0)$ $-0{,}01 = k_1 \cdot 1 \Rightarrow \boxed{i_x(t) = -0{,}01 \cdot e^{-3000t} A}$

$$\boxed{u = L \cdot \frac{di}{dt} = 30 \cdot e^{-3000t} A}$$

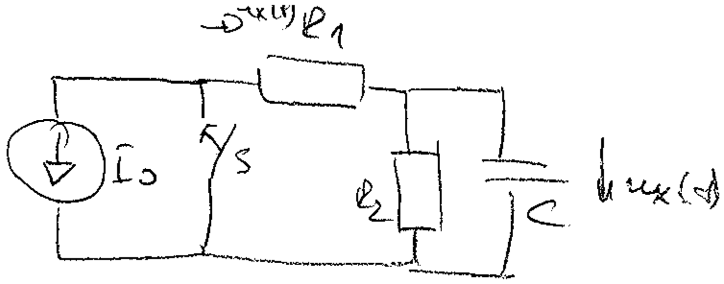


$$\boxed{u = 30 \cdot e^{-3000t} V}$$



$$\boxed{i(t) = -0{,}01 e^{-3000t} A}$$

2FL
G2



$R_1 = 10^3\,\Omega$
$R_2 = 2\cdot 10^3\,\Omega$
$C = 10^{-6}\,F$
$I_0 = 0{,}01\,mA$

$u_c(0) = -I_0 \cdot R_2 = -20\,V$

$u(\infty) = 0$

$R_i = \frac{R_2 \cdot R_1}{R_2 + R_1} = 666{,}\bar{6}\,\Omega$!

NAHRAZENI!

$C \cdot \frac{du_c}{dt} + \frac{u_c}{R_2} = 0$

$CR_2 \cdot \lambda + 1 = 0 \Rightarrow \lambda = \frac{-1}{CR_i} = -1500$

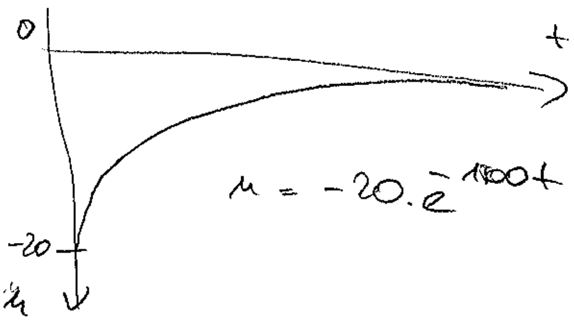
$u_x(t) = k_1 \cdot e^{-1500t} + 0$

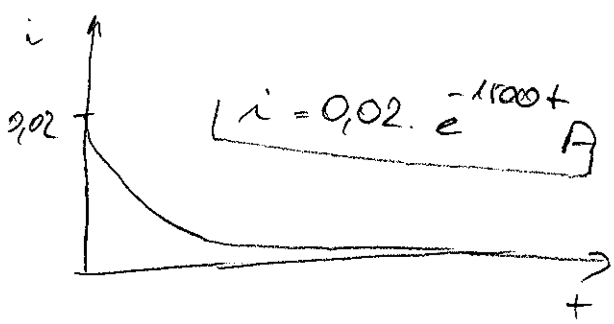
$-20 = k_1$

$u_x(t) = -20 \cdot e^{-1500t}\,V$

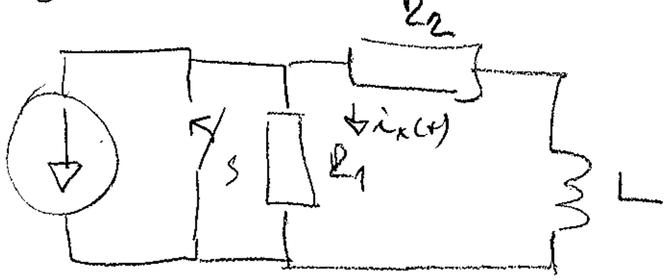
$i = C \cdot \frac{du}{dt} = 10^{-6} \cdot (-20) e^{-1500t} = 0{,}03 \cdot e^{-1500t}\,A$?

počítáno $I_0 = 0{,}01\,A \Rightarrow i_x(t) = \boxed{0{,}02 \cdot e^{-1500t}\,A}$





263



$R_1 = 10^3\,\Omega$

$R_2 = 2 \cdot 10^3\,\Omega$

$L = 1\,H$

$I_0 = 10\,mA$

NAHRAZENÍ

$$R_i = \frac{R_1 \cdot R_2}{R_1 + R_2} = 666{,}67\,\Omega$$

$i(0) =$

$i(\infty) = 0$

$$L \cdot \frac{di}{dt} + R_2 i = 0$$

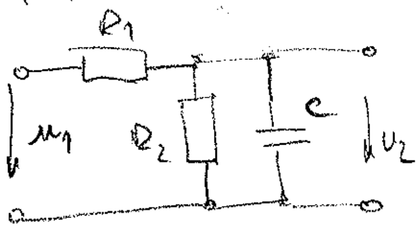
$$\frac{L}{R_2} \cdot \lambda + 1 = 0 \quad \Rightarrow \quad \lambda = -\frac{R_2}{L} = -2000$$

