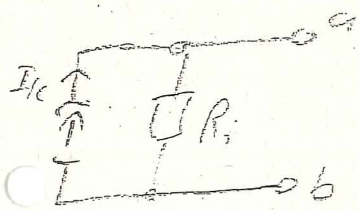
1. a) $\underline{\underline{Z_i}} = \frac{1}{j\omega C} + (j\omega 2L \,\|\, j\omega 2L) + (2R \,\|\, 2R)$

$= \frac{1}{j\omega C} + j\omega L + R = \underline{\underline{R + j\left(\omega L - \frac{1}{\omega C}\right)}}$ (2)

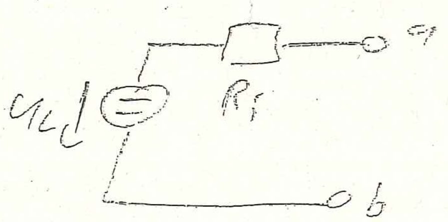
b) $\text{Im}\{\underline{Z}_i\} \overset{!}{=} 0 \Rightarrow \omega L \overset{!}{=} \frac{1}{\omega C} \Rightarrow \omega^2 = \frac{1}{LC} \Rightarrow \underline{\underline{\omega = \frac{1}{\sqrt{LC}}}}$ (3)

c) $\underline{\underline{R_i = 2R}}$ (1) d) $\underline{\underline{U_L = -U_{01}}}$ (1) $\underline{\underline{I_K = -\frac{U_{01}}{2R}}}$ (1)

e)

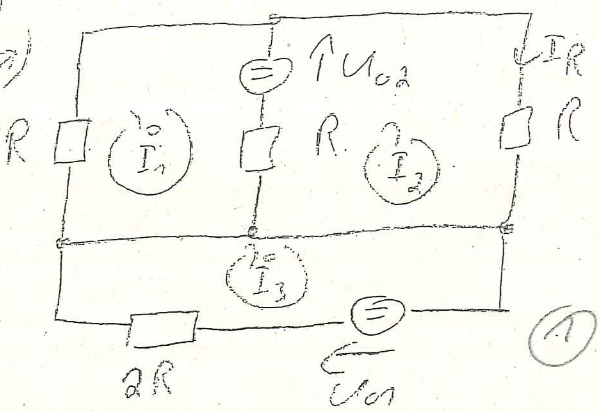


Ersatzstrom-ESB (1)



Ersatzspannungs-ESB (1)

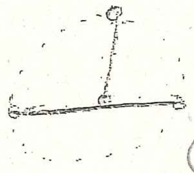
2) a)



$U_{02} = I_{02} \cdot R$

(1)

b)



(1)

c) $\underline{\underline{m}} = z - (k-1)$

$= 6 - (4-1) = \underline{\underline{3}}$ (1)

d)

$$\begin{pmatrix} 2R & -R & 0 \\ -R & 2R & 0 \\ 0 & 0 & 2R \end{pmatrix} \begin{pmatrix} \mathring{I}_1 \\ \mathring{I}_2 \\ \mathring{I}_3 \end{pmatrix} = \begin{pmatrix} U_{02} \\ -U_{02} \\ -U_{01} \end{pmatrix}$$ (2)

e) $I_R = \mathring{I}_2$ (1)

f) (i) $4R \cdot \mathring{I}_1 - 2R \cdot \mathring{I}_2 = 2U_0$ (2)

(ii) $-2R \cdot \mathring{I}_1 + 4R \cdot \mathring{I}_2 = -2U_0$

(i) $\Rightarrow 4R\mathring{I}_1 = 2U_0 + 2R\mathring{I}_2 \Rightarrow \mathring{I}_1 = \frac{2U_0}{4R} + \frac{2R\mathring{I}_2}{4R} = \frac{U_0}{2R} + \frac{\mathring{I}_2}{2}$

in (ii):

