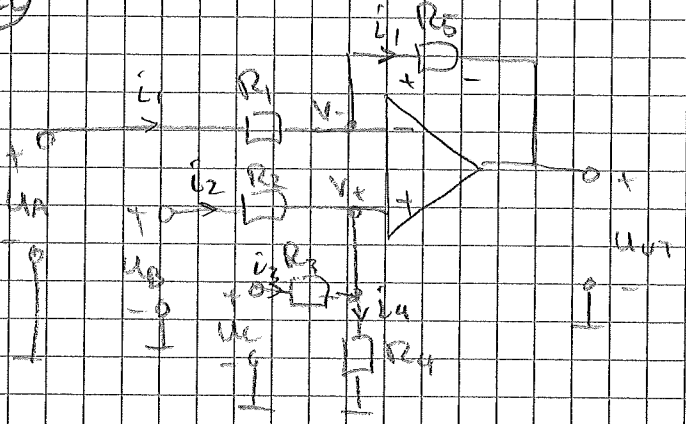
9.20



Bestäm u_{UT}

Ideal OP negativt återkopplad $\Rightarrow V_- = V_+$

Bestäm V_+

KCL $\quad i_2 + i_3 = i_4 \quad \Rightarrow$

$$\frac{u_B - V_+}{R_2} + \frac{u_C - V_+}{R_3} = \frac{V_+}{R_4} \Rightarrow$$

$$\frac{u_B}{R_2} + \frac{u_C}{R_3} = \frac{V_+}{R_4} + \frac{V_+}{R_2} + \frac{V_+}{R_3} \Rightarrow$$

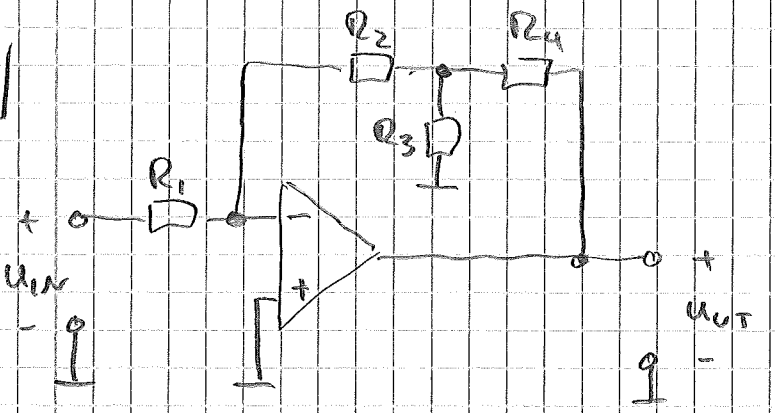
$$V_+ = \frac{\frac{u_B}{R_2} + \frac{u_C}{R_3}}{\frac{1}{R_4} + \frac{1}{R_2} + \frac{1}{R_3}} = \frac{\frac{0,8}{10000} + \frac{1,2}{2200}}{\frac{1}{1500} + \frac{1}{10000} + \frac{1}{2200}} = 0,5122\ V$$

$$V_- = V_+ = 0,5122\ V$$

$$i_1 = \frac{u_A - V_-}{R_1} = \frac{0,45 - 0,5122}{1400} = -13,23\ \mu A$$

$$u_{UT} = V_- - R_5 i_1 = 0,5122 - 8200 \cdot (-13,23 \cdot 10^{-6}) = 0,62\ V$$

9.22



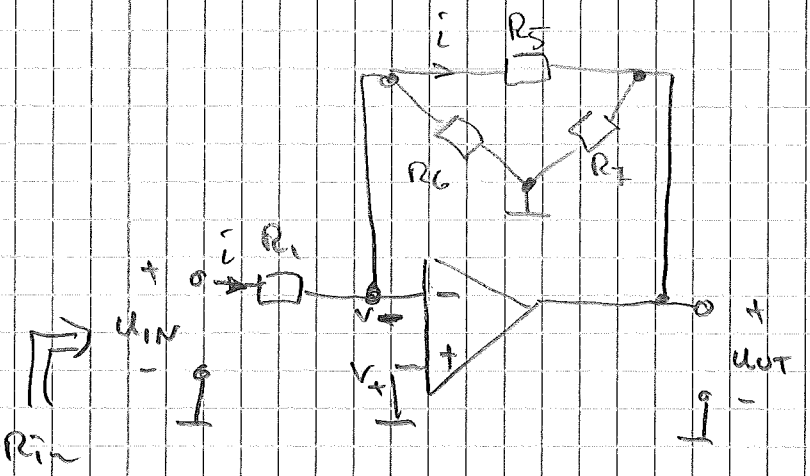
$R_1 = 1\,M\Omega$

$R_2 = 1\,M\Omega$

$R_3 = 10\,k\Omega$

$R_4 = 1\,M\Omega$

Stjärna-triangel transformation



$$R_5 = R_2 + R_4 + \frac{R_2 \cdot R_4}{R_3} =$$

$$= 102\,M\Omega$$

Ideal OP väg återkopplad $V_- = V_+ = 0\,V \Rightarrow$

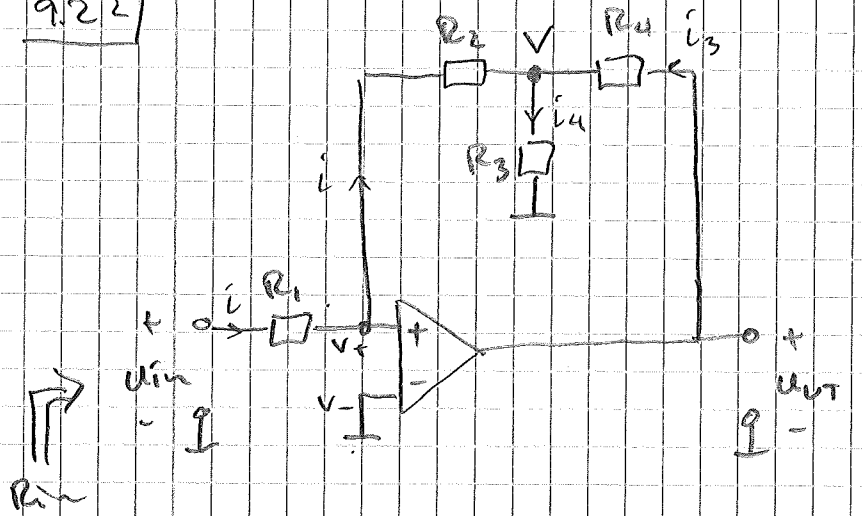
Ingen ström genom R_6.