$$i_x(t) = k_1 \cdot e^{-2000t}$$

$$i_x(t) = -0{,}01 \cdot e^{-2000t}$$

$$u = L \cdot \frac{di}{dt} = 20\,e^{-2000t}$$

4A1A



$R_1 = 10^3\,\Omega$

$R_2 = 4\cdot 10^3\,\Omega$

$C = 10^{-6}\,F$

$P = \frac{U_2}{U_1}$

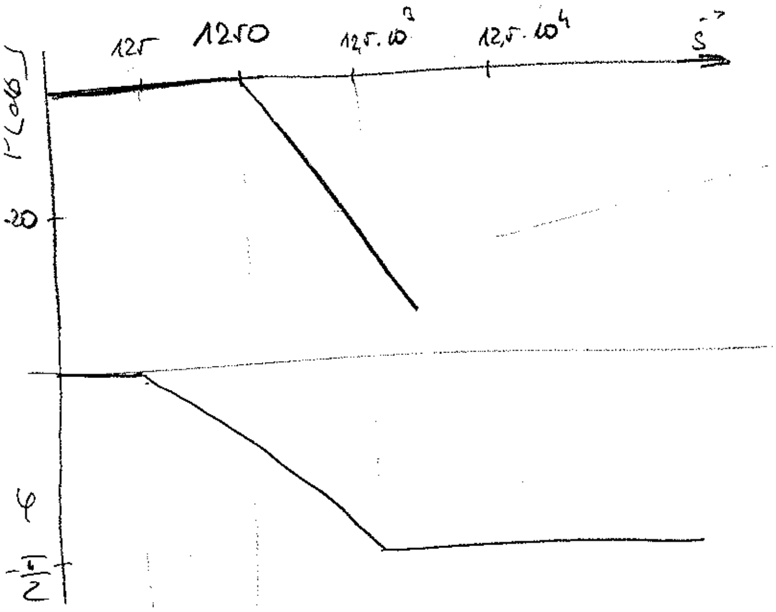
$$u_2 = \frac{R_2 \cdot \frac{1}{j\omega C}}{R_2 + \frac{1}{j\omega C}} = \frac{\frac{R_2}{j\omega C}}{\frac{j\omega C R_2 + 1}{j\omega C}} = \boxed{\frac{R_2}{j\omega C R_2 + 1}} =$$

$$u_1 = R_1 + \frac{R_2}{j\omega C R_2 + 1} = \frac{j\omega C R_1 R_2 + R_1 + R_2}{j\omega C R_2 R + 1}$$

$$P = \frac{U_2}{u_1} = \frac{\frac{R_2}{j\omega C R_2 + 1}}{\frac{j\omega C R_1 R_2 + R_1 + R_2}{j\omega C R_2 + 1}} = \frac{R_2}{j\omega C R_1 R_2 + R_1 + R_2}$$

$$= \frac{R_2}{C R_1 R_2} \cdot \frac{1}{j\omega + \frac{R_1 + R_2}{C R_1 R_2}} = \boxed{\frac{1000}{p + 1250}} \Rightarrow k\omega = 1000$$

$$\boxed{k = \frac{4}{5} = 0{,}8}$$



$P = \frac{1}{\frac{\omega}{\omega_0}} = \frac{\omega_0}{\omega} \Rightarrow$ klesá

4A1 B

Přechodová charakteristika

$$a(t)\quad \frac{F_u(p)}{p} = \frac{0,8}{p}\cdot\frac{1000}{p+1250} = \frac{A}{p} + \frac{B}{p+1250}$$

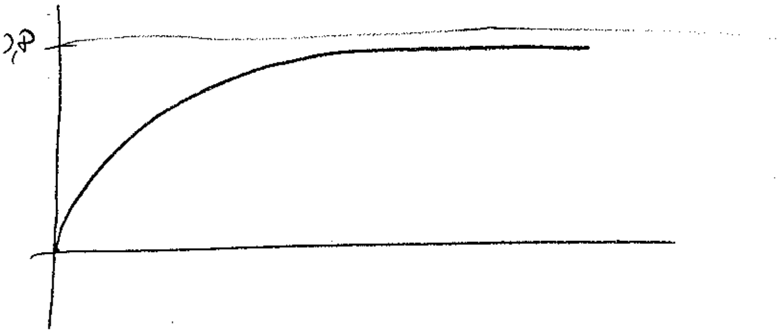
$$1000 = Ap + A1250 + Bp \quad ; \quad A+B=0$$

$$1250A = 1000$$

$$A = \frac{4}{5} = 0,8$$

$$B = -0,8$$

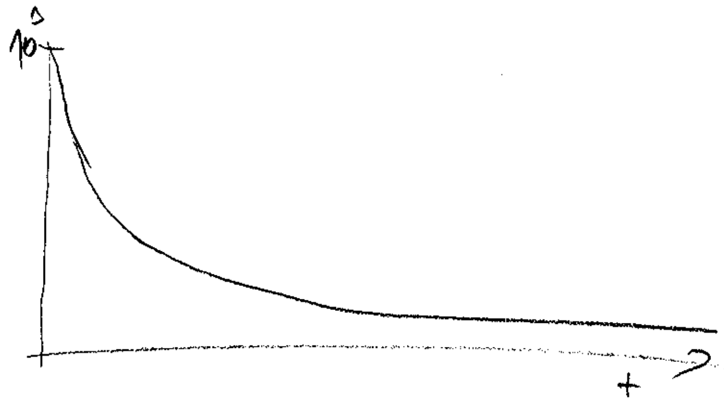
$$\frac{1000}{p\cdot(p+1250)} = \frac{0,8}{p} - \frac{0,8}{p+1250} \Rightarrow \boxed{0,8 - 0,8e^{-1250t}}$$



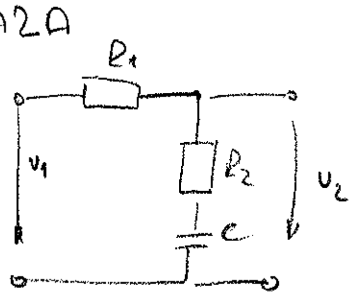
4A1C

Impulsní charakteristika

$$w(t)\quad \frac{1000}{p+1250} \Rightarrow 1000e^{-1250t}$$



4A2A



$R_1 = 4\cdot 10^3\,\Omega$

$R_2 = 1\cdot 10^3\,\Omega$

$C = 10^{-6}\ F$

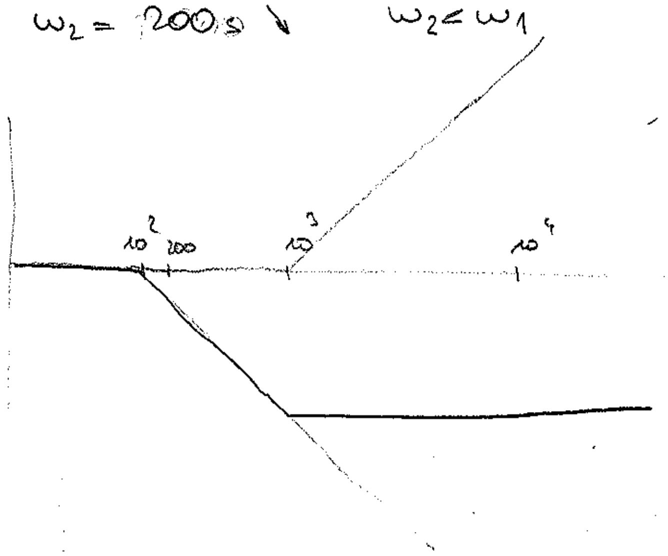
$$U_2 = R_2 + \frac{1}{j\omega C} = \frac{j\omega C R_2 + 1}{j\omega C}$$

$$U_1 = \frac{j\omega C\cdot(R_1+R_2) + 1}{j\omega C}$$

$$P = \frac{U_2}{U_1} = \frac{j\omega C R_2 + 1}{j\omega C(R_1+R_2)+1} = \frac{CR_2}{C\cdot(R_1+R_2)}\cdot\frac{p + \frac{1}{CR_2}}{p + \frac{1}{C\cdot(R_1+R_2)}} = \frac{1}{5}\cdot\frac{p+1000}{p+200}$$

