3.6 KOPLINGER MED USYMETRISKE ENERGIKILDER

3.6.1

a) $I = I_1 + I_2$

I $\quad I_1 \cdot R_{i1} + I \cdot R_y = E_1$

II $\quad I_2 \cdot R_{i2} + I \cdot R_y = E_2$

I $\quad I_1 \cdot R_{i1} + I_1 \cdot R_y + I_2 \cdot R_y = E_1$

II $\quad I_2 \cdot R_{i2} + I_1 \cdot R_y + I_2 \cdot R_y = E_2$

I $\quad I_1 \cdot 10\Omega + I_1 \cdot 50\Omega + I_2 \cdot 50\Omega = 230V$

II $\quad I_2 \cdot 13\Omega + I_1 \cdot 50\Omega + I_2 \cdot 50\Omega = 200V$

I $\quad I_1 \cdot 60\Omega + I_2 \cdot 50\Omega = 230V \quad | \cdot 5$

II $\quad I_1 \cdot 50\Omega + I_2 \cdot 63\Omega = 200V \quad | \cdot (-6)$

I $\quad I_1 \cdot 300\Omega + I_2 \cdot 250\Omega = 1150V$

II $\quad -I_2 \cdot 300\Omega - I_2 \cdot 378\Omega = -1200V$

$$-I_2 \; 128\Omega = -50V$$

$$I_2 = \frac{-50V}{-128\Omega} = \underline{0{,}390A}$$

I $\quad I_1 \cdot 300\Omega + I_2 \cdot 250\Omega = 1150V$

$$I_1 \cdot 300\Omega + 0{,}390A \cdot 250\Omega = 1150V$$

$$I_1 = \frac{1150V - (0{,}390A \cdot 250\Omega)}{300\Omega} = \underline{3{,}51A}$$

$I = I_1 + I_2 = 0{,}390A + 3{,}51A = \underline{3{,}90A}$

b) $U = I \cdot R_y = 3{,}90A \cdot 50\Omega = \underline{194{,}9V}$

3.6.2

$$\text{I} \quad I_1 \cdot R_1 + I_1 \cdot R_3 + I_2 \cdot R_3 + I_1 \cdot R_2 = U_1$$

$$\text{II} \quad I_1 \cdot R_3 + I_2 \cdot R_3 + I_2 \cdot R_4 + I_2 \cdot R_5 = U_2$$

$$\text{I} \quad I_1 \cdot 100\Omega + I_1 \cdot 50\Omega + I_2 \cdot 50\Omega + I_1 \cdot 130\Omega = 130\,V$$

$$\text{II} \quad I_1 \cdot 50\Omega + I_2 \cdot 50\Omega + I_2 \cdot 100\Omega + I_2 \cdot 70\Omega = 110\,V$$

$$\text{I} \quad I_1 \cdot 280\Omega + I_2 \cdot 50\Omega = 130\,V \quad | \cdot 22$$

$$\text{II} \quad I_1 \cdot 50\Omega + I_2 \cdot 220\Omega = 110\,V \quad | \cdot (-5)$$

$$\text{I} \quad I_1 \cdot 6160\Omega + I_2 \cdot 1100\Omega = 2860\,V$$

$$\text{II} \quad -I_1 \cdot 250\Omega - I_2 \cdot 1100\Omega = -550\,V$$

$$\text{I} \quad I_1\, 5910\Omega = 2310\,V$$

$$I_1 = \frac{2310\,V}{5910\,\Omega} = \underline{\underline{0{,}391\,A}}$$

$$\text{I} \quad I_1 \cdot 280\Omega + I_2 \cdot 50\Omega = 130\,V$$

$$0{,}391A \cdot 280\Omega + I_2 \cdot 50\Omega = 130\,V$$

$$I_2 = \frac{130\,V - (0{,}391A \cdot 280\Omega)}{50\,\Omega} = \underline{\underline{0{,}411\,A}}$$

$$I = I_1 + I_2 = 0{,}391A + 0{,}411A = \underline{\underline{0{,}802\,A}}$$

b)

$$U = I \cdot R_3 = 0{,}802A \cdot 50\Omega = \underline{\underline{40{,}1\,V}}$$

3.6.3

a) I $I_1 \cdot R_1 + I_1 \cdot R_2 + I_1 \cdot R_y + I_2 \cdot R_y + I_1 \cdot R_6 = U_1 + (-U_2)$