$$\begin{cases} i = \dfrac{U_{IN}}{R_1} \\ U_{UT} = -R_5 \cdot i \end{cases} \Rightarrow U_{UT} = -\frac{R_5}{R_1} \cdot U_{IN} \Rightarrow$$

a) $\underline{A_u = \dfrac{U_{UT}}{U_{IN}} = -\dfrac{R_5}{R_1} = -\dfrac{102\,M}{1\,M} = -102}$

b) $\underline{R_{in} = \dfrac{U_{IN}}{i} = \dfrac{U_{in}}{\frac{U_{in}}{R_1}} = R_1 = 1\,M\Omega}$

9.22



$R_1 = R_2 = R_4 = 1 M\Omega$

$R_3 = 10 k\Omega$

a) Ideal OP med återkoppl. $\Rightarrow V_+ = V_- = 0\,V$

$$i = \frac{u_{IN}}{R_1}$$

$$V = -R_2 \cdot i = -\frac{R_2}{R_1} \cdot u_{IN}$$

KI $\quad i + i_3 = i_4$

$$\frac{u_{IN}}{R_1} + \frac{u_{UT} - V}{R_4} = \frac{V}{R_3}$$

$$\frac{u_{UT}}{R_4} = V\left(\frac{1}{R_4} + \frac{1}{R_3}\right) - \frac{u_{IN}}{R_1}$$

$$\frac{u_{UT}}{R_4} = \left\{-\frac{R_2}{R_1}\left(\frac{1}{R_4} + \frac{1}{R_3}\right) - \frac{1}{R_1}\right\} \cdot u_{IN}$$

$$\underline{\underline{A_u = \frac{u_{UT}}{u_{IN}} = -\frac{R_4}{R_1}\left(\frac{R_2}{R_4} + \frac{R_2}{R_3} + 1\right) = -\frac{1M}{1M}\left(\frac{1M}{1M} + \frac{1M}{10k} + 1\right) =}}$$

$$= \underline{\underline{-102}}$$

b) $$\underline{\underline{R_{in} = \frac{u_{IN}}{i} = \frac{u_{IN}}{\frac{u_{IN}}{R_1}} = R_1 = 1 M\Omega}}$$

5.1 a)

$$I_1 - I_2 - I_3 - I_4 - J = 0$$

$$I_2 + I_5 - I_1 = 0$$

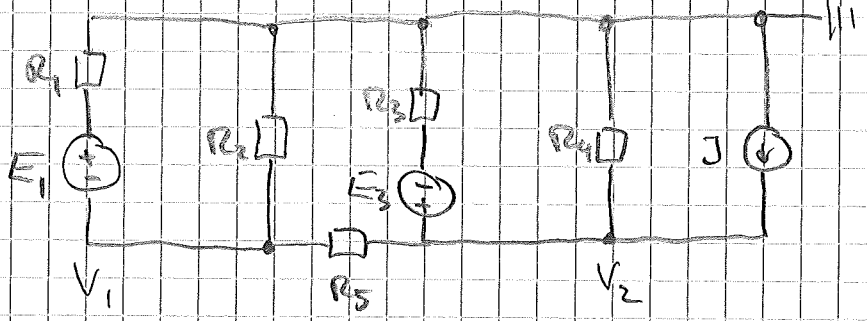
↻ $$E_1 - R_1 I_1 - R_2 I_2 = 0$$

↻ $$R_2 I_2 - R_3 I_3 + E_3 - R_5 I_5 = 0$$

↺ $$-E_3 + R_3 I_3 - R_4 I_4 = 0$$

---

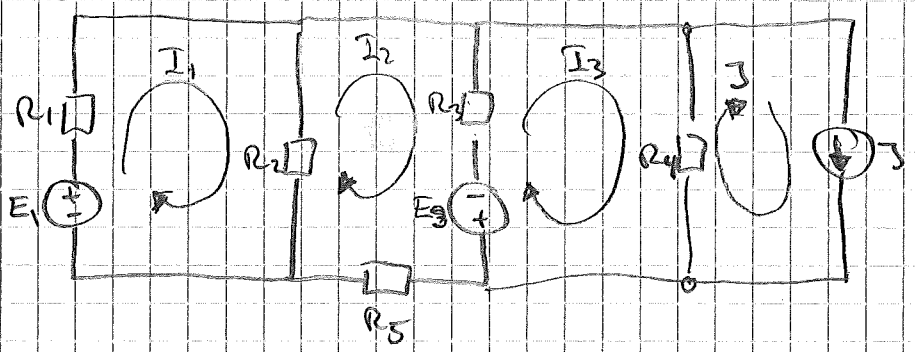
b)



$$\frac{V_1 + E_1}{R_1} + \frac{V_1}{R_2} + \frac{V_1 - V_2}{R_5} = 0$$

$$\frac{V_2 - V_1}{R_5} + \frac{V_2 - E_3}{R_3} + \frac{V_2}{R_4} - J = 0$$

5.1 c

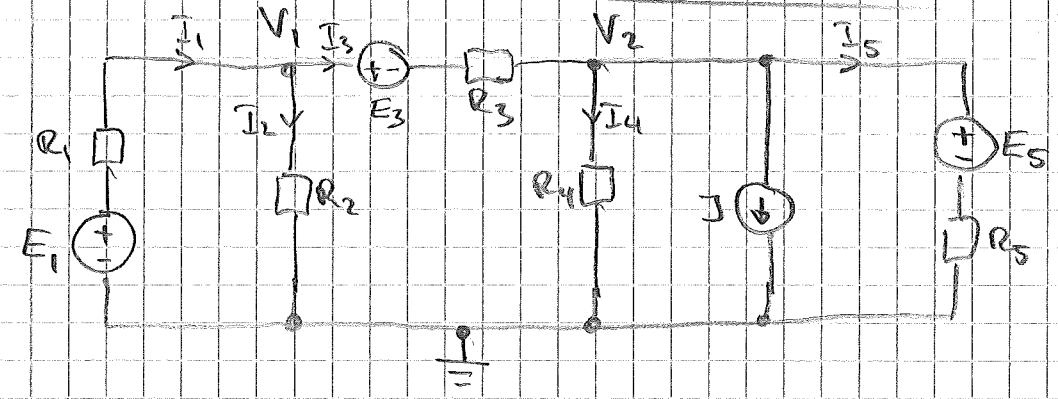


1) $E_1 - R_1 I_1 - R_2 (I_1 - I_2) = 0$

2) $-R_5 I_2 - R_2 (I_2 - I_1) - R_3 (I_2 - I_3) + E_3 = 0$

3) $-E_3 - R_3 (I_3 - I_2) - R_4 (I_3 - J) = 0$

5.3



$$\begin{cases} \dfrac{V_1 - E_1}{R_1} + \dfrac{V_1}{R_2} + \dfrac{V_1 - E_3 - V_2}{R_3} = 0 \\ \dfrac{V_2 - (V_1 - E_3)}{R_3} + \dfrac{V_2}{R_4} + J + \dfrac{V_2 - E_5}{R_5} = 0 \end{cases} \Rightarrow$$