$\omega_1 = 1000\ s^{-1}$ ↗

$\omega_2 = 200\ s^{-1}$ ↘ $\quad \omega_2 < \omega_1$



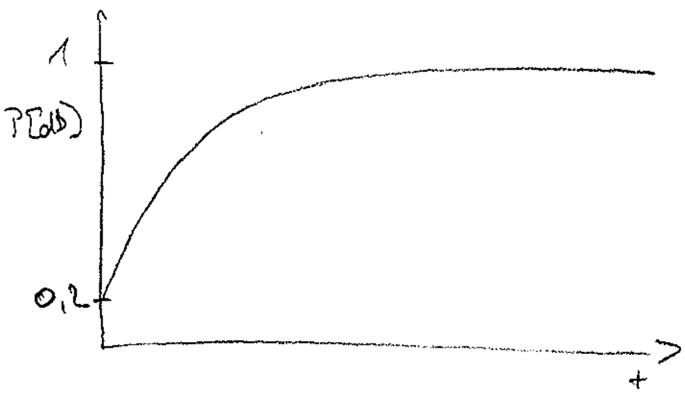
$$a(t) = \frac{P(p)}{p} = \frac{0{,}2}{p}\cdot\frac{p+1000}{p+200} = \frac{A}{p} + \frac{B}{p+200} = \frac{1}{p} - \frac{0{,}8}{p+200} \Rightarrow$$

$$0{,}2p + 200 = Ap + 200A + Bp$$

$0{,}2 = A + B \Rightarrow B = -0{,}8$

$200 = 200A \Rightarrow A = 1$

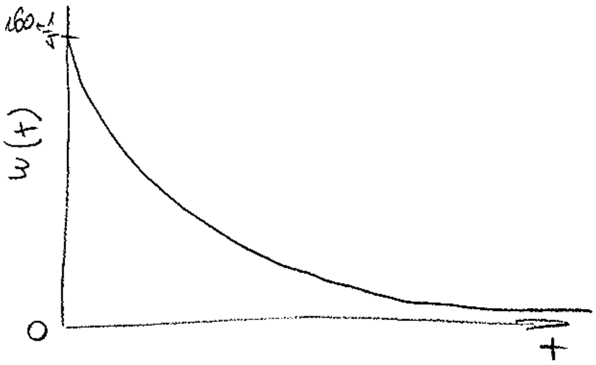
$\Rightarrow 1 - 0{,}8e^{-200t}$



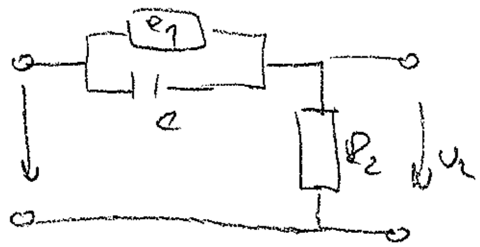
4A2B

$$P = \frac{1}{5} \cdot \frac{p+1000}{p+200} = \frac{1}{5} \cdot \left(\frac{p+200+800}{p+200} \right) = \frac{1}{5} \cdot \left(1 + \frac{800}{p+200} \right)$$

$$= \frac{1}{5} + 160\, e^{-200t} = w(t)$$



4A 4A



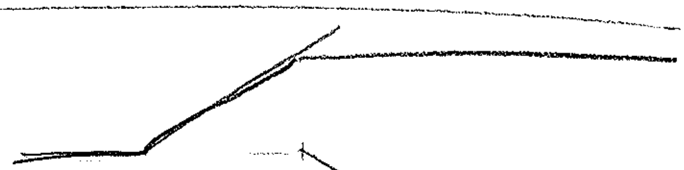
$U_2 = R_2$

$$U_1 = \frac{R_1 \cdot \frac{1}{j\omega C}}{R_1 + \frac{1}{j\omega C}} + R_2 = \frac{\frac{R_1}{j\omega C}}{\frac{j\omega C R_1}{j\omega C}} + R_2 =$$

$$= \frac{R_1 + j\omega C R_1 R_2}{j\omega C R_1} = \frac{j\omega C R_1 R_2 + R_1}{j\omega C R_1}$$

$$P = \frac{U_2}{U_1} = \frac{R_2 \cdot j\omega C R_1}{j\omega C R_1 R_2 + R_1} = \frac{j\omega C R_1 R_2}{j\omega C R_1 R_2 + R_1} = \frac{C R_1 R_2}{C R_1 R_2} \cdot \frac{p}{p + \frac{R_1}{C R_1 R_2}} =$$

$$= \frac{p}{p + \frac{1}{C R_2}} = \frac{p}{p + 1000} \qquad \frac{R_2}{R_1 + R_2} \cdot \frac{1 + j\frac{\omega}{\omega_0}}{1 + j\frac{\omega}{\omega_1}}$$



$$P = \frac{R_2}{R_2 + \frac{R_1 / pC_1}{R_1 + pC_1}} = \frac{R_2}{R_2 + \frac{\frac{R_1}{\cancel{pC_1}}}{\frac{pC_1R_1 + 1}{\cancel{pC_1}}}} =$$