$-2R \cdot \left(\frac{U_0}{2R} + \frac{\mathring{I}_2}{2}\right) + 4R \cdot \mathring{I}_2 = -2U_0$

$-U_0 - R\mathring{I}_2 + 4R\mathring{I}_2 = -2U_0$

$3R\mathring{I}_2 = -U_0$

$\Rightarrow \underline{\underline{\mathring{I}_2}} = -\frac{U_0}{3R} = -\frac{I_0 \cdot R}{3R} = -\frac{300\,mA}{3} \underline{\underline{= -100\,mA}}$

③

a) $$\underline{H}'(j\omega) = \frac{\underline{U}_2'(j\omega)}{\underline{U}_1(j\omega)} = \frac{R \,\|\, \left(\frac{1}{j\omega C} + j\omega L\right)}{R + \left(R \,\|\, \left(\frac{1}{j\omega C} + j\omega L\right)\right)}$$

$$= \frac{\dfrac{\frac{R}{j\omega C} + j\omega RL}{R + \frac{1}{j\omega C} + j\omega L}}{R + \dfrac{\frac{R}{j\omega C} + j\omega RL}{R + \frac{1}{j\omega C} + j\omega L}} = \frac{\frac{R}{j\omega C} + j\omega RL}{R^2 + \frac{2R}{j\omega C} + j\omega 2RL}$$

$$= \frac{R - \omega^2 RCL}{2R - \omega^2 RCL + j\omega R^2 C} = \underline{\underline{\frac{1}{1 + j\frac{\omega R^2 C}{2R - \omega^2 RCL}}}}$$ ②

b) $$\underline{\underline{Z_{CL}}} = \frac{1}{j\omega C} + j\omega L = j\left(\frac{1}{\sqrt{LC}} \cdot L - \frac{1}{\frac{1}{\sqrt{LC}} \cdot C}\right) = j\left(\frac{1}{\sqrt{C}} \cdot \sqrt{L} - \frac{\sqrt{L}}{\sqrt{C}}\right) = \underline{\underline{0}}$$ ①

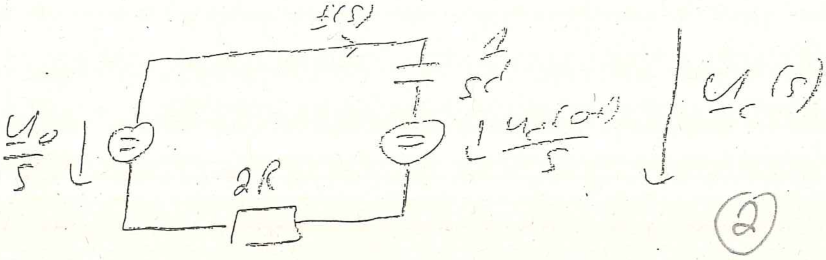
c) $\underline{\underline{\underline{I}_R = 0}}$ ①

d) $$\underline{I} = \frac{\underline{U}_1(j\omega_0)}{R + \underbrace{\frac{1}{j\omega_0 C} + j\omega_0 L}_{=0}} = \underline{\underline{\frac{U_0}{R}}}$$ ②

e) $$\underline{\underline{\underline{H}(j\omega_0)}} = \frac{\underline{U}_2(j\omega_0)}{\underline{U}_1(j\omega_0)} = \frac{j\omega_0 L}{R + \underbrace{\frac{1}{j\omega_0 C} + j\omega_0 L}_{=0}} = \underline{\underline{j\frac{\omega_0 L}{R}}}$$ ②

⑧

4. a)

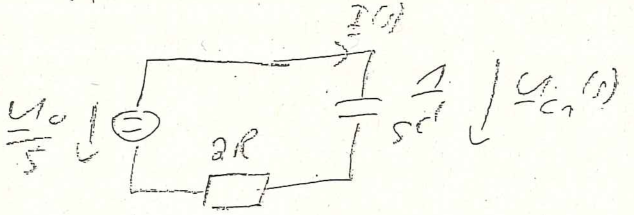


(2)

b) Superposition

$\underline{U}_C(s) = \underline{U}_{C1}(s) + \underline{U}_{C2}(s)$ (3)