$$\begin{cases} V_1 \left(\dfrac{1}{R_1} + \dfrac{1}{R_2} + \dfrac{1}{R_3} \right) + V_2 \left(-\dfrac{1}{R_3} \right) = \dfrac{E_3}{R_3} + \dfrac{E_1}{R_1} \\ -\dfrac{V_1}{R_3} + V_2 \left(\dfrac{1}{R_3} + \dfrac{1}{R_4} + \dfrac{1}{R_5} \right) = \dfrac{E_5}{R_5} - \dfrac{E_3}{R_3} - J \end{cases}$$

$$\begin{cases} 0{,}375 V_1 - 0{,}125 V_2 = 2{,}5 \\ -0{,}125 V_1 + 0{,}265 V_2 = -1{,}95 \end{cases} \quad (3\times)$$

5.3) forts

$$0,67\,V_2 = -3,35$$

$$\begin{cases} V_2 = -5,00\,V \\ V_1 = 5,00\,V \end{cases}$$

$$I_1 = \frac{E_1 - V_1}{R_1} = \frac{10-5}{5} = 1,00\,A$$

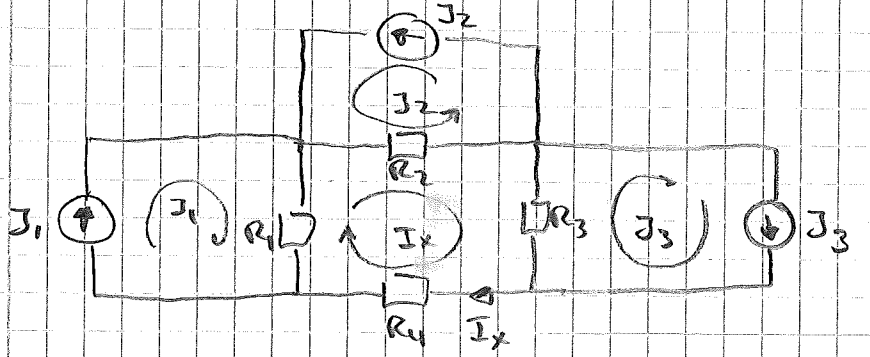
$$I_2 = \frac{V_1}{R_2} = \frac{5}{20} = 0,25\,A$$

$$I_3 = \frac{V_1 - E_3 - V_2}{R_3} = \frac{5-4-(-5)}{8} = 0,75\,A$$

$$I_4 = \frac{V_2}{R_4} = \frac{-5}{25} = -0,2\,A$$

$$I_5 = \frac{V_2 - E_5}{R_5} = \frac{-5-4,5}{10} = -0,95\,A$$

5.6



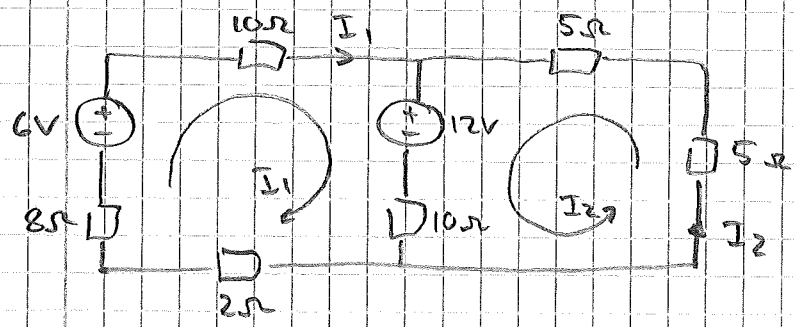
KU: ↻ $R_4 I_x + R_3(I_x - J_3) + R_2(I_x + J_2) + R_1(I_x - J_1) = 0$

$I_x(R_4 + R_3 + R_2 + R_1) = R_3 J_3 - R_2 J_2 + R_1 J_1$

$I_x = \dfrac{R_3 J_3 - R_2 J_2 + R_1 J_1}{R_1 + R_2 + R_3 + R_4} = \dfrac{3 \cdot 15 - 5 \cdot 11 + 2 \cdot 20}{(2+5+3+4) \cdot 10^3} =$

$= 2{,}14 \text{ mA}$

5.8



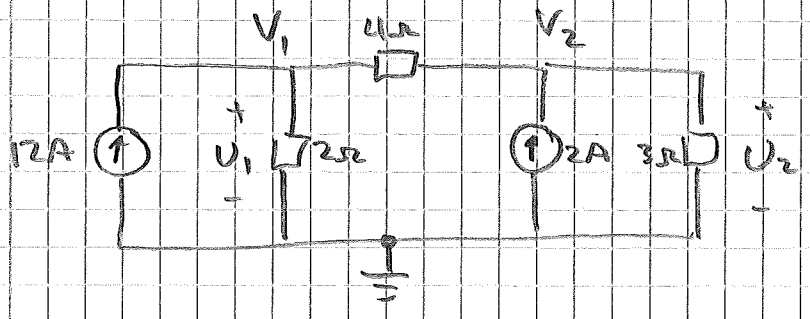
$$\begin{cases} 2I_1 + 10(I_1 + I_2) + 12 + 10I_1 - 6 + 8I_1 = 0 \\ 10(I_1 + I_2) + 12 + 5I_2 + 5I_2 = 0 \end{cases} \Rightarrow$$

$$\begin{cases} 30I_1 + 10I_2 = -6 \\ 10I_1 + 20I_2 = -12 \end{cases}$$

$25I_1 = 0 \Rightarrow I_1 = 0$

$I_2 = \dfrac{-6}{10} = -0{,}6 \text{ A}$

5.10



a)