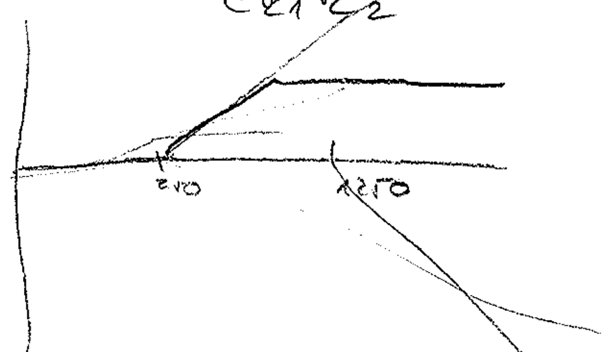
$$= \frac{R_2}{R_2 + \frac{R_1}{pC_1R_1 + 1}} = \frac{R_2 \cdot (pC_1R_1 + 1)}{pC_1R_1R_2 + R_2 + R_1} =$$

$$= \frac{pC_1R_1R_2 + R_2}{pC_1R_1R_2 + R_2 + R_1} = \frac{CR_1R_2}{CR_1R_2} \cdot \frac{p + \frac{1}{C_1R_1}}{p + \frac{R_2 + R_1}{CR_1R_2}} =$$

$$= \frac{p + 250}{p + 1250} \Rightarrow k = 1$$

$\omega_1 = 250$

$\omega_2 = 1250$



4AT

$$P = \frac{\frac{\frac{R_1}{pC_2}}{R_1+\frac{1}{pC_2}}}{\frac{1}{pC_1}+\frac{\frac{R_1}{pC_2}}{R_1+\frac{1}{pC_2}}} = \frac{\frac{R_1}{pC_2R_1+1}}{\frac{1}{pC_1}+\frac{R_1}{pC_2R_1+1}} = \frac{\frac{R_1}{\cancel{pC_2R_1+1}}}{\frac{pC_2R_1+1+pC_1R_1}{pC_1\cdot\cancel{(pC_2R_1+1)}}} =$$

$$\frac{pC_1R_1}{p\cdot(R_1(C_1+C_2))+1} = \frac{C_1\cancel{R_1}}{\cancel{R_1}\cdot(C_1+C_2)}\cdot\frac{p}{p+\frac{1}{R_1\cdot(C_1+C_2)}} = \underbrace{\frac{4}{5}\cdot\frac{p}{p+200}}$$

$$k = 20\log(0{,}8) \doteq -2$$

$$w(t) = 0{,}8\left(\frac{p+200-200}{p+200}\right) = 0{,}8\cdot\left(1-\frac{200}{p+200}\right) = \underbrace{0{,}8-160e^{-200t}}$$

$$a(t) = \frac{0{,}8}{p}\cdot\frac{p}{p+200} = \frac{4}{5}\cdot\frac{1}{p+200} = \underbrace{0{,}8\cdot e^{-200t}}$$

$$A = \left.\frac{0{,}8p}{p+200}\right|_{p=0} = 0$$

$$B = \left.\frac{0{,}8p}{p}\right|_{p=-200} = \frac{-160}{-200} = \frac{4}{5}$$

1A6

$$P = \frac{\frac{1}{pC_2}+R_1}{\frac{1}{pC_1}+\frac{1}{pC_2}+R_1} = \frac{\frac{pC_2R_1+1}{\cancel{pC_2}}}{\frac{pC_2+pC_1+pC_1pC_2R_1}{pC_1\cdot\cancel{pC_2}}} = \frac{pC_1\cdot pC_2R_1+pC_1}{pC_1\cdot pC_2R_1+pC_2+pC_1} = \frac{\cancel{p}\cdot(pC_1\cdot C_2\cdot R_1+C_1)}{\cancel{p}\cdot(pC_1C_2R_1+C_2+C_1)}$$

$$= \frac{C_1\cdot C_2\cdot R_1}{C_1\cdot C_2\cdot R_1}\cdot\frac{p+\frac{1}{C_2R_1}}{p+\frac{C_2+C_1}{C_1C_2R_1}} = \underbrace{1\cdot\frac{p+250}{p+1250}}$$

$$w(t) = 1-\frac{1000}{p+1250} = \underbrace{1-1000\cdot e^{-1250t}}$$

$$a(t) = \frac{p+250}{p(p+1250)} = \underbrace{0{,}2-0{,}8e^{-1250t}}$$

$$A = \left.\frac{p+250}{p+1250}\right|_{p=0} = \frac{1}{5}$$

$$B = \left.\frac{p+250}{p}\right|_{p=-1250} = \frac{4}{5}$$

4B7

$$P = \frac{pL_2}{p(L_1+L_2) + R_1} = \frac{L_2}{L_1+L_2} \cdot \frac{p}{p + \frac{R_1}{L_1+L_2}} = \underbrace{\frac{4}{5} \cdot \frac{p}{p + 200}}$$

$$k = 20 \cdot \log(0{,}8) \doteq -2$$

$$w(t) = 0{,}8 \cdot \left(1 - \frac{200}{p+200}\right) = \underbrace{0{,}8 - 160 \cdot e^{-200\,t}}$$

4B8

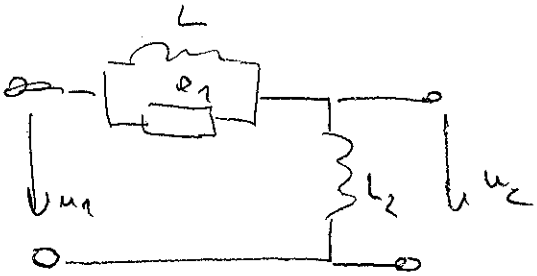
$$P = \frac{pL_2}{pL_2 + \frac{R_1 \cdot pL_1}{R_1 + pL_1}} = \frac{pL_1 \cdot pL_2 + pL_2 \cdot R_1}{pL_1 \cdot R_1 + pL_1pL_2 + pL_2R_1} = \frac{\cancel{p} \cdot (pL_1 \cdot L_2 + R_1 \cdot L_2)}{\cancel{p} \left(pL_1 \cdot L_2 + R_1 \cdot (L_1+L_2)\right)} =$$

$$= \frac{L_1 \cdot L_2}{L_1 \cdot L_2} \cdot \frac{p + \frac{R_1}{L_1}}{p + \frac{R_1 \cdot (L_1+L_2)}{L_1 \cdot L_2}} = \underbrace{1 \cdot \frac{p + 250}{p + 1250}}$$

