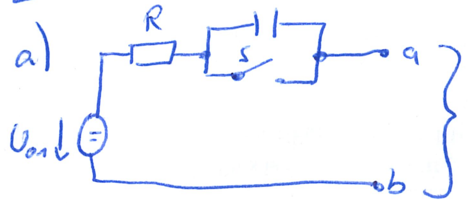
GdET WS24/25 (wdh)

Musterlösung

A1 8

a)



$$R_{Ges} = \frac{(R_1+R_2)(R_3+R_4)}{(R_1+R_2)+(R_3+R_4)} = \frac{4R^2}{4R} = R \quad 3$$

b)

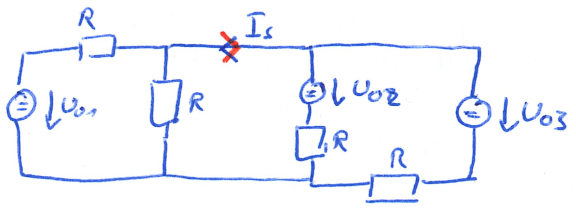
$$\underline{Z}_i^+ = R + \frac{1}{j\omega C} = R - j\frac{1}{\omega C} \quad ; \quad \underline{Z}_i^- = R \qquad 2$$

c)

$$I_K^- = \frac{U_{01}}{\underline{Z}_i^-} = \frac{4V}{R} \quad \Leftrightarrow \quad R = \frac{U_{01}}{I_K^-} = \frac{4V}{0{,}2A} = 20\Omega \quad 3$$

A2

a)



$$U_{02} = R_i \cdot I_{02} = \frac{R}{2} \cdot I_{02}$$

2

b) 1

Graph
Baum

c) 1

$$m = z - k + 1 = 6 - 4 + 1 = \underline{\underline{3}}$$

d) 1

$$\begin{pmatrix} 2R & R & 0 \\ R & 2R & R \\ 0 & R & 2R \end{pmatrix} \begin{pmatrix} \mathring{I}_1 \\ \mathring{I}_2 \\ \mathring{I}_3 \end{pmatrix} = \begin{pmatrix} U_{01} \\ U_{02} \\ U_{02}-U_{03} \end{pmatrix}$$

e) 2

$$\boxed{I_S = -\mathring{I}_2}$$

I. $2R \cdot \mathring{I}_1 + R \cdot \mathring{I}_2 = U_{01}$

II. $R \cdot \mathring{I}_1 + 2R \cdot \mathring{I}_2 + R \cdot \mathring{I}_3 = U_{02}$

III. $R \cdot \mathring{I}_2 + 2R \cdot \mathring{I}_3 = U_{02} - U_{03} = 0$

I. $\mathring{I}_1 = \frac{U_{01} - R \cdot \mathring{I}_2}{2R}$; III. $\mathring{I}_3 = -\frac{\mathring{I}_2}{2}$

In II einsetzen:

$$R \cdot \frac{U_{01} - R \cdot \mathring{I}_2}{2R} + 2R \cdot \mathring{I}_2 - R \cdot \frac{\mathring{I}_2}{2} = U_{02} = \frac{U_{01}}{2} - \frac{R}{2} \cdot \mathring{I}_2 + 2R \cdot \mathring{I}_2 - \frac{R}{2} \cdot \mathring{I}_2 \Leftrightarrow$$

$$\cancel{U_{02} - \frac{U_{01}}{2} = 2R\,\mathring{I}_2}$$

$$\cancel{\Leftrightarrow \frac{U_{02}}{2R} - \frac{U_{01}}{R} = \mathring{I}_2}$$

$$\cancel{\mathring{I}_2 = -I_S = \frac{2V}{400\Omega} - \frac{4V}{200\Omega} = -25mA}$$

$$\frac{U_{01}}{R} - \frac{R}{2} \cdot \mathring{I}_2 + 2R\mathring{I}_2 - \frac{R}{2} \cdot \mathring{I}_2 = U_{02} = \frac{U_{01}}{2} + R\mathring{I}_2 \Leftrightarrow \mathring{I}_2 = \frac{U_{02} - \frac{U_{01}}{2}}{R} = 0A$$