$$\begin{cases} \dfrac{V_1}{2} - 12 + \dfrac{(V_1 - V_2)}{4} = 0 \\ \dfrac{V_2 - V_1}{4} - 2 + \dfrac{V_2}{3} = 0 \end{cases} \Rightarrow$$

$$\begin{cases} 0{,}75 V_1 - 0{,}25 V_2 = 12 \\ -0{,}25 V_1 + 0{,}58333 V_2 = 2 \quad (\times 3) \end{cases}$$

$$1{,}5 V_2 = 18$$

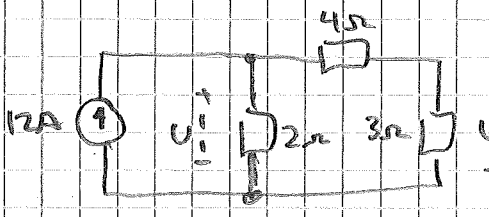
$$\underline{V_2 = 12\,V}$$

$$\underline{V_1 = \frac{12 + 0{,}25 V_2}{0{,}75} = 20\,V}$$

$$\underline{\underline{U_1 = V_1 = 20\,V}}$$

$$\underline{\underline{U_2 = V_2 = 12\,V}}$$

b) Bidrag från 12A källa

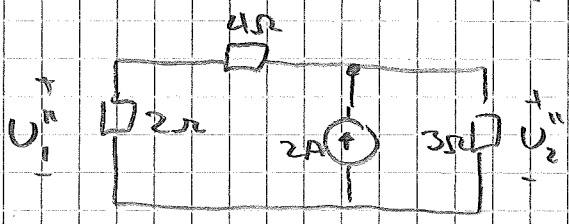


$$U_1' = 12 \cdot (2 \| 7) = 12 \cdot 1{,}5556 = 18{,}6667\,V$$

$$U_2' = \frac{3}{3+4} \cdot U_1' = \frac{3}{7} \cdot 18{,}6667 = 8{,}0000\,V$$

5.10b forts

Bidrag från 2A källa



$$U_2'' = 2 \cdot (6 \| 3) = 2 \cdot 2 = 4{,}000 \text{ V}$$

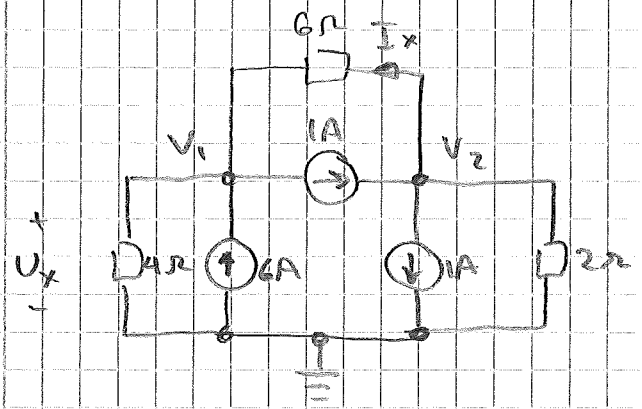
$$U_1'' = \frac{2}{2+4} \cdot U_2'' = \frac{1}{3} \cdot 4 = 1{,}3333 \text{ V}$$

Totalt

$$U_1 = U_1' + U_1'' = 18{,}6667 + 1{,}3333 = \underline{20{,}0 \text{ V}}$$

$$U_2 = U_2' + U_2'' = 8{,}0000 + 4{,}0000 = \underline{12{,}0 \text{ V}}$$

5.11



$$\begin{cases} \frac{V_1}{4} - 6 + 1 + \frac{(V_1 - V_2)}{6} = 0 \\ 1 + \frac{V_2}{2} - 1 + \frac{V_2 - V_1}{6} = 0 \end{cases} \Rightarrow \begin{cases} 2{,}5V_1 - V_2 = 30 \\ -V_1 + 4V_2 = 0 \end{cases} \quad (\times 4)$$

$$9V_1 = 120$$

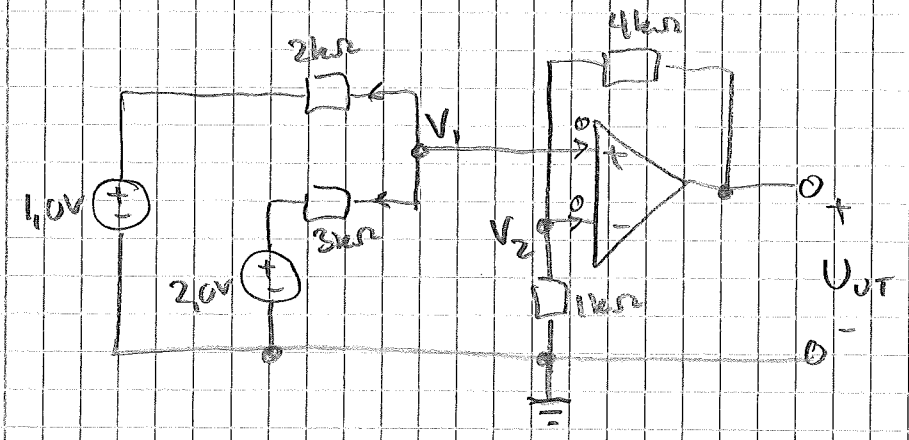
$$V_1 = 13{,}33 \text{ V}$$

$$V_2 = \frac{V_1}{4} = 3{,}333 \text{ V}$$

$$U_x = V_1 = 13{,}33 \text{ V}$$

$$I_x = \frac{V_2 - V_1}{6} = \frac{3{,}333 - 13{,}333}{6} = -1{,}67 \text{ A}$$

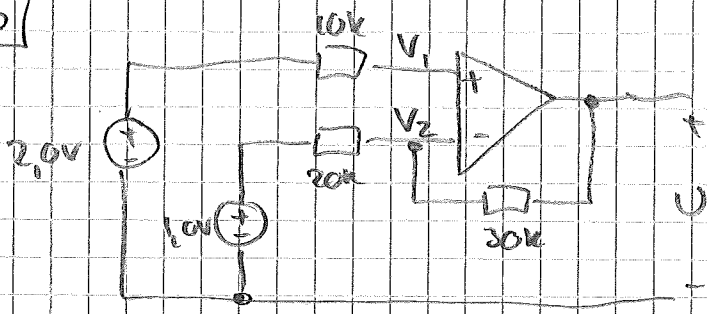
5.12



$$\begin{cases} \dfrac{V_1 - 1}{2k} + \dfrac{V_1 - 2}{3k} = 0 \\ \dfrac{V_2 - U_{UT}}{4k} + \dfrac{V_2}{1k} = 0 \\ V_1 = V_2 \quad \text{Ideal OP negativ återkopplad} \end{cases} \Rightarrow$$

