NEISSE - ELEKTRO 2000

LÖSUNGEN

1

Strom- und Spannungsteilung

$$R_{AB} = R_1 + \left(R_2 + R_3 \| R_4\right) \| \left(R_5 + R_6 \| R_7\right)$$

$$R_{AB} = \left[0{,}9 + (5+1) \| (1+5)\right] \Omega$$

$$\underline{\underline{R_{AB} = 3{,}9\ \Omega}}$$

$$\underline{\underline{I_1}} = \frac{U_q}{R_i + R_{AB}} = \frac{20\ \text{V}}{4\ \Omega} = \underline{\underline{5\ \text{A}}}$$

$$\underline{\underline{U_i}} = -R_i\, I_1 = -0{,}1\,\Omega \cdot 5\ \text{A} = \underline{\underline{-0{,}5\ \text{V}}}$$

$$\underline{\underline{U_1}} = R_1\, I_1 = 0{,}9\ \Omega \cdot 5\ \text{A} = \underline{\underline{4{,}5\ \text{V}}}$$

$$\underline{\underline{I_2}} = \frac{R_5 + R_6 \| R_7}{R_2 + R_3 \| R_4 + R_5 + R_6 \| R_7}\, I_1 = \frac{I_1}{2} = \underline{\underline{2{,}5\ \text{A}}}$$

$$\underline{\underline{U_2}} = R_2\, I_2 = 5\ \Omega \cdot 2{,}5\ \text{A} = \underline{\underline{12{,}5\ \text{V}}}$$

$$\underline{\underline{I_5}} = I_1 - I_2 = 5\ \text{A} - 2{,}5\ \text{A} = \underline{\underline{2{,}5\ \text{A}}}$$

$$\underline{\underline{U_5}} = R_5\, I_5 = 1\,\Omega \cdot 2{,}5\ \text{A} = \underline{\underline{2{,}5\ \text{V}}}$$

$$\underline{\underline{I_3}} = \frac{R_4}{R_3 + R_4} I_2 = \frac{I_2}{2} = \underline{\underline{1{,}25\ \text{A}}}$$

$$\underline{\underline{I_4}} = I_2 - I_3 = 2{,}5\ \text{A} - 1{,}25\ \text{A} = \underline{\underline{1{,}25\ \text{A}}}$$

$$\underline{\underline{U_3}} = \underline{\underline{U_4}} = R_3\, I_3 = R_4\, I_4 = 2\ \Omega \cdot 1{,}25\ \text{A} = \underline{\underline{2{,}5\ \text{V}}}$$

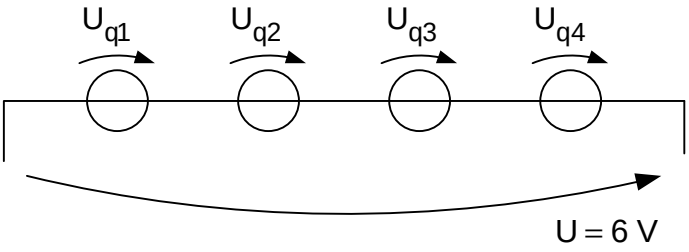
$$\underline{\underline{I_6}} = \frac{R_7}{R_6 + R_7} I_5 = \frac{I_5}{2} = \underline{\underline{1{,}25\ \text{A}}}$$

$$\underline{\underline{I_7}} = I_5 - I_6 = 2{,}5\ \text{A} - 1{,}25\ \text{A} = \underline{\underline{1{,}25\ \text{A}}}$$

$$\underline{\underline{U_6}} = \underline{\underline{U_7}} = R_6\, I_6 = R_7\, I_7 = 10\ \Omega \cdot 1{,}25\ \text{A} = \underline{\underline{12{,}5\ \text{V}}}$$

2

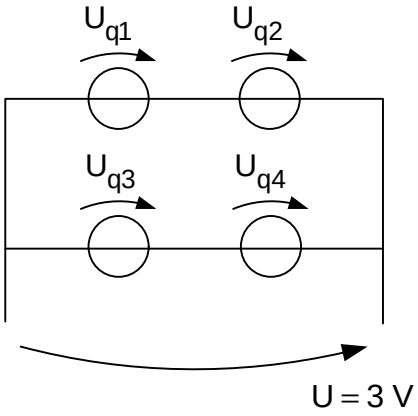
a) 1.



$R_i = 4\ \Omega$

$I_K = 1{,}5\ A$

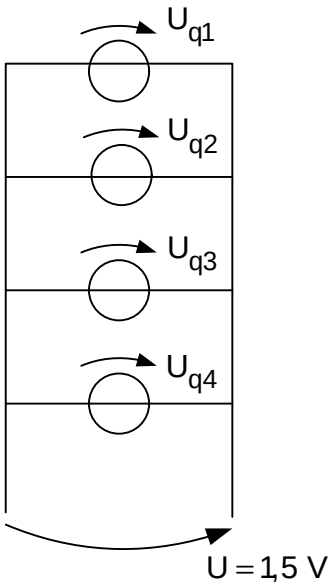
2.