$$w(t) \doteq 1 - 1000\, e^{-1250\,t}$$

$$a(t) = 0{,}2 + 0{,}8\, e^{-1250\,t}$$

4AP

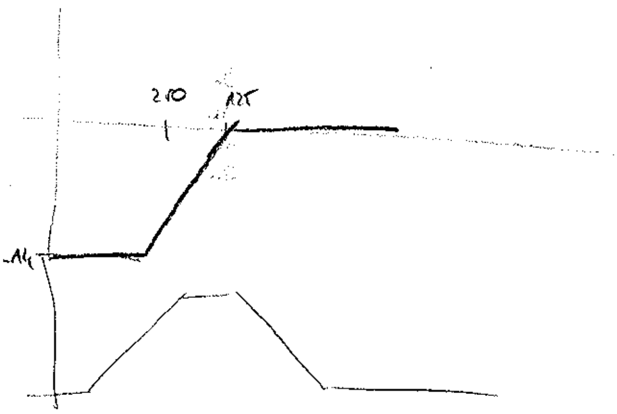


$$P = \frac{pL_2}{pL_2 + \frac{pL_1 \cdot R_1}{pL_1 + R_1}} = \frac{pL_2}{\frac{pL_2 \cdot (pL_1 + R_1) + pL_1R_1}{(pL_1 + R_1)}} = \frac{\cancel{p}(pL_1 + R_1) \cdot L_2}{\cancel{p} \cdot (L_2 \cdot (pL_1 + R_1) + L_1 \cdot R_1)} =$$

$$= \frac{pL_1L_2 + R_1 \cdot L_2}{pL_1 \cdot L_2 + R_1 \cdot L_2 + L_1R_1} = \frac{\cancel{L_1 \cdot L_2}}{\cancel{L_1 \cdot L_2}} \cdot \frac{p + \frac{R_1 \cdot \cancel{L_2}}{L_1 \cdot}}{p + \frac{R_1 \cdot (L_1 + L_2)}{L_1 \cdot L_2}} =$$

$$\boxed{\frac{p + 250}{p + 1250}}$$

$$20 \log\left(\frac{250}{1250}\right) = -14$$



$$w(t) = \frac{p + 1250 - 1000}{p + 1250} = \boxed{1 - 1000e^{-1250t}}$$

$$a(t) = \frac{p + 250}{p \cdot (p + 1250)} = \frac{A}{p} + \frac{B}{p + 1250}; \quad A = \frac{p + 250}{p + 1250}\Big|_{p=0} = \frac{250}{1250} = \frac{1}{5}$$

$$B = \frac{p + 250}{p}\Big|_{p=-1250} = \frac{-4}{5}$$

$$a(t) = \boxed{0{,}2p - 0{,}8 \cdot e^{-1250t} \, V}$$

$\rightarrow$ graf

4A8

$$P = \frac{\frac{1}{pC_2}}{\frac{1}{pC_2} + \frac{\frac{R_1}{pC_1}}{R_1 + \frac{1}{pC_1}}} = \frac{\frac{1}{pC_2}}{\frac{1}{pC_2} + \frac{R_1}{pC_1R_1+1}} = \frac{\frac{1}{\cancel{pC_2}}}{\frac{pC_1R_1+1+pC_2R_1}{(pC_1R_1+1)\cancel{pC_2}}} = \frac{pC_1R_1+1}{p\cdot(R_1\cdot(C_1+C_2))+1} =$$

$$= \frac{C_1\cdot\cancel{R_1}}{\cancel{R_1}\cdot(C_1+C_2)} \cdot \frac{p+\frac{1}{C_1\cdot R_1}}{p+\frac{1}{R_1\cdot(C_1+C_2)}} = \frac{1}{5}\cdot\frac{p+1000}{p+200}$$

$$\underbrace{k = 20\cdot\log(0{,}2) \doteq -14}$$

$$w(t) = 0{,}2\cdot\left(1+\frac{800}{p+200}\right) = \underbrace{0{,}2 + 160e^{-200t}}$$

$$a(t) = \frac{0{,}2p+200}{p\cdot(p+200)} = \frac{1}{p} - \frac{0{,}8}{p+200} =$$

$$= \underbrace{1 - 0{,}8e^{-200t}}$$

$$A = \frac{0{,}2p+200}{p+200}\bigg|_{p=0} = 1$$

$$B = \frac{0{,}2p+200}{p}\bigg|_{p=-200} = \frac{160}{-200} = -\frac{4}{5}$$

4B2

$$P = \frac{pL_1+R_2}{pL_1+R_1+R_2} = \frac{L_1}{L_1}\cdot\frac{p+\frac{R_2}{L_1}}{p+\frac{R_1+R_2}{L_1}} = 1\cdot\underbrace{\frac{p+1250}{p+1250}} \quad ?$$

$$w(t) = 1 - \frac{1000}{p+1250} = \underbrace{1 - 1000e^{-1250t}}$$

$$a(t) = \frac{p+250}{p\cdot(p+1250)} = \underbrace{0{,}2 + 0{,}8e^{-1250t}}$$

$$A = \frac{p+250}{p+1250}\bigg|_{p=0} = \frac{1}{5}$$

$$B = \frac{p+250}{p}\bigg|_{p=-1250} = \frac{-1000}{-1250} = \frac{4}{5}$$

5.1

$L = 0{,}5 \cdot 10^{-6}\ H \cdot m^{-1}$

$C = 50 \cdot 10^{-12}\ F \cdot m^{-1}$

$t_0 = 0{,}05 \cdot 10^{-6}\ s$

$U_a = \frac{U_0}{2}$?

$$s = v \cdot t \Rightarrow s = \frac{1}{\sqrt{L \cdot C}} \cdot t = \frac{1}{\sqrt{0{,}5 \cdot 10^{-6} \cdot 50 \cdot 10^{-12}}} \cdot 0{,}05 \cdot 10^{-6} =$$

$$= 10\,m \quad (\text{pro } U_a = U_0)? \Rightarrow$$

$$\boxed{s = 5\,m} \quad \left(\text{pro } U_a = \frac{U_0}{2}\right)$$

5.2

$R_s = R_0$

$L = -\text{"}-$

$C = \text{"}-$

$$R_0 = \sqrt{\frac{L}{C}} = \sqrt{\frac{0{,}5 \cdot 10^{-6}}{50 \cdot 10^{-12}}} = \boxed{100\ \Omega}$$

5.3

$L; C; = -\text{"}-$

$U_i = 10V$

$l = 100\,m$

$t_0 = 0{,}01 \cdot 10^{-6}\,s$

$R_s = 0 \rightarrow \left[\begin{array}{l} U_{konec} = U_{start} \\ I_{konec} = 0 \end{array}\right]$