$$\begin{cases} V_1\left(\dfrac{1}{2k} + \dfrac{1}{3k}\right) = \dfrac{1}{2k} + \dfrac{2}{3k} \\ V_1\left(\dfrac{1}{4k} + \dfrac{1}{1k}\right) = \dfrac{U_{UT}}{4k} \end{cases} \Rightarrow \begin{cases} 5V_1 = 7 \\ 5V_1 = U_{UT} \end{cases} \Rightarrow \underline{U_{UT} = 7V}$$

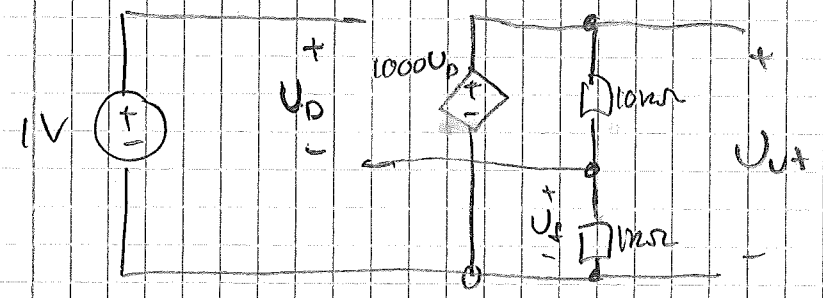
5.13



$$\begin{cases} \dfrac{V_1 - 2}{10k} = 0 \Rightarrow V_1 = 2,0V \\ \dfrac{V_2 - 1}{20k} + \dfrac{V_2 - U_{UT}}{30k} = 0 \\ V_1 = V_2 \quad \text{Neg återkopplad Ideal OP} \end{cases} \Rightarrow \begin{cases} V_1 = 2,0V \\ V_2\left(\dfrac{1}{20k} + \dfrac{1}{30k}\right) = \dfrac{U_{UT}}{30k} + \dfrac{1}{20k} \\ V_2 = V_1 \end{cases}$$

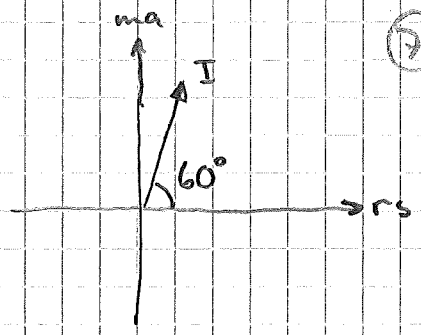
$$\underline{U_{UT} = V_1\left(\frac{30}{20} + \frac{30}{30}\right) - \frac{30}{20} = 2,0\left(1,5+1\right) - 1,5 = 3,5V}$$

5.14



$$\begin{cases} U_f = \dfrac{1k}{1k+10k} \cdot U_{UT} = \dfrac{U_{UT}}{11} \\ U_{UT} = 1000\,U_D \\ U_f + U_D = 1 \end{cases} \Rightarrow$$

$$\frac{U_{UT}}{11} + \frac{U_{UT}}{1000} = 1 \Rightarrow \underline{\underline{U_{UT} = \frac{1}{\frac{1}{11}+\frac{1}{1000}} = 10{,}88\ V}}$$



7.1

a) $|I| = 4A$

b) $T = 12\,ms$

c) $f = \frac{1}{T}$ 83 Hz

d) $\omega = 2\pi f = 524$ rad/s

e) $\beta = \frac{2}{6} \cdot 180^\circ = 60^\circ$

f) $i(t) = |I| \sin(\omega t + \beta) = 4 \sin(524t + 60^\circ)$ A

7.2 $u(t) = 128 \sin(\omega t - 1{,}17)$ V där $\omega = 600$ rad/s

a) $f = \frac{\omega}{2\pi} = \frac{600}{2\pi} = 95{,}5$ Hz

b) $\hat{u} = -128$ V

c) $u(t = 3\,ms) = 128 \sin(600 \cdot 3 \cdot 10^{-3} - 1{,}17) = 75{,}4$ V

d) $100 = 128 \sin(600t - 1{,}17)$

$\arcsin \frac{100}{128} = 600t - 1{,}17$

$t = 3{,}44\,ms$

7.4 a) $T = 6\,ms$

$f = \frac{1}{T} = 170$ Hz

$\alpha_1 = -\frac{1}{3} \cdot 180^\circ = -60^\circ$

$\alpha_2 = 0^\circ$

b) $u_1 = 7 \sin(\omega t - 60^\circ)$ V

$u_2 = 4 \sin(\omega t)$ V

$\omega = \frac{2\pi}{T} \approx 1{,}05$ krad/s

7.6 $|I| = 50\,mA \Rightarrow I_e = \frac{|I|}{\sqrt{2}}$

$|U| = 30\,V \Rightarrow U_e = \frac{|U|}{\sqrt{2}}$

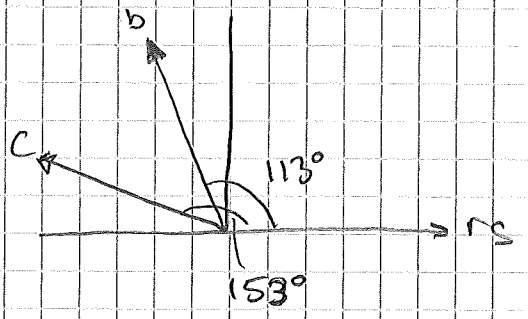
$\varphi = -40°$

$P = U_e \cdot I_e \cdot \cos\varphi = \frac{30}{\sqrt{2}} \cdot \frac{0{,}05}{\sqrt{2}} \cdot \cos(-40°) = 0{,}58\,W$

7.8 $|I| = 37\,mA \quad f = 14\,kHz \quad \beta = 113°$

a) $i(t) = 37 \sin(2\pi f t + 113°)\ mA$

b)