II $I_2 \cdot R_3 + I_1 \cdot R_y + I_2 \cdot R_y + I_2 \cdot R_5 + I_2 \cdot R_4 = U_3$

I $I_1 \cdot 70\Omega + I_1 \cdot 60\Omega + I_1 \cdot 100\Omega + I_2 \cdot 100\Omega + I_1 \cdot 70\Omega = 10V + (-12V)$

II $I_2 \cdot 50\Omega + I_1 \cdot 100\Omega + I_2 \cdot 100\Omega + I_2 \cdot 50\Omega + I_2 \cdot 40\Omega = 14V$

I $I_1 \cdot 300\Omega + I_2 \cdot 100\Omega = -2V$

II $I_1 \cdot 100\Omega + I_2 \cdot 240\Omega = 14V \quad | \cdot (-3)$

I $I_1 \cdot 300\Omega + I_2 \cdot 100\Omega = -2V$

II $-I_1 \cdot 300\Omega - I_2 \cdot 720\Omega = -42V$

$$-I_2 \cdot 620\Omega = -44V$$

$$I_2 = \underline{0{,}0710\,A} = \underline{\underline{71{,}0\,mA}}$$

I $I_1 \cdot 300\Omega + I_2 \cdot 100\Omega = -2V$

$I_1 \cdot 300\Omega + 0{,}071A \cdot 100\Omega = -2V$

$$I_1 = \frac{-2V - (0{,}071A \cdot 100\Omega)}{300\Omega} = \underline{-0{,}0303A} = \underline{\underline{-30{,}3\,mA}}$$

$I = I_1 + I_2 = -30{,}3 \cdot 10^{-3}A + 71{,}0 \cdot 10^{-3}A = \underline{0{,}0406A} = \underline{\underline{40{,}6\,mA}}$

b)

$U = I \cdot R_y = 40{,}6 \cdot 10^{-3}A \cdot 100\Omega = \underline{\underline{4{,}06V}}$

3.6.4

a) $U = U$ $\qquad I = I_1 + I_2$

$E_1 - \Delta U_{i1} = E_2 - \Delta U_{i2}$ $\qquad I_2 = I - I_1$

$E_1 - I_1 \cdot R_{i1} = E_2 - I_2 \cdot R_{i2}$

$100V - I_1 \cdot 0{,}2\Omega = 102V - I_2 \cdot 0{,}2\Omega$

$100V - I_1 \cdot 0{,}2\Omega = 102V - (I - I_1) \cdot 0{,}2\Omega$

$100V - I_1 \cdot 0{,}2\Omega = 102V - 2A \cdot 0{,}2\Omega + I_1 \cdot 0{,}2\Omega$

$-I_1 \cdot 0{,}2\Omega - I_1 \cdot 0{,}2\Omega = 102V - 100V - 0{,}4V$

$I_1 \cdot 0{,}4\Omega = -1{,}6V$

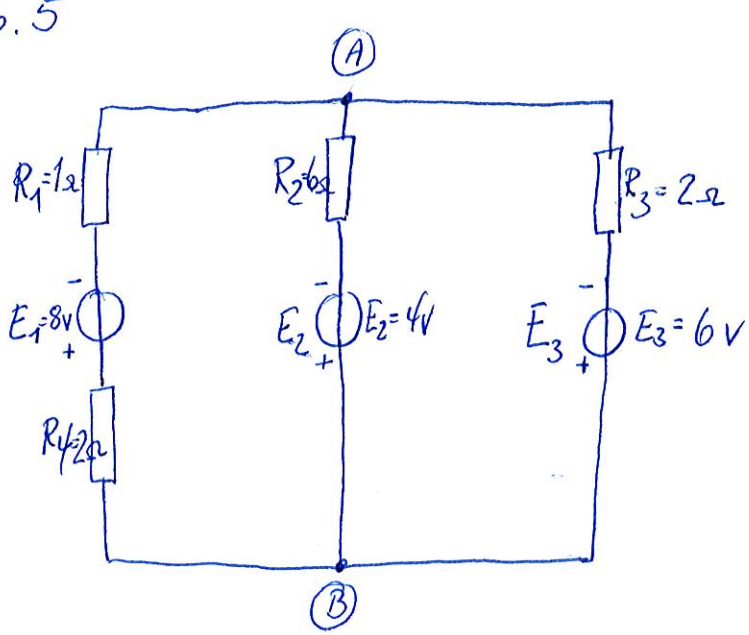
$I_1 = \frac{-1{,}6V}{0{,}4\Omega} = \underline{\underline{-4A}}$