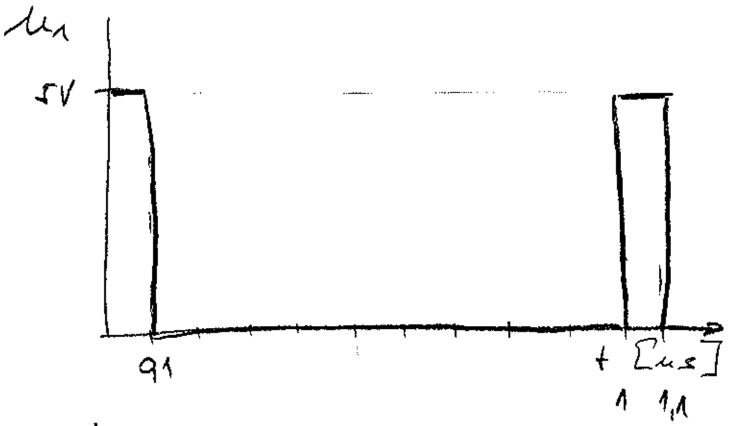
$R_i \neq R_0$

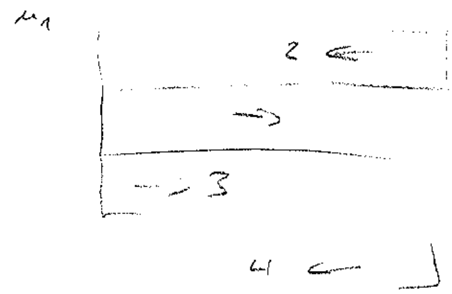
$\Rightarrow \rho = 1$

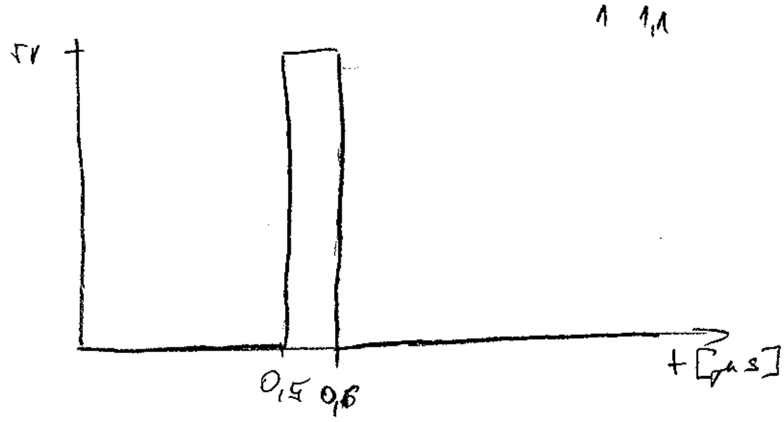
$$U_p = U_i \cdot \frac{R_0}{R_i + R_0} = U_i \cdot \frac{R_0}{2R_0} = \frac{U_i}{2} = 5V$$

$$s = v \cdot t \rightarrow t_c = \frac{l}{v} = l \cdot \sqrt{L \cdot C} = 0{,}5 \cdot 10^{-6}\,s$$

(doba limitu než doletí na konec)







5.4

$L = 0{,}5 \cdot 10^{-6}\ H m^{-1}$

$C = 50 \cdot 10^{-12}\ F m^{-1}$

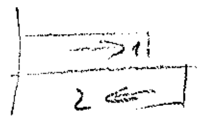
$U_i = 10V$

$l = 100m$

$t = 0{,}1 \cdot 10^{-6} s$

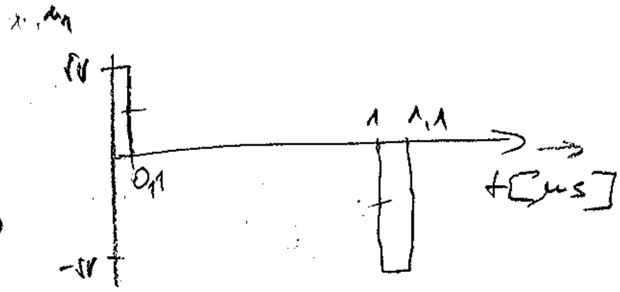
$R_i = R_0$

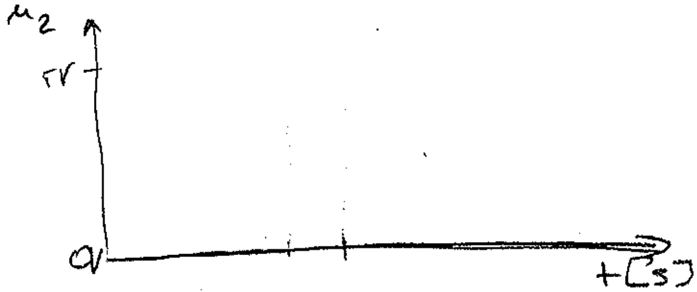
$R_s = \infty \Rightarrow \varrho = -1 = u_2 = 0$