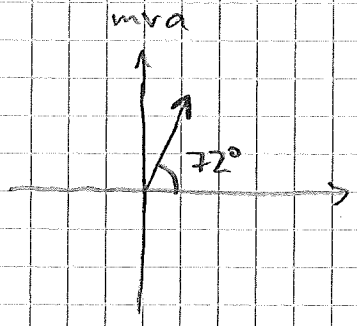
c) tidvinkel $\omega t + \alpha = 2\pi 14 \cdot 10^3 \cdot 8 \cdot 10^{-6} \cdot \frac{180°}{\pi} + 113° = 153°$
vid $t = 8\,\mu s$

7.10 a) $u = -1{,}8\,V$

b) Tidvinkel $\omega t + \alpha = 216°$ vid $t = 2\,ms \Rightarrow$

$\alpha = 216° - \omega t \cdot \frac{180°}{\pi} = 216° - 2\pi 200 \cdot 2 \cdot 10^{-3} \cdot \frac{180°}{\pi} =$

$= 72°$



7.7

$$\begin{cases} 200 \sin(\omega t+\alpha) = 155{,}7 \\ 4 \sin(\omega t+\beta) = \dfrac{u(4)}{u(2)} = \dfrac{212{,}5}{155{,}7} = 1{,}365 \end{cases}$$

$$\begin{cases} \sin(\omega t+\alpha) = 0{,}7785 \\ \sin(\omega t+\beta) = 0{,}3413 \end{cases}$$

$$\omega t+\alpha = \begin{cases} 0{,}892 \\ 2{,}250 \end{cases} \quad (1)$$

$$\omega t+\beta = \begin{cases} 0{,}348 \\ 2{,}794 \end{cases} \quad (2)$$

$$\varphi = \alpha-\beta = (1)-(2) = \begin{cases} 0{,}544 & \text{rad} \\ -1{,}902 & " \\ 1{,}902 & " \\ -0{,}544 & " \end{cases}$$

7.12 a) $\varphi = -30°$

b) $|U| = 45\,V$

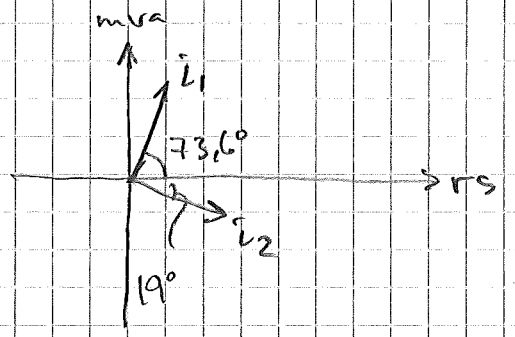
$|I| = 7,2\,A$

c) $P = U_c \cdot I_c \cos\varphi = \frac{|U|}{\sqrt{2}} \cdot \frac{|I|}{\sqrt{2}} \cos\varphi = \frac{45}{\sqrt{2}} \cdot \frac{7,2}{\sqrt{2}} \cos(-30°) = 140\,W$

d) $P = u \cdot i = 20\,V \cdot 6\,A = 120\,W$

7.14 Určíme f_{rs}

KI $i_3 = i_1 + i_2$



Kooordinátrahmig: Horizontal leď $I_{3h} = 473 \cos 73,6° + 319 \cos 19° =$

$= 435,2\,mA$

Vertikálně $I_{3v} = 473 \sin 73,6° - 319 \sin 19° =$

$= 349,9\,mA$

$|I_3| = \sqrt{I_{3h}^2 + I_{3v}^2} = 558,4\,mA$

$\beta_3 = \arctan \frac{I_{3v}}{I_{3h}} = \arctan \frac{349,9}{435,2} = 38,8°$

$i_3 = 558 \sin(\omega t + 38,8°)\,mA$

8.1

a) $C_{tot} = \frac{(C_2+C_3)\cdot C_1}{C_1+C_2+C_3} = \frac{(2+3)\cdot 1}{1+2+3} = 0{,}83\,\mu F$

b) $C_{tot} = \frac{C_1 \cdot C_2}{C_1+C_2} + C_3 = \frac{1\cdot 2}{1+2} + 3 = 3{,}67\,\mu F$

c) $C_{tot} = C_1 + \frac{1}{\frac{1}{C_2}+\frac{1}{C_3}+\frac{1}{C_4}} = 1 + \frac{1}{\frac{1}{2}+\frac{1}{3}+\frac{1}{4}} = 1{,}92\,\mu F$

8.2

Før omkobling

$Q_{tot} = C_1 \cdot E = 4{,}7\cdot 10^{-6}\cdot 24 = 1{,}128\cdot 10^{-4}\ As$

Efter omkobling

$C_{tot} = C_1 + C_2 + C_3 = 4{,}7 + 2{,}2 + 6{,}8 = 13{,}7\,\mu F$

a) $Q_{tot} = C_{tot}\cdot U_3 \Rightarrow \underline{U_3} = \frac{Q_{tot}}{C_{tot}} = \frac{1{,}128\cdot 10^{-4}}{13{,}7\cdot 10^{-6}} =$

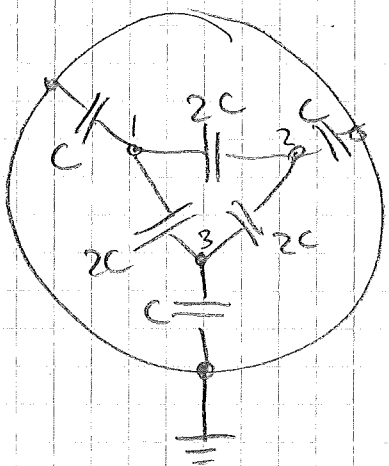
$= \underline{8{,}23\,V}$

b) $Q_1 = C_1\cdot U_3 = 4{,}7\cdot 10^{-6}\cdot 8{,}23 = 38{,}7\,\mu As$

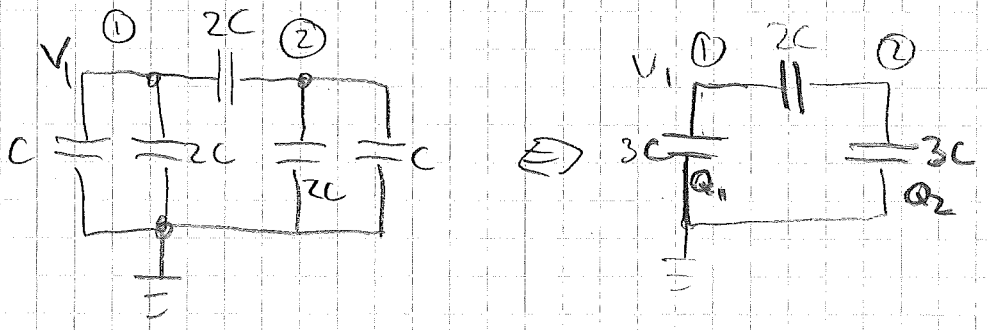
$Q_2 = C_2\cdot U_3 = 2{,}2\cdot 10^{-6}\cdot 8{,}23 = 18{,}1\,\mu As$