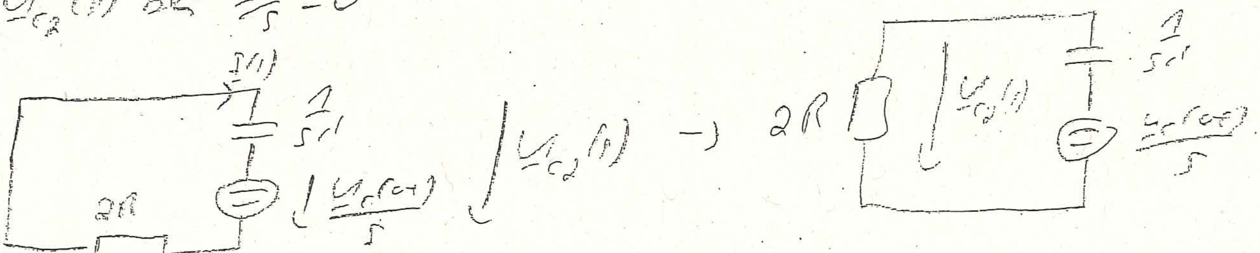
- $\underline{U}_{C1}(s)$ bei $\frac{u_C(0+)}{s} = 0$



$$\frac{\underline{U}_{C1}(s)}{\frac{U_0}{s}} = \frac{\frac{1}{sC}}{2R + \frac{1}{sC}}$$

$$\Rightarrow \underline{U}_{C1}(s) = \frac{U_0}{s} \cdot \frac{1}{2sRC + 1} = U_0 \cdot \frac{\frac{1}{2RC}}{s\left(s + \frac{1}{2RC}\right)}$$

- $\underline{U}_{C2}(s)$ bei $\frac{U_0}{s} = 0$

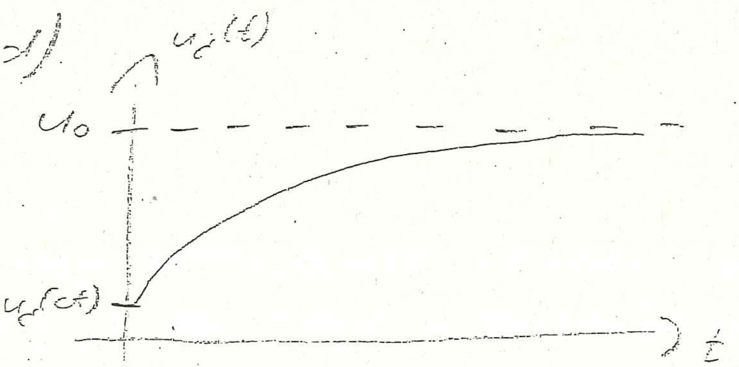


$$\frac{\underline{U}_{C2}(s)}{\frac{u_C(0+)}{s}} = \frac{2R}{2R + \frac{1}{sC}} \Rightarrow \underline{U}_{C2}(s) = \frac{u_C(0+)}{s} \cdot \frac{2sRC}{2sRC + 1} = u_C(0+) \cdot \frac{1}{s + \frac{1}{2RC}}$$

$$\underline{U}_C(s) = \underline{U}_{C1}(s) + \underline{U}_{C2}(s) = U_0 \cdot \frac{\frac{1}{2RC}}{s\left(s + \frac{1}{2RC}\right)} + u_C(0+) \cdot \frac{1}{s + \frac{1}{2RC}}$$

c) $$u_C(t) = U_0 \cdot \left(1 - e^{-\frac{1}{2RC}t}\right) + u_C(0+) \cdot e^{-\frac{1}{2RC}t}; \ t \geq 0$$ (2)

d)



(1)