$U_p = U_i \cdot \frac{R_0}{2R_0} = 5V$

$t_c = \frac{l}{v} = l\sqrt{LC} = \underbrace{0{,}5 \cdot 10^{-6} s}$





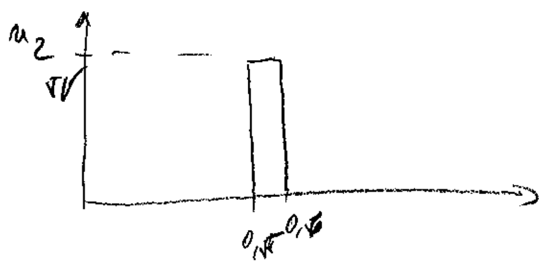
5.5

$L, C, U_1, R_i, t = — " —$

$R_s = R_0 \Rightarrow \varrho_u = 0$

$\boxed{U_p = 5V}$

$\boxed{t_c = 0{,}5 \cdot 10^{-6} s}$



5.6

LC; U_i, R_i, t_0 = — u —

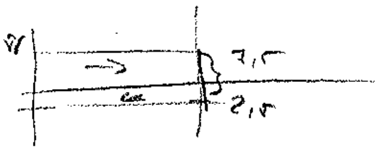
$R_S = 3R_0$

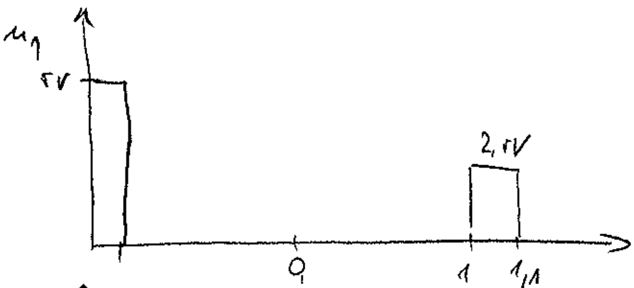
$R_i = R_0$

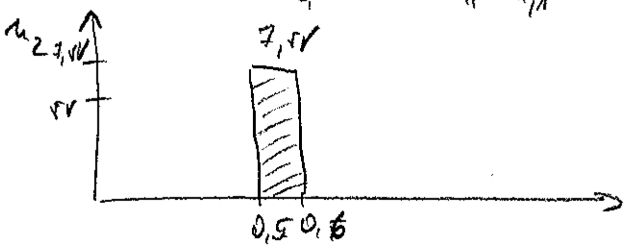
$$U_p = U_i \cdot \frac{R_0}{R_i + R_0} = 5V$$

$$U_2 = u_p \cdot \rho = U_p \cdot \frac{R_S - R_0}{R_S + R_0} = 5 \cdot \frac{(3-1) \cdot R_0}{(3+1) \cdot R_0} = \boxed{2,5V}$$

$t = 0,5 \cdot 10^{-6}$ s







5.7.

— u —

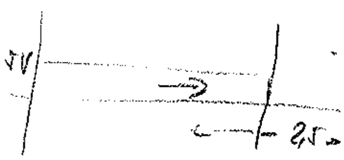
$R_S = \frac{1}{3} R_0$

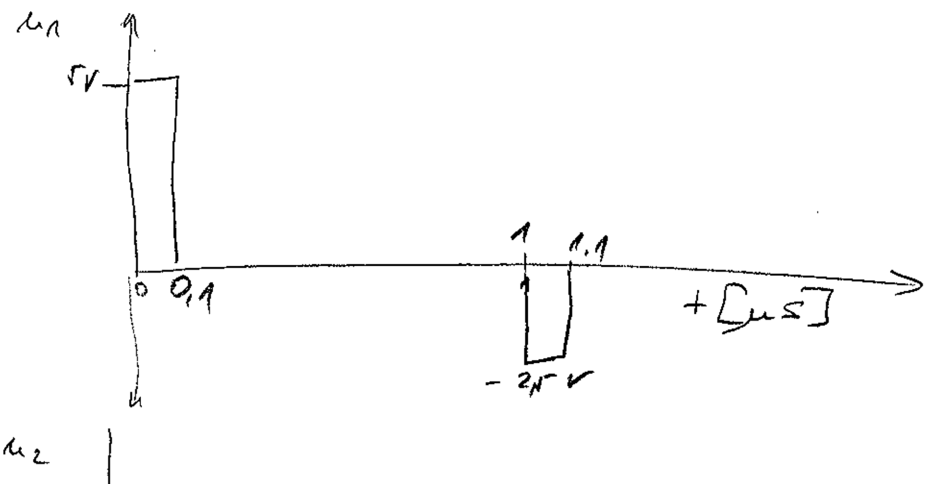
$R_i = R_0$

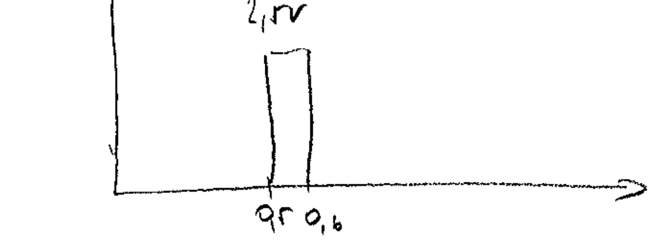
$$U_p = U_i \cdot \frac{R_0}{R_i + R_0} = U_i \cdot \frac{1}{2} = 5V$$

$$U_2 = U_p \cdot \rho_u = U_p \cdot \frac{R_S - R_0}{R_S + R_0} = 5 \cdot \frac{\left(\frac{1}{3} - \frac{3}{3}\right) \cdot \cancel{R_0}}{\left(\frac{1}{3} + \frac{3}{3}\right) \cancel{R_0}} =$$

$$= 5 \cdot \frac{-\frac{2}{\cancel{3}}}{\frac{4}{\cancel{3}}} = -2,5V$$







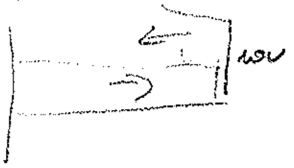
5.8.

LC; $U_{i0} = 10V$; $l = 100m$

$R_i = R_0$

$R_s = \infty \Rightarrow \rho = 1$

$u_2 = U_i = 10V$; $i = 0$

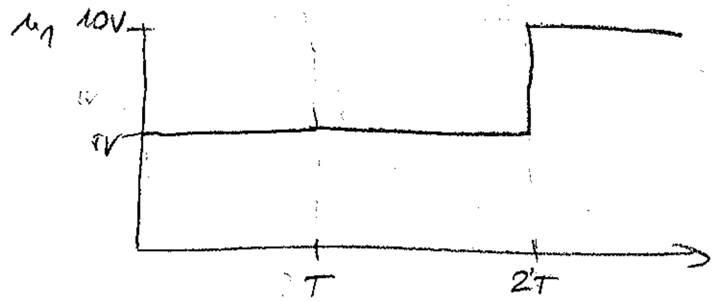


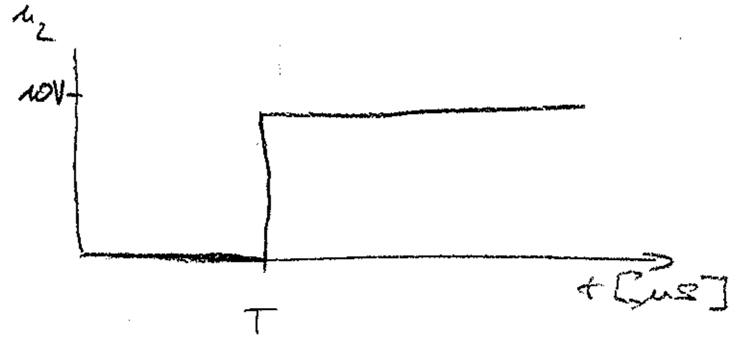
$U_p = U_i \cdot \frac{R_0}{R_i + R_0} = \frac{U_i}{2} = 5V$