$Q_3 = C_3\cdot U_3 = 6{,}8\cdot 10^{-6}\cdot 8{,}23 = 56{,}0\,\mu As$

8.3



Schema då ③ jordas



$V_1 = 100\ V$

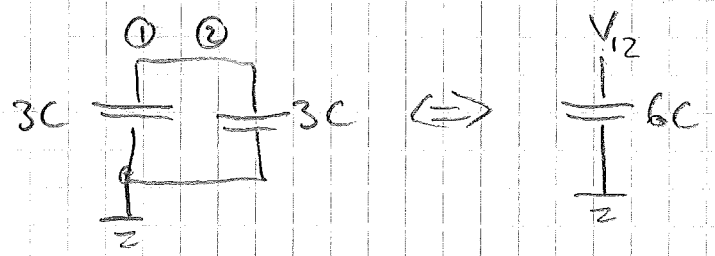
Total kapacitans ① till jord: $C_{1\,jord} = 3C + \frac{2C \cdot 3C}{2C+3C} = 3C + 1{,}2C =$

$= 4{,}2C$

Laddning i vänster kond. $Q_1 = V_1 \cdot 3C = 300C$

" i höger $Q_2 = V_1 \cdot 1{,}2C = 120 \cdot C$

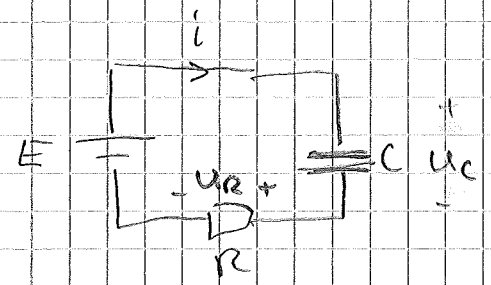
Koppla samman ① & ② $\Rightarrow$ $Q_{tot} = Q_1 + Q_2 = 420 \cdot C$



$V_{12} = \frac{Q_{tot}}{6C} =$

$= \frac{420C}{6C} = 70\ V$

8.41



Kondensator oladdad vid $t=0 \Rightarrow$

a) Begynnelsevärde $\underline{\underline{i(0) = \frac{E}{R} = \frac{120}{2 \cdot 10^6} = 60\,\mu A}}$

b) KV: $u_R = E - u_C = 120 - 60 = 60\,V$

$$\underline{\underline{i = \frac{u_R}{R} = \frac{60}{2 \cdot 10^6} = 30\,\mu A}}$$

c) $\underline{\underline{\tau = RC = 2 \cdot 10^6 \cdot 5 \cdot 10^{-6} = 10\,s}}$

d) $i(t) = i(0)\, e^{-\frac{t}{\tau}}$

$$\underline{\underline{i(2\tau) = i(0)\, e^{-\frac{2\tau}{\tau}} = 60\,\mu A \cdot e^{-2} = 8{,}1\,\mu A}}$$

e) Slutvärde $u_C(\infty) = E = 120\,V$

$$u_C(t) = u_C(\infty)\left(1 - e^{-\frac{t}{\tau}}\right) = 120\left(1 - e^{-\frac{t}{10}}\right)$$

$$u_C(8) = 120\left(1 - e^{-\frac{8}{10}}\right) = 66{,}1\,V$$

8.5

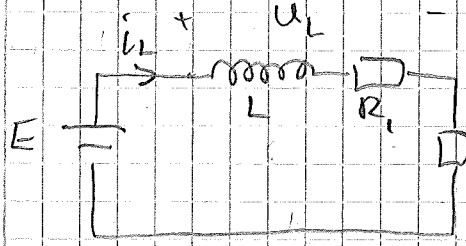
a) Begynnelsevärde $u_c(0) = \frac{R}{3R} \cdot E = 20\,V$

b) $i_c(0) = \frac{u_c(0)}{\frac{R}{2}} = \frac{20}{20 \cdot 10^3} = 1\,mA$

c) $u_c(t) = u_c(0) \cdot e^{-\frac{t}{\tau}} \to 0$ då $t \to \infty$

d) $\tau = \frac{R}{2} \cdot C = 20 \cdot 10^3 \cdot 5 \cdot 10^{-6} = 0{,}1\,s$

8.6



$E = 4\,V$

$L = 2\,mH$

$R_1 = 2\,\Omega$

$R_2 = 2\,k\Omega$

a) Spole utan begynnelseenergi $\Rightarrow i_L(0) = 0 \Rightarrow$

$u_2(0) = R_2 \cdot i_L(0) = 0 \Rightarrow$

$u_L(0) = E - u_2(0) = E = 4\,V$

b) Uppladdning $i_L(\infty) = \frac{E}{R_1 + R_2} = \frac{4}{2002} = 2{,}0\,mA$

$i_L(t) = i(\infty)\left(1 - e^{-\frac{t}{\tau}}\right)$

$i_L(0) = 0$

$i_L(\infty) = 2{,}0\,mA$

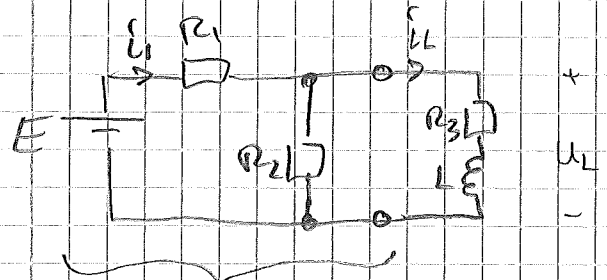
c) $\tau = \frac{L}{R} = \frac{2 \cdot 10^{-3}}{2002} \approx 1\,\mu s$

d) $u_2 = R_2 \cdot i_L = R_2\, i(\infty)\left(1 - e^{-\frac{t}{\tau}}\right) =$

$= 2000 \cdot 2{,}0 \cdot 10^{-3}\left(1 - e^{-\frac{t}{10^{-6}}}\right) = 4\left(1 - e^{-\frac{t}{10^{-6}}}\right) = 1$