$R_i = 1\ \Omega$

$I_K = 3\ A$

3.



$R_i = 0{,}25\ \Omega$

$I_K = 6\ A$

b) $$I = \frac{U_q}{R_a + R_i}$$

1. I = 1 A
2. I = 1 A
3. 0,66 A

c) $R_a = R_i$

1. $R_a = 4\ \Omega$
2. $R_a = 1\ \Omega$
3. $R_a = 0{,}25\ \Omega$

3

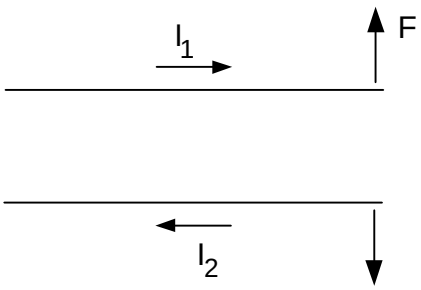
$\vec{F} = I_1 \cdot \vec{l} \times \vec{B}$ $\qquad \vec{I} \perp \vec{B}$

$F = I_1 \cdot \mathbf{l} \cdot B$ $\qquad B = \mu H$

$F = I_1 \cdot \mathbf{l} \cdot \mu_0 H$ $\qquad H = \dfrac{I_2}{2\pi \cdot a}$

$F = \dfrac{I_1 I_2}{2\pi \cdot a} \cdot \mathbf{l} \cdot \mu_0$ $\qquad I_1 = I_2$

$F = \dfrac{I^2}{2\pi \cdot a} \cdot \mathbf{l} \cdot \mu_0$ $\qquad \underline{\underline{= 4\ N}}$



4

a)

$$C = \frac{2\pi \varepsilon \cdot L}{\ln \frac{r_a}{r_i}} = 1{,}8\ \mu F$$

$$r_i = \frac{d}{2} = 26{,}5\ mm$$

$$r_a = r_i + D = 54{,}5\ mm$$

$$\varepsilon = \varepsilon_o \cdot \varepsilon_r = 20{,}36 \cdot 10^{-12}\ \frac{As}{V_m}$$

b)

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

$$I = \frac{U}{x_c} = U\omega C$$

$$\omega = 2\pi f = 314\ \frac{1}{s}$$

$$\underline{\underline{I = 124{,}4\ A}}$$

c)

$$S_{zul} = \frac{I_{zul}}{A}$$

$$A = \frac{\pi}{4} d^2 = 2205\ mm^2$$

$$I_{zul} = S_{zul} \cdot A$$

$$I_{zul} = 4{,}41 kA$$

$$\frac{10\ km}{124\ A} = \frac{x_L}{4{,}41 kA}$$

$$\underline{\underline{x_L = 355\ km}}$$

5

a)

$$H_{1L} = \frac{I}{4\pi r}\left(\cos\alpha_1 - \cos\alpha_2\right)$$

$$\alpha_1 = 45^o$$

$$\alpha_2 = 135^o$$

$$H_{1L} = 225{,}2\,\frac{A}{m}$$

$$H_{ges} = 4 \cdot H_{1L} = 900{,}8\,\frac{A}{m}$$

$$B_{ges} = \mu \cdot H_{ges} = \mu_o\, H_{ges} = 1132{,}3\,\mu T$$

b)

$$H_{1L} = \frac{I}{4\pi r}\left(\cos\alpha_1 - \cos\alpha_2\right)$$

$$r = \sqrt{\left(\frac{S}{2}\right)^2 + (50\text{ cm})^2} = \underline{\underline{0{,}701\,m}}$$

$$\tan\alpha_1 = \frac{r}{\frac{s}{2}} = \frac{2r}{s} \qquad \rightarrow \quad \alpha_1 = 54{,}73^o$$

$$\alpha_2 = 180^o - \alpha_1 \qquad \alpha_2 = 125{,}26^o$$

$$\underline{\underline{H_{1L} = 131\,\frac{A}{m}}}$$

$$H_{1L} = H_{1L_V} + H_{1L_H}$$

$$H_{1L_V} = H_{1L} \cdot \sin 45^o = 92{,}63\,\frac{A}{m}$$

$$H_{ges} = 4 \cdot H_{1L_V} = 370{,}52\,\frac{A}{m}$$

$$B_{ges} = \mu_o \cdot H_{ges} = 465{,}75\,\mu T$$