$U_+ = +U_p$

$t = \frac{s}{v} = l \cdot \sqrt{LC} =$

$T = \underline{0{,}5 \cdot 10^{-6} s}$





5.9

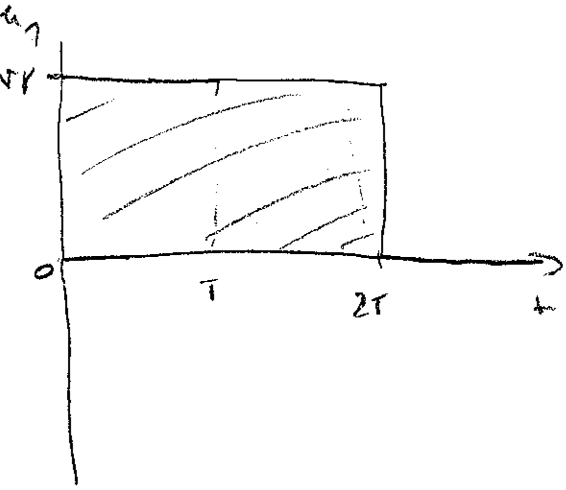
5.8 parametry

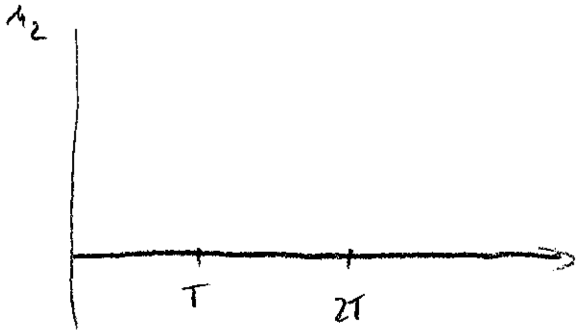
$R_s = 0 \Rightarrow \rho_u = -1$

$u_2 = 0$

$U_p = 5V$

$U_+ = -5V$





T.11

$L = 0{,}5 \cdot 10^{-6}\ H \cdot m^{-1}$

$C = 50 \cdot 10^{-12}\ F \cdot m^{-1}$

$U_{i0} = 10V$

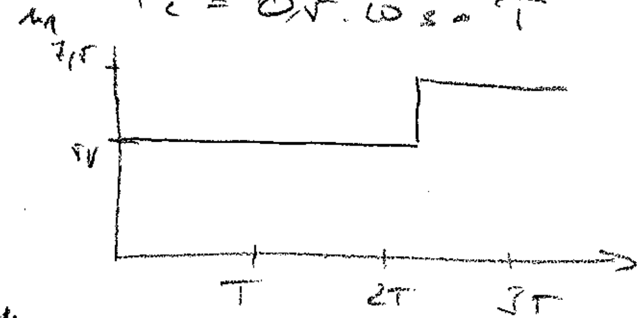
$l = 100m$

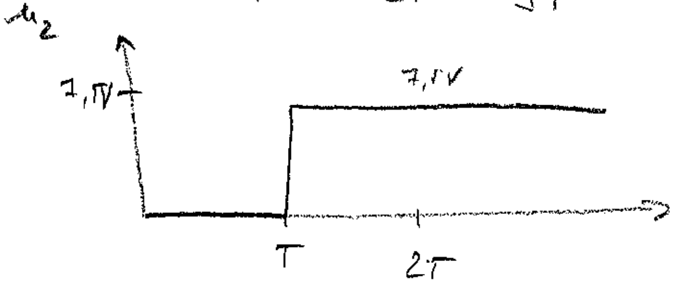
$R_S = 3R_0$

$$U_P = U_{i0} \cdot \frac{R_0}{R_S + R_0} = 5V$$

$$U_2 = U_P \cdot \rho_2 = U_P \cdot \frac{R_S - R_0}{R_S + R_0} = \underbrace{2{,}5V}$$

$$t_c = 0{,}5 \cdot 10^{-6}\,s = T$$





T.10.

$L = 0{,}5 \cdot 10^{-6}\ H \cdot m^{-1}$

$C = 50 \cdot 10^{-12}\ F \cdot m^{-1}$

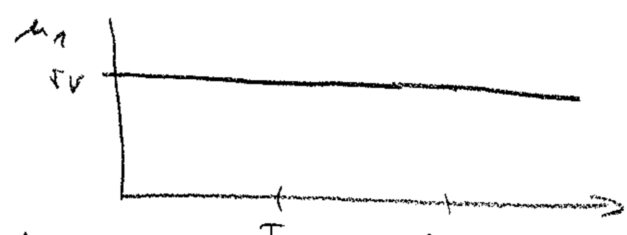
$U_{i0} = 10V$

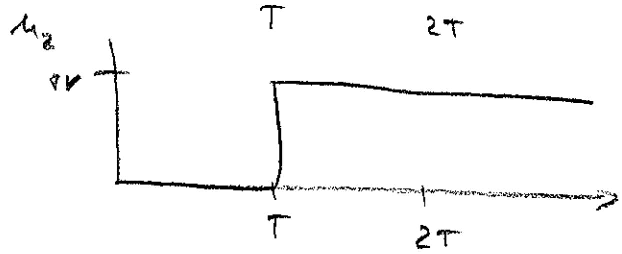
$l = 100m$

$R_S = R_0 \Rightarrow \rho_2 = 0$

$$U_P = U_{i0} \cdot \frac{1}{2} = 5V$$

$$U_2 = U_P\, \rho = 0V$$





T.12

$L = 0{,}5 \cdot 10^{-6}\ H \cdot m^{-1}$

$C = 50 \cdot 10^{-12}\ F \cdot m^{-1}$

$U_i = 10V$

$l = 100m$

$R_S = \frac{1}{3} R_0$

$$U_P = U_{i0} \cdot \frac{1}{2} = 5V$$

$$U_2 = U_P\, \rho = U_P \cdot \frac{R_S - R_0}{R_S + R_0} = U_P \cdot -\frac{1}{2} = -2{,}5V$$

$$T = t_c = l \cdot \sqrt{LC} = \underbrace{0{,}5 \cdot 10^{-6}\,s}$$