$I_2 = I - I_1 = 2A - (-4A) = \underline{\underline{6A}}$

b) $U = E_1 - I_1 \cdot R_{i1} = 100V - (-4A \cdot 0{,}2\Omega) = \underline{\underline{100{,}8V}}$

$R_y = \frac{U}{I} = \frac{100{,}8V}{2A} = \underline{\underline{50{,}4\Omega}}$

3.6.5



Finn strømmene i kretsen

Antatt strømretning fra pluss på polene til spenningskildene.

Tilfelle 1 E_2 og E_3 kortsluttet

$$I_{11} = \frac{E_1}{R_1 + R_4 + \frac{R_2 + R_3}{R_2 + R_3}} = \frac{8V}{1\Omega + 2\Omega + \frac{6\Omega + 2\Omega}{6\Omega + 2\Omega}} = 1{,}778A \text{ (OPP)}$$

$$U_{AB_1} = E_1 - \Delta U_{R_{1+2}} = -(I_{11} \cdot R_1 + I_{11} \cdot R_4) = 8V - (1{,}778A \cdot 1\Omega + 1{,}778A \cdot 2\Omega)$$

$$U_{AB_1} = 2{,}667V$$

$$I_{21} = \frac{U_{AB1}}{R_2} = \frac{2{,}667V}{6\Omega} = 0{,}444A \text{ (ned)}$$

$$I_{31} = \frac{U_{AB1}}{R_3} = \frac{2{,}667V}{2\Omega} = 1{,}333A \text{ (ned)}$$

Tilfelle 2 E_1 og E_2 kortsluttet

$$I_{22} = \frac{E_2}{R_2 + \frac{R_3 \cdot (R_1 + R_4)}{R_3 + (R_1 + R_4)}} = \frac{4V}{6\Omega + \frac{2\Omega \cdot (1\Omega + 2\Omega)}{2\Omega + (1\Omega + 2\Omega)}} = 0{,}555A \text{ OPP}$$

$$U_{AB_2} = E_2 - \Delta U_{R_2} = E_2 - I_{22} \cdot R_2 = 4V - 0{,}555A \cdot 6\Omega = 0{,}6667V$$

$$I_{12} = \frac{U_{AB2}}{R_1 + R_4} = \frac{0{,}6667V}{1\Omega + 2\Omega} = 0{,}222A \text{ (ned)}$$

$$I_{32} = \frac{U_{AB2}}{R_3} = \frac{0{,}6667V}{2\Omega} = 0{,}333A \text{ (ned)}$$

Tilfelle 3 E_1 og E_2 kortsluttet

$$I_{33} = \frac{E_3}{R_3 + \frac{R_2 \cdot (R_1 + R_4)}{R_2 + (R_1 + R_4)}} = \frac{6\,V}{2\,\Omega + \frac{6\,\Omega \cdot (1\,\Omega + 2\,\Omega)}{6\,\Omega + (1\,\Omega + 2\,\Omega)}} = \underline{1{,}5\,A}$$ (OPP)

$$U_{AB_3} = E_3 - \Delta U_{R_3} = E_3 - I_{33} \cdot R_3 = 6\,V - 1{,}5A \cdot 2\,\Omega = \underline{3{,}0V}$$

$$I_{13} = \frac{U_{AB_3}}{R_1 + R_4} = \frac{3{,}0\,V}{1\,\Omega + 2\,\Omega} = \underline{1{,}0\,A}$$ (ned)

$$I_{23} = \frac{U_{AB_3}}{R_2} = \frac{3{,}0V}{6\,\Omega} = \underline{0{,}5A}$$ (ned)

(OPP) (ned) (ned)

$$I_1 = I_{11} - I_{12} - I_{13} = 1{,}778A - 0{,}222A - 1{,}0A = \underline{0{,}555A}$$

$$I_2 = I_{22} - I_{21} - I_{23} = 0{,}555A - 0{,}444A - 0{,}5A = \underline{-0{,}389A}$$

$$I_3 = I_{33} - I_{31} - I_{32} = 1{,}5A - 1{,}333A - 0{,}333A = \underline{-0{,}166A}$$