$\Rightarrow 0{,}75 = e^{-\frac{t}{10^{-6}}} \Rightarrow t = -10^{-6} \cdot \ln 0{,}75 = 0{,}29\,\mu s$

8.7]

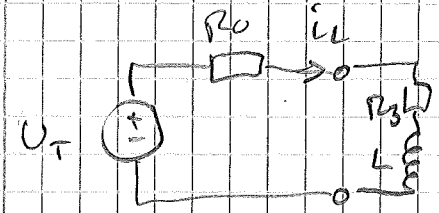


Tvåpol

Tomgångsspänning $U_T = \frac{R_2}{R_1+R_2} \cdot E = \frac{60}{30+60} \cdot 60 = 40\,V$

Kortslutningsström $I_K = \frac{E}{R_1} = \frac{60}{30} = 2\,A$

Inre resistans $R_0 = \frac{U_T}{I_K} = \frac{40}{2} = 20\,\Omega$



a) $t=0$ Spole utan begynnelseenergi $\Rightarrow i_L(0)=0 \Rightarrow$

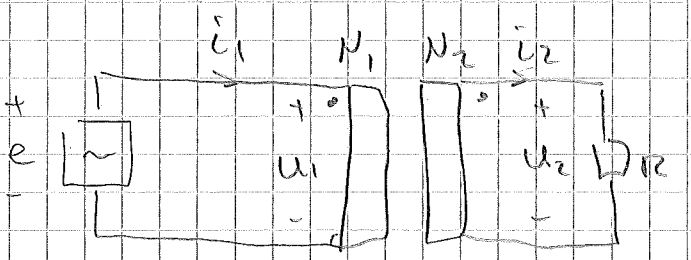
$u_L(0) = U_T - R_0 i_L(0) = U_T = \underline{40\,V}$

b) $i_L(0)=0 \Rightarrow \underline{i_1(0)} = \frac{E}{R_1+R_2} = \frac{60}{90} = \underline{0{,}67\,A}$

c) $u_L(\infty) = \frac{R_3}{R_0+R_3} \cdot U_T = \frac{20}{40} \cdot 40 = 20\,V$

d) $\tau = \frac{L}{R_0+R_3} = \frac{1}{40} = 25\,ms$

8.8



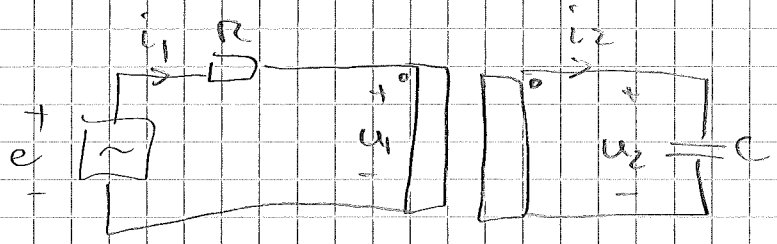
$e = u_1 = 50 \sin \omega t$ [V]

$R = 100\,\Omega$ $N_1 = 1000$ $N_2 = 100$

Ideal trafo: $\frac{u_1}{N_1} = \frac{u_2}{N_2} \Rightarrow u_2 = \frac{N_2}{N_1} \cdot u_1 = 5{,}0 \sin \omega t$ [V]

$i_2 = \frac{u_2}{R} = 0{,}05 \sin \omega t$ [A]

8.9



$N_1 = 5000$ $N_2 = 1000$ $C = 10\,\mu F$

$u_2 = 2{,}0 \sin \omega t$ [V] $R = 500\,\Omega$

$f = 1000$ Hz

a) Ideal trafo $\frac{u_1}{N_1} = \frac{u_2}{N_2} \Rightarrow u_1 = \frac{N_1}{N_2} u_2 = 10 \sin \omega t$ [V]

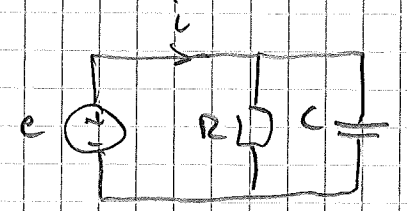
b) $i_2 = C \frac{du_2}{dt} = 10 \cdot 10^{-6} \cdot 2{,}0 \cdot \omega \cos \omega t$ [A] $= 0{,}126 \cos \omega t$ [A]

Ideal trafo $N_1 i_1 = N_2 i_2 \Rightarrow I_1 = \frac{N_2}{N_1} \cdot I_2 = 0{,}025 \cos \omega t$ [A]

c) $e = u_1 + R \cdot i_1 = 10 \sin \omega t + 12{,}56 \cos \omega t = 16{,}0 \sin(\omega t + 51{,}5°)$ V

=

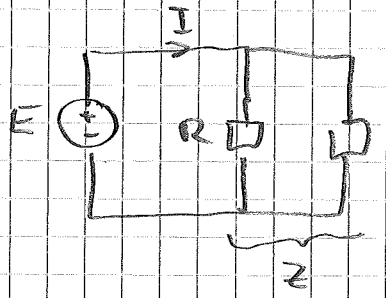
8.10



$e = 35,6 \sin(\omega t + 13,8°)$ V

$\omega = 80$ rad/s

$R = 1600\,\Omega$ $C = 6,20$ mF



$$E = 35,6\, e^{j(\omega t + 13,8°)} \text{ V}$$

$$Z = R // \frac{1}{j\omega C} = \frac{R \cdot \frac{1}{j\omega C}}{R + \frac{1}{j\omega C}} = \frac{R}{1 + j\omega RC} = \frac{1600}{1 + j\,0,794} =$$

$$= \frac{1600}{\sqrt{1 + 0,794^2}\, e^{j \arctan \frac{0,794}{1}}} = \frac{1600}{1,277\, e^{j38,4°}} =$$

$$= 1253\, e^{-j38,4°}$$

$$I = \frac{E}{Z} = \frac{35,6\, e^{j(\omega t + 13,8°)}}{1253\, e^{-j38,4°}} = 28,4\, e^{j(\omega t + 55,2°)} \text{ mA}$$

$$i(t) = 28,4 \sin(\omega t + 55,2°) \text{ mA}$$