Ex 2 / Blatt 12

$\boxed{46}$ b) $Z = R + Z'$ $\qquad \frac{1}{Z'} = \frac{1}{R_L + i\omega L} + i\omega C$

$$Z = R + \frac{1}{\frac{1}{R_L + i\omega L} + i\omega C}$$

$$= R + \frac{1}{\frac{R_L - i\omega L}{R_L^2 + \omega^2 L^2} + i\omega C} = R + \frac{1}{\frac{R_L}{R_L^2+\omega^2L^2} + i\left(\omega C - \frac{\omega L}{R_L^2+\omega^2L^2}\right)}$$

$$= R + \frac{\left(\frac{R_L}{R_L^2+\omega^2L^2}\right) - i\left(\omega C - \frac{\omega L}{R_L^2+\omega^2L^2}\right)}{\left(\frac{R_L}{R_L^2+\omega^2L^2}\right)^2 + \left(\omega C - \frac{\omega L}{R_L^2+\omega^2L^2}\right)^2}$$

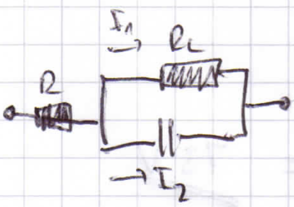
a) $L = 0 \Rightarrow Z = 40 - i\, 0{,}45$

$|Z| \approx 40$

b) $L = 150\,\mathrm{mH}$

$Z = 40{,}3 + i\, 9{,}0$

$|Z| = 41{,}3$

c) 

$I_1 + I_2 = I$ $\qquad U_R = R \cdot I$

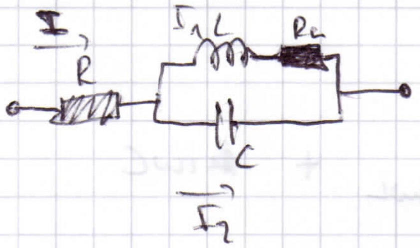
$U_R + U_{RL} = U$

$$U_{RL} = U - R\cdot I = U - R\cdot\frac{U}{|Z_{ges}|}$$

$$= U\cdot\left(1 - \frac{R}{|Z|}\right) = \frac{3}{4}U$$

$$= 75\,V$$

d)



$I = I_1 + I_2$

$U = U_R + U_L + U_{R_L}$ $\qquad U_L + U_{R_L} = U_L$

$U_R = R \cdot I$ $\qquad \cancel{U_L = I_1 X_L}$ $\qquad \cancel{U_C = I_2 X_C}$

$U_{RL} =$

$U = R \cdot I + I_1 \cdot X_L + U_{RL}$

$\cancel{I_1 \cdot X_L = U_L \cdot R_L}$

$I_2 \cdot X_C = I_1 (X_L + R_L)$ $\qquad I_2 = I - I_1$

$(I - I_1) X_C = I_1 (X_L + R_L)$

$I X_C = I_1 (X_L + R_L + X_C)$ $\qquad I_1 = I \dfrac{X_C}{(X_L + R_L + X_C)}$

$\Rightarrow U_{RL} = U - R \cdot I - I \dfrac{X_L X_C}{(X_L + R_L + X_C)}$ $\qquad \cancel{U = Z I}$ $\quad I = \dfrac{U}{|Z|}$

$= \cancel{U}\left(1 - \dfrac{R}{Z} - \dfrac{X_L X_C}{(X_L + R_L + X_C)|Z|}\right)$

$U_C = I \cdot |Z'| = 76{,}54\,V$

$U_C = I_1 \cdot |Z_{RL}|$ $\qquad |Z_{RL}| = \sqrt{R_L^2 + \omega^2 L^2} = 31{,}44\,\Omega$

$U_{RL} = I_1 \cdot R_L$

$U_{RL} = R_L \cdot \dfrac{I \cdot |Z'|}{|Z_{RL}|} = \dfrac{R_L \cdot |Z'|}{|Z_{RL}| \cdot |Z|} U = \underline{\underline{73\,V}}$

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$$\vec\nabla\cdot\vec E = \frac{\rho}{\varepsilon_0} \qquad \vec\nabla\cdot\vec B = 0$$

$$\vec\nabla\times\vec E = -\frac{\partial\vec B}{\partial t} \qquad \vec\nabla\times\vec B = \mu_0\vec j + \mu_0\varepsilon_0\frac{\partial\vec E}{\partial t}$$

mit $\vec\nabla\times(\vec\nabla\times\vec A) = \vec\nabla(\vec\nabla\cdot\vec A) - \Delta\vec A$

auf Elektrische Feld:

$$\vec\nabla\times(\vec\nabla\times\vec E) = \vec\nabla(\underbrace{\vec\nabla\cdot\vec E}_{=0}) - \Delta\vec E$$

$$-\vec\nabla\times\frac{\partial\vec B}{\partial t} = -\Delta\vec E$$

$$-\frac{\partial}{\partial t}\Big(\underbrace{\mu_0\vec j}_{=0} + \mu_0\varepsilon_0\frac{\partial\vec E}{\partial t}\Big) = -\Delta\vec E$$

$$\mu_0\varepsilon_0\frac{\partial^2\vec E}{\partial t^2} = \Delta\vec E$$

$$\Rightarrow \Delta\vec E - \frac{1}{c^2}\frac{\partial^2\vec E}{\partial t^2} = 0$$

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Poynting-Vektor: $\vec S = \vec E\times\vec H$

$$|\vec S| = \frac{P}{A} = \frac{1}{\mu_0}E\cdot B \qquad \text{mit } B = \frac{E_0}{c_0}$$

$$\frac{P}{A} = \frac{1}{\mu_0 c_0}E^2 \Rightarrow E = \sqrt{\frac{P\mu_0 c_0}{A}}$$

$$= 8{,}5\,kV/m$$

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a)/b) $B \overset{!}{=} 0 \qquad \vec B = \mu_0(\vec H + \vec M) \overset{!}{=} 0$

$\vec H = -\vec M \qquad \chi = \cancel{\frac{M}{H}}\ \frac{\partial M}{\partial H} = -1$