A3

a) $\underline{H}(j\omega) = \dfrac{\frac{1}{j\omega 2C}}{\frac{1}{j\omega 2C} + 2R} = \cancel{\dfrac{1}{21 + j\omega 2C(4R)}} = \dfrac{1}{1 + j\omega 4CR}$ 1

b) $|\underline{H}(j\omega)| = \dfrac{1}{\sqrt{1+16\omega^2C^2R^2}}$; $\varphi(\omega) = -\arctan(4\omega CR)$ 2

c) 2

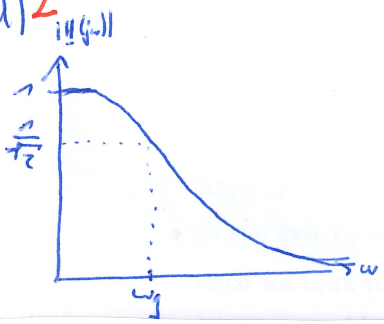
	$\lvert\underline{H}(j\omega)\rvert$	$\varphi(\omega)$
$\omega = 0$	1	0
$\omega \to \infty$	0	-90°

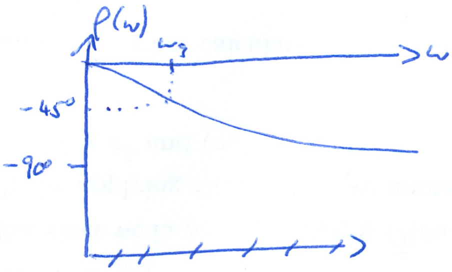
$|\underline{H}(j\omega_g)| = \dfrac{H_{max}}{\sqrt{2}} = \dfrac{1}{\sqrt{1+16\omega_g^2C^2R^2}}$ $\quad | \; \underline{H}_{max} = 1$

$\Rightarrow 1 = 16\omega_g^2C^2R^2 \Leftrightarrow \omega_g = \dfrac{1}{4CR}$

$\varphi(\omega_g) = -45^\circ$

d) 2





e) Tiefpassverhalten 1

f) $\underline{Z}_i = R + \dfrac{2R \cdot \frac{1}{j\omega 2C}}{2R + \frac{1}{j\omega 2C}}$

$= R + \dfrac{\frac{R}{j\omega C}}{2R + \frac{1}{j\omega 2C}} = R + \dfrac{R}{j\omega 4CR + 1}$

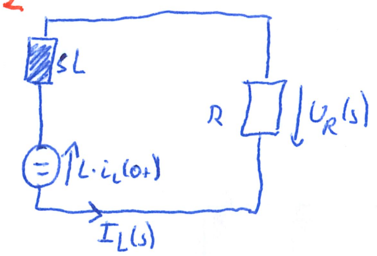
$= R + \dfrac{j\omega C 4R^2 + R}{1 + \cancel{2}16\omega^2C^2R^2}$

g) $\underline{Z}_{Last} = \underline{Z}_i^* = R + \dfrac{R}{1+16\omega^2C^2R^2} - j\dfrac{\omega C4R^2}{1+16\omega^2C^2R^2}$

A4)

a) $i_L(t=0-) = i_L(t=0+) = \frac{U_0}{R}$ 1

b) 2



c) 1

$$I_L(s) = \frac{L \cdot i_L(0+)}{sL + R} = \frac{L \cdot U_0}{sLR + R^2} = \frac{U_0}{R} \cdot \frac{1}{s + \frac{R}{L}}$$

d) 2

$$U_R(s) = -R \cdot I_L(s) = -U_0 \cdot \frac{1}{s + \frac{R}{L}}$$

$$u_R(t) = -U_0 \cdot e^{-\frac{R}{L} \cdot t}$$

e) 1